ADVISORY COMMITTEE FOR GEOSCIENCES

 ADVISORY COMMITTEE MEETING

 April 18, 2012

 8:30 A.M.

 National Science Foundation

 Room 1235

 4201 Wilson Boulevard

 Arlington, Virginia 22230

 P A R T I C I P A N T S

COMMITTEE MEMBERS PRESENT:

Dr. George M. Hornberger, Acting Chairman

Dr. M. Lee Allison

Ms. Vicki Arroyo

Dr. Daniel N. Baker

Dr. Jillian Banfield

Dr. Mary C. Barth

Dr. Margaret L. Delaney

Dr. Donald J. DePaolo

Dr. Scott C. Doney (via phone)

Dr. Karen M. Fischer

Dr. M. Susan Lozier

Dr. Norine Noonan

Dr. Walter A. Robinson

Dr. Roberta L. Rudnick

Dr. David S. Schimel

Dr. John T. Snow

Dr. Harlan Spence

Dr. Brian Taylor

Dr. Orlando Taylor

Dr. Joseph A. Whittaker

SPEAKERS PRESENT:

Dr. Cliff Jacobs, GEO

Dr. Tim Killeen, AD-GEO

Dr. Cora Marrett, Deputy Director, NSF

Dr. Jessica Robin, GEO

Dr. Subra Suresh, Director, NSF

Dr. Ben van der Pluijm, GEO

Dr. Eva Zanzerkia, GEO

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 P R O C E E D I N G S

Welcome and Introductory Remarks

 DR. HORNBERGER: Good morning. Welcome to the AC-GEO meeting. My name is Kellogg.

 [laughter]

 Ah, see, even those of you who don’t know Louise suspected it was not I. Unfortunately, Louise, sad happening. She can't join us today because her father took gravely ill, so she won't be with us at all. And Melissa called me and said she had a deal for me. And so, I'm George Hornberger and I'll be acting as chair for this meeting. And we have four new members and I'll just mention them and then we'll do a round of self-introductions and they can say a little more about themselves. Mary Barth, and Scott Doney is on the telephone. Scott, welcome. Karen Fischer over here. And Joseph Whittaker. So, welcome to AC-GEO.

 We have, as you see, a pretty packed agenda and it'll take us a little while to get all around the room with self-introductions. We'll try to do that relatively quickly. I won't take too much time with remarks. I just thought that I would sort of turn things on their head and instead of saying this at the end of the meeting, I'll say it at the beginning. You may know that Tim Killeen, ostensibly this is his last meeting and I think that it's appropriate that we recognize the tremendous leadership that he's provided and thank him sincerely for all of us. [applause]

 And we can lift a glass of wine in toast to him at dinner and then we can require him to give a speech, if that's okay.

 DR. KILLEEN: No, you just get it out of the way so [inaudible]. Thank you.

 DR. HORNBERGER: Now let's do a round of self-introductions and because we do have a full schedule we'll try to not be too extensive in our introductions. I'll try to set the tone. I'm George Hornberger. I'm a professor at Vanderbilt. I'm a hydrologist. I am the director of an institute for energy and environment there. The most fun I've been having recently is doing collaborative work with people in sociology, human geography and social psychology, along with natural environment.

 DR. KILLEEN: So I'm Tim Killeen, assistant director for the GEO scientists and I just want to say how delighted I am to see -- I know everybody around the table and it's just a great committee and I hope we've got an interesting agenda for you and that you'll enjoy it as well.

 DR. CAVANAUGH: I'm Marge Cavanaugh. I'm the Deputy Assistant Director in GEO and before anyone asks because they always ask, I've been at NSF 22 years. [laughter]

 DR. BAKER: I’m Dan Baker. I'm the Director of the Laboratory for Atmospheric and Space Physics at the University of Colorado. I'm a professor of Astrophysical and Planetary Sciences there and also professor in the Physics Department and my areas of science are solar terrestrial physics and space plasma physics.

 DR. DELANEY: Hi, I'm Peggy Delaney from UC-Santa Cruz. I'm an ocean scientist. I've had far too many involvements with the drilling program in difference phases including participating in the MREFC project so I've been familiar with that at NSF. And this is my second to the last meeting.

 DR. LOZIER: I'm Susan Lozier. I'm a professor at Duke University. I'm a physoceanographer with a research focus on ocean circulation and the role of ocean in global climate.

 MS. ARROYO: I'm Vicki Arroyo. I'm the executive director of the Georgetown Climate Center at Georgetown Law where I also teach climate change and the law, so I guess I'm the token non-scientist here although I have some undergraduate background and still dabble in it and am also pleased to be a new member of [unintelligible] board.

 DR. ALLISON: I'm Lee Allison, Director of the Arizona Geological Survey in Tucson. I co-chair the U.S. Geoscience Information Network between 50 state geological surveys and the U.S.G.S. in informatics.

 DR. BARTH: Hi. I'm Mary Barth. I'm a scientist at the National Center for Atmospheric Research, and I do most of my studies looking at clouds and chemistry. So been particularly thunderstorms and how they affect the chemical environment.

 DR. RUDNICK: Hi. I'm Roberta Rudnick. I'm Department Chair of Geology at the University of Maryland. I am a geochemist and I study how comets form.

 DR. WHITTAKER: Good morning. Joe Whittaker. The School of Computer, Mathematical and Natural Sciences at Morgan State University. Associate Director for the Goddard, the NASA GASTAR program at Goddard Space Flight Center.

 DR. NOONAN: I'm Norine Noonan. I'm Chief Academic Officer at University of South Florida, St. Petersburg, and I just solve other people's problems these days. That what the provosts do. And I think this is my second to the last meeting. We're the class of 2012.

 DR. FISCHER: Hi. I'm Karen Fischer. I am a professor at Brown University. My research specialty is in seismology and I focus primarily on studying the lithosphere and in particular, the continental lithosphere.

 DR. DEPAOLO: Don DePaolo. I'm Professor of Geochemistry at UC-Berkeley and I'm also now the Associate Laboratory Director for Energy and Environmental Sciences at Lawrence Berkeley Labs.

 DR. WALTER ROBINSON: I'm Walt Robinson and I'm the head of the Department of Marine, Earth and Atmospheric Sciences, NC State University and I'm an atmospheric scientist working on climate dynamics.

 DR. BANFIELD: I’m Jill Banfield from the University of California, Berkeley. I work on the [unintelligible] communities and many different environments and I'm most excited about how data and how mixed information’s changing worlds.

 DR. CONOVER: Good morning. My name's David Conover and I'm the director of the Division of Ocean Sciences. My expertise is in ecology, evolution and fishery science.

 DR. MORGAN: Good morning. My name is Michael Morgan. I'm division director for Atmospheric GeoSpace Sciences and my specialty is atmospheric dynamics and synoptic geology.

 DR. ABRAJANO: Hello. My name is Jun Abrajano and I'm currently the acting division director at Earth Sciences. As many of you may already have realized, Bob Detrick has moved on to be assistant administrator of NOAA and we are currently on the search for a new division director.

 MR. SMITH: Good morning. I'm Will Smith. I am the Budget Officer and the Director for Geosciences.

 DR. SCHIMEL: I'm Dave Schimel from NEON, the National Ecological Observatory Network and my scientific focus is in the global carbon cycle.

 DR. SNOW: I'm John Snow. I'm a Regents Professor of Meteorology at the University of Oklahoma. And I teach. I do some technology transfer work for the University and also involved in international development efforts.

 DR. SPENCE: Good morning. I'm Harold Spence. I'm the Director of the Institute for the Study of Earth, Oceans and Space at the University of New Hampshire. Also a professor of physics there. My areas are solar and space physics and also planetary science.

 DR. BRIAN TAYLOR: I'm Brian Taylor, Dean of the School of Ocean and Earth Science and Technology at the University of Hawaii, where I've had to suffer for 30 years. [laughter]

 DR. ORLANDO TAYLOR: I'm Orlando Taylor, president of the Washington, D.C. campus of the Chicago School of Professional Psychology. I was formerly Dean of the Graduate School and Vice President of Research at Howard University. My interests are environmental psychology and communication science.

 DR. HORNBERGER: Let's do the outer portion.

 MALE SPEAKER: George, did somebody new come in? [laughter]

 DR. HORNBERGER: I failed.

 MS. LANE: I'm Melissa Lane and if you need anything, George, we'll take care of it.

 [laughter]

 DR. HORNBERGER: Scott, would you introduce yourself?

 DR. DONEY: Yeah, sure. Scott Doney, scientist at the Woods Hole Oceanographic Institution, and I study ocean science and biogeochemistry.

 DR. JACOBS: I'm Cliff Jacobs. I work in the Directorate Office of Geosciences.

 DR. MURDAY: Jim Murday, University of Southern California.

 DR. SHOWSTACK: Randy Showstack, reporter with EOS, [inaudible].

 DR. WEBER: Larry Weber, acting executive head for ocean section in the Division of Ocean Sciences.

 DR. ROBIN: Jessica Robin, [inaudible], and I also worked in [inaudible].

 DR. CRAIG ROBINSON: Craig Robinson, GEO front office.

 MALE SPEAKER: [inaudible]

 MALE SPEAKER: [inaudible]

 DR. VAN DER PLUIJM: [inaudible], University of Michigan.

 FEMALE SPEAKER: Jennifer [inaudible], program director in the [inaudible] sciences.

 MALE SPEAKER: [inaudible], I’m a program officer [inaudible].

 MALE SPEAKER: [inaudible], ocean sciences.

 FEMALE SPEAKER: [inaudible]

 FEMALE SPEAKER: [inaudible] sciences.

 DR. ROM: Lisa Rom, Ocean Education.

 MALE SPEAKER: [inaudible]
 MALE SPEAKER: [inaudible]

 FEMALE SPEAKER: [inaudible]

 DR. SMULL: Brad Smull, program director for Physical and Dynamic Meteorology.

 MALE SPEAKER: [inaudible]

 FEMALE SPEAKER: [inaudible]

 FEMALE SPEAKER: [inaudible]

 MALE SPEAKER: [inaudible]

 FEMALE SPEAKER: [inaudible]

 DR. MIDSON: I’m Brian Midson, [inaudible].

 MALE SPEAKER: [inaudible], atmospheric and geo-space science.

 FEMALE SPEAKER: [inaudible]

 MALE SPEAKER: [inaudible]

 MALE SPEAKER: [inaudible]

 DR. BOB ROBINSON: Bob Robinson, Geospace facilities.

 FEMALE SPEAKER: [inaudible]

 MALE SPEAKER: [inaudible]

 FEMALE SPEAKER: [inaudible]

 MALE SPEAKER: [inaudible] for mathematical sciences.

 DR. ANDERSON: I’m Greg Anderson with [inaudible]. DR. HORNBERGER: Okay. Thank you for that quick round of introductions. We're going to move straight ahead and you see our next item in the agenda is the state of GEO. Tim.

An Overview and Update on GEO

 DR. KILLEEN: Well thanks very much, and so you might be expecting kind of a -- the committee members who've been here a while know that these talks start out with budgets and then move onto nitty gritty and then we flesh it out later. We're going to do something a little bit different this time, not because it's a valedictory or anything like that, but we have a date with Dr. Suresh to provide a director's review of the Geosciences on May 22. so you're going to -- you can either view this as a dry run and we're asking for your help to tune it up or you could view this as the premiere of our director's review. Either way, but why don't you see it before you comment too much on it.

 So we're going to -- I'm going to present basically more of a public discussion than a typical advisory committee presentation where we're going through chapter and verse of all the issues. You'll be getting that in full detail in the following and ensuing agenda. But I will touch on some of the things that are going on. Let me first say that the state of GEO is really healthy. The budget was submitted in FY 2013 is in excess of $900 million. When I arrived it was on the magnitude of $750 million so there's been growth. We've built facilities. We're in the process of building world class facilities. We have maintained a successful -- a good ratio of acceptance of proposals both in research and education grants above 30 percent which is very healthy for our community. And we're playing a major role internationally into agency and within NSF in terms of the interdisciplinary space.

 So the state of GEO is pretty, pretty good, I would think. But what we're going to tell the director is as follows: that we are also part of the Executive Branch. And of course part of NSF. And our new director at NSF has laid out a theme for the whole agency that's called One NSF and a vision of One NSF and we play a major role in what One NSF actually means. But we're also supportive and importantly supportive of the Administration's priorities as part of the Executive Branch where President Obama talks about innovation demanding basic research. We're all about basic research. And that's a dream quote for an agency like NSF. To connect innovation, the economy, and jobs to basic research is very important to us and we think we do that. So why GEO? Why now?

 Well, what we work on of course relates to many things that are happening on a fast-changing planet. And you see this everywhere you look. You can't open a newspaper without seeing something without seeing something about change. Either hazards or extreme events or the warmest four months ever in the last four months or, you know, the potential for a two sigma summer or the role of geosciences in energy production or in food security or in fresh water security. There's no question that society is calling for a robust geoscience knowledge creation enterprise and that NSF is at the leading edge of that. So why GEO? Why now? We think it's because it's that important to life, society and human well-being.

 [Video clip playing]

 And the only thing constant about our field is that change is ever-present. So the Earth's constant is change but that change is not constant. And what I'm showing you here is just a clip that shows the role of subduction, deep sea spreading. Clearly the solid body of the planet is changing. And heartbreaking news from nature that's just come out which I'll come back to later on that shows the relationship between carbon dioxide in the atmosphere and the global temperature of the planet for the last 20, 22 years. Just quickly, carbon dioxide leads the global mean temperature by about 500 years. So there's a relationship, even that step is clearly there. And this is from the highest resolution drilling capabilities that we have in place.

 So our role and our approach has been based on the strategic plan that you all developed in the advisory committee and it's to inform a new era of discovery and innovation through world-class facilities, world-class research and education programs, world-class simulation facilities and a commitment to human capital building both in building participation and in creating the workforce for the future. So we think that this is a pretty cool and exciting place to work at NSF. There's a rational that's deeply imbedded in what we need for the 21st Century. And we play well within the One NSF concepts of a seamless integration across disciplines because geosciences has been naturally interdisciplinary place. And we're doing it with a full portfolio of services and approaches.

 So the challenges for us for the geosciences were laid out in the GEO Vision document, which was a product of this committee only three years ago. And we're still using the five challenges that came out of your GEO Vision document as basically are major driving questions for the geosciences and they are: How can we predict extreme events and hazards and improve resilience? How can we help achieve thrivability for all? We're going beyond sustainability here because the word sustainability could be interpreted to mean sort of miserable but persisting level of what I call a blade-runner universe if you've seen that movie, but we don't want to be there. We want a future where people can enjoy life and there's a high quality and equitable approach for all. So we're using the term thrivability both here and internationally. Number three, how can we predict, protect and sustain life? Four, how can we understand and predict the changing environment? And five, how can we engage, inspire and energize human capital and capabilities?

 So these are the challenges you gave us a few years ago. We have just gone through a series of retreats, divisional retreats, all hands meetings and basically I can tell you that we feel within the building that these challenges are still the right set for us to move forward, and so I'm structuring this talk around that outline. So what you'll see in the following is an outline that goes through these five major challenges for the geosciences. And it shows examples of what we're doing. We're not trying to be comprehensive or anything like that. And so there will a little ticker at the top which will lead you through the talk. We'll start with extremes and hazards. And at the bottom there's another strip that talks about the methodologies we have to do this. Research and discoveries, which would include basic research, core fundamental research as well as interdisciplinary research, partnerships, facilities, people and engagement. And so we're going to try to kind of keep you oriented through the talk by referring to the grand challenge, one of the five grand challenges and highlighting some of the mechanisms and approaches we use for these things.

 So let me start with hazards. Hazards is going to be a significant new set of initiatives of geosciences and I think across NSF. And tomorrow the system director for computer and information science engineering is going to visit with the committee, and I think part of that conversation is going to be about smart senses, adaptive management, rapid response, on-demand computing related to hazards. We've all experienced things happening including, you know, tornado outbreaks, tsunamis, et cetera and we need to really look now at the scientific issues.

 There'll be a range of spatial and temporal scales. This will be challenging intellectually to really look at hazards. The diversity of phenomena ranging from oceanic to earthquakes to space weather events. We'll need to bridge an improved physical understanding with renewed and expanded attention to how people react to hazards. And so the interface with a societal aspect, a human dimensions aspect, planning in response will be very important to increased resilience.

 So an extreme hazard. A good example of this was the Deepwater Horizon where important environmental information was needed urgently when that happened, and we were able to deploy through our rapid mechanisms, robots like this one in the Gulf of Mexico. Five ships went down during the Gulf spill funded by NSF investigators and leading to, in fact, at about the time or even before the well was capped itself, the first papers appearing in Science Magazine that had the quantitative analysis of what was really going on. And here was the August 19, 2010, published less than four months after the start of the oil spill, which really unambiguously showed the presence of a deep plume of oil that persisted without substantial biodegradation.

 So we're proud of the ability of NSF, and it's because of the fact that grants are turning over all the time, to respond to societal needs. For the Deepwater Horizon oil spill, the total ship days was 224. A unit of GEO ship days. We also have bytes and petaFLOPS, but ship days is a very expensive and important unit for us. The total rapid geo-awards were that were greater than 70, we put out $9 million in rapid awards and a total ship cost of $5 million for that. And it made an impact on the understanding and the quantitative analysis of what was really going on.

 Cascadia here is another example of where our work is really honing in on extremes and hazards. We're putting out a new array of sensors both on land and in the ocean in the area of Cascadia, in the Pacific Northwest, where there is a subduction zone, which is going about the same rate as the plates off the coast of Japan that led to the big tsunami there and the disaster there. Cascadia has always thought to be rather low risk in the ring of fire. On the other hand, in January of 1700, 312 years ago, a tsunami devastated Japan which originated in Cascadia. And recent work shows that turbidite suggest a recurrence interval of between 300 to 600 years. A recent paper came out assessing the human vulnerability to a big tsunami event launched by a Cascadia earthquake, which is due or close to being due, will happen probably in the next 500 years certainly. And the at-risk population is over 100,000 people, which is a lot of people -- United States citizens living in the Pacific Northwest. So we need to build the knowledge the best we can, understand -- and you can see the fairly regular repetition of major earthquakes for this particular period here because those sheets are moving at a speed that's consistent. Another example of extremes and hazards is land loss and recovery. Twenty-six or so of the world's deltas are subsiding. A lot of the world's population lives in areas where the deltas are subsiding. The silt that comes down the Mississippi is moving so fast and furious at the end of that channel that it goes way over the continental shelf and is lost. So it's not actually building any additional land in that delta. And if you look at the loss of land in the Mississippi since 1932, it's over 2,000 square kilometers. That's a very significant change in the land around the Mississippi. So we're funding grants, a new sequence of grants, also national centers that are looking at ways to remediate, to change perhaps the flow of water coming down the Mississippi to build new land to use that sediment that's coming down the river in ways to support the quality of life there. Perhaps to protect New Orleans but perhaps to protect fisheries or economic productivity of the region. Key factors here include sediment and water transport, so we need hydrologists. We need social scientists. We need engineering aspects. And the impacts and solutions will rely on understanding through [unintelligible] and delta processes.

 Another example is our work in the Caribbean basin, which is new work. Really pioneered by Bob Detrick when he was director of EAI and in the aftermath of the Haiti earthquake, we recognized that the Caribbean basin which is threaded with faults, had tremendous societal vulnerability to earthquakes because of the kind of characteristics of the soils and the subsurface. And so we are funding something called COCONet, which is a partnership. You see I'm emphasizing here "partnership." A partnership with many countries in the Pacific region to establish a permanent 50-station continuous GPS and weather network for Caribbean multi-hazards science. A five-year award of over $6 million to do that. This will reinforce and prepare for catastrophic earthquakes in the Caribbean. It will lead to greater understanding of the causes and consequences, the whys and wherefores of the approach. But it represents an international partnership that didn't exist before, to look at extremes and hazards.

 Volcanic eruptions is another one. Here's a picture. Each one of these dots is a plane. These are planes that were in the air when the volcano went off in Iceland. Don't ask me to pronounce the name of the volcano. But if you look closely you can see the plume expanding and you can see the day/night cycle of European transportation, and you can see in the third day of this how those flights were massively deviated and in fact there was a multi-day -- basically Europe was, in some senses, shut down during that period of time and estimates of the economic loss were in excess of a few billion dollars. So understanding, being able to predict, looking at the decisional factors as well as the geophysical factors is important when we talk about extremes and hazards.

 And this kind of work extends to space physics, too because increasingly technological society is very dependent on GPS satellite systems, national security as well as other applications. And here's an example of the newest instrument at NSF NCAR’s Mauna Loa Solar Observatory which is called the Coronal Multi-channel Polarimeter or CoMP. There's a picture of the installation. And what I wanted to draw your attention to on the bottom right, you can see sort of a classical picture of a Coronagraph during the same time that a Corona mass ejection was occurring. A big explosion on the surface of the sun. But the details of that explosion were really captured by the Corona Multi-Channel Polarimeter, which is going to be a permanent new instrument there. So we have ways of using ground-based observatories also to look at extremes and hazards.

 Moving onto thrivability; I hope you get used to this term and if you don't like it, tell us.

 [laughter]

 I'm not sure I liked it the first time I heard it but it does actually capture what we need. We don't just need a sustainable planet. We need a planet where the quality of life and equity is maintained for all. And so this is an interesting example of NSF science at perhaps -- in a most amazing way, actually. In 1983 a $50K grant was given out to a Penn State investigator Terry Engelder [spelled phonetically], and the award for the test of the hypothesis that some joints formed as natural hydraulic fractures. So the genesis of hydrological fracking, which is now a major component of the domestic energy industry. So much so that President Obama, at the most recent union address, said we have a supply of natural gas that can last America nearly 100 years, more than 600,000 jobs by the end of -- that's because of the natural gas and our ability to -- now of course this thing comes with problems and issues and major issues. And so NSF is not only at the discovery end, but we're at the analysis end, and so recent work is now looking at -- there's a new SEES Research Coordination Network award that has just gone out that's asking the question "can the Marsalis Shale -- which is where the original work was done -- can that gas development and healthy waterways co-exist, sustainably?” So all of these issues about induced seismicity, fracture mechanics, aquifer leakage, new versus old water, metals reaction and transport, faulting and deformation.

 Like it or not, we have to build a knowledge-based society. We need to use all of our attributes and understanding to build an economy that is sustainable and equitable for all. And fracking is an important national asset right now for energy. And if you're ever asked what is GEO ever done to reduce prices at the gas pump? There's a good answer in this. If you think about the volume and capability that the domestic natural gas industry has brought to bear.

 So world sustainability is also a major part of NSF's and GEO's future. We've grown over the last few years our hydrological sciences program. We've led the effort to have a seas, water sustainability and climate initiative which is now in its second round. There's some internationalization of that going on. And so world sustainability assessments are a major part of our future in looking at this issue of thrivability. Understanding the world's cycle in detail, understanding the balance, understanding its relationship with climate change, and also all the myriad issues of decision support and legal issues that have come up before that include human dimensions is a major part of our efforts.

 Internationally on this issue of thrivability, GEO has led the development of a new alliance internationally, through something called a Belmont Forum, that we've talked about before and really was an outgrowth of our analysis of international activities within GEO. But two days ago, on April 15, 10 countries and 12 organizations launched a single call, international call, with about over 20 million euros on the table to support international research on issues of fresh water security and coastal vulnerability, which are also part and parcel of our own agency activities. These countries include Brazil, India and South Africa, so it's got the global south as well as the global north, and I personally think that this international alliance coordinating and aligning international efforts around the issues of our time is going to be very important. The MOU was signed by those countries a few weeks ago and next year there is going to be another round of an international call for research associated with things like urbanization and cyber infrastructure and things of that nature.

 The International Opportunities Fund that I just mentioned was launched on April 15 coastal vulnerability and fresh water security. It was joined not only with the Belmont forum but the G8 joined in as well when they saw the energy and commitment, which meant that Russia is part of this collaborative as well the countries that you might expect. The two themed program offices will be running the fresh water security and the U.K. will be running the coastal vulnerability and you can see the commitment there which includes the European Commission which has modified it's language for the framework 7 call in the summer to support this activity.

 So water is a major component, and [inaudible] how to protect life. Another theme I want to talk about, [inaudible] [overlapping speech and recording].

 [video clip playing]

 DR. KILLEEN: So for protecting life we need to know about the critical zone. We're going to, in about a year going to have a open call, for up to eight critical zone observatories which will be an augmentation from our current system of six. We're excited about this being a new network that is growing and the great capability that ties in with our other networks: our seismic arrays, our oceanic networks, our ocean observing system, our space weather networks, cosmic and things like that. We're moving towards more of a networked multi-sense approach to understanding the planet.

 So within protecting life, the first order of question is how much life is there? And this is in the research discovery category. And USTC has been launched to look at this particular problem. This is our drilling vessel. The joint [unintelligible] resolution, drilling sediments from way below the bottom of the sea floor at depths greater than a kilometer below the sea floor, as old as 111 million years, bringing up the cores and finding within those cores evidence of life. How life got there, how it metabolizes, how much is there, are all major questions. But there are analyses that imply that some big fraction of the prokaryotic life on the planet of the Earth may be in these sub-sea sediments. So that's a major discovery on how much life. We'll be following that up with more work in the future.

 On ocean observing we're also concerned about oceansidification and the role of carbon uptake in the ocean on the life in the ocean, the fisheries, et cetera. And of course, as you all know, we're building out the Ocean Observing Initiative called OOI. And this is a system that will be made up -- it's about half-way through its construction cycle. So things are getting deployed in the ocean now. But a couple years from now there will be more than 800 sensors, real time sensors, deployed in the world's oceans. Northern Hemisphere, Southern Hemisphere, both sides of the continent, some of them will be cabled. They'll all be real-time accessible. They'll all be translated into educational products that can appear on students' desktops. And we're going to be looking in way that we've never done before at the metabolism of the complex oceanic processes. And I'm not going to go through all of these; dynamic issues, but seismic issues as well as biological issues, uptake of carbon and the different biogeochemical cycles in the ocean is part of geosciences' future through the development of this array. And it's a very technically challenging approach. Here's a schematic that shows a cabled component, a small component of ocean observatories. A coastal cabled observatory in the Pacific Northwest, which is close to where Cascadia is, which is why I wanted to tie these two things together, with a lot of different kinds of instrumentation and technology that will be upgraded on an annual basis by our vessels -- our modernized fleet that will service these facilities.

 There'll be gliders, commandable, that can perform missions. There are floats. There are moorings. There are buoys. All coordinated with a cyber-infrastructure that will be very modern and will bring forward the knowledge base to the community. Very exciting prospect. So protecting life is part of what you challenge us to do and we're doing it with instrumentation. We're doing it with discovery class research. We're doing it at the interface of geosciences and biological sciences. We have in this building a node where we intermingle geoscience and biological science program offices. And please watch that space. It's a challenging space and it'll drive our research going forward.

 So now moving to the changing environment, which is our fourth challenge that you gave us in GEO Vision. How can we understand and predict the changing environment? I want to start this with deep earth and deep time, which is a major part of our portfolio within the geosciences. The planet didn't spring into life you know when global warming became a hot topic in the public dimension. But four and a half billion years of history -- we need to understand in detail how that history unfolded, what it portends for the future. All the analogs to what we're living through now that we can see in the deep Earth. And this integrates life processes, planetary processes, deep Earth processes, and in the last few years we've found the oldest rock on the surface of the land and analyzed that, Zircons. And we've looked at microfossils that tell major stories about episodes and climate dynamics in ancient times. And so deep Earth and deep time are major components.

 And of course everything I've talked about is being done by wonderful investigators in universities. And I'm just going to show a couple of these folks picked pretty much at random. Here's Professor Isabel Montanez, a NSF PI, successfully funded to do collaborative research on understanding climate change from the final stages of the Late Paleozoic Gondwanan Glaciations. So in order to make inroads on these big questions, you need these detailed analyses, deep science looking at specific issues quantitatively, analytically, deploying instruments, going into the field, perhaps with dogs at times --

 [laughter]

 -- to make the key observations that are important.

 Here I'm coming back to the recent nature paper that showed the relationship between carbon dioxide in the atmosphere and global mean temperature as just published in the April issue of *Nature.* And I just want to point out, which wasn't adequately pointed out in the paper itself, I confess, that this was driven by NSF assets deployed globally through drilling programs on land and in the water. You can see all the dots pretty much this is Geosciences' facilities utilized over years to create the database that then can be interpreted to say what happened with planet Earth and the relationship between greenhouse gases in the atmosphere and global warming.

 And the global warming here is in the title of the paper. It's not in the -- I'm not editorializing. This is the title of the paper. Very interesting work coming out. We're looking at, in the changing environment using fossil micro-organisms in important ways to study things like ocean circulation, glacial cycles, CO2 fluxes and marine biological productivity. This will be part and parcel of the ship borne [spelled phonetically] cruises, sampling, analysis of cores from our drilling program into the future and will help us understand the changing environment over long periods of time.

 Here's another of our investigators who was welcomed to the White House, one of our PECASE awardees from the paleoclimate program, Kim Cobb of Georgia Tech, who did collaborative research looking at fossil coral records of the el Niño seven oscillation from the Lion Islands and leading to this plot, which is a plot showing the el Niño, la Niña oscillations for the last thousand years or more. And you can see each upward spike is an el Niño. Each downward spike is a la Niña. You can see the clustering in the envelope nature of these. This is very important for our understanding of future climate change. As you all know, el Niño, la Niña cycles are very dominant in terms of regional climate on an inter-annual seasonal basis. And we need to understand the variability here. It's a semi-chaotic system. The new class of Earth system models are able to reproduce this kind of clustering, this kind of quasi-periodicity that is showing up in Kim Cobb's measurements looking at the fossil corals.

 We're also studying the changing environment through new instrumentation and new facilities. Here's some new pictures of the research vessel Sikuliaq being built in Wisconsin. We have a date for the launch. I believe it's October 13, this year. That will be an exciting event. I hope to be -- where I am, I hope to be invited to this because I think it might be an interesting moment. But it's a big ship. It's a new ship. It's custom designed for science. It will be ADA compliant. It will steam out of Wisconsin, make it all the way around to the arctic, and it will become a famous platform for looking at the changing arctic conditions over the next decades. It's got a 30-year kind of lifetime. So this is a world class facility that's coming out. It's on time, on budget. We've retired a lot of the risk and we have a date for the launch. It's not a bad situation to be in with concerns about overruns in facilities. Very proud of that system. We also have these cyber enabled networks. And this is one that we haven't talked much about. This is the Argo Float Network. But this network where floats are put in place and float around to fill up the space in the world's oceans, gives us a tremendous global perspective in detail of the dynamics of the oceans. Thirty-five hundred floats are out there. So we have a network of capability in the world's oceans. It's going to be matched now by the ocean observing initiative and also on land because we have the seismic array in EarthScope.

 We're also looking at the changing environment by looking at long-time series of observation such as mineral dust in climate forcing. Here's a facility that we fund through our atmospheric sciences program -- I’m sorry, the geospace sciences program in Barbados, which has a 40 year record of mineral dust in the atmosphere and plays an important role in waiting to transfer and find microphysic processes and rainfall. And of course it's a major source of iron to the water, which mediates and controls the bio-mass in the world's oceans. So GEO is committed to long-term records. We're proud that we've been funding the Mauna Loa record of carbon dioxide in the atmosphere for decades. That graph is inscribed upon the wall of the National Academy of Sciences and we've been funding it all that time. So we need to look seriously at the long-term trends and records. And you can see from all of these graphs, it's not linear. It's episodic. It's semi-chaotic. And we need to bring our best understanding of the physics and dynamics and chemistry to bear.

 Another area where we're looking at the role of combustion, this is the role of human-induced processes, bio-mass burning in the South American continent. This was a campaign effort that GEO launched. It had aircraft and ships involved. Looking at the global mission of organic aerosols from marine sources and bio-mass burning sources, which have been argued to impact cloud condensation nuclei and cloud properties. Weather uncertainties remain. But the role of combustion around the planet, often bio-mass burning, it's clearly important even for things like monsoonal failures. And here's an example of work going on in the other hemisphere looking at the role of black carbon and carbon monoxide levels.

 In the changing environment we come back to water. And it's not just precipitation and rivers and deltas. It's what happens to the water after it falls. Where does it go? And this is where I want to bring in the role of high performance computing simulation. Because if you look at our lack of understanding of what the future really portends in terms of precipitation, precipitation actually sometimes called the dirty little secret of meterology. John Snow will know all about this. We don't have great skill scores in predicting quantitatively how much H2O falls out of the sky in regions and for the different scenarios. We've made progress, but there's a long way to go before we can say that we're on top of predicting precipitation patterns. And this is true for climate models, too.
 And these circles represent regions of the planet where the projected sign of how much precipitation will fall in a globally changed planet differs from model to model. So you don't -- you know, the models are not all in agreement. The world class models of climate change are not all in agreement about how much precipitation will fall in regions where a lot of people live. So that's a call to arms for us to increase the knowledge base, increase the resolution and viability of these modeling systems so we can say a little bit more than we can today about what a globally warmed planet will provide in terms of precipitation and all that entails for food security.

 This brings us to computation. And this year as well, opening next month -- next month? Or the month after, in June, there will be a ribbon-cutting ceremony in October that Dr. Suresh will be at. The NCAR Wyoming Supercomputer Center will open. This is a greater than a petaFLOP machine. I've not been there, maybe Mary has. But in my mind's eye, it's like a Wal-Mart full of computers. So you can think about it that way. It's about the size of a Wal-Mart, a small Wal-Mart, not a Super Wal-Mart, but your regular Wal-Mart. It exists today. The computers are being trucked in. This is a greater than petaFLOP machine. A 1.6 petaFLOP is the number I've seen for Earth System Science simulation. It's world class and the thing that's really notable about this is it's data. It's a data monster. It's not really a supercomputer. It's a data monster with a supercomputer in the back room. 120 -- 150 petabyte mass stor. Some of you will have to tell me how many Libraries of Congress that is. It's a lot of Libraries of Congress. But with something like 18 petabytes rotating disk online, so we are indeed, I think as Jill mentioned, entering an era of big data.

 In fact, there was a White House announcement that we were part of a couple of weeks ago on big data. GEO is going to provide big data from simulation models and from these networks. And our estimates are that we have in flow, on an annual basis, about 20 petabytes of data moving from institution to institution today. And that's growing by about 20 petabytes per year linearly or probably exponentially. But we have a data tsunami, to actually use a term that my colleague Farnam Jahanian, who's sitting there I can see. [unintelligible] size he uses a lot, and we're going to provide that data tsunami. It's going to come out of facilities like the NCAR Wyoming machine. And here's a picture of the most highly resolved sunspot coming out of a computer. So we're able to look at resolution elements, spatial temporal like never before, and of course the data ingestion, data assimilation tools will be very interesting as we seek to make progress in all of these themes that you developed.

 Which brings me to the last theme. I think I'm doing okay for time. How about that? How can we engage, inspire, and energize human capital and capabilities in the geosciences? This is the challenge you gave us in GEO Vision and we've got a lot of work to do. But we think that engagement, inspiration and energizing are things that we can actually deliver because of the excitement, the visual nature of our science, the relevance of it, its importance to the future. Young people want to make contributions. We have places where they can make those kind of contributions. And I'm just showing you one example of this.

 I have the privilege of listening in to the real-time launch of a CubeSats, which is a small satellite experiment that we fund through the AGS Division. I think there is something like six of these and there will be more. And you can see the size of the CubeSat. But the students who built that system and launched it have been transformed. And they will be players in the future in building systems, having them function, the excitement of launching field campaigns and actually participating in the scientific enterprise. Now the CubeSats are going to do great science and are already doing great science as well. But they're also training the next generation of geoscientists in ways that are really captivating. So I just want to say there that creativity -- we like to harness and encourage creativity in the community but some of my colleagues in the audience here, the program offices in GEO, are very creative. This was a program that was invented by GEO program offices and brought into life through the persistence and the articulation of the importance of it. And I just feel very proud that we have those kind of caliber people here who are true visionaries for what science can be done, how to move the dial, how to bring forward new capabilities and try them out. So this is maybe the feel good, give you a friendly NSF program officer pat on the back once in a while because they have to make a lot of phone calls which are hard at times.

 So for human capital, I'm just going to show a short video clip from the Southern California Earthquake Center, the kinds of things that are going on and that we're supporting.

 [video clip playing]

 DR. KILLEEN: So we have research experiences that can captivate young people, learners in fact at all levels, and we need to do this in a way to broaden and deepen participation, too. And as you all know, we stress at each of these meeting we’ve got a long way to go to do that. We should take advantage of our attributes. And so I want to mention and highlight a couple of things, just examples. One is RESESS, which is a program to broaden and expand participation in the earth sciences. And you can see the kind of outreach activities and research experiences aimed at the risk groups of students. And RESESS has already shown to be very successful. I met with those students in Boulder, a few months ago, very active, very engaged. And RESESS was patterned after a longer term running program called SOARS, which you’ve heard about. There’s a lot of discussion about how to scale systems to make best practices work in other settings, and I think this is a great story because SOARS has been going since 1996, with 147 protégés having participated in it from diverse backgrounds. Fifteen of them have earned their Ph.D. already. I know there’s one faculty member. Twenty-four are currently in Ph.D. programs. Sixty-three have earned their M.S. Their attrition rate is very small for SOARS. If we can bring in people from different backgrounds into our communities and give them the kind of rich mentoring experiences that SOARS has provided and now RESESS is providing, I think we can scale these things up and really make a difference in broadening participation. And that’s very important for us. So I’m about to end here, and remember that this a dry run of the director’s review, so that’s why it’s a little bit different sounding. But let me get your thoughts, of course, on the presentation as well as its content.

 Society is demanding reliable projections of coming changes. I think we’re living in an era where that’s a true statement. But demand is going to go up, not down. There’s going to be more of it, not less of it. It’s going to be by region, by sector, by project, by discipline, by every -- any dimension that you can think of, and geosciences nationally as mediated and led by NSF has to step up to be this call, yet the forecast is challenging for all of the reasons I’ve tried to emphasize. The quasi-chaotic nature, the fact it’s hard to go out and measure seduction zones, yet we’re trying to do that. That it’s -- that the datasets are fragmentary and episodic. We don’t have enough ships. We don’t have enough super-computing capabilities, we don’t. So the forecast is challenging, it’s difficult. But that should make it exciting for us and for the people in the geosciences research community because it’s intellectually challenging, it’s engaging, it’s important, it has all of the One NSF rings. And it’s true to say that earth’s future has no analogs in its recent past so we have to look at the deep past, too. We cannot just focus on what’s going on now, but we have to really learn from understanding, and geosciences covers that entire portfolio.

 So while we are making unprecedented changes in the earth system at an unprecedented pace, we cannot predict then by simple extrapolation from the present or the recent past. There’s too much at stake not to build the knowledge base to really do this well, too many people everywhere relying on scientific knowledge to manage societies into the foreseeable future. So we need to do this well. So how do we do this? Well, we must identify and understand the key earth system processes in disciplines, across disciplines, across NSF, and across agencies, and then into international space. And build the understanding, and that understanding will only emerge from a continuous iteration among everything I’ve tried to talk about: the models, the simulation codes, the current observations, the past observations, the long-term observations, the new networks and reconstructions of earth’s history. And I guess we’re all, in this building, proud to say that this is what GEO does. This is our job. It is to create this understanding by, with, through this synthesis, all that.

 Okay, I -- that’s the end of our presentation but I could go into budget stuff if you’d like me to, George; whatever you would like to do. Oh, I have one last slide. You’d just -- it’s just a last slide. New picture of a planet with One NSF on it, and my friend and colleague, Farnam Jahanian, AD here. Beat that.

 [laughter]

 DR. KILLEEN: Picture [inaudible]. Yes you will, yes you will. You have -- actually have a very collegian and friendly group in senior management at NSF. It’s been a delight to be part of it, and this is indeed my last meeting, so I want to thank you all and all my colleagues in the back and all my partners in crime and co-conspirators in the senior management as well. So this is our presentation. I’ve got some other slides to talk about, FY13.

 DR. HORNBERGER: I think we can do that. Why don’t we take just a few minutes because you did request feedback and the people, while the presentation is still fresh in mind? Does anyone have any comments they want to give Tim? Don?

 DR. DEPAOLO: Well, that was a beautiful and inspiring presentation. I do have a comment though. It has a particular quality that I’ve seen before than geosciences tends to focus on this, and that is its usefulness, and it or maybe its criticality even to society. But on the other hand, I’m not sure who’s going to be doing the review or who the reviewers are going to be. But, I mean, what I didn’t see was like, what are sort of some conceptual breakthroughs that are very fundamental science, independent of being useful to anybody, but really show that as a basic science this thing is making leaps in a couple areas?

 DR. KILLEEN: That’s a great comment and if you have a couple of suggestions we could easily -- we’ve got a month before this goes live. So we could easily work in a couple of the -- we could call them useless or maybe. No, I’m joking.

 DR. DEPAOLO: You know, if you have, depends who you have on the review, the reviewers, are they chemists, or material scientists, or...

 DR. KILLEEN: It’s a public, it’s a public session. It’ll be webcast, so everybody -- the director and the senior leadership of NSF is the primary audience.

 DR. HORNBERGER: Other comments? Peggy.

 DR. DELANEY: The word technology early in the morning, California time, but Don could do it, so I could do it. [laughs] I think one of my comments -- it’s interesting, kind of the same topic that Don identified a little bit differently. This is a beautiful presentation and I really liked the five questions across the top. And I’m not sure what you’re calling them but, the kind of organizing topics, or organizing areas along the bottom. And I think you can just tell them, this is the structure I’m going to be using, because along the bottom some of those things fit in more than one category and so -- I think you know that. I think one thing you could say is kind of on the One NSF, on comfort and crossing disciplinary boundaries, you can kind of bring out the thing that GEO was there first. We’ve already been there and we now have an opportunity to really articulate that and, in fact, what’s really great about this talk is you’re not standing there talking about the structure of the division to tell people about what’s been achieved. You’re using these overarching questions, and these areas that are of key importance to NSF about what the Foundation does to talk about the accomplishments. But I wanted to -- and I think it’s almost already there, a little bit on we’re not just useful, these are basic research breakthroughs and it’s the investment. And you kind of get to it when you start talking about facilities because it’s the investment in basic research and the investment in facilities that -- there may be skeptics there right now. Why did we spend all this money and stuff, that’s about -- perhaps nobody cares about? And I think that this does a really great job of saying, here’s our utility. You just want to say, there is such a role for the Foundation and for GEO and investing in basic research even if the implications for applicability aren’t immediately obvious. And what’s also interesting in your CO2 and temperature example, which is a beautiful one, of all of these things, is that that also inherently involved international partnerships and drilling throughout. So it’s, again -- when I think of the GEO was there first, people struggle to think how are we going to do international partnerships? GEO can point to their long participation and, you know, people in the room who are now gray and wrinkled from, what is it like to really work meaningfully in the international framework. But, yeah, it’s a beautiful presentation, very nice.

 DR. KILLEEN: Thank you. Great comment.

 DR. HORNBERGER: Vicki?

 MS. ARROYO: I thought it was beautiful too. So one sort of policy thing, when you talk about natural gas and the link between gasoline, I mean traditionally natural gas is really getting us off more of like coal, so from stationary sources, you know. There’s some push for natural gas [unintelligible], but so far it’s done more I would say probably to get us off of coal. So from a climate perspective, then to get us off of gasoline, for example, although that that might be possible now given this new find. The videos don’t always work for me, and maybe part of it was just a question of timing because you were so trying to say something and I was really more interested in what you were saying, than hearing the, you know, verbiage on the video. And so maybe a little bit less than that.

 DR. KILLEEN: Okay.

 MS. ARROYO: And then on the substance, I think it might be clear to your audience how important the paleo work is to our understanding some of the feedbacks and some of the surprises that might be in store for us. But as somebody who works on climate change, I would love that link to be more clear, I mean, there’re so many areas where, you know, the open water in the Artic and what that’s doing to Jetstream patterns and our weather patterns that we’re seeing, methane releases, possible rapid sea level rise. I mean any of what your scientists have found that could inform those of us who work in the policy arena on adaptation to climate change. It might be taking it in more practical direction than some of the other comments but I think that it’s very helpful.

 DR. KILLEEN: Okay.

 DR. HORNBERGER: Susan?

 DR. LOZIER: I enjoyed the presentation as well, and one thought I had is that picking up on the One NSF theme. Geosciences really might think of the theme is one world, whether you’re talking about the connectedness because of the increasing, you know, networks that we have, the interdisciplinary, you know, work that’s done, and also the international collaborations. It’s sort of a very much an integrated approach, and so just if you wanted that playoff the One NSF, Geosciences is focusing on this one world and looking at it, you know, from a very integrated, interdisciplinary, international, you know, perspective. So it’s just a thought of how to sort of pull that together.

 DR. KILLEEN: Maybe we could do that with this last frame somehow.

 DR. LOZIER: Yeah.

 DR. KILLEEN: That’s great, thank you.

 DR. HORNBERGER: Norine.

 DR. NOONAN: So Tim, I had a little bit of trouble opening the presentation. Now it seems to be up, so I was able to open it. But I guess my one question I would have is that you mentioned a whole bunch of times cyber infrastructure. Oh, sorry, yeah. You mentioned a whole bunch of cyber infrastructure, and yet it’s not along the bottom of the, you know, sort of the enabling tool. I didn’t -- at least I didn’t see it. I’m looking again to make sure I didn’t miss it. And it -- that may -- yeah, research discovers partnerships, facilities, people and engagements. And yet cyber infrastructure was sort of this consistent theme. I was typing it in amongst many of those topics. So it might be helpful to talk a little bit more about the enabling character of that cyber infrastructure and how NSF/GEO in partnership with CISE and others is actually making that happen because you mentioned it a number of times and it just, it wasn’t along the -- I mean I like the idea of the big questions and then the sort of, the themes along the bottom. But cyber infrastructure seemed to be missing there and you mentioned it a lot.

 DR. KILLEEN: Thank you very much. Let me also mention that anybody in GEO and the audience who would like to comment on this, it’ll be great. It’s actually to -- any comments, to improve this in any way would be, would be very welcome.

 DR. HORNBERGER: Yeah, I think what we’ll do is we’ll take Joe’s comment and then maybe others here the offline and then we’ll let Tim finish up and proceed with our schedule.

 DR. WHITTAKER: All right, Tim, great overview. One thing I neglected to mention was that I’m the CS liaison to this committee so naturally I’m going to ask you, You gave two examples of your outreach and broadening participation, and consistently in your reports there’s this issue of sustainability in terms of training and you did mention that several times. And now that you’ve emphasized in this combination, science reaching across disciplines, which, you know, naturally that’s what you do in your field. Looking down the road in terms of sustainability in the future of the geosciences, after all of us this table evolve to other places, are there -- I didn’t see anything specific in terms of strategies or plans going forward. Are you just duplicating those kinds of programs, or -- because, I mean, the one size doesn’t fit all, so I just need to know what your plans look like.

 DR. KILLEEN: Yeah, it’s a great question and we had an AD retreat yesterday where this was a big topic of discussion. It turns out that NSF spends in the budget crosscut more than $700 million a year on broadening participation. And we have a lot yet to do to really make some of those visions and dreams work. So we’re looking hard within GEO and also across the whole Foundation at pulling out scalable best practices. That’s one of the things we’re definitely looking at to influence the national scale. I think we’ve shown that we can influence individuals and groupings of individuals, but if you want to operate at a national scale you’ve got to be able to find ways to scale that up. So that discussion and debate is going on I would say furiously within NSF, and certainly within GEO. We have, as you know, a new strategic plan that you have created within AC-GEO that touches on some of these issues too. But yes, I just showed a couple of highlights. We have other programs in broadening participation but we can’t claim success, nor can we really claim that we know the path to success. So I think your question sort of really is one that we need to continuously come back to and get as much advice as possible. And GEO, in particular, is low on the totem pole for accessing underrepresented groups and so we’ve got a lot of upward mobility that we need to take advantage of.

 DR. HORNBERGER: Okay, Tim, could, maybe you could just continue to finish your presentation and then we’ll have time for a break.

 DR. KILLEEN: Yes. Well, I just wanted to give you the headline news on the FY13 budget request for the Geosciences. As you probably know, the Senate markup is today or tomorrow and the House markup is coming up. So this is -- but the President’s budget request came out and it’s good for GEO, and it fully funds OOI, our Ocean Observing Initiative, in its penultimate year of funding, and it also provides these funds here. Sorry about that. That -- we’re looking -- I want to go back to that picture. There we go. We’re looking at a Presidential Budget Request that would increase the funds for basic research in all three divisions by a couple, 2, 3 percent; AGS 2.1 percent; EAR 3.1 percent; and, OCE 2.9 percent. Now, while these numbers may look modest to you, and they look modest to me from my perspective, we have seen numbers with another sign in front of them over the summer months that we have worked incredibly hard to make the most compelling case about the importance of earth science, the need for it, the readiness of our community. And so, given that our facilities are fully funded and we have our nose above sea level, I think we can be pretty happy with the support from the Administration. And as you all know in FY12, the budget request which was a bipartisan, the final appropriation was very good for science as well.

 So although we met on the doubling path, and we would love to be on the doubling path, I’m sure you would love to have us on the doubling path, we are a favorite agency and there’s strong support for the geosciences within the Foundation and with the Administration, and $21 million of new money above 2012, is not to be sniffed at. The highlights of our FY13 budget request -- and I’m going to stop with this, just give you some highlights. We can come back to anything you’d like to see. It is a central commitment to basic research, in and across the disciplines. In fact, late in the development of the budget there was a substantial augmentation that we requested and received for basic research in and across the disciplines. It went into what we call the core programs, which otherwise we’d have been looking at a negative number. And so that’s a central commitment in this budget. The Ocean Observatories Initiative request was fully funded at $65 million, so that’s in addition to the $906 million. So we’re not quite a billion dollar directorate, but we’re knocking on the door. The other investments that are fully funded are in the One NSF areas, which include Science, Engineering, and Education for Sustainability, which we’ve talked a lot about at this Committee and we’ll return to again. And there will be new solicitations this year on coastal vulnerability, tied with international one, with Arctic aspects coming out this year. So that continues, and preexisting proposals will recur as planned. The cyber infrastructure framework for the 21st century is fully funded. And for geosciences that means that EarthCube, which is our big initiative in that arena, is fully funded as well with $12 million in the FY13 budget request. We’ll touch on EarthCube a little bit later on in the day. Also, Expeditions in Education, which I also talked about last time is fully funded in the present FY13 budget request at $49 million. GEO is a big player in that, has been a leading experiment of the need for Expeditions in Education, which I kind of touched on a little bit. This is all about engaging, inspiring, empowering learners at all levels, and there will be three expeditions discussed in FY14. The first is on cyber learning, the second is on learning and sustainability so it directly relates to SEES, and the third one is on undergraduate stem learning. Those are the three areas in Expeditions in Education. These -- I’m particularly interested in this because it’s a big partnership, a new partnership with EHR, the director of education and the science directorates. So please pay attention to that. We can use any advice you have on any of these things. And then the Integrated NSF Support for Promoting Interdisciplinary Research and Education, called INSPIRE, of which there’s a component called Creative, are all fully funded in the present FY13 budget request. So we have a budget that is forward leaning, that contains exciting new content area that has this central commitment to basic research and is above the zero line that keeps momentum. We’re building our facilities. We still have some major challenges, broadening participation is clearly one of them. Connecting the dots with the data tsunami is going to be an important challenge for us. But basically this is the news from the FY13 budget request, and then we’ll see how the rest of the year plays out. I’ll stop there. There’s more information on the web if you want it. Norine wants to download it.

 [laughter]

 DR. HORNBERGER: Okay, great, thanks. I think we’re -- please.

 DR. BRIAN TAYLOR: Tim, this is not exactly a budget question, but as you showed the profile there with the division into four between AGS, EAR, IC, and ICER, it strikes me that this committee has subcommittees for three of those four and not for the fourth. And I’m wondering if you’ve made recommendations to whoever follows you, and as we consider the role of this committee, whether it might be time as ICER has grown above 90 million to think about some subcommittee for that.

 DR. KILLEEN: That’s an interesting -- yeah, I’d welcome conversations about that. Of course, education is a big part of those dollars and we do have a subcommittee on education, and we have a new strategic plan. Also some of the SEES activities are being funded through there and they touch on a number of things. So ICER is more of a distributor than a single monolithic thing that’s so. It’s a different kind of review. But we’re also having internal review about ICER too. But it’s a significant component of GEO’s budget, no question.

 DR. BRIAN TAYLOR: Well, just a follow up, especially as ICER is one of the places that gives you the -- we give you linkages and integration with other directorates in One NSF. Its place holds some importance for the geosciences as we position and prioritize how we’re doing the linkaging (spelled phonetically).

 DR. KILLEEN: Yeah.

 DR. BRIAN TAYLOR: So that’s why I bring that up.

 DR. KILLEEN: That’s a helpful suggestion, thank you.

 DR. HORNBERGER: Okay, very good. We’re just running just a little late so I would like to suggest that we take a break but restrict it to 10 minutes. Okay, and so according to that clock over there we will start again at eight minutes past.

 [laughter]

 [break]

Update on Science, Engineering, and Education for Sustainability (SEES)

 DR. HORNBERGER: Check my schedule here. Okay, so we’re going to have a SEES update now.

 DR. ROBIN: So, I’m going to give you a further update about where we are on SEES, more of the nuts and bolts. And I’ll do the first half of the presentation and Ben van der Pluijm, whose summary here, is going to give the second half. We broke it up into two parts. Someone has to tell me which. Okay, which one to use? [laughs] There’s a lot of things up here. Okay, so a little bit about SEES, but the first couple of slides might be a review for some of you, but just to give you a broad overview and then about some of the exciting new programs that we’re bringing on this year. As most of you probably do know, SEES was established in fiscal year 2010. It’s a cross-directorate NSF investment, so all the offices and directorates are involved. It’s a portfolio of existing, new, and upcoming programs. We currently have 11 programs. We’re bringing five new ones onboard this year and I’ll talk about that in just a second. It encourages system-based approaches. You’ll see that throughout all of the SEES programs or tracks we have within existing programs, and it really highlights NSF’s unique role. As you all know, that NSF supports funding in all fields of fundamental science and engineering and that’s very much highlighted in these SEES programs. Of course I don’t know what I’ve pressed this time.

 FEMALE SPEAKER: Is there a keyboard with arrows?

 DR. ROBIN: A keyboard would make sense, but --

 FEMALE SPEAKER: I have no idea. I don’t know what I’m doing. No keyboard. How about this right here? Right there.

 DR. ROBIN: Okay, so in SEES we have mission statement, which is to advance science, engineering, and education, to inform societal actions needed for environmental and economic sustainability. And we have three goals. One is to build the knowledge base; again it’s to support interdisciplinary research and education. The second is to grow the workforce of the future, and again in interdisciplinary scholarship. And the third is forging critical partnerships, both across federal agencies in the U.S., as well as internationally. And as I go through some of these programs I’ll highlight how we do hit each of these goals. Well, in the first two years of SEES we rolled out five new programs, all were climate related. Ocean Acidification; Climate Change Education; Decadal Regional Climate Predictions Using Earth System Models, EaSM as we call it here at NSF; Dimensions of Biodiversity in Water Sustainability and Climate. Now these competitions are held every other year. We are currently holding the second round of competitions for all five of these programs. We also added a SEES track within our longstanding program of research coordination networks, and added additional funding to our program Dynamics of Coupled Natural and Human Systems. So in the first two years the emphasis was on climate and then as we broadened it in the third year and looked at building our critical partnerships, so we rolled out a program, Sustainability Research Networks. That was rolled out last summer. We’re currently holding our first competition. We also developed a new program, SEES Fellows, which is specifically targeted for early career providing them that opportunity to engage in interdisciplinary research and education. And then we brought out a third program which focused on energy, sustainable energy pathways. In addition, our Partnerships for International Research and Education, which is a program out of our international office, had an exclusive SEES focus in this round of their program. And in addition, we continued the five climate-related competitions and the RCN/SEES track, as well as the CNH/SEES track.

 Just to give you a little bit of data in terms of the responses to the SEES solicitations. In the first two years, 719 projects were submitted to those five climate related solicitations I mentioned in the previous slide. One-hundred and thirteen awards were made, which encompassed $99 million in funding. And I just want to mention that $19 million of that funding did come from partnerships with the USDA and the Department of Energy. In the third year we’ve received -- Ocean Acidification received 78 proposals; again this is the second competition for that particular program; Water Sustainability Climate, 150 proposals. The PIRE has a pre-proposal and a full proposal part of their competition, received 187; 183 proposals were submitted to the SEES Fellows; 205 pre-proposals submitted to the Sustainable Research Network; and 311 projects submitted to Sustainable Energy Pathways. And so a very, very, healthy response that we got from the research community on these programs. In our fourth year now we have five new programs, as I mentioned, that we’re going to be rolling out. One is Chemistry and Materials in Engineering, SusChEM. This is being led by our Math, Physical Science, and Engineering Directorates, and this is going to be a program within -- they’re going to roll it out within existing programs that they have within those directorates. We’re also going to have a new solicitation on Coastal, as Tim mentioned, and Artic. Both will be coming out, the Artic very shortly, the Coastal sometime this summer. A new solicitation also on hazards and disasters, and then a fifth one on information, science, and engineering, the RISES as we call it, Role of Information, Science, and Engineering for Sustainability. Each one of these programs has its own acronym, so you have to get very good at memorizing all these. And, again, that was -- that one’s going to be rolled out this summer and you’ll hear more about that in tomorrow’s presentation by Farnam from Computer Science.

 As Tim mentioned One NSF, SEES is part of One NSF and I think it really highlights what -- SEES is really highlighting what One NSF is all about in terms of responsiveness, leverage, and leadership. Those are the three main characteristics of One NSF. We’re responding to global challenges, and as you see in each of these solicitations, they target specific areas of research and education dealing with sustainability. We’re leveraging resources both internally -- each solicitation has investments from across the Foundation and it really is something that’s uniquely different that can’t be done through the existing discipline programs or co-funding of those. We’re also leveraging across federal agencies. As I mentioned earlier, the USDA is involved in both Water Sustainability and Climate, as well as the Earth System Modeling solicitations, and the Department of Energy is also involved in EaSM as well. Internationally, Dimensions of Biodiversity has partnerships with China and Brazil. The PIRE program has partnerships with Russia, Japan, the Inter-American Global Climate Change, as well as the U.K., in addition to partnerships with EPA and the USAID. So you can see that each of the different programs have developed these partnerships as needed for the solicitations.

 And finally leadership. Tim had mentioned the Belmont is one area in terms of international leadership. We’re also -- the National Academy is going to have a Sustainability Symposium that’s going to be out in the 16th through the 18th, which really has -- showcasing the federal agencies and what they are doing in terms of sustainability and also how we go forward from there in terms of building critical partnerships across federal agencies as well as internationally. So that’s going to be coming out May 16th and 18th, the Symposium. And also in terms of leadership, I think it’s really important to highlight what SEES has done internally in NSF. We’ve been starting discussions with the cyber infrastructure framework, CIF21 group, as well as the expeditions in education in terms of how we can link and synergize our different activities, as well as share best practices that we’re doing across the Foundation.

 And along those lines, it’s important to show how SEES is organized because it really involves over 100 different program directors throughout the Foundation, and I really think we need to commend the program directors and the geoscience director; over 20 of them have really taken leadership roles in the different solicitations and programs.

 So, the way it’s organized is that you have the NSF leadership, the directors, the assistant directors, and they really are involved in the long-term planning and guidance of the SEES portfolio. Underneath that you have the NSF-wide implementation group, which both Ben and I sit on, as well as representatives from each of the directorates and offices, and we coordinate the different SEES activities, solicitations. We develop consistent guidelines, provide internal/external communication and we’re shaping the evaluation fan as we move forward. How do we go ahead and evaluate this large initiative that NSF has now undertaken? And we also act as liaisons both to the senior management in terms of discussions on long-term planning, and as well as to the programmatic working groups. We have 16 of them; one for each of the programs. They’re made of multi-directorate representatives from each of the directorates involved in those particular programs. Some have interagency engagement as well as international. We also have a communications working group that works very closely with Office of Public Affairs for both external communications as well as internal communications across the Foundation on these different programs; as well as the symposium working group, which is the May 16th through 18th, Symposium that the National Academies is going to be putting on that NSF has been very actively involved in as well.

 And I’m going to pass this over. I just want to mention one of the activities that we’ve done on this SEES Implementation Group, is we’ve developed this portfolio framework in terms of -- now that we have 11, soon to be 16 different programs, how do they all fit together under the SEES portfolio? And I’m going to pass it over to Ben, and he’s going to talk a little bit more of how we put together this framework.

 DR. VAN DER PLUIJM: Show me which button to press. Thank you. All right, it works. Okay. So I work with Jessica on the Implementation Group. And as you have heard, of course, there is a sequence of 16 of these programs currently there. And one of the things you learn at NSF -- I’m a rotator, I’m pretty new here -- is that you have to study acronyms and that’s one thing now you have to study 16 acronyms and be able to rattle them off. That’s -- gives you a sense of just a bunch of things put together there on the screen, but really what we wanted to do is to actually examine how really these programs in this SEES portfolio are mapping to the goals of SEES. And Tim, I prefer SEES for SEET [spelled phonetically]. I think SEES sounds better still than SEET. [unintelligible] hardly together.

 So, one of the activities that we did was to actually examine this entire portfolio in the context of, what are the commonalities? How does -- how do these various programs hang together? What are the overarching goals of those programs? Not individually but as a family of programs. Essentially what we’re trying to do is simply offer conceptual framework for this portfolio of SEES programs and their scenario. And we wrote down the number of categories, and I’ll walk you through those categories of how we can look at this total portfolio. And as we develop new programs and sunset old programs, you try to keep an eye on how the mapping of those programs plays out, relative to the totality of the SEES framework. And Jessica showed this slide, and I just put it up to emphasize again that we have the goals for the SEES portfolio, the SEES framework. We want to know where we’re going to get to. The knowledge base, we want to develop the workforce, and we want to emphasize the role of partnerships. And so how do all these other programs that we have under this umbrella get towards those particular set of goals?

 And so what we did is we looked at all these programs and said, well how can you examine, how can you group the characteristics of those family of programs? And we ended up breaking them down in three categories and you saw the categories in Jessica’s overview slide. We have topics. We look at topics. We look at functionality. How do we actually do the science and promote the science in these areas? And who are the people that are the target audiences? Who are the people we’re doing this for? So the topical themes sum up very predictable. Others actually are more specific. Obviously the natural system is a target for the SEES portfolio. We’re looking at the climate systems, the hydro system, the geosystem, ecosystem, the usual suspects of course in a natural system scenario. And the emphasis on systems, by the way, is key in this particular ingredient. But also we are very well aware, which maybe sets the SEES portfolio over the site, that there is this strong interface with the human and build systems that we have of today. In other words, it is not just the fundamental knowledge; it’s also how it maps to the activities of humans. And so how human behavior plays into this scenario and how the build, the natural, and the human systems interact with one another; key components of the programs under the portfolio.

 There’s also focus on energy and materials in a number of programs and it’s scattered through these various programs. And by the way, I realize there’s a lot of text on these slides but I also know you have them in front of you and so I’m not going to read the text that’s in detail there. And the fourth block on that scenario is hazards, adaptations, and resurgence, which is the program that you heard about also in Tim’s nice presentation this morning. It’s one of the new activities we’re working on hazards and coastal setting for SEES. So those are the topics that SEES portfolio is trying to address.

 Now how it does that is another way of looking at it. So how does the SEES -- our SEES programs achieve their goals? Systems thinking underlies all these scenarios. Multiple systems and interacting systems and inter-fingering systems is that particular scenario. That’s pretty much the root of many of these core programs. The other element is that you can’t do many of these research projects on your own. Teams are an important ingredient. So partnerships between scientists, but also between institutions, also between institutions and organizations, and even with the Federal government. Any connections or partnerships is really key element to achieve the goal for the SEES portfolio. So partnerships and networks -- there is one, but does it show on the white? Partnerships and networks is a key element there. Obviously the Foundation has a role in education and learning. It’s implicit in nearly all the programs and it’s explicit in some other programs like CCC [spelled phonetically] program, and we’re working on a structure of emphasizing the learning environment. Workforce development is actually something that’s really specifically identified here because the topic that we’re addressing are really -- the workforce there that’s fully developed, the integration of the topics is actually quite a struggle and quite a difficult scenario. So we realize that we should also play a role in helping create a new generation of scientists. And a workforce development component is a functional characteristic in most of those programs. And information systems, you heard a lot about that. Recognizing that data is the second scientific revolution really is a major player in collecting those data, using the data to better understanding of these scenarios.

 And then lastly, what we’re doing this for -- obviously the NSF doesn’t do the research, it just motivates the research. But it particularly focuses on early career scientists. People that are -- will actually carry this area forward, the area of sustainability forward in their careers or their positions, whatever they take to do down the road. It also emphasizes the fact that people have to work together, and talk together, and learn together to interdisciplinary teams as an ingredient that is the typical target ingredient for the various programs. Obviously we address educators and education and researchers in a number of these components.

 But the other office is also institutional networks, as opposed to targeting typically an institution or a few group of PIs, absolutely having multiple institutions come together both nationally as well as internationally is one of the clear targets in that scenario. And that’s what the last topic is up there, is that, of course, sustainability does not stop at the U.S. borders. Clearly it’s a global issue. It’s global sustainability, and so international collaboration is a key element in that particular scenario.

 So there’s not a whole lot written up about it. We have a website, which is identified there and the address is at the bottom, www.nsf.gov/sees. And more information is coming available, but we also gave you a small handout that is somewhere on your materials that Melissa, I think added, to the list of that scenario. And a starting piece is written up in EOS a couple of months ago, headed by Tim, on the SEES portfolio. So you can get started into a sense of this scenario. So I just wanted to give you that framework of the totality of these programs to show you that they are very well connected to each other. And that was our presentation. So, if there’s questions, then Jessica and I, I’m sure will be happy to answer them.

 DR. HORNBERGER: Great, thank you, Ben and Jessica. Walter?

 DR. WALTER ROBINSON: So, I’d like to see the previous slide I think it was, the focus on targeting early career researchers right at the top. So since you’ve had now a round or two of awards, do you have some of that geographic information about who’s actually getting, who are the participants in the awards you’ve made through SEES?

 DR. VAN DER PLUIJM: Well we are -- one of the things that we are starting to do is actually an assessment of the portfolio. Part of the requirements of where you put the SEES portfolio is put together is to build an assessment scenario. And so this is a project that we’re starting in the coming months to actually look at a demographic. But one example of early career research is the SEES Fellows Program. It’s the first time we did that and we hope to make 20 awards that will give you a very interesting perspective once we can release those names of these people and what they’re going to do. A very nice perspective of what the audience is. But that assessment that you were asking for is exactly something that’s on the plan for the coming year as a primary activity of the IG led by Jessica. You want to say something more on that?

 DR. HORNBERGER: Any comments, questions? Norine?

 DR. NOONAN: Thank you. So Ben, thanks. I also have a question about the target audiences. I -- this is mostly speaking to the community. In other words, everybody on that list is more or less the community. So I guess my question for you is, are -- do you anticipate target audiences beyond the community? That is, is this work important enough so that it attracts broader attention? I mean I know that sustainability, thrivability, whatever you would like to call it, is a big point of debate, discussion, whatever. In a whole variety of contexts and I think SEES might be helpful in informing those kinds of more public debates but you don’t, I know, you know, NSF always has the audience, the broader audience, blah, blah, blah. I get that. But I think for this one in particular, beyond international collaborators and the family, how are you thinking about SEES interacting in a more public setting?

 DR. VAN DER PLUIJM: Jessica’s nodding to answer it.

 DR. ROBIN: And that’s an excellent question. So, couple of different ways. If you look at specific solicitations in terms of how some of the language they have about engaging with policy makers, that’s involved in some of the solicitations. We’re also -- I think this is very much related to the education and learning research, and the informal education sector; we are, at the end of the month, we’re going to be having a special of the SEES Implementation Group with members of different program officers from the Education and Human Resource Directorate. We’re going to have a retreat to look at how we’re tackling that on different levels, to be a little bit more strategic instead of each program doing things individually. How we can have a more holistic approach, looking at that. As Ben mentioned, the assessment component that we’re now entering, and looking at, how do we really tackle that societal impact in the most effective way? I think the strength of SEES is that because we engage across the foundation we have all this expertise. We are definitely very much engaged with SBE, the Social, Behavioral, Economic Directorates, which has a very healthy program looking at that. And so, we’re well aware of that. As we’re now entering the third stage of the year, we sort of have different targets. The first two years was sort of more topical, but now looking at that. And the summit as well.

 DR. NOONAN: Right.

 FEMALE SPEAKER: Talk about some of the people who are talking in some of --

 DR. VAN DER PLUIJM: So your question, of course, ultimately comes down to what is the policymaking component and the public and education component in many a way. So one of the things we do is a step-wide sequence of course. First of all, you have to engage the communities, that is what we do right there I should point it out very correctly. But one of the things that we have, as we sometimes call a coming out party, but we have a symposium in May where we try to draw together a number of stakeholders both from the Feds, from NGOs, from researchers that will start to look at how the sustainability type science is actually playing into society. So it’s an actionable knowledge symposium where we try to look at, how do you make the step from knowledge, which we are of course as the NSF focusing on; it’s a knowledge-generating facility, to the decision-making process, the actionable part? And the symposium is one of our attempts to explore how to optimize that connection. And the symposium is organized by National Academies. Pam Matson is in charge of that particular component. And that’s one attempt to figure out how to make that connection. That’s why there’s no extra bullet point on there. The blah, blah, blah bullet point. We actually want to really carefully phrase that because this is something that indeed is the key element in the long run.

 DR. NOONAN: I would just encourage you also to look very carefully for representatives in the private sector because at the end, you know, many businesses now are focusing heavily on sustainability --

 DR. VAN DER PLUIJM: Correct.

 DR. NOONAN: -- as part of their triple bottom line strategy.

 DR. VAN DER PLUIJM: And they are invited to the symposium as well.

 DR. NOONAN: And I think that is going to be where, you know, more even than policymakers who, you know, won’t make a decision until their absolutely pressed to do it. The business community actually would be much more action oriented if you can show them that their -- and they can engage in the conversation, about how this contributes to their triple bottom line.

 DR. VAN DER PLUIJM: That is correct. And that’s why they’re part of that -- the group as well. Thank you. I see Dave with his hand up but you were in [inaudible].

 DR. SCHIMEL: I was going to almost speak exactly that same point that the language tends to be about a conversation between science and policy. And I think that it’s critical in the spirit of innovation for that actually not to be the first principal component. I think that the first axis is really between science and innovators who are rarely in the policy sphere. I mean there are innovations in policy of course. Thank you.

 But I think that inspiring this interaction, and I think that the SEES programs provide an opportunity for partnerships and I’ve seen this because of the very large number of SEES proposers ask for me on letter of support. A lot of them are engaging, non-traditional, either industry trade groups or businesses that have triple bottom line policies. And I think when you present on this, the word, “innovation,” to me seems to carry a lot more positive and affirmative message than talking to policymakers. So, I think that there’s a language and tone issue here, that I think would actually, at least from the SEES proposals I’ve seen, would be reflective of what many folks are actually interested in doing. That is, they’re not just interested in talking to policymakers. They’re engaged with a much broader spectrum of social organizations.

 DR. VAN DER PLUIJM: So we use the term, “use inspired,” in some of the write-ups that you have, what you’re describing is a use-inspired component.

 DR. HORNBERGER: Tim and then Vicki.

 DR. KILLEEN: Those were really interesting comments and, you know, like I had déjà vu because these comments came up at the international level as well. The -- at Rio+20 there’s going to be rolled out for the initiative called Future Earth, which is an alliance of funders including ourselves, through the Belmont Forum. The operational service providers which include places like the WMO, UNEP, United Nations Organizations, and the Academies as represent through ICSU and ISSC, the top bodies in social science, and stakeholders which would have things people like insurers, energy sector, water sector as well. So at the international level this conversation is really taking place, I think, and we can be part of it if we engage in civil society in its full respects. But NSF as an agency has to really concentrate a little bit on its knitting, which is the building of the knowledge base using our academic connections. But this conversation is starting to take place I think internationally and we’re part of it.

 DR. HORNBERGER: Vicki.

 MS. ARROYO: So my question is, you know, and I think it relates to the connecting the science with the policymakers. I mean organizations like ours, which happens to be at a university, but there are some other think tanks and NGOs that are doing some interesting work as well, creating things like tool kits that help people sort of go from the science and the downscaled modeling to what can you do as a policy maker to change, you know, where you locate infrastructure, for example, to build it differently, to retreat from some places, to allow the wetlands to migrate. We’ve got some people doing that actually, today with the State of Maryland, some students and staff attorneys visiting with DNR and other officials today in Maryland. And we’ve got things like, you know, this comprehensive clearing house that tries to serve as a conduit of information. That’s not just our work but other people’s work is up there. And I’m wondering whether or not there’s a place in SEES to facilitate this kind of thing because, I mean, speaking for my own organization, you know, the funding for this really has come from, you know, one of two foundations that have actually decided to do something on adaptation. And one of those two has pretty much decided to now move on probably focus more on international. And so there really is not a tremendous amount of support to do this, and yet the need is only increasing. And so I’m wondering if NSF will also facilitate these things that are really creating a community of practitioners that can be of help.

 DR. ROBIN: So I’d like to point you to two of the programs. One would be the Sustainability Research Networks, which is really networks of networks, and those are going to be large awards, up to $12 million that provides funding for both the research, the education, the outreach. The other one, which are -- it’s a smaller program, would be the RCMC track. But the idea behind those is that you are creating these networks of not just the academic community but across these different communities, and so with the RCMC track that just provides funding for the administration of the network with the understanding that the different investigators involved already have funding for their research. So those are really, I mean if you notice the three goals, one is the creating the partnerships, and so we do have that. And also, several of the other programs have research coordination network tracks, like Dimensions of Biodiversity, Coupled Natural and Human Systems. So that is a very strong emphasis throughout the individual programs.

 DR. HORNBERGER: Orlando.

 DR. ORLANDO TAYLOR: Could you go back to the previous slide about -- the one -- yeah that one. I think regarding about your early career researchers, this is really a takeoff on Walter’s earlier observation and Joe’s observation earlier. It seems that they -- this is a great place to really indicate some focus on, particularly on individuals from -- focused on issues around gender and underrepresented groups there. I also think faculty, graduate students, and postdoctoral persons at institutions where there may be clusters of people that would enhance broadening participation such as minority institutions, women’s colleges and so forth. So it seems like a natural place to be explicit about that. Regarding interdisciplinary research teams, I thought of saying this earlier when Donald made his observation regarding focusing on the applications and uses. It seems to me that it would be helpful to be, again, quite explicit regarding some of the social and psychological effects of, for example, catastrophic events for example. What happens when the event’s over? The psychological impact? Issues of depression, fear, et cetera. Economic impact, et cetera. Those topics we know can be very attractive to the underrepresented groups, because a lot of them are majoring in social sciences and these fields. So I think to explicitly point that out would be very helpful to that particular goal.

 DR. VAN DER PLUIJM: Just to make one response to the first part you said, what part of the assessment that we’re doing of course will be exactly to look at demographics for the people involved, but one interesting vignette is the SEES, fellows which is the most explicit early career program, because it entirely focuses on supporting young scientists. Gender wise it was a 50/50 split from where we end up funding ,and in the sense of applications it was about slightly more women than men. In underrepresented groups we had less success, and this is certainly something to target, but the objective [spelled phonetically] part, the assessment of the demographics of people engaged in this. Obviously we’ve seen this as a topic that crosses cultural boundaries and so you’re absolutely right.

 DR. HORNBERGER: Okay thanks, Ben and Jessica.

Update on EarthCube

 DR. HORNBERGER: We’re going to move on to our next topic which is an EarthCube update -- EarthCube update. [laughter]

 DR. JACOBS: Is there a keyboard? Yes, there is. Okay. Thank you. There’s a couple names listed on this slide. Eva and I are listed there, but by no means are we the only ones involved in this EarthCube endeavor. I guess our names are listed, because we have the longest longevity in it, but we actually have a number of people working on this activity. I’d say there’s probably about five of them from different directorates and some IPAs. So I wanted to give you an update. We’ve made a lot of progress since the last time I talked to you. Emphasize again the context of EarthCube, and the partnerships that have created it. A little bit about the vision of EarthCube. Progress we’ve made to date, and some of the synergies we are challenged to have happen over time. So we have two kinds of threads here. One is in the geosciences, and we are now using the term that geosciences is increasingly born digital, because a great deal of things we do are digital, digital, digital, and that doesn’t mean that that’s the only data, but there’s a lot of that now. Tim gave an excellent presentation on all the kinds of observational and modeling activities we have going on. We also hear about the Geosciences’ vision, GEO Vision 2000, and although there was a number of challenges there inside that report were also a number of areas that needed particular attention. Everything from water to climate, and other activities and those who are familiar with that report know that set of challenge areas. On the other side of course of our partnership is CIF, cyber-infrastructure for the 21st century; as you heard that is a budget element. It’s an element in this year’s budget and we have proposed it in the next year’s budget as well, and this is an institutional-wide, NSF-wide activity which is going to build a cyber-infrastructure for the 21st century. It tries to leverage these common methods and approaches across all of NSF, focus on interoperability of those activities, and tries to do the catalytic activity for investments that NSF has made or could make in the future. And it’s certainly based on the idea of shared governance across the foundation and across the community. And it is an idea that NSF would like to coherently manage, is the infrastructure for all of the foundation. And so EarthCube is the contribution for Geo sciences to this larger activity, and it does catalyze many of the points in that -- that you see in that slide.

 Let me emphasize again the issue that’s come up again about data across the entire foundation as well as Geo sciences, modern data, modern science. There’s a lot of it. The tsunami of data, there is an increasingly amount of multidisciplinary data that’s available to the Geo sciences community, and certainly this sea of data, whether it be in the computational side or whether it be the observational side, is presented a challenge. In geoscience something that’s very interesting to us is the fact that we have to deal with data at rest and data in motion. And both of those are very, very important. And so we have a huge number of observational networks out there, or we tap into other agencies who have observational networks producing data that’s quite important for research and education.

 When you look at what I call the flower diagram for CIF 21, and you look at the various leaves on that there is a very common set of areas for both CIF 21 and the Geo community. We have everything that we deal with in Geo is also in the portfolio of CIF 21. So we find a great deal of synergy in terms of that larger program, and how well we can play within that arena.

 So let me talk a little bit about the vision for EarthCube, and it really is a lot about an alternative approach that we have taken to deal with cyber-infrastructure. There is a number of daunting science problems that we are quite aware of, and there are a number of cyber-infrastructure challenges that we have to deal with. We said very early on, some of the folks that have heard my presentation before, EarthCube is a lot about an outcome and a process. We can articulate what we’d like to happen in 10 years. We are developing the process to get there in coordination and collaboration with the community. EarthCube really requires that broad participation. The players who are going to make a difference in EarthCube really have to engage in the process itself. So we have this goal that we’ve set out about transforming the conduct of research to really build this knowledge management system for geosciences, and I emphasize again we’ve used the term knowledge management recognizing it’s somewhat of a loaded word, because industry uses that as well, but we wanted to use the word knowledge management to emphasize this is not just about cyber. It is really about the way we do research, which is many, many components of research. There really is people involved. There is discovery of information, discovery of knowledge. There is the whole culture of how we do research, and how we’re rewarded for research. So we have a very high bar we set, and we want to not only build the cyber-infrastructure, but all the other pieces that you use as researchers or educators is part of that. So what we expect the outcome is this transformational process. We do expect unprecedented new capabilities for researchers and educators that they don’t have now, or if they have they’re so difficult to do they don’t actually undertake them. And that is the productivity argument in the next bullet, which we really need to make researchers far more productive than they are now. If you listen to folks like Bill Michener, who is quite in dealing with data, he would tell you that the rule of thumb that they use is that researchers spend 80 percent of their research funds on gathering the data and getting it ready, and 20 percent actually doing the research. We would love to see that changed, and that is because finding the data, getting it in the right format can be a very challenging activity. And certainly the end result would be the acceleration of research in the Geo sciences and about the Earth’s system, and to provide this framework for a knowledge management system. So what do we actually know? We know that we spend approximately $100,000,000 a year in supporting cyber-infrastructure in the geosciences in a broad context, broad definition of that word. And we also know despite spending all that money research is still frustrating. It’s not quite working right. It’s still too hard to find data in different areas, particularly if you’re doing interdisciplinary research. We also know that the only way this can really happen is not developing one-off systems, but having the community be engaged in the whole process, and to drive it in a way that they will reach some consensus. And move forward on that activity, and get much more broader engagement, and we would love to think that over time the community will have a sense of ownership of EarthCube, because they helped to build it. NSF has found that one of the roles we can play, we’ve always known this role we can play, is as a facilitator of the community. And the government does this every now and then. It brings together all previous investments that they have made over time, and brings them in a way that focuses on an outcome. And probably the best example of that that we all are familiar with, what happened when the United States needed to develop a nuclear weapon? They created the Manhattan Engineering District, or we know it as the Manhattan Project, where they brought the very best capacities from all over the world, but mostly from the United States to build that. And you had a deliberate outcome. And so the government has that capability of bringing the best investments they’ve previously made in educating these people, and building an entire infrastructure together to actually have an outcome. By no means is EarthCube the Manhattan Project, and I want to make sure we don’t go away with that idea, but the notion that the government occasionally can bring together the best resources is an important activity. And of course one of the things we have to assure the community of is that the modes of support that we have now are not going to change. We just think they will be better connected over the next decade. So we are not going to stop making individual grants or supporting large centers, or all the other groups in between. But many of the resources are devoted in those centers, and developing their individual cyber-infrastructure that may later on become increasingly difficult to connect when you want to work across the disciplines. So over time we have this idea of a spiral development where you would get convergence of the activities over time as we build more and more parts of EarthCube. The community collaborates more in these activities, and finally you get a framework for EarthCube. And we see this as at least a 10-year process of going on, and energizing the community, and getting their best ideas, and getting them to agree on things. Hopefully they will agree. We won’t force them to agree, but hopefully that’ll come to the right kinds of conclusions. So that’s the notion.

 So what have we been doing? We have had a very strong engagement by the community. An unexpectedly strong engagement and excitement in the community, but it’s been a little uneven. The researchers out there are saying, “We’re watching EarthCube. We’re interested, but I’m not quite sure how this is going to affect my research.” But the cyber folks who are well connected to the research community and the education community are engaged, and so we are aware of that uneven engagement, but that’s not a bad thing. We’re bringing very good resources to the table. We started this in June of last year. So we have been at it less than a year. We had a couple WebEx’s around July. We set up the social network website. An interesting idea caught on. We had that first charrette in November of last year. We’re planning a second one in June of this year. We’re accelerating -- we basically had an accelerated dialog among the communities at that first charrette. We really defined the initial scope of EarthCube in terms of its capabilities, because one of the things we asked the 150 people that were there, and some of the people that were online, there were at least 50 people online. So what would be your capabilities you’d want from an EarthCube type of system? So we defined the initial scope of what we would like. Then we announced in the Dear Colleague letter, send us your ideas about EarthCube, and how you could contribute to that. And as a result of that we certainly had a number of responses from the community. The current number -- I have 744, but the last time I looked it was about 752 people are on the EarthCube website from a variety of activities. It’s a global activity. It is -- industry is very involved there, and a number of people besides our traditional researchers are watching what we’re doing. As a result of that Dear Colleague letter I expressed earlier was, we got about 70 of those letters. We have now funded 14 community groups, they’re sped up and they’re working frantically [laughs]. There’s some members of the audience who are part of that frantic things so they might want to comment on that. It’s very interesting, very encouraging how the community is organizing themselves, and I’ll say a little bit in the next slide or two about what those groups are. Really there’s an unknown number of hours that the community has put into this, and we have not spent a lot of money doing it yet. We are trying to get the community to have a collaboration and discussion, but there really is a new sense, a new pulse of the geosciences community that we’ve got out of this activity that we’ve done so far. So in the Dear Colleague letter we had basically what we’re calling two scoops, where we took whole bunch of proposals in on January 18, and we had about 60 of those. We really shared all of those on the website. EarthCube has been a very open activity, and most everybody agreed to share those proposals. So all the ideas out in the community were basically put up on the website, almost all of them. And we basically funded six community groups, and one facilitating workshop, and five concept awards out of this first round. We got 18 submissions on the second scoop which was -- due date was April 2. We are looking at those now. We are sure we’re going to fund something out of that as well.

 So what we started with in this first thing you saw, we started with a set of ideas like data brokering. A group came together that we had never seen actually collaborate before, nationally, internationally testing the idea of data brokering. How you find data across different data bases. Another one was across the [unintelligible] inoperability, they wanted to test some ideas, service-based architecture. In the community groups, the blue boxes, we had received a number of proposals that wanted to deal with the things like governance. All of these folks have been told that they are going to essentially develop roadmaps for the June event. So each one will be developing roadmap for concepts, develop prototypes. Another, the blue groups will develop roadmaps about what would be needed for a standing working group in some of these areas. The data one actually has three subgroups dealing with various aspects of data, and so we tell them we’re going to go to the June event. We want you to come with roadmaps. We’re going to discuss those roadmaps, and out of those roadmaps out of the June event we are going to get the input from the community about what would need to be a roadmap for developing the various types of cyber-infrastructure. We don’t expect the roadmaps to be exactly the same. Maybe the different tasks will have different types of roadmaps, and out of the blue groups we expect to have different concepts about how would you develop a standing working group. And also as part of that we’re going to ask the question, “What did we miss? What are the unknown elements of EarthCube that ought to be there, and we outta be investing in?” And we will being that task before the charrette and we will continue that after the charrette.

 So these community groups are the way to engage all of Geo sciences in these particular areas. One of their essential tasks is to try to reach out to broad communities to find out what their needs are, and the concept groups are ones that are developing mechanisms that we would possibly use for developing the cyber-infrastructure. There’s probably been more than one of those, and we’ll look at competing solutions for the ideas of how you would actually start building a framework. We’re -- we want to get community engagement, and everybody is going to be aware what everybody else is doing. We have tried to make this as noncompetitive as possible, because out premise is that the best way to build infrastructure is not in a competitive mode, but in a collaborative mode. So the long-term timeline, it looks like we started back at the bottom of the graph in that first charrette. We developed these community groups and capabilities. We’ll go into this second charrette. We hope to fund some standing working groups out of that, and maybe some early prototype developments, and then we were going to have a series of events after each year as we move the community forward to developing some consensus on what EarthCube might be, a framework for EarthCube might be. We recognize that the top layer of EarthCube will be discipline specific, because there’s a bunch of different activities going on, but if you can get some agreement at the lower layers of how you share data, and how the middleware would work, or what the best choices are, then the top layers will be much easier to develop those over time.

 And here’s the last slide, the things that we think about. Certainly you can’t have these activities, like the cyber folk go off and develop their perfect solution, and the researchers are saying, “That doesn’t fix my problem at all. You don’t understand what I’m contending with.” So one of the things that we think about is how do we bring this as a synergistic activity together so that all parties who really are stake holders have something to do about it. That first bullet is one we think about a lot. That long tail of science. How do you engage the researchers in this activity so that you know that the outcome, what the cyber folks want to build and can build actually meets the research needs. The other one is that we also recognize that our community depends on other agency data to a great degree, and international data to a great degree. And so we need to integrate them into the dialog of how we develop EarthCube. We also thinking a lot about how NSF can be a more effective facilitator. We found that the EarthCube website was helpful. It is being challenged now. I think it’s been so helpful that we need to actually figure out how it can be more effective for the community, but there are other ways that we can do that, and we are talking about those internally as well as with the community. But of course the bottom line is we are really changing a culture of the community and actually are trying to. And how do you actually change the culture of the community is a tough thing, and that’s -- a tinier timeline might be too short for that in the long run, because the difference of phasing between technology and human change, there’s a pretty big difference between those two changes. I think that was my last line. I will stop there.

 DR. HORNBERGER: Thanks Cliff, that was great. When you said we spend 80 percent of our time getting data I thought you were going to say we spend 80 percent of our time writing proposals to the NSF.

 [laughter]

 Jill.

 DR. BANFIELD: Well this is fantastic and extremely important. I have to say what keeps me up at night is wondering what are we going to do when we get to the point we generate more data than we can store, and I fear we are getting very close to that situation particularly in the biological sciences. So I’m wondering about EarthCube, and I’d like to ask, is this in some component a database? Is the data stored in a central depository or is the model going to have many distributed locations of the data, perhaps even at the labs of the individuals investigators? So how’s the data storage part going to work do you think?

 DR. JACOBS: If you’re, if you’re talking about the fact that we have distributed data bases, real-time data flows, it is a problem that the community is aware of, and there are known data bases that are distributed, and there’s a lot of deducting that we don’t even know about. It exists on researchers machines. We don’t know how to get to that, but that’s clearly, as the community looks at this, we’ve started receiving some expressions of interest, but how do you find that data? How do you access that data? It is out there. We know it. We’re hoping the community will recognize that as a problem, and start to think about solutions. But each individual researcher doesn’t want to come up with a solution, his or her data somehow or another. We haven’t even dealt with -- the joke we have inside of NSF is, well how about the researcher that keeps the box of rocks under his desk, you know? How do you get to that?

 [laughter]

 And so we recognize these problems, but hopefully collectively we’ll actually solve some of those problems.

 DR. KILLEEN: Just a great question on the data. We see, you know in CIF 21 this is the major component, who cites the data? Who are the professional societies? Who curates it? Where the ownership is, where the visioning is. All of those things. I think you can look for NSF to be rolling forward over the next years in policies, and standards perhaps to address this question of, and I hope this comes up tomorrow. If you could restate that question tomorrow with Farnam Jahanian from CISE, because it’s a deep computer science problem as well as a geoscience problem. I think at EarthCube we have the opportunity to be the first domain to really explore this place comprehensively with a community, and I think that’s the exciting thing. And with the NCAR Wyoming machine we have a data monster, but who actually manages the data? Who takes responsibility for it? Who curates it over the long term, and the role of NSF. We’ve had some very interesting meetings with NIH recently on their approach to open-access publishing, because publications is also part of this. And they’re PubMed central system, there may be something like that for Geosciences within a few years, but I’d really like to hear Eva’s comments because she’s on the front lines of the data explosion as well.

 DR. ZANZERKIA: Well, thank you. I think that both Tim and Cliff have covered it. What we see EarthCube as is really a framework for the community to have that discussion. They may decide, because their data requires a single structure to maintain it all, that that is the mode they’d like to move forward for. But they may also, you know, survey what they already have. There are several resources out there to maintain data, and maybe what we need is a plan for moving those forward to address increasing amounts of data. Part of what we’d like to do with this process is allow the community to start organizing themselves, and then respond to what they see as their best needs.

 I mean we’ve moved toward centralized data sets, and then towards distributed data sets, and then back. So I think over the course of, you know if you look back in the history of how we’ve dealt with data we’ve tried several of these processes. And I think part of what we want to do here is have it done in a more organized sense across the geosciences.

 [music playing]

 [laughter]

 DR. SNOW: Cliff, two comments. One on your analog to the Manhattan Project. Do not forget that it was driven by a ruthless general. Much of its success was due to General Groves cracking the whip mightily much to the chagrin of some of the scientists, okay. So that’s not necessarily the best analog for what you’re trying to do here.

 But my second point is as you made this comment about, and you cited someone that 80 percent of the time is spent looking for data. That gets I think to one of the problems I see or challenges you -- actually you had it up here keeping you up at night, because ultimately you’re developing a tool, or a tool kit maybe is a better word. And I think the goal should be not more science, but better science. And that gets to how do people actually do science. So I would hope that somewhere in this process you actually have as part of your planning team moving forward over this next decade people who actually who have tried to understand how scientists work. And not how science works, but how scientists work. So that your tools are actually tailored to the way people want to do science. I think sometimes, I know I buy software that’s designed by computer scientists, and they think it’s the greatest thing since sliced bread and the electric toaster, but the reality is it doesn’t fit to doing certain types of problems. So I think there needs to be some sort of social or psychological aspect to this whole effort when you start talking about culture change -- and if you’re going to do this over 10 years or 20 years, whole generation of people are moving through the whole process. So you actually want to look ahead on how people are going to do science.

 DR. JACOBS: We certainly agree, and you articulated it in a little different way than we did. That’s why we use the word knowledge management, because that’s the way we actually do science, and that doesn’t mean just tools on your desktop. It means a whole bunch of different things. There’s a whole social networks we have in place that we use that. So we agree with that, and obviously the educational process is part of that. The way we characterize some of those words is to make the scientists much more productive and capable. So that he or she can go out there and say, “This is an interesting research thread, but I’m not going to go there. My grant would not allow me to do that, because it’s going to take so much work to find that data to really see whether that was an interesting piece of science and pans out.” But if you’re much more capable you can do that, and much more productive, so you could do that in a way that allow you to start exploring different data sets from other areas and seeing that. That's one of the things we meant by that. And that is really doing better science, in the end, because you don't have so many of these barriers preventing you from actually getting to explore the ideas you have in your head.

 DR. HORNBERGER: Susan?

 DR. LOZIER: I understand that data archaeology is very problematic, but I'm wondering if there isn't something that can be put in place now rather than waiting for the community efforts, you know, to coalesce in 10, 15 years, because surely the data, if we think about all the data that's to be collected in the next five years or 10 years, that is probably going to rival soon the amount of data we already have collected. So every investigator is required to come up with a data management plan, and so I'm wondering if you've thought about what NSF might be putting -- you know, asking in terms of those data management plans now, not in 2015 or 2020, to start priming the pump, because, to me, we need to start priming the pump of the data we're going to be collecting, and then it seems as though the data archaeology people understand, then, the utility of the tool, and the data archaeology becomes easier, perhaps.

 DR. JACOBS: One of the things we said during this talk was that, you know, we weren't going to change the way people were actually collecting that data. There's a whole bunch of modes of support that we're going to continue. But we're hoping that they get increasingly connected. So part of the changing the culture was, when a person comes to NSF and asks for a grant and they say, "I'm going to keep the box of rocks under my desk, and that's the way I'm going to do it," that you know they're not going to get it. But if the culture of this community -- and there's a framework being developed saying, "Okay, I'm plugging into this framework which allows, no matter how much data it is" -- hopefully you develop something scalable, because that's going to be one of the criteria, that you, over time, over 10 years, you actually start organizing this, whether you add a layer on top of existing databases or build databases that really speak to that framework. That was our notion of how we actually transform the culture over time.

 DR. ZANZERKIA: I would add that we do recognize that some communities have really well-developed systems. They're very well organized. They understand their user communities' requirements. And there are some communities that we serve in the geosciences that are far behind that, and we've recognized that that's a part of EarthCube -- there's an avenue there for EarthCube and NSF to facilitate discussions in these communities exactly about that. How should you, as a community, organize? What -- you know, what is a data policy that would serve your community's needs now and in the future? So we recognize that this is a very important issue in all of the disciplines that geoscience covers, and we're going to try and find ways to start addressing that and have those plug into the pieces that we've already started here.

 DR. KILLEEN: So, Susan, great question. This is where an advisory committee can help NSF, because, in a way, we've stuck our neck out with EarthCube. We've said, we're not just going to continue funding all these preexisting cyber infrastructures by discipline forever. We need, actually, to find a mechanism to bring the community together. Data citation might be the next step. There's already a "Dear Colleague" letter up saying, "Geosciences: it's not enough to have 5 percent of the publications have, you know, reproducibility, because you can access the data sets. Let's push on that." So think in terms of advising NSF on what we should -- how fast we should go down the path that you're suggesting. I think there's a willingness to go down that path. We obviously don't want to break things that work, but we want to support the acceleration of science and the different kind of science. To John's point, look at the website, John, and look at some of those use case studies, because some of the younger investigators who are on that website have really answered your question with practical use case studies that make very interesting reading.

 DR. HORNBERGER: Great, thanks. This really is an exciting field, and very challenging. And, as Tim said, any advice that we have to offer, I think, would be welcome. Cliff and Eva, I'm sure we can find their phone numbers.

COV Report for the Deep Earth Processes Section, EAR

 DR. HORNBERGER: I think we'll move on now, however. It's almost 11:00. So, Don, I guess you're going to --

 Dr. DePaolo: Almost.

 [laughter]

 Yes, I'm going to turn [inaudible] -- and give you -- and this shouldn't take too long -- but give you a short overview of the committee visitors report for the Deep Earth Processes section of EAR. This committee met in early November. Originally, the meeting was scheduled for September, but it was postponed on account of a hurricane forecast. And then the composition got changed a little bit because some people couldn't make it in the following timeframe. So the programs that were reviewed were geophysics, petrology and geochemistry, tectonics, earth scope, and continental dynamics. I don't have any visuals here, but maybe what I could have done is get just the pictures of all the program managers, who are the star of the show and whose efforts we really appreciate.

 As usual, the charge to the COV was to review the actions taken by the five research programs during three fiscal years, 2008 to 2010, and evaluate products and contributions supported and overseen by the programs. And, of course, COV efforts are mostly focused on process and evaluating whether the proposals were appropriately handled, sorted, and the most deserving were funded, and there's documentation for all of that. When the committee arrived, they also read the charge a little bit more closely and also were given a template as to what they were supposed to comment on, and there was a part in there on management of the programs, including responsiveness of the program to emerging research and education opportunities, the planning and prioritization process that guided the development of the program research portfolio, and the responsiveness of the program to previous COV comments and recommendations.

 So, anyway, those first two -- the idea of managing the portfolio caught the imagination of the committee members, and they've decided they wanted to focus on that a little bit more than maybe some of the previous COVs have. So partly in response to that, on the second day, the committee requested a modest rearrangement of the schedule so that each subcommittee -- so we divided the committee up into subcommittees to deal with each program, and actually the whole committee worked on continental dynamics except for me, because I was judged to have a conflict of interest. And on the second day, then, we requested this change in the schedule so that each subcommittee could meet with the corresponding program officers for about 30 or 45 minutes to discuss program management and what it meant to them and what they did and that sort of thing. And this actually turned out to be very useful. It wasn't a normal part of the schedule for the COV, and everyone on the committee agreed that this was a kind of useful thing to do. And it also helped us answer some of the questions that were provided in template.

 On the basic level, there's abundant evidence that the proposal evaluation process is very healthy. It's sound. It's carefully, meticulously shepherded and administered by the program officers. They do a fantastic job. They put a lot of effort in. Everyone appreciates what they do, and they feel like they do an excellent job of it. Also, the committee wanted to weigh in again on the three-part review process. There was no one on the committee who disagreed that this was a good way to do things. Every component of that process, from the mail reviews, the panels that meet, and the input of the program managers, is important in many ways. You know, disseminating information through the proposal review process, the panels bringing in people to the NSF, especially young people, and cycling them through, so that they understand how the process works, and so on, but then again, giving the program officers the authority to make, you know -- do things that they think are best for the program. All those three things are very important for the review process. So even though there are always calls to streamline things, there's important roles that each one of those play.

 So, with regard to the portfolio management, the committee, like I said before, sort of got interested in this issue of responsiveness of the program through merging research and education opportunities, planning and prioritization that guided the development of the research portfolio. And the reason the committee thought this was important was that the specification, development, and evolution of a program's so-called portfolio is an implicit means for ensuring that the best and most potentially transformational research ideas are submitted as proposals to the program in the first place, not that they're only treated well once they get submitted.

 So let me come back to that in a minute. So the -- and then the only way to sort of get information on that was to talk to the program managers, sort of understand -- if you look at the programs, they all have a solicitation. It's relatively brief, and there were -- you know, we ask questions like, you know, "Where'd that solicitation come from? And, you know, if you have workshops and that sort of thing, how do we trace the outcomes of those workshops and how they affect the solicitation? How has the solicitation sort of evolved over time? How often has it changed?" And that kind of thing. These are all kind of interesting questions and things that I think actually could be paid a little bit more attention to.

 We also looked back at what the previous committee visitors recommended and evaluated what had happened in the meantime. One of the things they recommended was to increase the number of career proposals. This, in fact, has happened. They recommended that there be preservation of a healthy faction of awards to individual PI projects. There's no question that that's still the case. Interestingly, the previous COV recommended that steps be taken to communicate to the constituent communities the means by which proposers can satisfy the broader impacts criterion, and I know that this is the subject of current discussion. But the members of the committee -- I don't know that I would include myself -- so felt that they were totally confused about what was meant by "broader impacts" and were unclear not only what they should put in the proposal but how it was viewed by the reviewers and weighted by the reviewers and reviewed and weighted by the program managers. So despite trying for many years to do that, there's still some questions there.

 The committee also recommended that the programs stress the importance of substantive commentary in mail reviews and pay particular attention to the most expert mail reviewers. We found that this was generally the case. It was almost unavoidable. Some reviews were comprehensive, clearly authoritative, and those had more influence than some other reviews that were very brief or were not clear where the reviewer had paid enough attention to one of the details of the proposal. There was also some comment in the previous COV about encouraging multi-investigative proposals to pay attention to a management plan, and there was evidence that that was actually being done.

 So, finally, with regard -- to go back to this program structure, sort of the scope of the individual programs and so on, the solicitations, and the relationship between the programs. So, ultimately, what the committee was thinking was that if you look at the Deep Earth Processes section, in many ways, the structure of the program hasn't changed much in quite a while, and there's some sense that this -- there's an implication there, regardless, kind of in optics that maybe things haven't changed very much in 10 or 20 years, when, in fact, we felt that probably they did. Now, whether this needs to be reflected in the program structure and titles and that sort of thing is not entirely clear, but somehow there was some feeling that maybe there could have been a little bit more evolution to the programs. And then there was another side of that, too, that we sort of focused in on, and that is that if you read the solicitations, they're each written to be general enough so that the individual programs are not restricted in what they can fund, but what it ends up being is that there's so much overlap between the programs, if you read the solicitations, that it isn't clear to a proposer, unless they happen to know a lot of how those programs actually work, where they might be sending a particular proposal. So we thought there was some food for thought there, and perhaps even enough food for the idea of thinking about a program review at some frequency where you might be wondering whether you could reestablish or reorganize the same topical spectrum in a slightly different way. That, first of all, might sort of just reinvigorate the whole thing, and as well as making it clear to proposers where the proposals should go.

 So, overall, I think the summary was, this COV meeting turned out a little more interesting than I expected it to be, because we saw what we expected, that the programs are handled very well, but we started thinking about the programs themselves, their structure and their evolution, and thought there were some things that maybe the NSF could pay attention to and think about for the future.

 DR. HORNBERGER: That's great. Now, I think it's my understanding that Don is effectively moving the AC accept this report. Don can make that motion. Is that correct? You have made that motion, Don. Is there a second?

 DR. DEPAOLO: Well, I should point out that a response has been prepared and already submitted.

 DR. HORNBERGER: Yes. I want to point out that accepting the report just means that we have received it. It's not --

 [laughter]

 We can still have discussion and grill Don afterwards, but I think that we have a motion and seconded, so could we vote? All those in favor say, "Aye."

 MULTIPLE SPEAKERS: Aye.

 Any opposed?

 Okay, good. Now, comments or questions for Don? Norine.

 DR. NOONAN: Don, I noticed in the report and then in the response -- and it's a technical matter -- but you all -- COVs work very hard, because they have a lot to cover in the time that they have to do it in, and you all noted that it would have been helpful to have some e-jackets ahead of time, and the response from NSF was, "Well, we need a full confidentiality, NCOI briefing, and so, you know -- and that can't be just written materials. It could be a webinar, but we have trouble scheduling all this time." People, now, come on. Surely, surely, would an electronic digital learning webinar do that committee members could take as a tutorial ahead of time? Would that work, rather than be just written materials? Essentially like a little webcast that could be resident on the COV website, and ask the members to view that conflict and confidentiality -- COI and confidentiality webinar, if you will, individually, rather than trying to get people all together in one place? I mean, we do asynchronous learning on our campuses all the time. You know, we teach online classes, and those classes, those class sessions, are resident on the course website for an entire semester, and so it seems to me that that might be one way, with a set of written materials as well as a sort of a broadcast for whoever you choose, in the GC's office or whatever, to do that briefing so that the members then could have access to e-jackets ahead of time, because I think that would really increase the COV's productivity so they could get to some of these bigger questions during the course of their visit. Yes? No? Something to think about?

 DR. DELANEY: I don't want to have a quiz on my conflict of interest understanding, but I'm on an upcoming COV for ocean sciences, and we are looking at e-jackets ahead of time. So whatever --

 DR. NOONAN: Well, the response from NSF was, we can't do it.

 DR. DELANEY: Well, that's why I don't want to actually tell you that we are --

 DR. NOONAN: All right. So maybe the response needs to change.

 DR. HORNBERGER: No, Peggy didn't tell you that.

 MALE SPEAKER: Maybe Jim or...

 DR. MORGAN: When this question came up, we looked into this, and I investigated with the conflicts officers of NSF, and what they said was, if you were to do this, you have to have a simultaneous meeting of all the members of the COV and give them the conflicts tutorial --

 DR. NOONAN: Uh-oh.

 DR. MORGAN: -- all together, and we thought that, you know, it was hard enough getting everybody together to come for the COV, but to get everybody together for a online thing was too difficult to do. And I'm not sure how much time that would save. I guess it would save some time. But ask Don. I mean, did you feel like you had enough time to go through the proposals?

 DR. DEPAOLO: As chair, I agree to put this statement in the proposal, because some of the people on the committee felt pretty strongly about it, but I don't feel strongly about it myself. I think one of the things that the NSF is sensitive to is that they're asking people to do a lot of work, but at least they're only asking them to do it for the three days that they're there. And, you know, I kind of agree with that. And I also think that there's a certain level of thoroughness that's necessary, and then there's another level you could achieve, but it's not clear that you would come out ahead on that.

 DR. KILLEEN: I think these are very helpful thoughts and comments, and we'll consider -- you know, I think we're always open to improving the productivity and the time of the people. Every time I go into the elevator and you see all these people with the white badges, you know that the clock is ticking in their institutions, and their pro bono services are greatly appreciated. So we'll definitely take a look at this across Geo. And with travel constrictions and restraints, you know, this may become more important -- we may have to do some things that we have not done in the past.

 DR. NOONAN: I can tell you, when I serve on accreditation -- regional accreditation teams, we have everything electronically ahead of time, and I had to do a visit this past couple of months ago where we didn't have the stuff ahead of time. We had it ahead of time, but it was all on paper, and what the institution told us was, "Oh, when you come to the institution, you can review all this in the work room." And we just threw up our hands, because it was damn near impossible for us hardly to get our work done, and as a result, the institution got a lot of recommendations. Hey, you know. So I think, you know, anything that -- in my view, anything that can be done, within reason and within the law, to assist panel members in doing this work ahead --

 DR. CAVANAUGH: I think what we have to do, obviously, given that Jim talked to the general counsel's office about it, is to work with them on, you know, on how -- they might not realize the constraints that -- you know, that that interpretation puts on things. And we can go back with that to them about it.

 DR. HORNBERGER: Walter.

 DR. WALTER ROBINSON: I was intrigued by this idea that the solicitations -- standing solicitations are generic and overlapping. I'm sure that's not unique to the set of programs, and I think the key -- yes, you can spend a lot of time rewriting those standing solicitations and having reviews, and probably it has to be done at some point, for any program. It seems the crux of the matter, though, is the responsiveness of the program directors, that old -- what the PIs are always being told: "Talk to your program director." And I'm sure that's still being told to PIs, and the key to that is making sure that the workload of the program directors is managed in a way that they can be responsive to those inquiries. So I think that the informal, organic basis for doing this, for keeping the PIs informed, is probably going to be more important than rewriting some solicitations, and maintaining that informal, organic basis is a workload issue.

 DR. DEPAOLO: I agree, and in fact, I think we said something about that in the report, in some way. The program managers do a very good job of coordinating among each other, taking advantage of other opportunities, even outside their section, and communicating with the PIs who talk to them about what their programs are about. But on the other hand, with regard to this solicitation, the program structure, and everything, you know, look at it this way. If the program structure doesn't change over 10 years, that's not a problem, but if it didn't change over 40 years. You know? I don't know. I mean, there's got to be some -- at some point, you know, there's got to be some review.

 DR. CAVANAUGH: Again, I actually was there at the report out during that conversation, and one of the things -- what I thought was interesting about that conversation, I think, was a little different, and that was that you had people on the COV saying that they had been told and read about some very exciting things that were happening in the programs and that what they were hearing and seeing was much more exciting than what they were reading in these descriptions. And what I was getting out of it was that the descriptions weren't up-to-date enough to reflect the current excitement of the programs, and so some of it was not necessarily related to how you might reorganize, although there was a lot of confusion where the lines were between some of the programs, but that was expressed. But I think a lot of it had to do, also, with, "Can you do better at communicating what's going on in these programs? Because it sounds the same as it did 20 years ago, even though it's changed a lot."

 DR. KILLEEN: Comment on the evolution issue. I think that's very important, that the COV states those things and maybe has a good interaction with the program officers, and I hope that, if it's not already on the agenda in the splinter groups in EAR, you could have that conversation with the program officers. EAR just had a really successful daylong retreat of all hands and looked exactly with that question in mind. Where is the frontier of the field moving? And we also commissioned, as you know, the NROSE [spelled phonetically] document, which is a very forward-looking 10-year output document. But as you already saw with EarthCube, EarthCube didn't exist a year ago, so some things have to move more fluidly and perhaps faster than others, and I think this evolution question is a very important question to really think through. And I know our program officers would really appreciate a conversation with you, particularly having gone through the recent COV, and hoping maybe we can hear more about this after this splinter group.

 DR. HORNBERGER: Good. Let's move on. Thank you very much, Tom and Jim.

AC GEO Subcommittee Report on Ocean Drilling

 DR. HORNBERGER: So we're going to talk about the ocean drilling report. This is going to be a tag team.

 DR. CONOVER: Yes, I'm going to say a few words, first, about the genesis of this subcommittee report, and then Susan will deliver the report itself.

 The ocean drilling vessel JOIDES Resolution is a key facility in support of the geosciences and was part of the highlights of Tim's opening presentation. It's supported in the Division of Ocean Sciences. The drilling vessel itself is a key component of the Integrated Ocean Drilling Program, which is an international program involving 25 countries, of which the U.S. is a major participant. And this platform, the JOIDES Resolution, is our contribution to this international program.

 The program is reaching the end of a 10-year authorization by the National Science Board, and that 10-year authorization would end at the end of 2013. The program itself is around a $65 million investment by the division. All but about $10 million to $12 million of that is in the operations of the facility itself. And that's a level of investment that requires NSB approval to continue, and so we will be bringing the new information item to the board in the very near future.

 The Integrated Ocean Drilling Program has been vigorously reviewed in terms of how it's operated, in terms of the science that's been accomplished. There is a science plan for the coming decade that has also been thoroughly reviewed, most notably by an NRC report that came out last fall. But what we didn't have was input on the relative importance of this investment in ocean drilling relative to all the other things we're responsible for doing in the ocean sciences. And we have a lot of investment in infrastructure, the drilling vessel being one type, but we have many other ocean vessels that are more of a general-purpose nature, and we have the Ocean Observatories Initiative, which is a new major investment in infrastructure, and the division itself is feeling a lot of stress relative to our investments in infrastructure and supporting science at the same time while, in the last couple of years and maybe for the next couple of years in the future, living in a budget environment that is not likely to see dramatic increases.

 So what we asked this community to do was to give us an evaluation of the contributions of ocean science, but also looking forward in how -- what level of investment is appropriate for geosciences going forward. And so I want to thank -- so you endorsed the creation of a subcommittee for AC-GEO. The subcommittee consisted of people from across the ocean sciences. And you've endorsed Susan Lozier to be the representative of AC-GEO, and Susan chaired the committee. And with her input, we sought nominations from throughout the ocean sciences community and from AC-GEO, and with Susan's help, we convened a blue ribbon committee. And I want to really thank Susan immensely for her outstanding leadership in chairing this group.

 And now I'm going to turn it over to Susan.

 DR. LOZIER: Thank you very much. I’m going to start by talking about the charge; I just want to read, specifically, a part of that charge, just so everybody can be clear about what this committee was being asked to do. So this committee was asked to produce a synthesis that considers past advancements in knowledge acquired through scientific ocean drilling programs, assess importance of future advancements in knowledge likely to result from a continuation of scientific ocean drilling, and scale these in a context of resource requirements and the broader need for improved understanding of ocean sciences, geosciences, and climate sciences in general.

 So, David mentioned I was the chair of this committee, I think largely because on the AC-GEO I'm an ocean scientist member and perhaps the only one that doesn't have some ties to the ocean drilling program. As I mentioned in my introductory remarks, I'm a physical oceanographer. I do know there's a bottom to the ocean.

 [laughter]

 I didn't know they drilled it to that extent, but I did know there's a bottom to the ocean.

 Joining me on this committee, just so you can have an idea of the breadth of the representation across the oceanography committee, I'd like to read the names. Joining me in this committee was Robert Aller from Stony Brook University, Catherine Constable from Scripps, David Karl from Hawaii, Charlie Langmuir from Harvard. I was the chair. Jim McCarthy from Harvard, George Philander from Princeton, and Lori Summa from Exxon Mobile. I will mention that Lori served as a member as well on the NRC committee that was doing a review specifically of IODP, and that report was available to our committee last fall. It came out, I think, in October of 2011.

 Before I go on to sort of the committee's recommendations, I do want to give some acknowledgement to the NSF personnel that worked with us. As many of you are aware -- most of you in oceanography are aware of this -- this issue is one that brings out a lot of passion in the community on both sides of the issue. I think that's fair to say. It was remarkable, to me and also to the others on the committee, that the NSF personnel brought to this discussion none of that volatility. We were very impressed with how even they were, how nonbiased they were. And that was just extremely helpful to our deliberations. The other thing is, they were extremely helpful in getting us any information that we asked for in a very timely manner. So I really want to call out David Conover and also Tom Janecek in terms of their efforts. They were very professional, very competent, and it made the work of the committee just much, much easier in dealing, especially, with this issue that many in the community have found to be somewhat volatile.

 So, that said, the committee met twice, once via teleconference, which was just really a preparatory meeting, making sure we had the background material that we needed for the deliberations during our November meeting. So we had a one-day -- one and a half-day meeting here in D.C. in November of 2011. If you've read the report, you'll see that there were a number of presentations by NSF personnel and others giving us background information that we needed about the science of IODP and also the projected cost of IODP as well as NSF's budgets.

 So what I want to do is tell you that our deliberations leading to our recommendations were based on two assumptions and two guiding philosophies. So the two assumptions we used as a basis for our recommendations were, one, the NSF budget would be flat into the foreseeable future. I think many of us can agree that 2.9 percent is pretty close to flat, or at least closer than doubling. The second assumption was that JOIDES Resolution contract will be recompeted [spelled phonetically] and presented to the National Science Board in three years, and you'll see why that assumption becomes important later when I get to my recommendations.

 The two guiding principles we used for deliberations were these. One, investment in core science should not be sacrificed to meet rising OCE infrastructure cost. The committee believes that the total infrastructure cost should constitute no more than approximately 40 percent of the total OCE budget, which is the current level. We urge NSF OCE to at least preserve its current investment in core programs and, preferably, aggressively explore opportunities to grow that investment. The second guiding principle that we used was this: Legacy programs, with the benefit of years or even decades of NSF funding, should largely bear the responsibility for broadening their base of support to stay mature so that NSF has funds available to seed new programs. Such investment in new programs is vital to the health of ocean sciences. Broadening the base of support for legacy programs provides additional benefits from the infusion of new ideas, goals, and partners. Although the obvious advantage of spending less of NSF funding on legacy programs as they mature is that funding opens up for new innovative and promising programs, another real advantage is that legacy programs are given the opportunity and the challenge of looking for efficiencies, partnerships, and refreshing their scientific goals and objectives.

 So with those two assumptions and those two principles, the committee went through and explored four scenarios, or four options. The first option we considered was abandoning an active IODP drilling program yet maintaining legacy repositories. The second option was abandoning the JOIDES Resolution yet maintaining a modest drilling budget to support ECORD [spelled phonetically], MSPs, and the participation of U.S. scientists in these programs. In this scenario, we would encourage the pursuit of ocean drilling science from legacy corps and international partner drilling. The third option we considered was to continue with the IODP but recommend that IODP costs consume no greater and preferably a smaller portion of the total OCE budget than they currently do. For this option, we would encourage a vigorous search for cost savings and other funding sources. The fourth option was to continue with IODP as envisaged in the science plan. Each of these options, we went through completely the advantages and disadvantages of each option. They're contained in the report.

 After our deliberations, we recommended the third option be pursued. And something I wanted to say at the outset when I was talking about the committee is something I'm quite pleased with, is that every recommendation in here is unanimous from the committee. With the information that we received from NSF and also the other speakers that came in and with the committee deliberations, it was remarkable how quickly we were able to receive -- get to consensus and then also unanimity in terms of our understanding about what we needed to go forward.

 So the recommendation about the third option is this. Understanding that in three years the JOIDES Resolution will be recompeted. Essentially what we're saying is that there's a three-year window for the IODP committee and NSF to look for cost-saving measures, to look for new international partners, to really broaden that base. So, rather than saying, you know, that -- thinking that now, you know, changes have to be made now, it's more realistic to think that in a three-year window, look to see if those changes can be made in the programs such that this program is sustainable in the context of the ocean sciences budget and in the context of the ocean sciences science goals.

 So, essentially, what the committee is saying, it should be clear in the three years where the IODP goals that we've enunciated and the pathways we've enunciated in this report could be accomplished. If so, at that time, the continuation of IODP should be encouraged, but if not, the termination of the program should be considered at that time.

 Just briefly, the specific recommendations, other than saying that we prefer the third option. Again, we recommend that IODP be funded at no higher fraction of the OCE budget than its current level, with that fraction on a declining trajectory in the years ahead. We recommend a vigorous investigation of new and expanded funding sources for IODP. We recommend further investigations of cost savings and encourage NSF to continue to look for efficiencies in the program. We recommend that, to the extent possible, IODP be configured more as an infrastructure program than as a science program. In particular, we recommend better integration of IODP education and outreach funds for the general ocean sciences education and outreach funds. Such a change could have two advantages. One, IODP costs as a percentage of the OCE budget would decline; and two, IODP education and outreach could more effectively leverage the EO budget for all the ocean sciences. Finally, we recommend that the IODP planning groups reconvene to reconsider their science goals given the realities of a more limited program with a broader base.

 So I'm -- this concludes the summary of the report, and I'm happy to open up and answer any questions. I'm sure David can answer questions as well. George?

 DR. HORNBERGER: Thanks very much, Susan. Great report. Questions or comments? Peggy.

 DR. DELANEY: Well, I was bound to have comments. It's a very solidly done report. I think the committee did an excellent job, and I like the way it built on the NRC report. I think the identification of community volatility is an important one, and especially with my rotating off, I'm really mindful of that choice, and it's because within OCE there are people who say, "What we need to do is end ocean drilling so we can have observatories," or, "What we need to do is end observatories so that we can have ocean drilling," or, "What we need to do is end observatories and ocean drilling so that we can support the fleet." And while I want to acknowledge the difficulty in maintaining our capacity to access the environment in all the ways we need to in ocean sciences, I think we really do, as a community, have that challenge before us. And I think -- I think it's important when you select OCE members for this committee to make sure they're not a true believer in one of those extremities, because -- and it's also very true in our community, I think, that people don't always put their cards on the table about that factor, so you'll have to be -- use all of David's subtle skills of perceiving belief. I think that --

 [laughter]

 Right.

 DR. LOZIER: If I can just say -- yeah, I agree with you completely, and that's why I thought it was really important that the NSF personnel that we're involved with us came in and were very, you know, unbiased and evenhanded, and I think that really helped set the right tone for the committee work.

 DR. DELANEY: Yeah, I mean, this is an enormous challenge, and we've known it in ocean sciences for quite a while, as the MREFC rules change that pose huge challenges for both the drilling program and the observatories about how the out year operating costs would be funded. You know, the dreams of the -- I mean, I live in a state university system now, and the dreams of what things looked like 10 years ago, pre-crash, right, was when some of our scientific vision for these programs, the expansive ones, were crafted. But I think the strength of OCE is going to come through the advances we make in all those areas. And Tim's talk gives a great link between how having the necessary facilities really allows the scientific advances to take place.

 I think there's -- in the groups that say, "Well, if you just get rid of this, then we could have more money for that," I think there's a naiveté in assuming, for example, if you close the drilling program that OCE would keep all of its budget and could just use it for other things, right, and if you close all of observatories that all of the money would stay and you could use it for other things. I think that's a really dangerous and naïve assumption.

 The U.S. community is about to hold a meeting to do, I think, exactly some of this prioritization and selection, from our perspective in Denver. And, you know, I think the diversification of funding sources is a great charge. I think that program has worked diligently and achieved some success in that regard. And some of these things, I think, we'll just need to be mindful that many of these things -- the diversification of sources -- are dependent on factors outside of the program's control. Other nations are struggling with their science budgets. They may very much want to participate. And we can be as persuasive and attractive as -- and present compelling scientific opportunities, and they still may not be able to come to the table. So I think we'll have to have some way that doesn't just say, "If you don't raise this by this point, sorry, you're gone," but some way that looks at, "What are the activities that are done to bring other partners to the table?" So, but, you know, it is hard in this community, because I think it is a little bit of our -- I don't know if it's our dirty laundry, but that kind of, "You have to pick one of the other, and you have to try and work to kill the other to allow yours to survive," has been a really challenging part of the community.

 DR. LOZIER: Yeah, and if I could just follow up on that, we wanted to get away from, you know, "Is it IODP or is it OOI?" And so, in many ways, what we were trying to do was to say, "We need to allow for the possibility of new programs to be funded." So regardless of which side of the community those new programs are coming from, we really tried to say, you know, legacy programs should bear the responsibility for, you know, broadening their base, et cetera, because otherwise, there's just only so much of the pie, and if they continue to take the same piece of the pie, we can't allow new things to come in. So you're absolutely right. In our community, it's easy to sort of be in one of the camps or the other, but we didn't want -- we wanted to just sort of break it and say that we need to allow, you know, the possibility that new things come in. And so that means, you know, lessening the investment in other programs that have been around for a while. So...

 DR. HORNBERGER: Norine.

 DR. NOONAN: Thanks. Great report, Susan. I applaud you. It's a narrow line to walk, but let me echo my colleague. Number one, money is not fungible, and money not used for one thing won't be given to another thing. And ask the hydrogen physicists about what happens when you try to do that and circle the wagons and fire inward.

 But let me ask a question about the recommendation, because I want to make sure that I understand what the committee is saying. I applaud the notion of aligning and prioritizing the scientific goals of the IODP program in the context of a budget scenario which, perhaps, is not as expansive as it once was believed to be. But in your recommendation going forward and assessing in three years’ time whether or not the IODP goals have been met, you're talking about that prioritized and realigned set of goals, not the original goals of the science program.

 DR. LOZIER: The realignment.

 DR. NOONAN: Okay, because it doesn't actually say that, and I want to make certain that, in going forward, that the program is not being asked to meet something that it could never do now in the context of prioritizing and --

 DR. LOZIER: Right, right. The inference there was that it was the realigned goals.

 DR. NOONAN: Fair enough. Thank you.

 DR. BRIAN TAYLOR: So I want to declare my conflict on this subject, so I won't speak directly to the issue of IODP. So why am I speaking? The -- I want to challenge a couple of the assumptions related to legacy programs, and I'm not sure if it was an assumption or a statement, but I think, actually, if you get the facts at the moment, the so-called infrastructural facilities programs, they now see more than 40 percent of the budget. I won’t put David on the spot, but it is more than 40 percent today. But the challenge I really want to make relates to the assumption concerning legacy programs. We heard that, earlier today, Tim and others have mentioned that we're still supporting the Keeling Curve, and I hope we can continue to support the Keeling Curve for as long as I'm alive, and after that as well. There are some legacy programs that I think are fundamental. So I'm concerned about that statement, not so much actually in the context of this report but generically. That's why I bring it up before AC-GEO.

 I think we have to be -- for example, again, from Tim's report this morning, I mean, in my scientific career, the acceptance by NSF, for example, of time series as a way of doing science that didn't exist back in the '70s, didn't even exist, really, in the '80s. Even though the Keeling Curve was happening, it was not an accepted part of proposal writing to come up with a time series approach, even. So I'm really cautious about the generality of the report's statement about the need to sequentially divest from legacy programs as a fundamental direction.

 DR. LOZIER: Thank you. Actually, I had the same thought when Tim put up the Keeling Curve as well, and I thought, "Oh, well, there's always exceptions, you know, to the rule," because I don't think anybody around this table would argue that we should stop the investment in that. And I think here what we're trying to say is that legacy programs, because they're legacy programs, do not guarantee, you know, continued funding. I think everybody would agree. And that, in general, we should expect that those legacy programs, with the benefit of having a broad scientific community many years, should look to have more efficiencies as they move forward. And so we're putting this forward not as an absolute but something that we think could be something that guides, you know, the investigation or the assessment of these programs as we move forward. But I agree. It's not an absolute and wasn't taken to be an absolute.

 DR. HORNBERGER: Walter.

 DR. WALTER ROBINSON: Right, so this is -- obviously, as they say, I don't have a dog in this fight, being atmospheric sciences. But I guess the question is, whenever someone says "efficiencies" and "broadened support," I mean, I hear that from my dean all the time. [laughs] And I think -- I'm curious, actually -- this is really a question, not a rhetorical question. It's a real question. What would be some examples, in this particular case, of how that might happen?

 DR. LOZIER: I think -- David, do you want to, because they're already --

 DR. CONOVER: Yes, actually, we've already moved in this direction, and we did that by proposing a dramatic change to the management structure for the international component of IODP. And that change is going to enable each of the platform-providing countries to independently manage their facilities and also independently bring in revenue to support those facilities. So there is going to be, in the extension of this program, the opportunity for other partnering countries to directly contribute to the cost of running the JR. And they will -- we will have a U.S. committee that governs the activities of the JR. The proposals will still be reviewed at an international level, the drilling proposals themselves. There will still be an international program. But each of the platform providers will act independently. Then, also, we can gain efficiencies in another way, asides from new revenue. So we're going to save some money by reducing the structure that supports the international program. But also -- and just the way that the vessel takes on drilling projects in the past has not been primarily based on the cost of transiting from one drill site to the next. Under the new program, we will be looking very hard at the sequence at which drilling is taken, the costs of transits from one to the next, and we will come up with a long-range plan that maximizes efficiencies. One of the biggest costs is the fuel, and the transit from one part of the world to another can be enormous. So there are actually real efficiencies that can be gained, and there is real leveraging that we can achieve.

 DR. HORNBERGER: I know Dave Schimel had a question, but he stepped out, so, Tim.

 DR. KILLEEN: Yeah. Thank you, Susan, for a great -- and thank everybody for the comments. I think this is a -- I said this is a great advisory committee, and, you know, when we ask groups like this to take on hard problems and get concrete advice back, it's a fine hour for the way NSF functions and the way the community provides input and so on. This is a real issue of affordability of infrastructure versus performance of science, and I think you gave us a direction and an approach that we are going to utilize going forward, recognizing the seminal science that can be done with these programs, the need for continuing records, the vitality of the research community, and a realism looking forward at the budgets as we look out. And as David has already said, we've gotten to work on this recommendation already in terms of fashioning a new international program that is less expensive for us and that actually provides resources to support scientific campaigns, actual science being done with the IODP program. And we're looking to see how that can move forward into the future. Nobody has the perfect crystal ball on financial outcomes, but we do have something that we feel is really important. It's got a great track record, rooted in international science, important for the future, but we need to make it affordable with respect to everything else, and we need to be moving forward and having our programs evolve in sensible ways. And so I think this input from multiple sources now, the NRC, but particularly the blue ribbon committee that really looked at this and interacted really well with -- we've had a lot of internal conversation where a lot of different vantage points were expressed. I think we have a path forward we're going to present to the NSB, that path forward, week after next. And that would be a strong signal to the community of our commitment to IODP on an affordable basis. And I just want to thank everybody who was involved in this. We gave you a real task. It wasn't an easy nut to crack, and you gave us -- and you looked at the extreme in ways that our staff, I know, fully appreciates and understands. And I particularly thank both Peggy and Brian for their comments, too, which I think really add a lot of value and context to the overall conversation.

 DR. ALLEN: May I make a very brief comment?

 DR. HORNBERGER: Yes. Please come to a mic, though. Please use the microphone.

 DR. ALLEN: Okay. Yes, I'm -- thank you, yes.

I'm Jamie Allen. I oversee operations of IODP. I just want to make a brief comment about the term "legacy," and I'd like you to consider that making observations or taking samples under the seafloor is really no different, intellectually, than taking samples or making observations in the water column. And, in a sense, both are legacy activities, and we've been doing them a long time. So that just -- that's the comment I just want to make.

 DR. HORNBERGER: Thanks. David?

 DR. CONOVER: I want to add one additional comment that addresses, I think, part of Peggy's comments and part of your question about efficiencies. So I just want all of you to be aware that IODP is not being singled out for reexamination to gain greater cost efficiencies and scaling of operations. We have also told the OOI project team that they need to bring down the expected costs of operations, because we -- going forward, we don't foresee being able to afford what was originally planned as operation and maintenance costs for OOI. Doesn't mean we want to de-scope it, but we need to do it in a more efficient manner. We are looking at vessel operations in exactly the same way. We will very likely be retiring vessels at a faster rate than we might have planned a year ago. We're going to be rightsizing the fleet at the same time that we build new vessels. So this is -- all of our facilities are going to go through the same rigorous process. This is not something that IODP's being singled out on. And I think that helps -- and then it's my job to communicate to the community why we're making these decision and that we are taking a balanced approach that doesn't favor one segment of our community over another.

 If you'd like to know more, come to the OCE subcommittee meeting this afternoon, and you'll get the real gory details, including the trends in percent of our investment in infrastructure right up to 2012.

 DR. HORNBERGER: Great. Thank you, David. Okay, so I think that finishes our morning session. We have a very important work --

 MALE SPEAKER: [inaudible]

 DR. HORNBERGER: Oh, I'm sorry, yep. We have to accept this report. So Susan has made a motion that we accept the report. Do we have a second? Norine seconds it. All those in favor say, "Aye."

 MULTIPLE SPEAKERS: Aye.

 DR. HORNBERGER: Opposed?

 DR. BRIAN TAYLOR: I have to abstain.

 DR. HORNBERGER: And Brian has to abstain.

 DR. BRIAN TAYLOR: I don't want to abstain, but I have to abstain.

 DR. HORNBERGER: Yes.

 [laughter]

 Right. Yes.

 MS. LANE: Lunch isn't quite here yet, but just -- [inaudible].

 DR. HORNBERGER: Okay, so we do have a very important working lunch coming up, because the director is coming to visit us, and as you know, we have to -- we always prepare. We discuss the questions that we want to put before the director and do a schedule of who's going to ask what question. So this is really important. Because I slighted Melissa this morning, she put me in charge of logistics, and now lunch is not quite here yet. But we are going to take a break, and as soon as you can mingle a bit, and then grab your lunch and come back, and we will get to work.

 [break]

*Working Lunch*: Preparation for Meeting with the Director and Deputy Director

 DR. HORNBERGER: I would like to call our working lunch session to order. I hope that you all can take bites in between our conversation. We have a half an hour before the director joins us. And what we want to do is organize ourselves to make sure that we know the questions that we want to put to the director or answers that -- and we also have to prioritize those because we may run out of time and we want to make sure that we ask the first ones first. So, Walter?

 DR. WALTER ROBINSON: I’ll start. I think this is one actually I asked him a year ago. But I think it’s becoming more timely, and that is, we have a directorate-wide SEES initiative and that’s great; it looks like it’s going great. That’s wonderful. But even the words we’re using are -- even the word “sustainability” -- maybe the word “science,” but I wouldn’t go that far. But certainly the word “sustainability” is politically charged. So I’m sort of interested in how he feels about NSF -- how it’s going to negotiate that landscape in a very -- in an increasingly polarized environment. The science objectives are exactly what they should be. I think everyone in the room is on the same page in that. But how does he see that working, going forward? Where’s the -- where’s the space for NSF to continue to be the honest broker in these areas?

 DR. NOONAN: Is thrivability less politically charged? [laughs]

 DR. HORNBERGER: Jill.

 DR. BANFIELD: So I still sort of pressed this one time before and I know I definitely should not ask questions because I don’t have any hope for being tactful enough and this is a really tactless question so I’m going to throw it out there. Maybe you can defer the comment for another discussion. But I understand NSF is rejecting proposals at present at a measurable rate based on the fact that the references aren’t formatted properly and some other technical details. And I think this really is something that I would like to hear the rationale for -- why it’s not just, give you some opportunity to correct them; if that’s too much work, why not just make it part of the review process. But to actually outright reject proposals for really trivial things, it seems to me to be putting in jeopardy the potential to support the best science. You probably don’t want me to ask that question.

 DR. HORNBERGER: I think it’s a fair question. We can ask it, perhaps, in a --

 FEMALE SPEAKER: [inaudible]

 DR. HORNBERGER: Well, no, I’m not too worried about that, but it’s a general -- it’s not so much the reference formatting; it’s really the form on content.

 DR. BANFIELD: That was just an example. I know about this particular case because it happened to me on an international collaboration and the German government appealed this decision and NSF told them, bad luck, that’s just how it works here. So I’m sure this -- I know from our sponsored project officer this is happening through a variety of a different reasons but I think it’s something that should be discussed.

 DR. HORNBERGER: Roberta?

 DR. RUDNICK: Yeah, this is a topic that came up in discussion. When I mentioned that one of the recurring themes in the Deep Earth committee of visitors report was the load for the program officers and how heavy that is. And it seems that it continues to get heavier, in large part also because of the cross-disciplinary, cross-directorate, cross-NSF initiatives. There are so many of them. And so how do you -- how does he see the balance between new initiatives versus supporting -- I guess we probably talked to him about this last time, I think. But new initiatives versus supporting core science. And also, how that relates to the load on program officers.

 DR. LOZIER: My question relates to the issue about graduate education. So one of the big issues across the nation in terms of graduate education is what people term the “overproduction of Ph.Ds.” And, really, it’s the overproduction of Ph.Ds. who have expectations to go on into, let’s say, research or academic careers.

 So we also hear about the amazingly small number of proposals that are awarded and we also know there’s a large emphasis, as there should be, on funding postdocs, graduate students and early researchers. But at the same time, the number of positions available for those increasingly is smaller. And so I know graduate schools across the country are looking at this -- at this issue.

 So I’m just wondering if NSF has any thought as to what should the size of the graduate student population be in the sciences. And does NSF have any role in terms of -- this is really one that isn’t very tactful at all, but does NSF bear any responsibility for an overproduction of Ph.Ds. with expectations of careers in science and jobs not being there, or for also funded work?

 So I’m participating in some of these discussions at Duke, and so I’m not sure if I’m framing this quite the same way, but -- or, quite the way that I would if I’d thought about this a little bit more. But it does seem to me that there’s lots of funding at this early stages and then we lead to low proposal acceptance rates.

 And so is -- what is the balance that we want in the -- in the field?

 DR. KILLEEN: Can I -- can I just say -- are you -- what about -- a little about that with Dr. Suresh from GEO because we have the highest success rates in GEO.

 DR. LOZIER: But high is 30 percent?

 DR. KILLEEN: Yeah. Low is 5, 8 percent. I mean, if you want to support improved success rates then funds might go from GEO to other directorates, which would be okay, but --

 DR. LOZIER: I guess I wonder about the philosophy overall. So the philosophy would be for us, we would just fund as many students as possible.

 DR. KILLEEN: Well, I think that the question about graduate student enterprises is a very good one. We spend $220 million a year on graduate research fellowships. We’re just reviewing that now as a sort of enterprise. That’s been going for 60 years. That’s a venerable program.

 DR. LOZIER: I know. And it is a fabulous thing. But you know, there’s this whole national discussion about what’s called “no plan B,” meaning that our graduates -- Ph.D. graduates don’t have a plan B, so they’ve been trained for careers in sciences, engineering, et cetera, and moving on into academia, and there’s no fallback. Now, does NSF have a role in creating a plan B or is that up to universities?

 DR. KILLEEN: I think the whole issue of where people go, the workforce development, the sort of STEM workforce of the 21st century is part and parcel of this vision of One NSF. There’s a lot of deep thinking about education and outreach and diversity going on now as a sort of -- and it’s not just creating Nobel laureates and professors at prestigious universities, but it’s about the workforce -- that development. It’s something he’s very interested in.

 DR. HORNBERGER: Vicki.

 MS. ARROYO: So, in Tennessee, a bill passed that said that teachers can teach the alternative theories of evolution and climate change, so I’m wondering what role NSF has in educating policymakers about when there are or are not viable alternative theories to be taught in schools or put in our casebooks that are sometimes funded by corporations, for example.

 DR. BRIAN TAYLOR: But I’m concerned that the committee is coming up with questions that are ours to solve and not the NSF’s. I mean, in fact, Susan, most of us do teach plan B's and plan Cs and plan Ds. And, you know, the issue with social perception of teaching evolution over -- and it’s alternatives -- I mean, is this really what we want to be asking the NSF director about. I mean, I question it myself.

 DR. KILLEEN: I think -- if I could address that. I think he wants to learn about GEO -- about what this prestigious group of advisors to GEO has on their minds about the future of our science and its role and its importance and its vibrancy and the kind of challenges we face -- we talked about some of them: the facilities and basic science. I think some of the other challenges are clear, you know. Pitfalls, jobs, et cetera. But I think he’s looking for -- he’s relatively new. He’s been here for a year. One NSF is his vision. It’s not quite fully defined yet. GEO’s role in that is really important. So I think there are some things that he would be looking for advice on. And so if he were to ask you, he would be asking you to paint a picture of the NSF.

 DR. LOZIER: Right. There’s two things here, though, right. I mean, you’re saying he wants information from us but don’t you think it’s open that we can ask him for information about NSF’s -- I mean, we’re members of the community that are interested in NSF’s approach to graduate education, NSF’s approach to scientific literacy. So, you know, to me, I think those questions are legitimate to ask -- to ask the director.

 DR. HORNBERGER: Being from Tennessee, I only wish that NSF could do something.

 [laughter]

 Dan?

 DR. BAKER: Yeah, I think that NSF has played a tremendously important role being a catalyst for the mission agencies such as NASA and NOAA. And the things I would point to would be things that Tim emphasized, like space, weather, and CubeSats. And I think it really set the tone for how the nation has moved forward. And it’s really changed the mind of some pretty height-bound agencies. And the question I would ask him -- or I guess that would be a preamble to -- I would like to encourage NSF to continue to play that role; to use its efficiency and effectiveness to help to push the agencies in the right direction to have more -- indeed, more efficient and effective programs of some of the things that are having massive cost overruns like satellite programs that are key to our nation’s future.

 DR. HORNBERGER: Peggy.

 DR. DELANEY: I would be interested in hearing him talk a little bit more just about the One NSF and what he views the role of geosciences in One NSF. It’s a really interesting conceptual kind of tag phrase, but now that he’s been here for a bit, it would be good to hear him talk about that.

 DR. BRIAN TAYLOR: Yes, please, again, I would declare my IODP and OOI, and all of those complex -- but do we know if he’s going to show us his little movie, Tim? Is that expected?

 DR. KILLEEN: He didn’t mention it to me.

 DR. BRIAN TAYLOR: Okay. For those of you that don’t know this -- about this, but in the One NSF and in the international part of his One NSF, which is one of his three to five platforms, it’s -- so, recognize my conflict here. It still surprises me that the most successful international scientific program ever is never mentioned. So I don’t understand -- and I am referring to OIDP -- and I don’t understand then what is the vertical alignment from program manager to division director to AD to the director. I guess he’s going to be briefed on the One NSF regarding IODP tomorrow, so I’m not sure if the timing is here.

 I know in India, they were bringing up the drawing program to him, rather than the other way around. So I’m wondering what the advocacy at the director’s level is for one of the most successful international scientific programs ever.

 DR. KILLEEN: Well, he knows all about IODP, I can tell you that. There have been multiple briefings and we’ve, you know, talked about the science and the changes in the planning.

 DR. BRIAN TAYLOR: But, I mean, I’ve seen -- we had him come to ocean leadership, so in speaking to the ocean community, doesn’t mention their own program. In the -- in his video, it’s not there. So when I look at how he’s sort of voting with his feet in terms of advocacy, I don’t see it. So I’m wondering, why is it missing?

 DR. KILLEEN: It is a five-minute video so -- give him a clip.

 DR. HORNBERGER: Let’s see. We had Lee, first, and then.

 DR. ALLISON: I’ve got both, something that I’m going to suggest we make a point to the director, and then a follow-up question with that. And that’s if we look at One NSF, we have an analogy going on in a “One GEO” through EarthCube. And I’ve been heavily involved in some of the work groups there, and we’re seeing, I think, the most comprehensive cross-disciplinary approach that I’ve seen within the GEO directorate among all the divisions coming forward through the EarthCube initiative. And then -- so I think making that point, that GEO is implementing the One NSF vision across the whole directorate and can be a type section for that.

 And then to follow up with that, in the big data initiative that the White House put out, NSF looked really good there. But overall, in the program, what I came away with was that it seemed to be kluged together. That whoever they could get to show up and have an example -- but there wasn’t a real synthesis and a real vision going forward. It seemed like a whole bunch of little pieces and let’s put it under this umbrella.

 So is there a leadership role for NSF in this big data initiative? And, again, I look at EarthCube as something we’re doing with the computer sciences, and could this become the leadership program for the whole big data initiative, or across all of government, and really use this as a platform, as the model, of how to implement this?

 DR. HORNBERGER: Roberta.

 DR. RUDNICK: I’m not sure exactly what the question is I want to ask here but it has to do with international collaborations. And we’ve seen NASA scientists prohibited from doing anything collaboratively with China. We’ve seen the OST budget slashed by a third because of their interactions with China. And so far it doesn’t seem to have impacted NSF, but I’m just curious, is this something that’s going to come down the road to NSF or, you know, can you fill us in on what his thoughts are? Because I know international collaborations are highly regarded and encouraged, but how does it fit into this sort of reactionary stuff that’s happening elsewhere?

 DR. SPENCE: I’m interested in learning what the director’s take is on the success, or the status, maybe, of the creative program, which is the first of the INSPIRE initiative that he really promoted in terms of having these interdisciplinary projects to break down barriers that are high-risk, high-payoff with a sort of somewhat unusual, perhaps or atypical process of not having external reviews. And so there were -- there’s kind of a programmatic aspect of it as well as, is it effective?

 Maybe it’s too early for that but I think it would be interesting to get his take on where that is.

 MS. ARROYO: Okay, so maybe I’ll take another shot at --

 [laughter]

 -- the political question because I think what’s bugging me is that there’s this real disconnect between the science, which is coming in, you know, faster and worse than we thought, in terms of, you know, what we’re seeing that impacts that less than 2 degrees, and yet the political discourse is we’re not on any course to stop it at 2 degrees, anything close to that.

 And so I’m struggling with understanding that there are limitations to what NSF can do in this political climate, but there’s also something about speaking truth to power and advocating for just the science, if not policy. And I think that people sort of retreated in the failure of the climate and energy legislation and the “Climate Gate” fiasco. And so, as a result, there really had not been -- there hasn’t been a strong counterpoint to some of the recent information that’s being spread in the media and through other venues.

 And so I guess I’m trying to struggle with how do you connect the sort of dire projections -- for those of us who follow them -- on the science side and yet the lack of political discourse?

 DR. KILLEEN: [inaudible], because this is obviously happening in everybody’s minds. You know, we’re in a competition of ideas in some ways, scientifically, and you’ve got advanced manufacturing; and you’ve got down technology; you’ve got cyber-infrastructure; you’ve got sustainability. And they don’t all have the same political standing at different times. But the science that is compelling ought to be fostered by the agency providing that knowledge base.

 I would -- I would think that that might be an entry into that conversation. Rather than saying, well, it’s almost -- we should be standing up for science, wherever it comes from, particularly important science, compelling and intellectually-rich science -- and he gets to preside over the NSF budget, of which GEO is a piece, Biology’s a piece, Engineering’s a piece. And I think in the competition of ideas, it’s important to have -- to have compelling rationales. That’s the way I would -- there will be settings on the Hill where the words “climate”, “global warming,” will create discourse and, you know, and talk about China and certainly with certain folks it'll create a big discourse, but that shouldn't stop us. I think that's where you're both coming from. It's almost a [unintelligible] kind of moment, right? Go do the science. DR. HORNBERGER: Yeah, I mean, I think somebody mentioned the science literacy aspect and I think that that's also part of it, right? It's not -- it's somehow being active about science literacy rather than passive.

 MS. ARROYO: Right. Right.

 DR. KILLEEN: He's very interested in scaling things up. That's something that would really resonate within science literacy, STEM talent, you know, public understanding, importance through science [inaudible].

He's very interested in scaling up. You could really resonate with that.

 DR. HORNBERGER: Walter.

 DR. WALTER ROBINSON: Right, so here's a completely nonpolitical question following up on what Tim said. I think, you know, one of the barriers we see to students succeeding certainly in the atmospheric sciences is that we have a culture that's convinced young Americans that they can't do math and physics, and they opt out. I'm stating this negatively. So, the question is, how do we -- so it's great to get kids excited about science and we do a lot of that and we all work on that, I think, but we have to get -- there are some cultural barriers that are pretty tough, and we see students excited about severe storms, but then oh, I have to take calculus. I can't do that. I'm going to go major in, you know, speech communications. So, you know, I'm interested to hear about the NSF's strategy where I see some of the real barriers are in the educational pipeline in bringing people into our discipline.

 DR. HORNBERGER: Joe will answer the question, right? [laughs]

 DR. WHITTAKER: I don't know if I'll answer that, but I think one needs to be careful when you talk about cultural barriers. There are cultural barriers in the entire scientific environment in one sense, and I think that's what you're referring to, but there are also those local aspects on their respective campuses that you must be concerned about and, for the most part, there are lots of standard things that people just hold in their mind; this is how we always do it. And, I mean, academic institutions do that very well. Now you're in an environment where you have to be flexible. You have to change. Many of our campuses are not changing to accommodate those cultural evolutions that are taking place around you and the demographic shifts that you've seen. So, the same way the weather and the climate is changing, demographics are changing, but the academic institutions are holding fast to the old standards of who you admit and how you do this. And so, I don't know if you can put that entire ownership on NSF, but you must -- we must take responsibility for ourselves and also push the envelope on the funding agencies to make sure they can appreciate what the challenges and issues are that they must address.

 DR. WALTER ROBINSON: Can I just clarify? Actually, what I had in mind actually was I think you -- I was not actually raising the broadening participation question, though I certainly could have.

 DR. HORNBERGER: We have to wrap this up.

 DR. WALTER ROBINSON: What I was talking about is if I walk into my campus during the week, and unfortunately my campus has very poor minority representation, if I'm there during the week I see mostly Caucasian Americans. When I'm there on the weekend when students don't have to be there, the Asian American students are much more well represented. So, at the risk of being politically incorrect, what I'm seeing is white kids who think they can't do math because -- and who think those Asian kids can do math because they're smarter; then what I see is that the Asian kids can do the math to get on through the curriculum because they're working harder. [laughs] And so the message has to be -- and the broadening participation is important, but the message to society as a whole has to be that yes, science is cool, but there's an activation energy of effort and we have to get people to think that they can succeed if they make the effort, but also they have to be prepared to make the effort. And I see that as a real obstacle to the future workforce in the sciences.

 DR. HORNBERGER: Okay, we can't do this. Okay? We can't have this discussion. We have four minutes to organize our questions into a priority order.

 [laughter]

 And who's going to do it? I understand. We can do it this evening.

 DR. LOZIER: I just wanted to offer that I was inspired by Vicki, because I want to rephrase my question about graduate education, and so instead of asking about the acceptance rates and proposals, I want to ask that in light of the -- that we ask for postdoctoral mentoring plans and we ask for management plans, can we ask investigators for plans on how they plan to expose their graduate students or, you know, mentor their graduate students and expose them to careers that can fulfill the needs of the STEM workforce?

 DR. HORNBERGER: Okay. So --

 DR. ORLAND TAYLOR: Briefly for 30 seconds?

 DR. HORNBERGER: Thirty seconds.

 DR. ORLANDO TAYLOR: I apologize for having to be out, but maybe this came up. There was a major White House event, that came up about issues with gender in the workforce. Are we going to ask about the progress of that meeting from the White House meeting? I think we should ask for progress on that. It was quite a to-do.

 DR. HORNBERGER: Okay. We have to prioritize these questions and we have to assign people who are going to ask them, because that's what we do. I would suggest that -- I assume that Suresh will tell us the status of the search for AD-GEO. If not, that would be the first thing that I would ask him. So let me see. Does anyone have a favorite having heard all of these things?

 FEMALE SPEAKER: One NSF.

 DR. HORNBERGER: One NSF. The role of GEO. I would think that perhaps we could have -- would you ask that question?

 FEMALE SPEAKER: Sure, but somebody else brought it up, so why not --

 DR. HORNBERGER: Oh, okay. Who?

 DR. DELANEY: I did. I brought it up.

 DR. HORNBERGER: Peggy. Okay, Peggy will ask that question and I was thinking that maybe Lee could follow up with his EarthCube example, because it ties in.

 DR. DELANEY: I'm going to work Brian's point into the question.

 DR. HORNBERGER: That's fine. That would be great. So we have international collaboration as an issue. We have the progress on the White House meeting on gender. The declining proposal based on format. The graduate education program. The --

 DR. RUDNICK: The initiatives and how it impacts workload [inaudible].

 DR. HORNBERGER: That's right. The increases by cross everything, increasing workload. Any suggestions on what should go next after one? I'm going to suggest -- I'd like to hear personally the progress on the White House meeting on gender. Okay?

 DR. NOONAN: George, someone asked a question about --

 DR. HORNBERGER: Orlando, will you ask it?

 DR. TAYLOR: All right.

 DR. NOONAN: -- NSF’s relationship with other federal agencies, and catalyst, partner, collaborator, and perhaps that comes after --

 DR. HORNBERGER: That's right. Yes, Dan. I think Dan did that.

 DR. NOONAN: -- I mean, as long as we’re going to talk about White House initiatives, then I think what is NSF's role as a partner, as a catalyst, as a collaborator?

 DR. HORNBERGER: Dan?

 DR. NOONAN: And interagency initiatives like what be coming on gender [inaudible].

 DR. HORNBERGER: Great idea. The international collaboration restrictions coming. Okay.

 DR. NOONAN: I don’t like that notion of punishing you for collaborating with the wrong partners. If somebody decides not to like France, I guess we won’t collaborate with them anymore either.

 DR. HORNBERGER: So, do we want to also follow up -- I think it was Harlan who asked about the status on creative. That sounds -- again, I'm -- people will disagree here. We have other things favorite that you want to move up.

 DR. BRIAN TAYLOR: You're doing well. We're [inaudible] with you.

 [laughter]

 DR. HORNBERGER: You'll let me know. Okay. Harlan, I have you down for that. Should we go to the -- Walter?

 DR. WALTER ROBINSON: So there were a few questions about the whole issue of standing for science at a time in which science has become polarized and politicized.

 DR. HORNBERGER: Yes. Right.

 DR. WALTER ROBINSON: And I actually would like to hear him say something about that. It wouldn't have to be specifically about climate change, although I'm also interested in climate change, but more generally.

 DR. HORNBERGER: Vicki? Okay, that's going to go up to six.

 FEMALE SPEAKER: We need to slow this down a bit, so we know what we’re supposed to ask and what order.

 DR. HORNBERGER: Okay. How about declining proposals based on format?

 DR. RUDNICK: I’m happy to not bring that up, [inaudible].

 DR. HORNBERGER: Okay. We do that offline. The load for POs, the increased --

 FEMALE SPEAKER: I’d like that to be asked.

 DR. HORNBERGER: Yeah, so is that too far down? Do we have to move that up? We don't know. Here we are. Okay, we're going to start.

 [laughter]

Meeting with the Director and Deputy Director

 DR. KILLEEN: Dr. Suresh, Dr. Hornberger is our acting chair.

 DR. HORNBERGER: Thank you very much for joining us. We're -- it's a pleasure to meet with you again and I gather that we have approximately an hour and you have some remarks that you will start with.

 DR. SURESH: Sure. So, I think -- let me just give you a few updates from the time you were here last time on what has transpired. A couple of things. First is the budget part of it, so the 2012 budget. I don't quite remember whether you were here just before or just after the 2012 budget resolution. So we did end up, contrary to our fears during most of last year, on the right side of flat. So, we did receive --

 [laughter]

 DR. SURESH: -- under the circumstances, what I would view as quite a remarkably successful outcome, a two and a half percent increase in budget. So that was one item I wanted to highlight. The second item I would like to highlight is within the budget, which is particularly germane to this group, Congress -- let me step back a little bit. Historically, the MREFC budget, which funds our facilities, has been a separate line item in the budget. In 2011, we requested something on the order of about $250 million for facilities. Congress provided less than one half of that amount. Then in 2012, after a lot of pushback from us and justification from us, they not only raised it, nowhere close to the level we asked for, but something on the order of about $160,000 -- $160 million dollars or so. But then they added a provision that I could, at my discretion move up to $50 million -- up to $50 million from RNRA research and related activities to MREFC. While that gives some flexibility, as I've said to other groups, it's not a cause for celebration and it's something that we need to take very seriously. And that sort of brings home the message that it is indeed a zero sum game, and in the current budget reality, because if we provided justification for one activity, it has to come from somewhere. It's not only a zero sum game for a particular field, it's a zero sum game for the agency overall, because we did exercise $30 million out of $50 million because that would potentially save a lot of other money. Because this would fund the projects that were well on their way, so that we don't end up wasting money for which we already spent tens of millions of dollars and things that have been in the planning for five years, six years already.

 So what that brings home is that anything we spend for facilities in one corner of NSF, whether it's GEO or physics or astronomy, or anywhere else, can affect mathematics, chemistry, and other fields. I think this is something we need to keep in mind. I would even go further. The budget implications for one agency have implications for other science agencies as well. So it's a zero sum game in that sense as well. And so I think this is something that this group is very much aware of, but our community at large in different fields is -- doesn't fully appreciate. They view MREFC as one pool of money, research funding as another pool of money, the two of which are unconnected, but that's why I want to emphasize that point. Going from 2012 to 2013 budget, the president proposed a 4.8 percent increase in NSF budget compared to 2012-enacted level. So, that's a very good beginning, but it's beginning of a long road in this year and, nevertheless, it shows the strong commitment of the administration to support science and NSF has fared very well, even within -- among science agencies in that regard in terms of the absolute increase proposed by the president. And since the president's budget proposal, I've had five testimonies to Congress, mostly in March, last month, three of them on budget. And I can report that even in this very choppy election year climate in Washington, there is bipartisan support for agencies like NSF, and that was abundantly clear in the questioning in various committees in the Senate and the House. What is not clear is that how that support will translate into actual dollar figures by the end of this year, but I can report that, especially this year, it was very clear that the value of NSF is being recognized in the community, especially at times like this. But not to the extent we would like to see, but still it's nice to see that support. So where we go from here remains to be seen, but at least it's a good beginning for this year with respect to that part of it.

 The Senate committee was yesterday starting to mark up the NSF budget and the House committee has not done so yet, and I hope that'll happen in the next few days to within a week or so. Then we'll have at least an initial picture of where they stand and then take it from there. So that's sort of an update on the budget process and where we are.

 We framed the 2013 budget. “We” meaning the entire senior leadership team, and with input from colleagues in different parts of the foundation under the framework of One NSF and the idea for us is while we cherish and celebrate the excellence of different corners of NSF, different fields, different disciplines, different cultures associated with different disciplines and different needs for infrastructure, how do we take the strength of one corner of NSF and leverage it for another part of NSF in the most effective way? And the analogy I gave to the MPS community is we want to make sure that not -- we want to make sure that all of our cylinders in our engine are firing in unison. So One NSF in a way, if you think of it as a seven cylinder engine, I don't know any commercial car that has seven cylinders, but we have seven directorates and research offices on top of it, nor do we have 11 cylinder engine, but if you have such a multi-cylinder engine, how do you make sure that you fire in unison?

 So we have -- I'm sure you have a copy of this document. We talked about examples of what One NSF is and there are three characteristics of this that we wanted to happen: responsiveness, leverage, and leadership. And how do we take best practices of one corner of NSF and elevate it to benefit all of NSF? Because NSF has only one mission. We don’t have a GEO mission. We don't have a Bio mission. We don't have a mathematics mission. We have -- NSF has one mission.

 Another aspect of it in my own thinking, and I think that's consistent with the conversations we've had throughout last year, is One NSF is not just internal to the building, it's also external to the building. So what do I mean by that? In the -- take clean energy as an example. Every part of NSF is engaged in this. SEES activity. Every part of NSF is engaged in this. Different communities outside of NSF are engaged in it. How do we make sure that NSF investments in one part of the country benefit another part of the country? So let me give a specific example of relevance to GEO. Whether we have real-time data coming from OOI, or IRIS, or NCAR, how do we make sure that the needs and the infrastructure from this collective investment, even though they may address slightly different communities, benefit all of the NSF community or even beyond all of the science community in the U.S. in the most effective way. And that's another notion of One NSF.

 And last but not ‑‑ and one of the activities we've launched, specifically we want to make sure that different NSF-funded activities in the country, even though they may have many international collaborations, often times it's somewhat surprising they don't collaborate among themselves within the U.S. And that's also part of what we mean by One NSF. And how do we ‑‑ there are a few programs that we launched last year that are specifically targeted at making sure that different NSF funded-communities in the same field talk to one another the way they should anyway. And if not, how can NSF help facilitate that conversation?

 So that's just a quick summary. I want to leave enough time for discussion. So let me just add one other thing: Last time at the meeting, I mentioned we were going to launch a search for a replacement for Tim and his mandatory end of tenure by federal law, unfortunately, is June 30th. And if we had flexibility we would go beyond that, but the firm deadline imposed on us is June 30th of this year, which is coming up pretty soon. So we launched a search around the time you were here last time. And the search committee did a phenomenal job, chaired by Pam Matson at Stanford, and they gave a recommendation. We've interviewed candidates. We hope to close on the search very soon, very, very soon. And then we're already having conversations with some of the candidates who came here.

 So I have nothing more to report at this stage other than the search committee worked extremely hard and my colleagues at NSF worked extremely hard. We had the candidates come‑‑we had some candidates come more than once and we've talked to the community. We got confidential reference letters and we hope to move on this. And hopefully it will work out well in time for a smooth transition. But these kinds of positions, until we are ready to announce, I'm not able to say anything. So ‑‑ but that's an update as of this morning that I want to convey to you.

 We also have a search and panel for which we are interviewing candidates for MPS. And there the transition time point is September 1 of this year. And just two weeks ago, we launched a search for engineering where the transition point is January of next year, so that we have plenty of time to talk to the community. The MPS search, we are already interviewing candidates. The engineering search will start in a couple of months or so. So in any of these, if you have suggestions, please do let us know.

 And we have ‑‑ we also have retirement in an area that sort of has an intellectual overlap with the GEO and that's the Office of Polar Programs. Karl Erb, who had led the OPP since 1999, retired at the end of March, a few weeks ago. He is currently on a three-week cruise to Turkey, and so we will be announcing plans for ‑‑ so Kelly Faulkner, Dr. Kelly Faulkner, is the acting head of the Office of Polar Programs and will be announcing plans for replacement of Karl before too long. So that's our hope.

 And so that's a quick summary. Cora, do you want to add anything?

 DR. MARRETT: I have nothing to add right now.

 DR. SURESH: So we would be happy ‑‑

 DR. HORNBERGER: Thanks very much and we do have some questions and thank you for that briefing. I do appreciate it. As you know, the GEO Advisory Committee really appreciates Tim and the entire staff. It's a tremendous organization, GEO, and we're very glad to hear about the progress on getting a new leader in place.

 I will also mention that the division director for EAR, which I know you're looking for, that's another very important position for GEO so we look forward to that concluding as well.

 So we do have a set of questions and as is typical, we'll go around.

 DR. SURESH: I just thought of a couple of items I forgot to mention. And you may know this, just for completeness, in the event you know, here is the information. Two official openings have been scheduled. One is for the NCAR Wyoming Supercomputing Center on the 15th of October, and the computer is already there. The building will officially open and we have plans to ‑‑ a number of us here ‑‑ to participate in that event. The other is the Sikuliaq will be launched on the 13th of October, and hopefully it will get to Alaska and start its research operations by 2014. And that's on schedule, on budget. And that's also moving along. So I'm sure Tim has mentioned this to you earlier but in case, I just wanted to make sure that everybody knew that.

 DR. HORNBERGER: Great, thank you. And actually our first question Peggy has is a nice follow‑on to your presentation.

 DR. DELANEY: Well the question I'd really like to ask is what are the initials of the people you're talking to? But I'm going to resist that.

 [laughter]

 That was just enough information to really put us on the edge of the chair.

 It falls on your remarks about One NSF and I know some of us have seen the brief video and also want to make sure you recognize that GEO has a long history of international collaboration, including the drilling program and we could give you some nice footage in there as the most successful international program ever.

 But one thing that I'd like to ‑‑ NSF framing as your internal and external way to think about the agency and the challenge that you all face in describing zero sum as not a bad thing. Right? Like it's better than ‑‑ I learn all these useful budgets phrases from the University of California.

 DR. SURESH: I'm still learning.

 DR. DELANEY: On the right side of flat, that's the one I'll take home this time.

 [laughter]

 On the right side of the flat this time. But how with some time here how have your views about One NSF changed or matured or how would you expand on how you think about One NSF, especially in the budget context and the programmatic context?

 DR. SURESH: So, you know, this is not something that was created out of the blue. We've had ‑‑ so I can answer that in a number of different ways so let me answer it in the following way: First is, we framed the budget document under the rubric of One NSF. From the White House and OMB's response to that has been very positive. And that's a necessary first step but not a sufficient step. So that's one.

 The second is congressional response to this. So that obviously did come up in my testimonies and offline conversations with congressional staff and senators and congressmen. And I think that has been very good.

 So another way to look at this is at a time of significant fiscal constraints, I view One NSF as also a leveraging point. So let's take international as an example. In a multitude of ways, we use the One NSF narrative to form certain international activities in a certain way that, compared to say five years ago or 10 years ago, where NSF would have ended up being the biggest financial partner in certain activities. We bring to the table now discussions of leveraging all kinds of resources. Historically, we have done this because we are way ahead of our competition, our collaboration, whichever way you look at it, on an international scene and therefore we put in the money to initiate it all because of national security issues. All because of need to create a certain type of infrastructure where we have complete ownership.

 But at a time when there are significant new investments and resources on the horizon, from entities that previously were not engaged to a level that we were engaged in, I think it will be a prudent use of taxpayer resources and also a leadership opportunity. And so in that context I have continuously made these two statements that I want to repeat because it directly addresses your question. One is, I think leveraging resources is going to be key for the future to keep the U.S. and scientific community at the forefront, and anything we can do to do that would be essential.

 The second is, on the international front, one could make an argument ‑‑ and this is my personal view ‑‑ is that and it's almost an exact quote that I made, that I said somewhere, but I'm trying to paraphrase it to the extent I can, I believe that good science anywhere is good for science everywhere, provided that you have a peer review system, a merit review system, scientific ethics and integrity, and respect for intellectual property that are open, transparent, clearly specified and be available. And we have a leadership goal to create that in new and unique ways. And if we can do that, I think that will be one of the global achievements of One NSF.

 There are a number of activities that GEO is engaged in. GEO has many, many international programs including the area of climate change, Belmont Forum, and other activities; and those are significant leadership activities. And there are other areas where NSF has an important role to play and this is something‑‑this is another way to capture the One NSF scientific community.

 DR. HORNBERGER: Lee, you had a follow-up.

 DR. ALLISON: Great, thank you. All right. We think we have a good, successful implementation of the One NSF concept coming out of GEO through the EarthCube initiatives, and it's really worked across the directorate at the individual PI level, bringing them together, and then across NSF by tying in OCI and computer sciences. So we wanted to kind of make sure you see that GEO is walking the walk within the concept you have there.

 DR. SURESH: Well, I think GEO is walking the walk in a number of areas. SEES is another example of an activity that does this. So you can even take ‑‑ we had the big data launch on the 29th of March at the White House. And so what was particularly pleasing to see is how different corners of NSF have come up with activities. For example, CISE, engineering and OCI had significant joint activities in big data, and CISE had, for example, four ‑‑ let me get the right word ‑‑ expeditions in computing each for $10 million. I looked at the list of institutions that participated in this ‑‑ this goes back to my notion of One NSF in the community ‑‑ so many different institutions collaborating in new and unique ways. You mentioned EarthCube, that was another thing that was announced on the day between the activities of GEO and OCI. And Tim uses a number of different French words. This is a charrette.

 [laughter]

 I want to make sure I ‑‑

 DR. DELANEY: It's a new world.

 [laughter]

 DR. SURESH: I don't get nervous, but the French get nervous when British use French words.

 [laughter]

 But is it charrette? Yes, it's EarthCube charrette that was another very successful launch and using the latest tools through web engagement. In fact, that big data launch, itself, was an interesting experiment. I heard that 4,700 people watched the webcast. It was by far the highest audience for any NSF webcast outside of the building. The previous record was 1,300. So I think technology is catching up with us or we are catching up with technology, whichever way you look at it.

 DR. ALLISON: There's a follow‑up to that, which is, given the view that for many of us that NSF stole the show at the big data event, what's the role of NSF on this initiative with all of the other agencies and groups across the country?

 DR. SURESH: Good point. So with NIH, we launched an initiative that's $25 million that was announced at the big data event. And within NSF we have several activities that are going on. In fact, I had dinner with the acting director of DARPA last week on things that they're interested in participating in the future with NSF.

 There are activities that were not announced officially which are in the background where there is significant potential for additional collaborations. For example, one of the biggest big data generators for NSF are the telescopes. And so within name astronomy community at NSF, we have discussions of activities, the next stage of activities, some of which will be jointly with the Department of Energy basic science and what they would contribute. And so these are examples.

 At the time of the budget rollout for CIF 21 we also announced a new vision document and a five-pronged strategy on what used to be called high‑performance computing, we now call advanced computing infrastructure. And what that talks about is our vision of NSF's role over the next five to 10 years on what we would do to facilitate cutting edge science and infrastructure into especially networking at the highest end of computing but not necessarily the fastest supercomputer in the world. That may be used by a tiny fraction of the scientific community at a very significant cost to the overall scientific community.

 So what we articulated in that vision statement was what we will do over the next five to 10 years and, equally importantly, what we will not do over the next five to 10 years and how we will engage with other agencies. And our goal would be, to your point, in the next few months we'll be putting out a vision document for all of CIF21, not just one component of CIF21 that deals with infrastructure but all of it. Cora, you want to say something?

 DR. MARRETT: Actually, my comments were back to the first notion of the comment about One NSF and One Geo. The mathematical and physical sciences directorate has adopted the slogan, One MPS, suggesting that the five parts of MPS really come together, meaning there are conceptual ways in which the five divisions come together and that there are systems areas that require that movement across all of the parts, all of the divisions. It's especially, I think, that second sense that Earth scope represents for the GEO directorate, this idea of Earth system sciences as Tim has talked to us constantly ‑‑ quite a bit ‑‑ I won't say constant‑‑

 [laughter]

 ‑‑ of a way of bringing together then the three divisions of GEO, that that's the notion there that there are the commonalities building on what has to be special within an area but there are enough so that there is the unification of GEO. So I think the same notion of a One GEO comes, as you've just suggested, around the idea of Earth scope and that then contributes to what the director continues to talk about, about some other matters at a systems level, that we have to pull things together if we're going to understand these larger systems. That was the only comment.

 DR. SURESH: But One MPS, nobody mentioned during that meeting one telescope.

 [laughter]

 DR. ORLANDO TAYLOR: Thank you, Dr. Suresh. And I will speak in English.

 [laughter]

 Many of us were excited by -- in fact, I would say many of us were really quite inspired by the meeting you had at the White House in late September around the Career Life Initiative. And I just wonder if all of us on the committee, the council would wonder how ‑‑ what kind of progress are you making at NSF, particularly the issues around allowing grant winners to either postpone their awards or to delay their awards or suspend their awards or get supplemental funding to support family friendly interests.

 DR. SURESH: Thank you. I'll be happy to answer that. So there is a “Dear Colleague” letter that's about to go out, following up even for FY'12, some other things that we announced. So that's already in the FY'12 plan. We will make it automatic and burden-free for those seeking either no cost extensions or deferral of NSF-funded awards.

 And also one of the other proposals in that was technician support, which was a key component of it as part of the career life balance. So that's another activity that will be part of this.

 So we announced certain things that we will start with and all of those would be done in FY'12, in this year's budget.

 The second thing is, after we launched it for the external community, I forget exactly when it was, probably in January this year, just three months ago, we launched a career-like balance for NSF for the people inside the building. Because we don't want do something just for the external community that doesn't reflect on the internal staff. And there was an event that was held and there are activities that are followed up. And there is a working group that made the recommendations, an NSF working group representing different corners of NSF, that made the recommendation that led to the event at the White House with the First Lady, has also continued the work. I've given an advice charge to the committee to continue the work so that we can systematically follow. On the 26th of September last year when we launched the career life balance at the White House we signed a letter jointly with the Association of American Universities, AAU and APLU. The president of AAU, Hunter Rollins, and the president of APLU, Peter MacPherson, and I, signed a letter to work together among the three entities to further the career life balance goal for the country because NSF has a major role to play for the country but we're not the only influencer of outcome in the country, even though we can set a tone, we can take a leadership role. So what they've offered to do is to initiate activities in their organizations, the 60 universities that represent AAU and 140 some universities that represent APLU to come together on things that they will do. It could be taking best practices of some of the universities already and having other universities adopt them, not always with NSF funding. So my question to them was, this is what we said we are going to do, this is what we have done to follow up what we said, now it's your turn. What are you doing? And to follow that up, in June of this year there is a plan for a workshop. Again, this is the 150th anniversary of land grant colleges and universities this June. And that will be commemorated ‑‑ I'll be speaking at that event and AAU and APLU are now working together to come up with the pilot project on what they will do to complement what NSF has initiated.

 We've also started a conversation with other agencies. So I went to visit NIH in November, met with all 27 institute directors in one place and talked about NSF's career life balance initiative and NSF ‑‑ NIH ‑‑ has parallel activities and we are talking about how we can coordinate the two and leverage each other's activities.

 DR. HORNBERGER: Thank you. Dan.

 DR. BAKER: Yes, I think my question continues this theme of NSF leadership, and I would just say that it's been extraordinary, in my view, what NSF has been able to do with relatively few resources in programs like Leadership of Space Weather, the CubeSat program, and I think this has lighted the way for other agencies like NASA and NOAA to look at more efficient and effective ways to manage programs. And I guess my question is, is it your hope, is it your aspiration that NSF continues to be a catalyst for these kinds of improvements for the mission agencies?

 DR. SURESH: Absolutely. In fact, I went on a trip to Antarctica last November, along with Marcia McMahon [spelled phonetically] from USGC and also Laurie Garver, who is the deputy administrator of NASA. As you know, we have a number of activities. NSF is sort of the ‑‑ provides the base for a number of activities for NASA and NOAA and USGC in that location but it's much farther than that. I was in Chile visiting NSF telescopes but also met with the director of IRIS who joined us and, again, there are lots of possibilities of NSF taking a lead role and a supporting role for other agencies. And I think at a time like this it is extremely critical.

 Unrelated to the topic of research but related to the topic of NSF activities, we recently ‑‑ there is a committee of the National Science and Technology Council called COSTEM committee which I co-chair with, Carl Wieman from OSDP. And that committee has looked at, in the STEM education area, all the funding provided by 15 federal agencies per year with U.S. taxpayer money. And it's worth $2.4 billion a year of STEM targeted programs, of which 80 percent comes from only two agencies: U.S. Department of Education and NSF. The other 13 agencies collectively provide less and 20 percent. So one of the activities we have initiated is, with the Department of Education, how we can redouble our efforts. So we had Secretary Arne Duncan come here last week in a town hall meeting with the NSF staff. So these are the kinds of things where we can play, in the case of education, we have a leadership role in new models, innovative models for STEM education but we have a supporting role in large‑scale implementation. So one of the things we discussed earlier this week in a senior management retreat was how do we scale up NSF's activities and therefore its effectiveness by focusing on scale up as a theme?

 DR. MARRETT: I was going to make a comment. I understand that the questions are coming in this direction and I think the director has already indicated, yes, there's a big commitment for a mission‑less agency, which some people have called NSF, working closely with the mission agencies. So that commitment is there. The question becomes in part, what are the most effective mechanisms to do that? And that's a part of what we look to an advisory committee like this to offer, because especially, from your angle, of seeing what kinds of experiences researchers might have, with reference to NASA or NOAA. So I would hope, probably not now, but a part of your conversation will be, this is the commitment that's there but that commitment can only be enacted if we get the kind of input and advice from a committee like this. So we'd like to hear more.

 DR. BAKER: You got it.

 DR. HORNBERGER: Roberta.

 DR. RUDNICK: So my question is based on international collaborations and you'd mentioned as part of the One NSF trying to leverage funds and also to foster international collaborations. But we've also seen recently, for example, NASA scientists and people funded by NASA being prohibited from collaborating with the Chinese. OST had their budget cut dramatically because of collaborations with Chinese. So the question is, do you see that as a trend and is NSF going to be impacted by that at some point? And what can we do to sort of change this culture, I guess?

 DR. SURESH: So, you are right. I think there was an OSDP budget was trimmed by $1 million out of $6 million last year. You will notice that NSF is not mentioned in that language. And all I can say is, it's not accidental that NSF is not mentioned in the language. And we have a lot of conversation with the right committees, right people, at different corners of Washington articulating the need for why ‑‑ and this is why I mentioned in my opening remarks, if we operate under the philosophy, good science anywhere is good for science everywhere, provided there is an element of transparency, we cannot have good science if we shut our conversation ‑‑ open conversation. And I think it's a sign of the political times but we have to stand our ground, we have to articulate principles and that's why I stuck my neck out and made that statement in print. So I hope that answers your question.

 DR. SPENCE: Let me return to NSF leadership in a different form. I think when you first came, the Inspire initiative was one of your early initiatives, bold and fresh in November when CREATIV was rolled out. I think GEO directorate looked at it because in many ways we embrace inter disciplinary research already. I think the hope was that CREATIV would produce opportunities for these high risk, high payoff opportunities. And I would say while other agencies talk about innovation, often they shrink from actually going for those high payoff type proposals. So although it's still early, the payoff is yet to be determined. We were wondering if you could give us a brief status report on Creative and Inspire and how we move forward?

 DR. SURESH: So CREATIV is ‑‑ the Inspire program has two parts to it. So the first tier, it was a -- again, this was a committee of program officers from across the Foundation that worked over a number of months and they designed this mechanism. And my understanding from the most recent data that I have from the group is more than 100 proposals have been received for the first phase of Creative, and they’re in the process of trying to converge on the first round of awardees, and by design it was set up in such a way that there are no deadlines. And this is their choice and did not come from me. And so there is an agency-wide group that’s looking at this. The second phase of CREATIV will be announced for FY13, and the preliminary discussions are that it’ll have a slightly different flavor. Again in the same spirit of identifying the research that may not fit traditional molds but will provide opportunities, perhaps even in the mid-scaled range of research projects that go across traditional boundaries. And so once we have the awards and once the awards are publicly announced, we’ll be monitoring it very closely to see how the outcome matches our original aspirations and goals of this award.

 DR. HORNBERGER: Vicki.

 MS. ARROYO: Thank you for being here again. So, you know, because of NSF’s leadership and because of GEO’s really important work that is the underpinning of so much in our society, our economy and innovation, and what we know and understand about the Earth’s systems, and for those of us who work on climate change, how we might look at the past and interpret that for what it might mean for the future. It concerns me that, you know, we’re still having these debates in a lot of forums about what we know about science, and whether or not alternative theories of evolution or climate science should be taught. So given your work at all scales, you know, from schools to states to the Federal level and international level, what do you see as the role of NSF in promoting this science literacy actively and really engaging so that people know that there really is a truth out there?

 [laughter]

 DR. SURESH: So, if it was only up to NSF to fix the perceptions in all across the country it’ll be a very easy job to do.

 [laughter]

 DR. SURESH: But unfortunately I think it’s well beyond NSF’s mandate. But, you know, I think it sort of goes back to another comment we discussed earlier. You know, we are sort of in a unique position compared to even other Federal agencies in that we cover all fields of science. We do no internal research, and everything NSF receives is given to the community. The community develops the science. It’s very important that we provide an open, transparent, free opportunity for the scientists to disseminate that information, to use everything in our power to do that, whether it’s being able to talk to scientists from all over the world, whichever country they may come from, to even a controversial viewpoint which may not be accepted by all. But that’s how science works. I think part of the problem we have is when dogmatic views mix with the objectivity of science, and given the fact that science always proceeds with an element of uncertainly, there’s nothing 100 percent sure in science. If it is, it is being done all ready and there is no need for NSF to fund it any more. I think that’s where we have problem in the society, including in this town, and I think the way to address for us is to articulate our principles, stand by our principles, and keep reminding people that we foster the best ideas and the best people, no matter how controversial those ideas may be. Science has a mechanism to -- ready to filter it and to sort it out, and scientists and the peer review system for which NSF is the gold standard, as imperfect as it may be perceived by somebody, there is no better system than this, and we should let that system work. And until the system sorts the results -- I, you know, as troubling as this is I personally feel that if we stick to that principle that the truth will come out, and it always does. Indeed it’s a minor blip, but I think articulating that along the same line, you know.

 Another way I try to communicate the same sentiments, whether it pertains to climate change or whether it pertains to something else is the following: You know, we have -- China invested about 22 percent per year in research. The increase was 22 percent per year from 1996 to 2007. Ours was six percent a year during the same time. Of course they started at a much lower level then where we were and we still are, but they’re catching up pretty fast. Other countries have invested very heavily, even small countries like Singapore or others. But here is the point: All of them look to NSF for leadership in this, on how to put in place a process and a mechanism for the global scientific community to take a lead. And in about three weeks we’re going to host an event here in this room that’ll involve my counterparts from about 50 countries who are coming here at their own expense to talk about how we as scientists can work together. And one of the topics we’re talking about is how to make sure that the skeptics of science around the world, not just here, how we can talk with a unified voice and a set of principles so that people understand. I think part of this is a lack of understanding of how science works, and I had a conversation with a very powerful person in Washington yesterday. It was very clear that this individual did not understand how the managerial process works, and why scientists should review other scientists’ proposals and not the lay public passing judgment in a blog on how science should work. And I think if we consistently stick to their schedule -- but I wish it were a lot easier than it is, and this is part of the problem.

 DR. MARRETT: I just think that when I hear the big questions like that, the inspiration that comes out as it says there’s a large community ready to tackle these big issues. NSF, if we talk about just the number of employees, we’re not talking about a big organization at all. That’s why groups like this -- and I would assume that this Advisory Committee then is ready to take on -- particularly when it comes to matters of climate, it’s so important. How -- what kind of advice would you give us about how to respond? How to -- what to know about that context and what should take place? That because if there’re different kinds of views that have been expressed over time. Those of you that said NSF was succeeding when it stayed below the radar screen. That radar -- as long as the radar -- that if nobody knows what you’re doing you can go ahead and do it.

 [laughter]

 DR. MARRETT: That is rather -- that’s very inconsistent with this notion about leadership, but you can’t do it anymore because as budgets grow, you’re much more visible. But also, what does it mean to take on that kind of leadership role? What kind of mobilization is required? What kind of advancements of science would be there? And those then become the things that, again, I just see an advisory committee through the kinds of working groups that you have created, that you might create, being the ones to help us really confront what are these very large and concerning issues in a number of ways.

 DR. HORNBERGER: Peggy?

 DR. DELANEY: I just wanted to comment. I’m going tie something you just said, which was right on the mark, with something the director had mentioned and it’s the polite phrase we all use right now in publicly funded institutions. I’m in the UC system. That we are operating in a time of significant financial constraints, right? It’s the polite way for saying this is the biggest reshaping of our publicly funded institutions of the last six decades. And, you know, from 2:00 to 3:00 a.m., we lie there in a cold sweat thinking, will we still be functioning in 10 years in a way that we recognize? And I think that it really makes it impossible to fly below the radar. If NSF could’ve done that once, you can no longer do that, and I think we really do have a role, this committee and you, in saying basic research, if you’re going to judge it by the way it gets presented in the media, there’s half of one and half -- six of one, half dozen of another. Or looking for certainty, you do not understand science as a mechanism, and part of what we’re going to do is tell you about science as a mechanism and that individual scientists may not be the ones who are best at putting their work in a policy context or explaining it. In fact, some of them will look downright dorky, but they have a way to find out how things actually work. That is vetted through the peer review process, through a process of absolute transparency, and I think the issues of conflict of interest being dealt with right up front, right? It is a way to ensure that those public researchers are used effectively. Yeah, you can’t go below the radar anymore. It’s just -- everyone wants to know what you’re doing with them, who you don’t have.

 DR. SURESH: Well, also I think this is what Cora was pointing out. I think if we make a deliberate attempt to go below the radar screen, I think we are passing up significant leadership opportunity, not only on a national scale, but on an international scale. I’ll give you -- go back to this example that I gave you. The White House and the Europeans asked NSF if we could lead a global network that will lead to principles of scientific merit review, professional ethics, scientific integrity, intellectual property framework, respect for transparency and openness of the scientific process, and so forth. And I think the easiest response for all of us in the building would have been to say that we are too busy doing too many things right now, we don’t want to take this on, and it’ll put us in the spotlight. And I’m really impressed with my colleagues at NSF, and they took this challenge on and the response to this has been overwhelming, and I hope that it’ll also lead to -- if we can influence. Influence not in a dominating sense but in a positive sense of having the right outcome with respect to the new billions and billions of dollars that are being poured into the scientific enterprise all over the world. But it furthers the frontiers of science with NSF leadership. I think we would have served a very useful purpose and I think that’s sort of what you’re mentioning.

 You have a particularly more constraint situation than everybody else’s, well given the State of California right now.

 DR. DELANEY: Right, but we’re just, I mean, we’re just an example. It’s the same thing.

 DR. HORNBERGER: Slight switch of gears, but only slight. Cora mentioned, of course, that you don’t have a huge workforce, and one of things that we continually come up against in our committee of visitors is the workload issue for inferior program officers who are, as you know, a very dedicated bunch but, nevertheless, there are limits. And it appears to us that these crosscutting initiatives that go across the Foundation as a whole, as well as within the GEO division, have to add to the load for the POs. And I’m just wondering about your views on how things ultimately get balanced out and so, you know.

 DR. SURESH: This is something for which, again, there is not an easy solution. The one thing is not going to happen in this environment, and that is we have a significant increase in Federal workforce. That just is not going to happen.

 [laughter]

 DR. SURESH: So that’s a reality that we have to face. And, in fact, it’s pretty remarkable that we’ve done everything possible to -- not to reduce the workforce at a time when other agencies have lost significant reductions in workforce. So I think we will continue to fight to maintain that workforce. So that’s the first thing.

 It is true that the workforce issue comes from multiple directions. It’s definitely true. One is the proposal, the sheer volume of proposals coming in, in relation to what we are able to fund, and the need and the mechanism to have a fair process for these proposals. That’s one. The second is the software and hardware that we use to handle these proposals and the way in which we distribute the workload in different -- between administrative staff and program staff. And there’ve been changes over the past few years on how we address this. The third is our conviction about doing certain things a certain way, which have served us very well. But going forward, is it realistic to be able to sustain that form? For example, we’ve had a panel review process as the dominant mechanism for selecting proposals. So if you receive -- so if you take a hypothetical example of a particular directorate where you have, say, 20 percent of the proposals that come in to that particular directorate have no chance of ever getting funded because they’re so far below the standard that’s expected for funding. Are you doing a young faculty member a favor by taking eight months to go through a panel review process, or are you being fairer to them by letting them know very quickly that this idea has no chance of ever getting funded unless you define it and come up with a better idea? So that requires a completely different thinking.

 So what we’ve done is that we have taken a multipronged approach to that. One is to make sure not only does the workforce doesn’t decline, but to make sure it even has an opportunity to slightly increase even in this climate because of the way certain calculations are made in the -- in OMB. So that’s one. It’s very difficult to grow significantly in this climate. So the second is to pilot a number of activities that will address the way in which we handle proposals and see if there is potential in the [unintelligible] state, not initially, for significant improvements in the workload. So there is a taskforce that we set up. They are making recommendations; actually they have a draft of a report that’s ready to be circulated before too long. And what they have decided to do, rightly so, is not every solution works for all of NSF. So we’re going to pilot different new ideas, some very bold ideas in different corners of NSF. So, biological sciences directorate already in two divisions has a completely different mechanism for proposals starting this year, which initially caused some rumblings in the community. As the community understands more and more, they will -- we will see. And if it’s not the right idea to do, we can fix it. But we need to do something bold, and status quo is not a solution. A third is new software and hardware. So we’ve made significant investments in our financial system, a system called iTrack [spelled phonetically]. Those investments will be completed next year. Our next -- our goal is to look into ways in which we can invest in both in hardware and software for proposal-related activities. In fact, we’re already having conversations with the heads of those parts of the organization about this. So those are the kinds of things that we’re starting. But a fourth one, to go back to something that Cora mentioned, a lot of this is also community expectations including at the universities. There are universities that relate success not to outcome but to attempt. The number of proposals that are submitted is cherished as much as the number of proposals funded, and I think that’s a completely wrong metric, and it puts young people at a disadvantage. So I think a group like this can really help us, at least in this community on how to separate expectations in the community.

 DR. MARRETT: I’d add to that that this matter of workload is on a high priority item for the group that Marge Cavanaugh sits on. And that’s the Deputy Assistant Director’s Executive Officers, popularly known as the DADEOs.

 [laughter]

 DR. MARRETT: The DADEOs have actually been looking at matters about workload, and I think your question was in part, how do the interdisciplinary cross foundation activities add to that workload? Well, the first, one of the first things I think they’ve come out with is that we have something like 750 working groups in the Foundation. That’s almost a working group per person. So they’re asking that we take a look closely at what kinds of groups, what’s the purposes are being served, where do some of the groups originate? Some of these are out of other kinds of directives that come to us. That means we’ve got to be bold enough to say, we don’t have to put together a group just because there is some kind of directive that has been stated.

 But in addition to these kinds of matters, it’s very interesting that if you look at certain areas -- SEES I’ll take as an example. I believe there’re about a hundred program officers associated with SEES. This was not something imposed. This is something in which the -- where the program officers said we want to engage in the work across lines. So that’s the kind of a thing where we’ve got to make sure that there is that level of engagement in the exciting ideas that would be possible. So we’re working, on the one hand, of trying to streamline the things that probably don’t add a lot to the intellectual life of the -- of all of our communities and, at the same time, allow for the possibilities of any number of groups and segments coming together in very different ways that might have been the case if we just did things strictly within the disciplinary lines.

 DR. LOZIER: I just had some very quick comment on that, and surely this discussion about workload is not divorced from the discussion you had in January within NSF about the work life balance.

 [laughter]

 DR. MARRETT: Yes.

 DR. LOZIER: Yeah, so that’s --

 DR. RUDNICK: I just wanted to say that you have got a terrific group here and the fact that this division works so well, this directorate works so well, is largely, I mean not only, but largely due to the program officers. And the fact that so many have stepped up to the plate to participate in these interdisciplinary things just emphasizes that. But I hope that there is some sort of a mechanism whereby there is a direct line of feedback between the program officers and the upper level management so that, you know -- I am very sympathetic to overload. [laughs] Because I feel it -- it’s very -- in my own life, and I think it’s really important that there is this open line of communication because we’re a terrific group of people and, you know, there may be ways of reducing or, you know, making it better. But you don’t want people getting burned out and losing them. That would be the worst case scenario.

 DR. HORNBERGER: I think we’ve reached the 2:00. I want to thank you very much, Director Suresh and Cora. Thanks very much for coming by.

 DR. SURESH: Well I want to, again, thank you for taking the time. You know, this is very hard work and it takes you away from your families as well to get here and --

 [laughter]

 DR. SURESH: And you have to balance a lot of things to get here and devote your time, time for us. So I want to thank you for your time and suggestions and I want to, again, reiterate that a lot of the ideas and policies that we put in place, whether it’s SEES or CIF-21 or Big Data, or any other things, come from groups ideas that we, you know, we get them through groups like this. So anything that you want to recommend to us will be taken very seriously and followed through, so thank you very much.

 [applause]

 DR. HORNBERGER: Okay. Brian can’t wait for his break. What I’d like to suggest that you do, as you take this 15 minute break, and we’re going to, as you see, break up into our division meetings. But reflect a little bit on what the Director said. When we come back, later this afternoon, to see if there’re anything that we want to ourselves send back in our report from us, anything that we want to suggest. So we’ll -- I think we’re scheduled for a break until 2:15, and then reconvene in the appointed rooms.

 [break]

Wrap Up

 DR. HORNBERGER: Okay, it is 5:00, as you see. We’re longer half an hour behind. So that’s progress.

 FEMALE SPEAKER: Twenty minutes behind?

 DR. HORNBERGER: Yeah, something like that. We are -- we have a dinner as you know at, well --

 MS. LANE: Tutto Bene.

 DR. HORNBERGER: Tutto Bene, okay? And Melissa’s given, I think, everybody a map.

 MS. LANE: I will.

 DR. HORNBERGER: Okay. You’re going to get directions and it’s very close, so that’s not too bad. And that’s started --

 MS. LANE: 6:00 to 6:30. Just get there.

 DR. HORNBERGER: Get there by 6:30. Don’t be later than 6:30.

 MALE SPEAKER: First drinks are paid for.

 DR. HORNBERGER: The first drinks are paid for, so you better get there by 6:00.

 [laughter]

 FEMALE SPEAKER: Okay, 6:00. Bada boom bada bing.

 DR. HORNBERGER: Okay, and actually this is [laughs] -- what our schedule says is that this is to be wrap up. We won’t have -- as you see we’ll start tomorrow morning with the report outs from the division meetings. So we won’t do that today and I thought it was a good day, overall. I think that we did learned a lot. We heard a lot. And I think that as wrap-up what I’m going to do is, Tim has volunteered to throw out an easy question for us to cogitate on over dinner and possible to keep everybody awake tonight. Tim?

 DR. KILLEEN: Marge is --

 DR. CAVANAUGH: I’ve heard these.

 DR. KILLEEN: -- she’s grimacing already. I can tell. She knows me too well. First of all, thanks for today. It’s a great day and I thought the interaction with the director and deputy director was just right on it. You know, it’s very helpful to GEO to have this presence, this stature of this committee really engaged in all the issues that are going on. So thanks for that, and for bearing with the dry run of the presentation, and your comments were really helpful and great. And then I’m sure you’re all now steeped in divisional issues and I, you know, we know there are many and we’re going to hear about them tomorrow. But since this is my last meeting as the -- in this role, and there’ll being somebody else sitting here next time, I am starting to think about sort of the body of work that we’ve done as collectively over the last four years. And as you saw in my presentation it all started with GEO Vision, which was the Advisory Committee’s report that we kind of actually tried to implement, believe it or not. And I think we’ve made a lot of inroads in implementing it and there are four sub-reports in that that you’ve also blessed and they’re in your packet here on cyber-infrastructure. It talks about EarthCube on education outreach and diversity. We’re now engaged in E Squared on facilities and use for the progress we’ve made on facilities. And the fourth one is on international, and we’ve made a lot of progress I think on international, opened up a lot of doors and so on.

 So here’s I guess the start of the question. As I look at that stuff and because I’m in the thick of it at lots of levels and my colleagues are, too, you know, there are workload issues, there are interface issues, there are all sorts of technical and, you know, things that consume time. But I’d like the Committee to step back a few paces from that if possible. Maybe now would be a good time having heard this sort of overview, the public overview that we’ve given, and help us with sort of the overall framework of where GEO is, and has gotten to, post GEO Vision, post implementation effort in GEO Vision. And the way I look at it or think about -- dream about it at 3:00 a.m., is we’ve got these flying saucers which are pretty good independent systems. International flying saucer connected out internationally, leadership role. It’s spinning. It’s humming. It’s -- wow! It’s up there. It can do things. It’s to some extent it’s under our control. We’ve got at least a tether to that flying saucer. Then there’s an interagency flying saucer, too, that is very interesting. We’ve led the effort to develop the U.S. TCR Peace Strategic Plan. We’ve seen all the agency partnerships that we’ve put in place, the SEES, and now we’re working on an E Squared one.

 The intra-agency partnerships are remarkable, I think. GEO is extremely well placed within NSF, and we have all of these connections. And we’ve led SEES and it’s brought the whole directorates and officers into a new level of partnership with 12 solicitations out. So you’ve got international, interagency, intra-agency, and then GEO itself I think is -- we’ve got a great leadership team. I hope you agree. Division directors, section heads, program officers, it’s just a fabulous, fabulous team, and the front office staff is great, and I can’t speak highly enough of Marge. So I think you have got a great team in GEO, and it’ll be there when I’m gone, and so I've been very fortunate to be blessed with that team. Within GEO, I think we've dealt with a number of issues, actually staff respect issues, workplace environment issues, and you know, there's still issues to work through. So that's a fourth flying saucer. So you've got international, interagency, intra-agency, GEO, and then you've got all these mechanisms of what we do, facilities we built. They're independent artifacts in a way. EarthCube is there. You've got E Squared there.

 Is there a way, oh committee, here's the question, that we could somehow connect those dots into a framing that somehow speaks through the presentation I am to give next month to Subra and other colleagues that, you know -- I think is facile to say One Geo, but is there a way we could connect that? They're all so similar in a number of ways, these layers, but there are different people working on them and so how to articulate the parentalist picture is there made up of these blobs. So that's the question for today, because I think if we could do that it would actually be -- if it was an advisory committee product it would be -- it's almost like a preamble to what we're doing or it's a statement of purpose, or perhaps it's an integrating framework statement of what GEO is doing on all of these. We talked about seven pistons today, right? So I'm -- there are only five or six of these ones, but I think we're missing that. I think we've made progress on a number of fronts and a number of layers, but the connective tissue isn't quite there yet or it's not sufficiently articulated. So help us with that.

 DR. HORNBERGER: That's the question.

 DR. KILLEEN: Is that clear or is that totally mysterious?

 DR. HORNBERGER: It's clear, right? Brian?

 DR. BRIAN TAYLOR: Well, it was -- I think it was Susan who said earlier one world and [unintelligible] one thing which we're now hearing from Norine and Dan and [inaudible] and many others, but in many senses, I think, Tim, where you've led the directorate is in positioning itself and, you know, I think of your slide with all of the magazine covers on it, "Time" magazine and the many others, that the sort of natural sciences, environmental sciences, natural resources issues facing humankind, and we become suddenly the most invasive and the most over-using species on the planet, where you can't get away from us anywhere from the deepest part of the ocean to the Arctic or up.

 So I think that the thing that in all of those inter-things and the similar stuff, it's really about how the future, frankly, of humankind is dependent on those relationships that all of those layers from international down to intra-divisional; that's the positioning that you've made happen, whether it be the Belmont Forum or the interdisciplinary things and making even programs like GeoPRISMS, you know, and now sort of working between EAR and OCE, for example. I mean, at all of those levels, it's really about positioning the geosciences. The vision has been positioning the geosciences as pivotal to developments that matter. So that's what I see as the connection throughout that vertical structure.

 DR. ORLANDO TAYLOR: If I might, as you were talking, Tim, I could not help but think you were describing most universities, which talk about the same sort of thing in terms of silos. We typically talk about them, as you know, and for me there -- and I think you were getting at it, maybe in the presentation this morning, the glue that makes an institution, whether it's GEO or NSF or a university, seems to be a set of core values that permeate the institution while each of the constituent parts may reflect on those core values in different ways. They are bound together by that. The other thought I had was when we were talking -- I think it was you, Brian, today about -- maybe it was someone over here about change in ten years. It may not be a big deal, but 40 years [laughs]. And so you may have some structural questions that you might want to think about reconfiguring, which would provide an operational or an administrative framework that would sort of "force", in quotes, that kind of cohesion I think you're referring to.

 And then finally would be the question of incentives. What are the incentives in place that would encourage, indeed almost -- dictate's a hard word. I don’t want to use that one, but mandate. Yeah, mandate -- people to work together. People do things often when it's in their best interest, so they're associates by profession.

 DR. KILLEEN: That sounds great.

 DR. LOZIER: Tim, are you asking -- oh, I'm sorry. Are you wanting feedback on how you present this then to the director or more like how you sort of position the directorate for moving forward with all these different flying saucers?

 DR. KILLEEN: I guess I'm asking -- these are great comments -- I'm asking what the binding is for the overall framing of what geoscience is and is doing today at all of these different -- all of these component parts. And so what I've written down so far is bindings, use that word, which I think is really interesting and helpful, I want to think about that. And then things that matter, core values, and cohesion are all kind of, I think, elements of what I'm struggling to find is the connective tissue that gives us the picture, the overall picture. And it's not language so much as I think bindings is an interesting term.

 DR. DELANEY: So I'm always like the undergraduate and ask how long should the paper be?

 [laughter]

 And I heard your -- do you want it double-spaced? What type size? So I think part of what you're asking -- part of what you're asking, I think, is where are you on GEO Vision 2009? And now when you ask these questions I can see what you're searching for in giving your presentation is a little bit more of the glue and not just, “I have this and then I have this and then I have this and then I have this.” Right? Okay. And, I mean, there's 10 specific recommendations at the end of GeoVision. They're not very specific, but you could ask us for the next meeting, for example -- you won't be here. You could ask us --

 DR. KILLEEN: Oh, I'll be haunting. I'll be up there.

 [laughter]

 DR. DELANEY: -- you could ask us before your presentation to ask a small group of this committee to look at the report and give you two or three pages on where are you relative to that. Because I -- and the point I would keep making, you know, I said to you earlier both in a bragging way, but I think seriously, geosciences was often there first. Having to work in a field, having to work with facilities has taken us to topics like ocean acidification long before we were calling them that topic. So the transformation for geosciences has not necessarily been we were doing dull, boring things, and all of this helped move us into interesting things. We were doing interesting things that were of critical societal importance and we've gotten better at communicating that and pulling that together, and GeoVision was part of that. The integration across NSF was part of that. The work you've done with external agencies and external parties is all part of explaining the genuine excitement and importance of this science, including the basic research. So, I mean, I don't know if you want -- I mean, there's -- these are 10 recommendations that are a little bit hard to say did you do them or not? I think we could look at those 10 and say --

 DR. KILLEEN: Progress report.

 DR. DELANEY: -- how have you done? Progress report. And Dave down there.

 DR. WALTER ROBINSON: Well, I always like a historical perspective. So, I think if you think about where the geosciences were, and they were completely separate if you go back even 50 to 60 years, you wouldn't even talk about the geosciences for the most part. They were descriptive largely. They didn't have a unifying series -- and now we've gotten to -- I would say NSF, we can't -- Tim can't take all the credit because it happened -- some of it happened before you got here. [laughs] But over -- but NSF -- I think geosciences can take a lot of the credit for moving the geosciences to where they are now, where they are predictive, integrative, and really leading the sciences at looking at the impact of six or eight or however many billion of us there are on the planet. So from a historical perspective, this field -- the geosciences have really transformed physics. It's pretty much the same. I mean, you know, we have different theories. We have string theory. We didn't have a string theory 150 years ago, but physics was still kind of basically the same.

 But geosciences are completely transformed. You wouldn't recognize, you know, a geologist from the 19th century would be pretty much -- wouldn't understand most of what we do. So much of it is computational. The geosciences have led in using computations to make successful quantitative predictions about how the parts of the earth's system really changed. It's actually very rare. I mean, astronomers have been able to do it, because they have [unintelligible] things, but you know, it's very rare to be able to make good quantitative predictions and yet that's -- now we've expanded it beyond the weather to a whole broader spaceship. So I -- I don't know if this helps or not, but a historical perspective might be of some use.

 DR. HORNBERGER: Dave Schimel.

 DR. SCHIMEL: So I think that there are several very concrete things that the directorate has done that are bindings, and I -- you know, I tend to think in these two areas. The first is integration of the earth's system using observations with EarthCube and the, you know, really very comprehensive refresh of the facilities as a component of that. And, you know, one of the things that really struck me is, although the facilities have divisional homes, they're not really very divisional anymore. So one of the big applications of Deep Ocean drilling is climate. And there are many more of those kinds of stories. So, observations flowing into a real earth system archived by EarthCube is a way of binding together the data collection and data analysis efforts through data integration across the field. And then earth system modeling is the other binding, where the earth system modeling enterprise actually pulls together all of the -- increasingly all of the divisions within the directorate and science from many other parts of the foundation as well. And so the one is the observational integration of our knowledge with EarthCube being the sort of, you know, programmatic representation of that and then Earth system modeling is more of the theoretical and computational integration of our knowledge. Somebody in our group called it a monument to our knowledge. You know, models are, amongst other things, a monument to our increased knowledge. Thank you for that. And those two activities really pull together and bind the different programs within the directorate in, I think, very tangible ways. And those are both areas where the programmatic landscape looks totally different from four years ago. You know, with much more of a focus on integration exclusively across the -- literally tens of thousands individual activities.

 DR. HORNBERGER: Norine.

 DR. NOONAN: So binding seems so binding.

 [laughter]

 It seems so rope-like.

 [laughter]

 I guess, I mean, I think, Tim, that I want to go back to what Orlando said about having -- that what makes institutions strong, I think, is their core values and the things that they would do when no one is paying them, okay? I mean, this is -- what would you do when no one pays you to do it? I take that from Jim Collins' book. So to me, I think, in framing this, I see this as a set of layers, both beginning at the bottom up from intra-divisional all the way up through the layers of international activity. But, to me, the thing that holds the geosciences together through GeoVision are the -- that set of scientific questions, which is really your grand challenges. Because that's what you would do if nobody was paying you. Those would be interesting no matter whether or not, I think -- no matter whether or not you actually got paid. One probably couldn't do it without getting paid, but let's set that aside for the moment. But those are the most interesting questions that would intrigue people whether or not they got paid to do the work. So I think along with your operating principles, and your operating principles are essentially that part of your core values which allows you to carry out these scientific questions like collaboration and human capital development and infrastructure, providing infrastructure, essentially enable GEO, as a directorate, but more importantly NSF, I think, to leverage what you all -- what geosciences is doing into a much broader national context of what is it? You -- MALE SPEAKER: Use inspired.

 DR. NOONAN: -- use inspired. Thank you. Use inspired science, which does in fact impact real people in real settings. So if I were going to pursue anything about -- or if I was going to say anything about geosciences I would probably have anchored -- anchor whatever I was going to say in those scientific questions, because they're what -- independent of however you choose to attack them, that is what is most important to the, at least by consensus, I guess generally, what seem to be the most important things that people want to know. What needs to be known.

 DR. LOZIER: Yeah, this is actually very interesting to hear everybody's perspective, because what I was thinking follows on a little bit from what Norine was saying, in that I'm not sure if it's a four-year horizon, but it seems as over the past decade, geosciences along with the other fields in the sciences, realized that we need to be more societally relevant because of the, you know, just in general, the cost associated with everything. And so because of that then we've moved toward where we're interested in hazards, sustainability, climate modeling, all these things, and when you do that you realize that nothing's local anymore and nothing's simple. And if nothing's local, then you start looking for sort of the connectedness, you know, with the international partners. If nothing's simple then you break down the disciplinary barriers. And so when we start dealing with these societally relevant issues, I think that -- the approach of having a very disciplined based approach, U.S.-based approach no longer is adequate. So in large part, to me, we've been moving in this direction of the international collaborations, interdisciplinarity, because we've been pushed out of our sort of disciplinary niches by, I think, a really, you know, need to address things that are societally relevant or, you know, talk about knowledge in the services society. And that, to me, has been a driver, and so then if we need to observe more, you know, we necessarily need to involve, you know, others in that effort.

 DR. WALTER ROBINSON: Yeah, I don't know. I'm not sure we were pushed out, Susan. I think we sort of -- with a lot of internal motivation, you know, I go back to -- I don't think it was a mistake, although I think he was working for NASA at the time and then when Francis Bretherton came up with the Bretherton Diagram it was after being an NCAR director. [laughs]

 DR. LOZIER: Maybe we were pulled out, maybe not pushed.

 DR. WALTER ROBINSON: Or pulled ourselves out or realized a lot -- a lot came out, you know, I mean, yeah.

 DR. LOZIER: Yeah, excuse me. Yeah, if I used that language. I guess what I'm saying is I think it's been a real plus that we are really talking now about societally relevant problems. And so I think that's given us a lot of opportunities, not just to sell our science. I don't mean it that way. I think it's given us a lot of opportunities to look across disciplines and look for international partners.

 DR. HORNBERGER: So I think that this is quite an interesting question that Tim has posed for us. We don't have to think that we have answered it all right now. I think that it deserves some additional thought on the part of as many of us who care to weigh in, and Tim would be glad to either talk about it over dinner, but not only that, also I think hear suggestions, because one of the really important things is a month he has to give this presentation, and it would be nice if he had some new ideas on the nature of this integration.

 DR. KILLEEN: Yeah. These are all great comments. I think I particularly like some of the, you know, the bindings and some of the historical where we come from, yeah. I do a little French. I'm with the French. But Latin, my grandfather was a Latin teacher and "quo vadis?" where are you going to go and then "unde venis?" where did you come from is the counterpart of that. I think we know more about where we came from than -- but being pulled out of our comfort zone, which is what I think maybe you're implying, too, is a -- is not a bad thing to be asked to do. So this is all great. I've -- I hope other people have taken notes, but maybe you'll see next time little echoes of some of this conversation in what we come forward with, but very helpful. Thank you.

 DR. ORLANDO TAYLOR: I was thinking, if I could. I was thinking when I was hearing the last comment from Susan, about Donald's comment earlier today, about perhaps being pulled, I'm probably paraphrasing this not quite the way you said it, but basic science questions that are independent -- I think you said this -- from whether it's societally relevant or not, you raised that. And I was thinking when you were speaking that we can't answer the societal questions without the basic science questions, so they become integrated. They cannot be pulled apart. And so it's that integration of basic science with societal relevance that makes all of this worth doing when we weren't even being paid for it, Norine.

 DR. NOONAN: That's great.

 DR. KILLEEN: That's great.

 DR. ORLANDO TAYLOR: It's not a dichotomy.

 DR. NOONAN: Correct. And I think it goes to my three questions, which I always ask, you know, my people when they come to me with initiatives. My three questions are so what, who cares, why bother? And --

 DR. WALTER ROBINSON: That's one question.

 DR. NOONAN: No, it's three. So what, question mark. Who cares, question mark. Why bother, question mark. [laughter]

 Although you can say it all in one sentence. And I think that always pushes me when I'm asked those questions to be able to say not only why is this important in its intrinsic -- for its intrinsic value, but why is it important in a broader context? Why will people care about it? And that gives me the answer to why bother. Okay? So, you know, those are the three questions that my deans are so sick of hearing, but it -- I think it isn't a dichotomy. I agree with you. I don't -- and I think if we make it a dichotomy it's a false one.

 DR. ORLANDO TAYLOR: [affirmative]

 DR. HORNBERGER: Peggy.

 DR. DELANEY: I think there's another unifying thing and if you think about the fact that Brian Taylor and I have spent probably, you could count them, but countless hours in meeting rooms together over the past couple of decades, it's the -- It is. We don't do the same thing. Right? Even within the ocean sciences world we don't do the same thing. Within geosciences we don't do the same thing, but the need for complex facilities that need to be run by a major agency like NSF has pulled together a wide range of scientists into talking to each other about their science, about the priorities, about -- and I think ocean observatories will do the same thing. Physical oceanographers and biologic oceanographers will no longer get to pretend that they are different kinds of scientists. They will have to talk about what are they doing, How does it integrate, how do you communicate with the atmospheric scientists? And the drilling part is another great example of pulling the microbiologists in to the deep biosphere. You know, a few experiments here and there over the years and they are -- because the facility allows you to get samples, data, and measurements you couldn't get any other way, it unifies a broad array of geoscientists, and I think it forces you to think across what might seem otherwise like disciplinary boundaries.

 DR. HORNBERGER: So, I'd actually like to call it a day so that we have at least 18 minutes before 6:00. [laughs] So we can decompress for 18 minutes before that first drink. Okay? So let's break and, you know, see at least most of -- most everybody over at the restaurant.

 [Whereupon, at 5:43 p.m., the meeting was concluded, and the Advisory Committee for Geosciences meeting was adjourned.]

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ADVISORY COMMITTEE FOR GEOSCIENCES

 ADVISORY COMMITTEE MEETING

 April 19, 2012

 8:30 A.M.

 National Science Foundation

 Room 1235

 4201 Wilson Boulevard

 Arlington, Virginia 22230

 P A R T I C I P A N T S

COMMITTEE MEMBERS PRESENT:

Dr. George M. Hornberger, Acting Chairman

Dr. M. Lee Allison

Ms. Vicki Arroyo

Dr. Daniel N. Baker

Dr. Jillian Banfield

Dr. Mary C. Barth

Dr. Margaret L. Delaney

Dr. Donald J. DePaolo

Dr. Scott C. Doney (via phone)

Dr. Karen M. Fischer

Dr. M. Susan Lozier

Dr. Norine Noonan

Dr. Walter A. Robinson

Dr. Roberta L. Rudnick

Dr. David S. Schimel

Dr. John T. Snow

Dr. Harlan Spence

Dr. Brian Taylor

Dr. Orlando Taylor (via phone)

Dr. Joseph A. Whittaker

SPEAKERS PRESENT:

Dr. Bob Houtman, GEO

Dr. Sylvia James, Deputy Director, DRL/EHR

Dr. Farnam Jahanian, Assistant Director, CISE

Dr. Craig Robinson, GEO

Dr. Maria Uhle, GEO

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 P R O C E E D I N G S

Division Subcommittee Reports

 DR. HORNBERGER: Good morning. Ready for day two. Melissa asked me to remind everyone to sign in, otherwise she will be very unhappy.

 [laughter]

 DR. HORNBERGER: So, you -- that’s fair warning. Okay, we’re going to start off this morning with our reports back from the subcommittees, and I think what we’ll do -- let’s go in alphabetical order. VTP, EAR, and OCE? Yes, there’s somebody on the phone.

 DR. DONEY: Scott Doney.

 DR. HORNBERGER: Scott. Scott Doney, right. So, let’s see. Who’s AGP? That you, Walter?

 DR. WALTER ROBINSON: Well, this is going to be an informal report and constrained by my ability to read my notes, but we -- actually it was a really informative meeting and I thank the AGS program officer and Michael for coming and getting good discussions about things, and I’m going to be brief, but I’ll be a little less brief on the things from which we had the most discussion, I think is most productive. We’ve heard about budgets and the bottom line there, I won’t go into figures --

 DR. HORNBERGER: Walter, just a second. Scott, we’re getting some noise across the phone. Perhaps you could mute your end?

 DR. DONEY: My end is muted. It’s coming from your end.

 DR. HORNBERGER: Oh, thank you. That’s right, dial M for murder is what they got.

 [laughter]

 DR. WALTER ROBINSON: Budgets, without going into figures -- somebody take it out of infrastructure extensively fit into core, but that core really, as it was explained to us, is going into the One NSF initiatives. So, the core program is at the -- as a conventionally thought of, are not really getting an increase, except to the extent, of course, that the core programs are participating and their PIs would benefit from the One NSF and issues, and I think I’ll just leave it at that. Some feeling that the AGS community did not take advantage of the creative opportunity to the extent it could, and that’s going to be an issue for us to communicate us and probably the division to communicate to the community, to bring up more -- certainly there are ideas out there, but they have to be brought forward.

 Okay, one of the very positive things we heard about is long-term [inaudible] in terms [laughter]. This is going to be challenging, yes. Okay. Well, I’ll just soldier on. Okay. I was actually interested to see and pleased to see sort of engaging program officers and long-term budget planning, you know, of fiscal years ‘14 through ‘16, so that when the quick turnaround comes, the agility is there to come up with good ideas and be ready, and I was struck by that, because we’re doing exactly the same thing at the university. So, turnarounds from the higher ups really is quick and you have to be ready with your ideas thought out and discussed in advance. And this also involves coordination with NCAR, to have discussions with them, with the program officers -- and you can correct me if I misrepresent this, Michael -- before the annual budget review ends. So, it’s pre-ABR process, to use the jargon.

 Okay, moving ahead quickly, we heard about the A-10. This is a storm-penetrating aircraft project. There are going to be two airframes, one of which will -- this is a -- NSF will -- the planes will be operated by surplus military. Scientific management will be a grant or contract process, but there are going to be two airframes, one of which is a source of spare parts for the operational one. And this is bringing back a storm penetrating aircraft capability that has been lacking now. It’s over decades. I don’t think we’ve had it in this century. A couple of other things they were working on are leadership development. They’ve had a couple of workshops, one on transformational leadership. These are lunch time things, Michael, and one on unconscious bias that were felt to be productive.

 Okay, moving along, we heard about Arecibo, the management of that facility -- and that’s the radio, telescope, radar in Puerto Rico -- has transitioned from Cornell to SRI. Astronomy, which was the lead funder that is ramping down, I’m not phasing out completely, but ramping down to 40 percent of what they were providing previously. AGS is coming up from two million to four million, and there’s also money coming from NASA, and that money is actually -- NASA’s interest is in planetary work. So, there was a workshop very recently. We heard about -- the total sum of money is still less than it was before. So, how do you keep the facility operating and productive, and their ideas about building on the education activities, which are already active, discussed upfront, perhaps developing a science and technology center proposal, more international involvements, an international consortium, the potentials for commercialization, and, yeah. And the other thing I guess is also trying to manage the facility more efficiently. So, that was Arecibo.

 Let’s see, okay, NCAR -- reviews recently about the science and the management, generally positive review. The most recent one was the management, positive review of the management of NCAR by UCAR. The success, obviously, well, presumably, it’s about to open of the Wyoming center, and some discussion at this meeting, it just was raised as an open issue of the extent of which the operational community, the operational forecasting community -- so, NOAA would be an example -- and the private sector in atmospheric sciences should be broadened to have a more direct and active role in the management of NCAR, and there are felt to be pros and cons of this, and that’s still under discussion.

 Okay. So, the thing I’m going to try to be, continue to be reasonably brief, but really, I think the key -- the thing we spent the most time on was a recent program officer retreat -- was aimed at this idea to have this long-term -- where investments should be made over the coming few years, we’re talking fiscal years ‘14 to ‘16, and later within the core, and within and beyond the core programs. So, there were a number of ideas raised, which we had a lot of discussion about, one is hazards and hazards SEES, and we had a lot of discussion about [inaudible] continue here about, if you want to engage -- if the goal is to make a science useful to people, is the most effective way to do that, to engage the social scientists, academic social scientists? You certainly need partnerships outside the atmospheric and geospace sciences, but are the most productive partnerships necessarily with academic social sciences? And this led into a general discussion we came back to later, and I’ll mention it now, about if you want to have a project, an initiative that engages in hazards research of -- certainly there are hazards out in this directorate outside of AGS, do you want to do that through a rather, a solicitation? Solicitations tend to get long and prescriptive, as we discussed, or can this have been made open ended, creating opportunities through the mechanisms like “Dear Colleague” letters, in which you’ve allow us the best ideas to bubble up.

One of the emphasis, and I think in a number of these things, is the NSF investment in these areas isn’t just an NSF investment like we’ve seen in a lot of SEES, can catalyze investments from other agencies.

 Okay, other topics that were discussed: geoengineering, and that’s intentional geoengineering, was discussed as a possible area of investment.

 DR. KILLEEN: Can I just ask, before you move on, you raised the question whether it was going with academic social scientists is the best path. And it seems like the implicit answer was no?

 DR. WALTER ROBINSON: Well, I think the feeling was that should not be the exclusive path, yeah. So, we -- you know, we’re not ready to -- the discussion was that the social science -- academic social scientists are interested in social science research, of course, and if you’re goal is to demonstrate that scientific capability is useful, you might want to partner with a communicator or something. John mentioned mass communication. You might want to partner with managers, people you actually might want to partner, but the actual decision makers and stakeholders directly, rather than through academic social sciences. So, it wasn’t intended to dis social sciences. [laughter] Geoengineering came up, and I have to be careful about summarizing the committee’s -- subcommittee’s view, and putting too much of my own in it, but there would certainly be some questions -- possible risks to NSF, and actually explicitly raising geoengineering, and solicitations and opportunities. So, that’s a step that would have to be taken carefully.

 One of the topics that was mentioned for an area of investment, which is aerosols and atom particles, and if you pursue research in that area, that would certainly have an impact on many of the ideas for geoengineering. So, you can sort of back into geoengineering. It might be advisable to do that. Talked about CubeSats and Nanosats. It’s been a very successful program so far. Built a lot of excitement. The funded projects have been in the geospace science, the -- what I used to call upper atmosphere side of the atmospheric sciences. It’s felt that there are certainly opportunities to move down into a lower atmosphere, into other parts of the earth system with the CubeSats. And we even discussed the idea of generalizing the CubeSat idea to a small, relatively inexpensive sensory development. So, getting academic institution students involved in the sensory development, they might -- it’s very exciting when they go into space, but that’s not the only way to deploy a center, to get that excitement. So, maybe it’s a possibility for generalizing that.

 Other areas, I mentioned aerosols and atom particles. I think we agree, that’s an interesting area. We didn’t really discuss that very much. Earth system prediction did have some discussion about predictability and prediction, and what the best approaches are for that, and I don’t think we reached any conclusions, but that’s certainly an interesting area for investment. Again, personalizing this, I think you want to have some paths that are not exclusively, again, the path of developing the bigger and better model, but there are other approaches out there, and interesting ones that might involve collaborations with people like mathematicians, and so on.

 And the last topics was suggested for investment was the impacts of energy production on the atmosphere in climate such as domestic mass production, and fracking.

 Let’s see, and I’ve talked about hazards already, a little -- and I think I’ll stop there, and take any questions, and probably the best answered by other people.

 DR. HORNBERGER: Thanks, Walter.

 DR. WALTER ROBINSON: They can be directed to me anyway.

 DR. HORNBERGER: Other comments or questions? Okay, good.

 DR. KILLEEN: Can I ask just a question clarification? The active engagement --

 MALE SPEAKER: Can you talk with the mic?

 DR. KILLEEN: -- the active engagement of nontraditional partners in NCAR matters, what was the -- did the subcommittee discuss that or just touch on it?

 DR. WALTER ROBINSON: Well, we didn’t discuss it. I think, and again, other people in the room should chime in. Let me get back to my page in my notes. I think there was some discussion organizationally how you would do it and the feeling that the UCAR board of directors would possibly not be the best way to do that; and of course, the UCAR board has already had in the past, people from these other sectors. There was discussion about how you would engage with people from other federal agencies. There are some -- people are constrained. But these -- given that the NCAR is our national center for atmospheric research, and is an ever growing interest from, obviously from the operational side, but also from the private sector, increasingly from the private sector, and the atmospheric sciences, and therefore, and what NCAR does, maybe it’s appropriate for them -- for participation management. I don’t we reached any conclusion on it and the person who raised the issue -- is Steve Nelson here? [laughter] Okay. That was something he just brought up. It hadn’t been raised as an issue.

 DR. KILLEEN: I have another question, I guess I -- just some of the things you listed, like hazards, earth system prediction, geoengineering, energy production are not sort of canonically core activities of AGS, I would say. So, they could be seen or construed as being more in the directed research arena than perhaps in the core research arena, and yet, you started out worried about the health of the core versus the sort of SEES investments. I’m wondering if there’s some tension there, or some clarification of that discussion might be helpful.

 DR. WALTER ROBINSON: Right. Well, I mean that core directed tension is perennial, as you certainly know. And the core was, you know, as you know, of course, the core was protected this year. I think the reason I mentioned that some of those things had showed up in the core, the research budget, we’re not actually going back to the core, because that’s something that Michael had brought up, so that the community doesn’t think, wow, the core programs have expanded and there’s a lot more money in the core. In terms of these directions versus core programs and the planning, I’m going to defer to Michael, who was, of course, present at the program officers retreat.

 DR. MORGAN: Great. So, the ideas that were presented of the program officer retreat, obviously became represented a partial synthesis of the idea is that program officers have brought forward the ideas. We’ve presented these as ideas that we thought could benefit broadly Geo, but certainly felt that AGS could play a central role in either leading or certainly -- we know our community would be able to be engaged in those pretty effectively, and so, that’s why we brought those over. But even with the geoengineering, we already do accept and fund some proposals that are related to geoengineering, through climate large scale dynamics. It’s a limited number, but there’s an anticipation that there may be some growth or pressure in that area at times, and so, certainly that would benefit the core area program that might allow for that, but we have to think carefully about how we actually formulate that. Hazards is just restating the idea that we think hazards in ‘13 is great, but we think we could continue to do that for the next several years, and this is certainly opportunity. Among all of the SEES activities we’ve had thus far, I think for the geospace section, this is a great place where they could certainly play a significant role, and so, we put that forward.

 And some of the other things like the aerosols and atom particles is an interest across the board, in all the sections -- in all the programs within the atmospheric section, and so that is a significant area of potential for investment. Seeing growing interest in that, in the community. Space-based sensors or broadly just sensors in general: Again, that’s something that we think benefits the atmospheric science community, but could be something that could be NSF wide, and we would certainly support that.

 So, they do link -- they have close links to the core programs, but -- and you could imagine RPIs that we’re funding now in the core programs, or those programs that discover the linkages within an individual program. We think we could expand that out very easily and have -- see a community ready to be engaged in those activities.

 DR. HORNBERGER: Okay. We have Orlando and then Brian, and then David.

 DR. ORLANDO TAYLOR: Just a word about social science research. In fact, I think the point is regarding for sake of -- you didn’t quite say it like this, but I think you were suggesting when you referred to outside the university or outside the social sciences service community, perhaps more of an emphasis on the practitioner side, right? And so, the point I want to raise is that because of the great diversity of the society, I think we want -- we don’t want to go too far away from recognizing the important research underbelly for that. So, that, for example, you mention mass communication. If crafting messages that could be responsive to the very diverse segment of the population -- segments of the population, good social science research or mass communication research would be essential in my view, to make certain that those messages really reach the appropriate targeted audiences in a way that perhaps a one-size-fits-all model would not do. So, some kind of a marriage between the practitioner, if you will, and the social science researcher would be critical.

 DR. WALTER ROBINSON: Yeah, I agree, and the other thing, which I neglected to mention, is an important link for the hazards is -- links to engineering are absolutely critical, and I meant to mention that, and failed to.

 DR. HORNBERGER: Brian.

 DR. BRIAN TAYLOR: So, yeah. I want to follow up on this because I think Walter has put his finger on a huge issue, not just for the AGS, but in fact, obviously, ocean and earth as well. I mean this is an ACG-wide issue. And of all of the -- well, of the many SEES initiatives, I think there’s a huge community in universities waiting for what was going to be [unintelligible], which is now going to be hazards SEES, I guess, because it affects all of our disciplines, I mean earth, ocean, atmosphere. There’s just, you know, there’s a whole lot of guns ready to be fired, and depends on what the target is, and so, the discussions that are happening inside NSF at the moment about how that solicitation is going to be crafted, which is Walter’s, you know, point, is really important, and as different directorates have repositioned themselves and now come in to be supportive of that initiative, it’s changing arguably, maybe changing the proportionality and the emphasis of where that solicitation is going to go. So -- and even relative to the steering committee, who I will say had a very strong social science co-chair, and was quite descriptive in what we’ve written. So, if this is a moving target, and frankly, the geoscience community at the universities is sort of wondering what’s happening, and I don’t know if we can get any feedback here, because they’re concerned as to know how this is going. Certainly, the geosciences community see this as theirs. I mean they want to be driving this thing up, sort of riding along in the saddle car, and so, you know, I put that to you, Tim. I don’t know how you’re going to marshal the subtleties of different people wanting to be in the driver’s seat.

 MALE SPEAKER: Safety?

 [laughter]

 DR. KILLEEN: I guess everybody in a university campus is probably sort of recognizing the sort of things that you’re talking about. I think, you know, NSF generally works through these issues with a lot of discussion and cordiality, and geniality. It does come down to the investment scenario in the long run. So, if Geo, as we are behind, as you’ve seen from AGS, this kind of emphasis area, and we commit resources to that, then we should have a very strong voice on what it looks like to our community. So, that’s the way that works.

 DR. BRIAN TAYLOR: Just to follow, I mean do you -- you know, Walter was pitching a scenario where the solicitation or whatever form it comes out in, isn’t so prescriptive as to force people to be inclusive of aspects if they don’t necessarily want to do, and that’s a non-trivial issue. So, for example, if you have to have, you know, the combination of social sciences, engineering, and MPS, and Geo, that’s a different looking proposal than if you really want to go after one aspect that is very Geo, and a couple of the little friends. So, how you prescribe that is a big deal.

 DR. HORNBERGER: David.

 DR. SCHIMEL: I got to -- I think expand on the same issue in two different ways. Our discussion, I think, of social science was a little bit more nuanced than has come across, now. What we really discussed was the fact that there are academic social scientists who are fundamentally interested in understanding human systems in the same way that more academic natural scientists are, but within the university and allied community, there are also people who are interested in translating academic knowledge into societally useful information in a variety of ways, and some of those people are within academia, and some of them are partners of academia, and that however this program is framed it should recognize that their legitimate roles for both the development of fundamental understanding about how human and natural systems interact, and the translation of that knowledge into usable policy recommendation, innovation for society. And that I think it’s a common problem that natural scientists don’t recognize, that the social structure of the social sciences in its diversity. And I think that in that mix, in that second category of scientists who are interested in the translational activities, engineering plays a very prominent role, and in some cases, is almost indistinguishable from social science. We discuss the example of the interaction of hazard warnings with highway traffic conditions where social scientists, psychologists, and engineers work together very closely. And I think that the sense of our sub-committee was that however this opportunity is framed, it’s vital to the scientific future of the geosciences, and AGS, obviously in particular, and that there should be enough flexibility that a creative group of investigators can identify the most crucial problem, whether it lies more at the natural science end of the spectrum, right at the interface, or on the social science end of the spectrum. And I think this is going to the point that Brian just made, that, you know, implicitly requiring some sort of balance across that spectrum could eliminate or reduce the opportunity to really put direct resources to the largest unknown, wherever it lies on the spectrum, from natural phenomena to human action. I don’t think that should be taken as implying that the project should emphasize the earth sciences, although in some sense, that’s an investment with a decision that you guys are going to have to make, but that there should be an opportunity for the creativity and the innovation of the PIs to be focused on the hardest problem, the one that really requires research to solve. And, you know, and we’ve seen solicitations that were, frankly, a little ham-handed in terms of how they described how projects ought to be organized in ways that PIs then have to work around in effect. And so, I think that at least the subcommittee viewed the hazards area, has really been, you know, this is a huge opportunity and a very high payoff area for the directorate to show leadership in. But even the crafting of the solicitation should enable what I think we all agree is a large group of engaged PIs that really want to do the right thing, to do it the right way.

 DR. HORNBERGER: Thanks, David. I think we need to move on. This is an interesting discussion and I think as these folks have indicated, it transcends AGS. It’s a Geo issue. EAR, Don.

 DR. DEPAOLO: Sorry. We heard presentations from four of the NSF staff, Jun Abrajano gave us an overview of the state of EAR. Paul Cutler talked about strategic planning. Enriqueta Barrera talked about the Critical Zone Observatory Program, and recent review, and some plans for that. And then Greg Anderson talked about EarthScope. So, just going through them quickly, Jun’s summary -- my summary of Jun’s summary of the state of the EAR is that we have a lot to be excited about, but the budget is not one of those things.

 [laughter]

 DR. DEPAOLO: So, we got a little -- a few details about the budget and the thing that stood out, was of course, some of the facilities. In particular, IRIS was going to get a bit of a cut, and then there was some questions about why that came out to be and what the rationale was behind that. I think we sort of got that picture last night at the bar, talking to Tim, and -- but it was a complicated process, as usual, and I think it was -- I’m not going to try to reexplain it. With regard to challenges in the section, they are the things that we’ve heard about before; balancing fundamental sort of individual disciplinary research with interdisciplinary, the workload that is growing for the NSF staff, support for mid-sized infrastructure, and then sustaining large data initiatives. And also, now that there is a new report, this NROSE [spelled phonetically] report, and also, some other ones that have come out fairly recently, integrating those with plans for the programs in the near future.

 So, if you’re going actually straight on from that to the strategic planning that Paul Cutler talked about, they had a February retreat, basically in the wake of the NROSE report, and probably, I mean the most interesting thing that we sort of picked up on was that overall and, you know, tell me if I’m stating this too strongly, that there was a little bit of disappointment with the NROSE report, because some of the things that were viewed as really sort of breaking state of the art areas weren’t covered very strongly in the report. And some things like education, linkages to engineering, and international connections, and even infrastructure weren’t really sort of worked in there in a very strong way. So, this is not - we viewed as a huge problem, because there’s a lot of other reports that cover these things, and so, if you take the sort of array of reports that have been generated over the last two or three years, I think many of these things are covered. But anyway, that was something that we thought was an interesting outcome, and so that will mean that the NROSE report by itself probably won’t be adequate to make a very good template for thinking about how to move forward with the program evolution.

 And then this strategic planning exercise is going into the next stage, which is to develop priorities for Geo in the EAR area, in the FY ’14 following timeframe, but as far as we could tell, this hasn’t gone very far, yet.

 So, on the Critical Zone Observatory Program, Enriqueta talked a little bit about this, actually was very interesting presentation. The NROSE report did recommend continued EAR support for programs focused on integrative studies, and of course, there was a review of the CZO program that was sponsored by this committee recently, and that came out mostly very positive. They were impresses by the real interdisciplinary work that was being done, and they recommend maintaining the current observatories, and strengthening their connections to each other, and also recommended that there be separate funding pathways for critical zone research, so that all research doesn’t have to go through existing CZOs. And I’m not sure that I got all the details at the end, but it seems like there’s -- Enriqueta has worked out a plan for recompleting CZOs in the near future. I don’t remember whether it was 2013 or later than that.

 So anyway, that program, I got the impression, was doing very well, and largely, I mean, a large part of that has to do with the people who are running CZOs, doing a very conscientious job, and they’ve now set up a coordinating office that will be at Penn State, and a steering committee, and there will be an annual meeting and site visits, and so they look like they’re preparing to have this program have a lifetime, substantial lifetime, could be well organized.

 Greg Anderson then moved on to EarthScope. His point was overall it’s operating very well, but there’s a couple of things that have to be addressed in the near future. One of them was what to do with the safe SAFOD Observatory. As we discussed in a meeting a couple of times ago, one of the objectives of SAFOD was to have a long lived down haul observatory near the San Andreas Fault. That didn’t quite work out because the instruments didn’t last very long after they put them in the haul. But what to do about that has not been fully worked out yet, because not only is it a technical challenge, but it’s a funding challenge, and the idea is that will be worked out, but this is going to be a multiyear effort to figure out how to do it, and how to fund it. And it will probably involve some rescoping, looking for new management of the facility, probably an RFP, and so on, but that’s going to take some time.

 And then the other thing that I thought was quite interesting is the future of Iris and UNAVCO relative to EarthScope, and apparently, if I got the message right, there is a plan to do some kind of integration of the seismology and of the geodesy in about a year. And Greg was pretty sanguine about the, you know, ability to do this. I thought that it raised a number of questions that were kind of interesting since one -- two of those programs are in one part of the EAR structure, and then the rest are in the EarthScope program, and something might have to change, obviously, in the future. But I think it’s the right thing to do. It seems like the right thing to do, though it should be coordinated in the long term. And Greg mentioned that there was a little bit of concern, because EarthScope was supposed to have a lifetime of 15 years. It still has five or six years to go yet, and this reorganization was going to happen, you know, five years in advance of the sort of end of the EarthScope tenure.

 So overall, we saw a number of issues that were raised that we thought were kind of interesting, that would have to be kind of worked with over the next year or two.

 DR. HORNBERGER: Thanks, Don. Questions? Comments? Comments from any others?

 DR. KILLEEN: I don’t see Greg, but maybe he’s there somewhere. Just a point of clarification, the conversion strategy is a multiyear strategy. It’s not an instantaneous strategy. So, it’s quite consistent with the scope. Greg, do you want to comment on that?

 I just didn’t want to let the committee feel that there’s a parentary disruptive merger happening has not been thought through.

 DR. ANDERSON: Yeah, so, Don, the plan, as we were talking about yesterday. It’s been developed over -- it took about a year to develop and then present it to the National Science Board, back in 2009. It’s intended to be a very deliberate process, to bring together the management of what is now the core facilities that IRIS manages with the U.S. array of seismic part of EarthScope, through one coordinated proposal that would then cover the activities, and while all of those parts of those facilities in one managing entity, that proposal coming to us from IRIS. And then the geodetic part of EarthScope, PVO being brought forward in an integrative way, with the current core facilities that IRIS -- I’m sorry, that UNAVCO manages -- again, under one cooperative agreement. That plan’s been, as I said, been described a number of times to the science board, and it’s really trying to go down the middle between the guidance that the board has given, that periodically, large facilities should be recompeted, regardless of how well they’re operating, regardless of how well or poorly things are going, periodically, for the health of the facility and the health of the community and the health of the science, encourage us to do a recompetition. And as you say, the idea would have been -- that recompetition would have been coming up here fairly shortly at a time period where it would have been critical to continue, if EarthScope is to continue until 2018, which is the plan, and the science board has said that twice, at a time that it would have been very difficult to keep that going without the larger facilities that IRIS and UNAVCO currently manage. So, it was an attempt to address the science board’s guidance while minimizing the disruption to EarthScope operations, sort of take that fine line.

 There are a number of issues that need to be worked out. How it is managed internally, we know that now. I will be the program officer that will oversee the review process for the IRIS proposal, and if it’s an award, for the IRIS award. Russ Kelz will be the program officer who will oversee the review process for the UNAVCO proposal, and if there’s an award, the UNAVCO award. It is true that right now, that is we have two EarthScope awards that I’m the program officer for. We have the UNAVCO Core Award that Russ is the program officer for, and we have the IRIS Core Award, that Dave Lambert is the program officer for. That’s part of the reason behind this, but right now, we have four awards with three program officers. We will be moving to two awards and two program officers. So, it minimizes management issues that we have to deal with here, streamlines the internal process for us. It doesn’t necessarily require that either award be moved either into or out of IF, or EarthScope. They can be managed jointly across the programs, because we co-fund awards all the time. So, it’s entirely possible that we could have me; I have my EarthScope hat, I have my [unintelligible] hat and, as with many other program officers, lots of other hats. But the money that I oversee right now through EarthScope, there may be some of the funding that goes to IRIS and some of the funding that goes to UNAVCO, would continue to live inside in the budget a nominal Earthscope line, that would be co-funded with money that lives in the budget, in a nominal IF line.

 The activities would be done in an integrated fashion, regardless of how the dollars actually are divvied up inside NSF pots. It’s not an issue to co-fund that. It actually streamlines things along for us.

 DR. HORNBERGER: That’s great. Walter, and then Lee.

 DR. WALTER ROBINSON: Yeah, this is just probably just displaying my ignorance, but UNAVCO has had involved in their activities atmospheric sensing as well, and there have been these discussions, and I was just wondering where that stood, and how that fits -- how the atmospheric part fits in with what we’ve just heard about, and what that’s going to be like going forward.

 DR. ANDERSON: Sure. Right now there are over 200 PVO stations that have metrologic sensors installed at the station, and so -- we used to call them tiki torches, because that’s exactly what they look like. There’s a metpack [spelled phonetically] that sits on a post. It’s attached directly to the back of a PBS receiver. That data flows into the system just like any other data that come into the PVO dataflow system. So, there’s no -- effectively no overhead that is dealt with on that. Those stations, assuming that UNAVCO isn’t making some radical change in the way they want to do things in the next proposal, will continue to operate as part of the PVO for the next five years, assuming that were to go forward. And the other stations that are not core PVO stations, but are the stations that UNAVCO manages, that also have metpacks, will continue to operate as well, unless, as I say, they decide to make a big change. Those data come in typically about every 15 minutes. They get used by the folks at UCAR and folks at the forecast systems lab, and at the severe storm centers. So, those get used quite a bit already, particularly for looking at perceptible water vapor, but also these days, they’re looking at atmospheric rivers. And in fact, NOAA has paid to upgrade a number of PVO stations in California, specifically to provide higher rate metrologic data that they can use for looking at atmospheric rivers coming in off the Pacific, so.

 MALE SPEAKER: [inaudible]

 DR. ANDERSON: Oh, sure, yeah. In COCONet, which you heard about yesterday during Tim’s talk, 50 stations that are new going into the Caribbean and each one of those has metrologic sensors as well. Part of the funding for that comes from AGS, and that is work that’s going with John Braun’s group at their cosmic center in Boulder. So, this is continuing and will continue, and it’s a nice way of leveraging investments from both sides.

 DR. HORNBERGER: Lee.

 DR. ALLISON: One of the things we heard yesterday was kind of a surprise in that OMB has sent down fairly specific instructions to reallocate $3 million a year, if I recall, of EarthScope money to kind of purchase and move those stations on to a central and U.S. separate research program, and I have not heard of OMB kind of doing these kinds of earmarks before, and I wondered how unusual that is, or unprecedented.

 DR. KILLEEN: It’s unusual, I guess. I’m not sure how unprecedented it is. It makes quite a bit of sense, because it’s looking at interagency collaboration. It’s utilizing the research base and the instrumentation base that we’ve developed at NSF for actually national security and national infrastructure protection reasons for -- the East Coast has a vulnerability and there’s a discussion with USGS in picking up the maintenance activities.

 And then we do have an augmentation in the budget. I realize that these augmentations don’t look like augmentations but based on -- relative to what happened in the summer, they feel like augmentations to people in the -- in the building. There a $3 million augmentation to cover the additional costs to EAR’s budget for -- to make this happen. Now, of course, the budget ended up where it did. So it’s -- it makes a lot a sense.

 We were consulted extensively by OMB. We went to several meetings with agency representatives, so it was not a -- not a shock. And I think it’s -- makes a lot of sense.

 DR. ALLISON: If I could follow up then. The point I reached yesterday was that this is for Central and Eastern states only. The Western states, we have already purchased many of the USRA stations state by state and created statewide networks across the Western U.S., which is more tectonically active. And yet, we’re not included in that. So I think there’s a -- there’s a disconnect here. I think all the reasons you just laid out are great. But we now have a national program that excludes the most tectonically active part of the country.

 DR. KILLEEN: That’s a very interesting comment. [laughter]

 I’m sure our EAR colleagues are thinking -- they’re writing down seriously what will come next at us. But it’s worse to protect the East Coast and it was in the wake of the big Japanese disaster where there were nuclear power reactors that were affected. So it was a response to make the U.S. more resilient on the East Coast. No question about it.

 DR. ANDERSON: An additional comment, Lee. I would point out the seismic station density map is considerably higher in the Western U.S. as well. So it does have a considerably higher seismicity, does have a considerably higher hazard -- although there are certainly hazard areas here in the East that are high as well. But it’s also got considerably higher coverage. And that may not be exactly the answer that you would hope I would say but that is true, I think.

 DR. ALLISON: And I won’t drag this out too much but I would debate that we have now for the first time a seismic network in Arizona which, until we bought the eight stations we had six analog stations around the city of Flagstaff and that was it.

 So for the first time in history, we can now detect probably any magnitude three or larger than that in Arizona, that we never had before. So, yes, in certain parts of the West, there were high densities. In other parts of the West, there have not been. So...

 DR. KILLEEN: We’ll seek a reimbursement from OMB. [laughter]

 DR. HORNBERGER: Roberta.

 DR. RUDNICK: I just wanted to make a statement and see if this is correct, but my understanding was that there would be the opportunity for community input into exactly where those stations would be deployed. Is that correct?

 DR. ANDERSON: So my understanding of the situation is there is a USGS working group that was put together. Bill Leith asked for a working group to be put together to prioritize where stations would be specifically located out of the existing TA grid of stations in the Central and Eastern U.S.

 The western limit is 105 degrees longitude. So, basically the Midwest. So, from there to the east, the idea is the stations would be picked in a way that would prioritize the science and prioritize basically hazard-critical facilities identified by the NRC, by the Department of Energy, by the Tennessee Valley Authority, by -- let’s see -- the Army Corps of Engineers and a few other groups, as well as the USGS. They put together a working group that has a lot of agency representatives but it also has -- Anne Meltzer, who’s the chair of the USRA advisory committee, and about three or four other scientists -- research scientists -- who are there to represent the research community.

 My understanding is that once that report is done, the plan is that that report will then go to the USRA advisory committee, through Anne, and that they will have a chance to comment on it further.

 And the USRA advisory committee is a committee made up of active research scientists that use the seismic data, and will be an opportunity for there to be input there. That report is due to go to me and to Bill Leith and to Anne fairly shortly, and certainly won’t necessarily be the final word but it is a prioritization model that they’ve come up with for up to 200 stations at this point.

 DR. RUDNICK: Thank you.

 DR. HORNBERGER: Okay, I think we are going to move on, and OCE is next. Who’s doing OCE?

 DR. DELANEY: I am.

 [laughter]

 DR. HORNBERGER: Okay.

 DR. DELANEY: My new super power seems to be sleeping through alarms.

 [laughter]

 I did that on the way to the airplane, too, and when you live in Santa Cruz that’s not a good idea. You have to drive to San Francisco. But, this week, who knows? I’m awake from 2:00 to 3:00 but my alarm doesn’t get me up.

 We had a very, I think, productive time with our program officers. And every time I’m here, I learn some great new budget catch phrases. And we were debating which of the two best applied to us: On the right side of flat versus approaching the cliff edge. So we were kind of debating where were we in -- as a community.

 I think one of the things we touched on yesterday resonated when Tim asked more about, step back and talk to me about geosciences because one of the things we really wanted to emphasize about OCE was the tremendous scientific excitement and accomplishments that were taking place in that area. And all of the challenges about core versus facilities and all of the kind of nuts and bolts that we can talk about, we didn’t want to obscure just the huge advances and the really exciting stuff that’s being done. And we felt that that really fit within the One NSF context and within GEO and GEO Vision, and that we also thought grappling with the tough questions that the program officers in the division were doing an excellent job standing by the community.

 And NSF is the major funding source for the community, so it really -- with the changes at ONR and other things over the years, so it’s critical to the basic and applied research in ocean sciences. The major points that we really focused on are probably no surprise for anybody, is that the balance between infrastructure costs and core sciences is a really critical question. And the division struggles mightily to make sure that the infrastructure costs don’t eat everything.

 We also thought -- and I know that this has changed so many times within NSF, that some of that look at facilities versus core will require directorate-level approach and assistance, not just the division, because I think there are bigger questions about geo sciences that these facilities tough on.

 One comment from the committee, kind of what they were hearing from people in the field was that we have the big facilities, we had healthy -- reasonably healthy single-investigator core science support but kind of midsize field programs. Three or four groups at a time might be having trouble making its way through the funding system; the things that are big but not enormous and small but not really small. And they have faced some challenges recently. We had the program officers with us we wanted -- and when we were by ourselves we wanted to commend them for their high quality of work even with the pressures that they’re facing and the kind of -- we have the same challenges, so let’s be really interdisciplinary, which can mean, let’s spend all your time in meetings and not getting your job done. And we felt like they were doing a really good job of balancing that community pull and program officer push. That’s the place where you want NSF to be: leading the community and knowing what the community wants to have done.

 And it’s interesting, I think. Tim, you had commented about the improvements -- or the changes in the workplace in GEO. And although workload issues are of importance to all the program officers, I don’t know if they’re just resigned, but they seem more cheerful and more recognizing that everyone is dealing with that and that there’s, you know --

 DR. KILLEEN: We put things in the water.

 DR. DELANEY: Yeah, we put things in the water which really helped, yeah, yeah. Really made a big difference.

 [laughter]

 No, I thought he meant we put chips in the water and so everyone was happy again.

 [laughter]

 The travel dilemma was that, you know, it’s funny the things that people think are wasteful. We wanted to emphasize the importance of program officer travel -- both for their contact and presence in the community where they can really be faces that you get to know, that you can send your young investigator off talking to right at the meeting in an informal setting, and that we thought that some of that travel was really support for IPAs.

 And we know that in our field, we really have to make it clear to people who are going to come to Washington on a rotating basis that it’s worth it to the rest of us. And being able to support their time at NSF and their transition back is an important one. And we thought the targeted use of virtual panels as part of the solution was really a good idea. And as you get rid of old dinosaurs, it’ll probably -- people will even be more used to doing that than -- yeah.

 DR. KILLEEN: Technology.

 DR. DELANEY: Yeah. You know, and -- well, yeah, no, I’m --

 [laughter]

 DR. CAVANAUGH: Technology.

 DR. DELANEY: Yeah. There’s technology. I mean, it’s -- you know, there was a line on a television show the other night when someone made a call on the cell phone and the two characters looked at each other and said: Oh, that’s right. She was born in the ’80s. She still uses her phone as a phone. Which is what my kids would say: Why are you calling me? Text me.

 So, one of the questions that came up both last time and this time is whether it’s time for the decadal survey in ocean sciences. And what we said last time, I think, still applies, which is we would really need to see the framing and focusing questions to evaluate whether it’s a good idea for NSF to be part of the push of this. We certainly have a lot of national ocean sciences reports, I think, that kind of lead from the coastal eco-zone management level or from the applied agency push. And so we would want to make sure that this really looked at the full scope of ocean sciences with a -- I don’t want to say NSF-centric but with a good focus on the issues that are important to the basic research community.

 Certainly, things that we heard as important across NSF and across GEO, like handling massive amounts of data, the operations and facilities, and cross-divisional initiatives are all part of the ocean sciences mandate. And many areas of ocean sciences, MGG has had NOAA NGDC Data Center. So questions that other fields have about, should we archive our data someplace where it’s probably available -- is expected scientist behavior in large part of our field. It’s just part of your obligation.

 And what was interesting, thinking about the decadal survey and going off what the director had said, other places now were coming up with One NOAA and One this. But also his comments were about really seeing it as one set of federal agenc9es. So again we saw that as a -- as a potential reason that it could be time for the decadal survey.

 One of the areas we wanted to talk about for our next meeting, I think, was this question of graduate student education and how are we doing on graduate student support and education in the field for a variety of career outcomes. And you know, I think there’s real positive about the attention that’s being paid to post-doc education and we just wanted to kind of -- it was especially Susan’s point, but we wanted to surface that issue for next time.

 Again, with -- we always see a lot of progress from the last meeting to this and a lot of responsiveness to the issues we’ve raised and we were really happy to see that, so...

 DR. HORNBERGER: Thank you, Peggy. Tim?

 DR. KILLEEN: You mentioned education and the graduate student process. Did COSI come up? That’s one question. And did the RCRV and the right-sizing of the fleet be discussed? And if so, what?

 DR. DELANEY: Right, we did not discuss COSI. We didn’t even come close to it. We had a lot of hot-button topics to talk about. And I don’t think -- we really didn’t get a chance to talk about the regional vessels, and one, two or three; zero, one, two or three. So...

 DR. BRIAN TAYLOR: I mean, I’d say that we -- I mean, we did take the vessel plan in the context of the facility science infrastructure core, you know, as part of the need to balance. And so it wasn’t overtly addressed as an individual topic. It was certainly subsumed under that larger question.

 DR. DELANEY: Yeah, I think the whole question of fleet right-sizing and -- I think there’s, you know, very valid concerns about the balance of regional versus global vessels and operating costs. And I think that -- yeah, we didn’t get to spend much time on that, but that’s under the facilities question.

 DR. KILLEEN: I think maybe the regional research vessels is worth a sentence or two from David because it is in the FY ’13 budget request. And it might be good for the whole committee to hear what the plan -- action plan is.

 DR. CONOVER: Well, yes, I did mention at my review yesterday that we do expect within a matter of days to release a solicitation that would be -- take the first step towards designing construction of three regional class research vessels. And this is a huge success story because it’s been a long road to get to this point. The community’s been very anxious to see this solicitation come out. We had put on an announcement over a year ago that such a solicitation was coming. And then we had to pull that off. So we’re very excited about the fact that we will take the first step towards building three new vessels.

 DR. DELANEY: Right, and I should say we had heard that very clearly from David as an area of concern that we were discussing. We took his successes as given.

 [laughter]

 That was good. Let’s talk about the problems, though.

 DR. KILLEEN: You know, that’s great, but when we talk about GEO helping out, this is a huge GEO commitment --

 DR. DELANEY: That’s enormous success, yeah.

 DR. KILLEEN: -- to oceanography. It’s a substantial three decades or more, yeah.

 DR. BRIAN TAYLOR: I would like to add, about the decadal review, and probably this is full of discussions that happened last night at dinner, I’d say the sense, David, is that we need to be convinced when -- put it another way: We’re not convinced that a decadal review necessarily at this time is a great idea.

 And the NROSE report is a perfect example of how not to get what you want. I’ll put it more strongly. Also, unlike the astronomers or NASA and some of their decadal reviews, because of the multiplicity of federal agencies vested in the ocean sciences, not only NSF and NOAA and the Navy and Army corps and many others, they’re boring me by the framing thing -- framing this to the benefit specifically of NSF. Especially given the number of things in build-outs, not only with the regional vessels and OOI and SODB and the coastal programs, in a sense, we’re doing the decadal build-out. And so having a decadal review to sort of second guess what is happening right at the moment is a somewhat strange thing.

 So I guess what I would maybe say it more strongly than we did yesterday in the meeting, is we are cautious about that -- value of that at this time. So that’s why we say when we want the framework and the questioning and the positioning, that’s s what we’re -- that’s an elaboration of what was talking about.

 DR. CONOVER: Right. I think the value of the decadal survey -- we could talk about this for hours, so I’ll just try to be very brief -- isn’t to second guess what we’ve done in the past but really to help us prioritize amongst the many initiatives that we could move forward in the future, which are the ones that are most important in the ocean sciences community. And I see its greatest value as providing input from the community to NSF and perhaps the other federal agencies, depending on how many play along, as to what are the principal priorities, how much is too much investment and infrastructure.

 I mean, I could -- we here at NSF can sit here and make these decisions without input from the community. But I would feel much more comfortable if we had a formal mechanism that on a regular -- the thing about a decadal survey is it puts you on a schedule of doing it on a regular timeframe, so that when you have all these individual reports like the NRC report on infrastructure in the year 2030, what does that feed into? It doesn’t feed into anything frankly.

 We have a lot of separate reports that deal with different aspects of what’s important in the ocean sciences but no comprehensive overview of which of those are of highest priority to the community. And we’ve had a long -- well, at the recent subcommittee in the ocean science technology meeting, we had a panel discussion including representatives from NASA and astronomy and a staffer from Congress and Susan Roberts from NRC, and we had a very interesting conversation about the pros and cons of decadal reviews in those disciplines that have a history of doing it. And no firm conclusions were reached.

 And no doubt in ocean sciences, it will become more complicated because we’re a much more diverse discipline than some of the ones that presently use a survey. But I think there’s some very valuable outcomes that we shouldn’t quickly dismiss as being important to that -- would result from a decadal survey.

 DR. HORNBERGER: Jim, do you have a follow-up? Because I have Walter next.

 DR. WHITCOMB: I’d like to strongly second what David said and I would like to sort of temper some of the discussion about the EAR report, NROSE. It’s very rare that department divisions have a chance to have an overview of the entire program and even though, you know, individual reports from specialized parts of the science are useful from the -- from the academy, it doesn’t give the overview. And to me one of the things that the NROSE report said was that there wasn’t anything obvious that we were missing. That was one of the charges that we gave to them. And I think that it was sort of a vote of confidence basically in the actions that we took on the previous academy report. And we changed our science significantly and followed the recommendations. And they didn’t t see anything that we were missing and so I think that in that sense, the report was a very useful thing, and I would second what David said that these sorts of exercises that look over the entire portfolio of a division are quite useful.

 DR. HORNBERGER: Walter.

 DR. WALTER ROBINSON: This is back to the regional vessels, goes back a year ago. A couple of us have suggested it would be good if those were viewed as GEO facilities, particularly my interest would be that they are designed as -- to be effective platform of stratospheric research. And I was wondering what had evolved in terms of designs and the plans for those vessels since -- I missed the last meeting -- the meeting a year ago.

 DR. CONOVER: Well, there hasn’t been any changes to the design so far since the last meeting because we’re been in a holding pattern. There will be -- the first step in phase one is a project refresh, so we have some preliminary designs that we worked with the Navy on. And we had a [unintelligible] committee down select which of those initial designs was the best to take forward. And the first step in the process is to take a new look and refresh that design. And I’m sure that we’ll be taking a look at what sort of atmospheric sensors are -- be able to be a part of what’s on those vessels.

 DR. HORNBERGER: Tim.

 DR. KILLEEN: Just a very quick question, Peggy. Thanks very much for the report. You mentioned the midsize field programs are having difficult and I’m just wondering if that’s related to the balance question or it’s a missing piece -- missing opportunity space that we need to think through.

 Is it -- is it just the availability of funds or is it availability of platforms or is it a missing piece of our portfolio of opportunities?

 DR. HORNBERGER: Well, Brian might comment after I do, kind of from a dean’s perspective. This was a comment from one of the subcommittee members and so I would offer it to David as something they should look at and consider. And you never know whether you’re hearing a group of people who didn’t fare well in review, saying it doesn’t work for this category of proposals or whether it really is a space that’s hard to fund because of its size. And I don’t -- I don’t think we know the answer as a subcommittee. I offer it as a word in the community as saying, hey, it’s hard if you’re trying to fund this level of program, but I don’t know the validity.

 DR. HORNBERGER: Okay. David.

 DR. BRIAN TAYLOR: It’s the sort of, you know, collaborative search amongst, say, four different universities with the groups of players and each presented a budget size and the potential for multiple paths of jeopardy in the review process. That’s what has been reported. We’re simply passing that on, not offering a judgment on the situation.

 DR. KILLEEN: Thanks.

 DR. HORNBERGER: Yeah. It’s interesting; I recalled the COV for a surfacer processes made a very similar comment -- was these middle-sized projects seem to have -- not a home.

 DR. KILLEEN: Well, the reason I ask is that --

 DR. BRIAN TAYLOR: Especially if they’re not -- that would work in the SEES context, right, because it’s targeted. But if it’s -- if it’s those type of proposals coming into a core type of panel, they’re --

 DR. KILLEEN: Yeah, yeah, well the reason I ask is there is an NSB taskforce that’s looking specifically at midsize infrastructure, midsize proposal opportunity. We’re involved in those discussions and the reports coming out so it is a topic of a lot of interest that -- at NSF.

 I will say, in defense of our ability to do things, that COCONet was an unsolicited midscale proposal, not in response to a SEES initiative, and we were able to fund it at $7 million roughly.

 MALE SPEAKER: That’s impressive.

 DR. HORNBERGER: Oh, any last comments on the --

 DR. DONEY: Oh, this is Scott. Peggy, one thing we did talked about was to give some kudos to the response to the rapid proposal process for a lot of ocean -- recent ocean events.

 DR. DELANEY: Division and the directorate hint on a wonderful job with response, for example, to the oil spill and getting people and vessels and local power in the field very quickly with a lot of work on the part of individual program officers to make that happen.

 DR. BRIAN TAYLOR: And Fukushima and --

 DR. DELANEY: And Fukushima, yes, thank you.

 DR. BRIAN TAYLOR: And Mali, you know, for the earth sciences before. I mean, generally speaking.

 DR. KILLEEN: Thank you very much for that comment. As you noticed, I started my presentation tomorrow with that very example.

 DR. DONEY: I just want to underscore that the -- our success, the rapidity with which we got out rapid awards is really a function of the great program officers that we have and all the work they did and our ships -- our ship operations office. It’s not very much the director did, frankly. It’s really what the troops did that makes that all a success.

 DR. HORNBERGER: Great, thank you, Scott.

Update on Expeditions in Education (E2)

 DR. HORNBERGER: Okay, the next item on our agenda is an update on education and diversity: expeditions in education. Who do we have?

 DR. JAMES: Good morning. My name is Sylvia James. I’m representing the director for education in human resources, and Dr. Joan Ferrini-Mundy, who’s our assistant director. And this morning, what I’d like to do is talk to you a little bit about a new activity that’s proposed in the Fiscal Year 2013 budget for EHR, specifically expeditions. And in the course of doing that, I’ll talk a little bit about some of the challenges that we’re facing in education, which I’m sure you’re familiar with, and STEM education specifically, and how this particular strategy may be one mechanism to help address some of the big challenges and issues and questions that EHR and NSF as a whole is addressing with respect to STEM education and the future STEM workforce.

 Okay, so you’re probably familiar with these particular concerns that have been compiled from trends in STEM education. What’s happening in, I’m sure, GEO sciences education is reflected across all of the STEM disciplinary areas, that we are basically not getting the influx of individuals that we need to fulfill the STEM workforce needs. We won’t have enough qualified STEM workers to fill future -- jobs in the future. We really need that influx from all areas to compete successfully in the global marketplace. Technical expertise, if we don’t have it, it’ll really jeopardize national security and national defense. And we need a strong education base for the future of societal well-being.

 Some of the challenges in STEM education and education overall are reflected on this slide. The first one -- the inconsistent use of best practices across the nation’s 14 public school districts. And when you hear that number -- 14,000 public school districts -- it’s really not surprising with that large number of individual districts, although there are state-level standards and frameworks that attempt to really focus what should be addressed in STEM curricula, what actually gets implemented in the classroom can vary. And that’s a challenge.

 While a lot of effort has been put into addressing the achievement gap between white and minority students -- underrepresented minority students -- it still exists. The national assessment for educational progress, or NAEP, has shown that while in -- there’s been some progress; the gap persists throughout the K-12 years.

 There’re decreasing number of U.S. students seeking STEM majors in college. There’s a lack of interest, there’s a lack of engagement. And for those that do begin with STEM majors, there’s a lack of persistence due to high degrees of attrition.

 In the K-12 classroom, the challenge that I’m sure you’ve heard about in terms of the lack of teachers who have the strong STEM backgrounds necessary to ensure that the curriculum -- even if it’s a well-developed research base curriculum -- if you don’t have the right teachers to implement throughout the K-12 continuum, then the students may not get all that they need.

 And then there’re issues related to U.S. students pursuing graduate-level degrees. And overall, in terms of research, there isn’t -- we really don’t know all that we need to know about what works, why, and for whom, in terms of STEM education.

 This table is from the NSF science and engineering indicators. It shows, first, university degrees in natural sciences and engineering; natural sciences including the physical/biological, earth/atmospheric, and so on, sciences. And you can see, in terms of degree attainment from ’98 to 2006, the U.S. level has remained almost relatively flat, whereas degree attainment in China has risen dramatically. And then when you look at college attainment overall -- not just STEM -- in terms of the U.S. compared to other developed nations in the OECD studies, you can see that, while the U.S. is not at the bottom of the pack, they’re right in the middle tier at 41 percent below other developed nations, including the U.K., Korea, Canada and Japan. So we have a lot of work to do.

 Some good news is that if you think about, well, you know, this seems really -- you’ve heard all of this before. What is NSF’s role in all of this? A recent inventory was done called the CoSTEM inventory, led by the OSTP, Office of Science Technology and Policy. They looked at federal investment in STEM across the government. And they took into account the role of mission-based agencies versus broader STEM investments, which is where the NSF and Department of Ed falls. And what the -- they say -- the advantage of this particular inventory, which was completed in December 2011, is that it’s thought to be more accurate than inventories that were conducted by the American Competitiveness Committee previously because they use a common unit of analysis, and that’s investment: investment in a program at $300,000 or more on an annual basis as their definition of a STEM education activity.

 And you can see that, first of all, the reason why this table shows NSF and Department of Ed, 80 percent of the STEM investment in education in the U.S. is made by three agencies. That’s Department of Education, NSF, and Department of Health and Human Services. What this shows is areas where there are some common investments in the areas that were identified under the inventory as STEM education: learning, engagement, educators, post-secondary careers, capacity building, and STEM education research. And you can see areas where there’s -- are common investments by NSF and Ed. But it also shows -- it reveals that there are two areas where there isn’t overlap. And overlap doesn’t necessarily mean duplication in terms of programs. It means that the focus of the activities are similar, based on the questions asked in the inventory. But learning and engagement are two potential areas where NSF could ramp up its investment and build on the leadership that it’s already established in STEM education.

 The inventory, I should point out, does not include things like fellowships, scholarships, volunteerism, agency outreach and so on. And overall, the investment by NSF in STEM education, out of the 252 STEM investments, the total amount is $3.44 billion. NSF investments amount to $1.17 billion, or 34 percent, of the government-wide investment. And that’s significant because the EHR budget is around $800-, $850 million. So where’s that other education investment coming from? It’s coming from the other research directorates, including GEO.

 So some questions that might get everyone thinking about how NSF can capitalize, not only on the areas where there’s already considerable investment but areas where they can grow the investment, such as learning and engagement. How can we really establish our leadership and expertise in those areas? What are the internal and external partnerships that are needed to really move forward? How can we strengthen education, research, and development? And the evaluation base at NSF is an ongoing challenge. How can we use and extend partnerships between EHR and the RNRA directorates and offices?

 We have some really great models in place. Things like the international poly year, NAISNet [spelled phonetically], which is a nanotechnology informal science education network, that I’m most familiar with, and others to build on. But the goal of the expeditions is to be more deliberate and really bring together the best of both worlds in terms of NSF-wide collaborations. How might these types of activities address the national diversity crisis in STEM? The need to really draw in all segments of the U.S. population into STEM and to filling our need for the future STEM workforce. And what is our action agenda to sort of move the dial forward on STEM engagement and learning, those two areas that were on the left side of the chart from the CoSTEM from report.

 Expeditions in Education have been put forth as a possible mechanism beginning in Fiscal Year ’13 to achieve some of these goals. The benefit over previous collaborations that expeditions have is that they will really have a clarity of purpose. They will allow us to experiment with process and relationships, bring in new partners and awardees across programs and directorates. There will be more research incorporating testing hypotheses relating to R&D; model development; synthesis of research; deployment and scaling. It will, we hope, will really encourage more innovation and risk-taking. Previous programs may have come -- previous collaborative efforts, I should say, may be a little bit one-sided because they were submitted to one division or one program or one directorate whereas the expeditions begin as a partnership, and there would be more of a balance. And so we hope that there would be also an opportunity to -- for greater dissemination.

 This is all part of the One NSF theme proposed by Dr. Suresh. And, again, it emphasizes the balance. Educational excellence in all of NSF’s research activities -- so the research directorates are conducting education activities, bringing the NSF investment over $1.17 billion. But do they always tap into the appropriate education research resources that can really strengthen those activities?

 By the same token, there should be a high level of research excellence in all of NSF’s education activities. So while the EHR programs are, of course, addressing STEM in all of the different areas -- and I didn’t indicate initially EHR is composed of four divisions: division of undergraduate research, division of graduate education, division of human resource development, and DRL -- division of research on learning in formal and informal settings, which is the division that I’m in.

So we might conduct or support activities that focus on STEM but are we capitalizing on the frontier, cutting-edge science that is represented by the programs in GEO and the other research directorates? So this is pushing for both of those efforts.

 This chart represents -- or diagram, excuse me, represents R&D cycles in STEM education, which really gives you a sense of how challenging it is to go from your basic research on STEM learning -- on learning to scaling -- large-scale deployment. At each of these stages, you have the opportunity to include evaluation, research, and development -- some to more degrees than others depending on which stage you're at. But getting to the large-scale deployment, ensuring what we call “fidelity of implementation” throughout all of these stages requires, as you can see, a great deal of investment in research and development, and small-scale implementation, building capacity of the institutions and organizations and so on before you get to the point where you can really scale -- say that you’re scaled on a national level.

 What we’re hoping that the expeditions will do in pushing for innovation and knowledge management is to take advantage of the great NSF. Research investments, such as those represented here: the astronomy observatory, ALMA; NEON, the national ecological observatory network, which is focusing on continental-scale research in ecology -- in the ecological sciences. How do we take this -- the data and the knowledge that’s being generated in NSF centers and large-scale facilities and infuse that into the EHR programs and vice versa?

 The three expeditions that are proposed for 2013 -- these are all under development, so I really don’t know what the funding mechanisms will be or the design. We have the topics here: transforming learning for STEM undergraduates, which will be under the auspices of the division of undergraduate education. Really looking at how do we meet the needs of the 21st century and enhance undergraduate learning across disciplinary boundaries; utilizing, as was suggested, the resources of the NSF facilities and centers and expanding our research on undergraduate STEM instructional practices, and hopefully the impact as well.

 The division of graduate education will be responsible for the second bullet topic; people and the planet, which will really build on the sustainability imitative -- the NSF-wide sustainability initiative; and the climate-change education program. And then finally -- and that will be under graduate education. And cyberlearning and Big Data will be under the division of research on learning. And that will really focus on large-scale data sets on student learning and teacher professional development -- using that data to help improve learning and teacher performance. In the ’13 budget request, the proposed budgets $49 million with EHR almost equal contributions from EHR and the RNRA directorates.

 And you may have heard some of this previously, but this is the basic design for expeditions, which we hope will accomplish the goals listed under the first bullet of “transforming STEM learning.” We hope that these investments will make -- first of all, will make frontier science front and center; build on education theory and research associated with STEM learning; again, a push for innovation and somewhat risky ventures; committing to common metrics; bold learning outcomes; and designing for scale. They won’t initially necessarily be able to go from the basic research to scale, but designing for scale, with scale in mind, so that with continual investment that might be realized. And, again, working across all NSF directorates and offices to engage, empower, and energize STEM learners.

 This is all part of a reframing of EHR’s investments in Fiscal Year 2013 into these three areas. A research and development corps, which includes the programs -- EHR’s currently-over-35 programs, I believe we have -- as well as establishing a core investment launch in ’13, focusing on areas with a $5 million investment in each of four areas of STEM learning: learning environments, growing participation, and institutional capacity, and professional workforce preparation.

 Leadership, the second area, is a focus on development of the next generation of STEM researchers and educators, and this includes things like the fellowship and scholarship programs, grants to students and teachers, presidential awards for excellence in math and science teaching and mentoring, and the graduate fellows, as well as expeditions, which I’ve just covered. The budget for EHR in 2012 is $829 million. The request for ’13 is $875 million.

 So in summary, we hope that the expedition with -- in collaboration with GEO and other directorates across the Foundation will enable us to realize that goal of balancing -- creating a balance between the frontier science and the excellence in education research theory design to create these collaborative efforts that enable us to capitalize on the needs -- on opportunities in the field and meet the needs of STEM learners. So, any questions?

 DR. HORNBERGER: Thanks very much, Sylvia. We’ll take questions. Norine?

 DR. NOONAN: Oh, dear. So, Sylvia, I hope -- please do not take this personally, and I’m -- because what I’m going to say, I think -- okay, so, I hardly know where to begin. So, for 30 years, almost -- since I’ve been associated with NSF, EHR has gone from a couple of hundred million dollars of -- actually, it was down as low as $9 million --

 DR. CAVANAUGH: Why don’t you introduce yourself?

 DR. NOONAN: Sylvia, Norine Noonan, University of South Florida-St. Petersburg. I’m so sorry, I apologize.

 So the directorate was as low as $9 million in about 1982, and since that time -- and the only thing left in the directorate was graduate fellowships. That was it. And since that time, it’s come back. And so for the last, you know, 30 years, the directorate has grown and it’s added these programs and I have to tell you that not only don’t I see anything that has happened to move the dial, but actually we may have taken some steps backward, currently. I mean, if you think of the number of students who are currently majoring in STEM, I think your presentation noted that it has actually declined as a percentage of the overall undergraduate population.

 So I guess my question for you is this. You talked about scalability. I’ll try to limit my comments to this. You talked about scalability. I would like one example where EHR -- except for graduate fellowships and REUs, which are funded in by -- you know, somewhat by the directorates and somewhat by EHR, I think, but I think they’re run out of EHR, if I’m not mistaken. One example -- they’re run out of the directorates. Okay. Fair enough. Then forget about that one. Graduate fellowships, however. Forget about those for a minute. Just set those aside. One program in the K-12 or in the K-20 area that has been successfully scaled; has been successfully scaled to a national level. I mean, you talked about scalability but I have to tell you, I’ve never seen an example of one. I’ve seen a lot of small-scale stuff and I see a lot of individual stuff. But please give me some -- at least one example of a program that’s been scaled up from an NSF pilot, grant, whatever. I’m struggling with that one.

 DR. JAMES: There are certainly examples, and some of those will be presented for those inside NSF at the EHR's directors review next week. And so [laughs], yes?

 DR. NOONAN: Can you give me one?

 DR. JAMES: And the programs that I am most familiar with are in DRL, directorate for -- Division of Research and Learning in formal and informal settings. And in particular, I have worked most closely in the informal science education program, which is probably not an arena that you’re as familiar with.

 DR. NOONAN: Correct.

 DR. JAMES: But I would say that within DRL, there are -- I’m not going to -- I’m not going to give you an example. But I will be glad to provide you with that information. There are examples. Within DGE, DUE, DRL, and others, the things that come to mind are a lot of the curriculum-based efforts and as well as in the informal science education program efforts associated with infusing evaluation in -- throughout the portfolio, and in fact, throughout the field.

 DR. NOONAN: Okay, so, I get a follow-up. So, do you have evidence that any of those things have actually moved the dial? You talked about moving the dial in your presentation. So do you have evidence that any of those -- what you claim have been scaled up, and I accept the curriculum, have actually moved the dial on getting -- addressing what is claimed to be a shortage of STEM graduates?

 DR. JAMES: The evidence exists, and it can be provided. Obviously, I’m not the person who can respond to that question effectively without preparation. [laughs]

 DR. KILLEEN: So, may -- can I chip in, Sylvia, if this would be a --

 DR. JAMES: Sure, absolutely.

 DR. KILLEEN: Because I think this whole issue of scalability is really resting on a hypothesis that in the future we can actually do this scaling up, and we can actually move the dial. We talk about moving the needle, poking the dial, and the expeditions as part of NSF’s kind of commitment to use our major calling card. And what is our calling card? Well, our calling card is the excitement of the scientific research that we do fund that does scale and is across the nation and in all congressional districts and so forth, in this more intimate kind of action with an educational enterprise at specific levels. The curriculum one is actually a good analog because if you look at the curricula innovations in the ‘60s and ‘70s, it really transformed textbooks. Now, you can -- it’s hard to do the null experiment -- what if that hadn’t have happened? But if you look at today’s textbooks, which cause me to be revitalized in the 21st century, but through the ‘70s and ‘80s and ‘90s, the imprint of the NSF investments --

 DR. CAVANAUGH: [inaudible] by professional societies.

 DR. KILLEEN: -- and curricula transformed the STEM. So if you think about that as an example -- maybe it’s challengeable; I don’t know. But maybe now in 2012 and beyond, we can think of bringing the excitement and vitality of our science, particularly GEO -- you’re in GEO, and sort of the “people and the planet” is one that we really have in our crosshairs in a way that does promote scalability. But, working with the Department of Education in a much more concrete way than perhaps before in the past.

 I don’t think any of us are going to defend a record of success because the national metrics are not really there to show that these dials have moved. We have seen some very dismaying trends in the retention, all of these things. You can’t do the null experiment, but let’s move forward from here and take advantage of the fact that NSF is a big player on STEM education. Nationally, it’s the second-biggest player, and in post-secondary, we’re it in terms of -- so we have a responsibility.

 DR. JAMES: And I would add that in addition to curricula, teacher professional development activities have also been quite effective. And finally, not all of the efforts in NSF and -- NSF’s investments in education were intended to be scaled up. So, while you can, you know, challenge whether or not there are numerous examples -- and there are examples in the areas that have been described -- the goal was not for all of the efforts that were invested in across EHR in the past 30 years to be designed for that purpose.

 DR. HORNBERGER: Brian.

 DR. BRIAN TAYLOR: Sylvia, I think you can take Norine’s comment as reflecting a general recognition around this advisory committee that what you are proposing and what we’d like to do, we see as challenging. And when -- we’ve been doing it for a while. And the geosciences writ large, I would say, prides itself for mentoring in the field as well as in the classroom. I mean, if ever there’s a discipline that plays to experience and expeditions, if you will, for education, we’re it. So, you know, it is part of our nature to do this type of mentoring.

 The challenge that I think those of us who’ve been doing this for a while see is indeed, sustaining that and scaling it up because many of our best examples -- they’re not necessarily one-offs, but there’s a whole lot of things that are -- that are not up at the state scale, let alone -- more even at, you know, a school-district scale, let alone the national scale.

 So I think the pushback you’re hearing is that we recognize how hard it is to get to the right side of your diagram in terms of the scalability. We’re great down at the left side of that diagram. And I think the challenge is going to be -- in this new initiative both for EHR and the GEO implementation in our area is, indeed, building something that is sustained and does scale and has wide impact.

 So it’s not questioning the desire. We’re sort of recognizing the challenge. And it’s tough.

 DR. JAMES: I would absolutely agree with that. I mean, I think that is something that is clear, not just in NSF’s education efforts but the other major investors in education across the federal government, Department of Education, and programs within Health and Human Services.

 And it may be that all of the efforts that are initiated under the expeditions, again, the goal is to look at them from the -- from the beginning and determine what -- how far along that continuum they would be intended to move. Some efforts may be appropriately scaled at the state level, regional level, and then national level. So it really varies depending on the goals of a project.

 DR. HORNBERGER: Okay, I have John, then Karen, then David, and then Mark.

 DR. SNOW: Two things. First of all, I endorse exactly what Brian said. Just communicate -- oh, John Snow, University of Oklahoma. I endorse what Brian said. I think there’s lots of people -- certainly not the majority but a significant minority of people in our community in all of the GEO disciplines who have spent a lot of time trying to educate, mentor, interest students from K to post-doc. Most of those are not scalable because the nature of the work, it's one on one, small group, one individual getting through the system. Second point: I really don't think anybody inside the Beltway is a particularly good partner. Department of Education, I would put an X across it, because my experience is in the U.S., education is local. It is a pride of most states, communities, counties, cities -- their school system. And the Department of Education is not viewed favorably. They're mainly viewed as a nuisance. If you want to find partners, go out to the states, go to the state department of education, or some of the big cities like New York where they have a huge city -- or some of the big cities work this way. But you'll get a lot more impact for your dollar by finding partners in the field outside the Beltway.

 DR. JAMES: With respect to expeditions, there was never a implication or [laughs] insistence that Department of Education would be a partner. These are collaborations between EHR and the RNRAs within NSF. EHR does have efforts where we've collaborated with the Department of Education and to good ends. So I'll just leave it at that.

 DR. FISCHER: Without being naive about the challenges, I think one of the things that's really exciting about what you're describing and looking at some of these programs across NSF is the possibility of linking the programs together to make a really rich experience for a given individual. One of the things we talk a lot about in my university is how to take people -- students who've been involved in a program at the K through 12 level, how to then sort of project them through to the college level and then onto the graduate level. And one of the real challenges has been, you know, sort of providing a continuum of experiences, because in the end what we're talking about are individuals and how they grow and how they learn. And I guess I just wonder, at the NSF-level, how much discussion has there been about how to link the programs together so that, you know, where you're talking at a national scale, they're just an incredible variety of resources where you could imagine, you know, students are getting a continuum of experiences. So, I mean, is that something that's been discussed because it seems like a real opportunity.

 DR. JAMES: Yes, that's a great question and one example of where that was -- funding was provided to do that in a deliberate way -- was through a small initiative that was initiated in EHR a few years ago -- I guess about three years ago -- integrated into EHR programs but it also allow for the -- to provide cohesion across programs at a individual campus or through university partners. It was called ICube: Innovation for Institutional Integration. A small portfolio of projects was funded. They're all listed on NSF website, and what it really -- the goals associated with the EHR goals in terms of broadening participation and strengthening STEM programs, but it really provided one model -- a test bed, if you will, of initiatives that did exactly what you said: link programs to hopefully have a -- strengthen the overall impact on students. And that's just one example. There are other examples, I'm sure, within the other divisions of EHR and probably through the foundation, where that's been done more effectively -- as effectively.

 With ICube, we're just going through a series of, basically reverse site visits, reviews to see sort of where these projects are, what impacts they are having. And that might provide some insight into some of the similar types of exhibitions that could be proposed, but it's definitely something that's been discussed and addressed in some program efforts.

 DR. HORNBERGER: David.

 DR. SCHIMEL: Dave Schimel from NEON. Early in your presentation, Sylvia, you showed this critical endpoint, which is the graph of -- essentially of production of STEM graduates internationally, showing stasis in the U.S. despite a growing population and acceleration in at least one particular country. So, clearly, that suggests that an important endpoint for EHNR [sic] is to, in fact, increase the number of STEM graduates significantly.

 And then when you went through the balance of that, of your presentation, that -- it wasn't clear how that goal mapped onto the rest of the program. It became more process-oriented: research to evaluation to scaling. How do you work with your principal investigators to put that goal front and center, and do you have any mechanism for collecting those ideas that work so that they can become more broadly known both by other principal investigators, and obviously by groups that are trying to apply these best practices? In other words, are there a few of these programs that have dramatically increased STEM engagement in an institution that look like real models? And if there are, they should be like on the web page, in the newspapers --

 DR. JAMES: Right.

 DR. SCHIMEL: -- and so on. I think that's kind of what Peggy was asking, too. You know, with all this investment, where are the, you know, where are these few -- you know, we always cast a 1,000 seeds before we find the ones that flourish in the right soil. Where are the success stories? How can we find out about them? Tell them to our colleagues. Use them to inspire other researchers.

 DR. JAMES: Okay. Good questions. There are a number of mechanisms that are being used to address some of the questions that you asked. I would say that the program evaluations that are underway, that have been in place for -- in many of these programs, for many years and are underway -- the results of those are generally published in reports that are available on the NSF website. The success stories associated with the programs are also highlighted in the Committee of Visitor reports and other evaluative measures that the programs have to respond to throughout the course of their lifespan. And, you know, in terms of what's on the -- I guess, promoted, there are publications, reports, et cetera, are they all together on the NSF website highlighting EHR successes? They are there but they're also embedded with all of NSF successes. If you look on the website, the Office of Legislative and Public Affairs have been undertaking a number of efforts to highlight programs, success stories, through the website, through basically many case studies, if you will, and promoting those efforts there. If you want specifics, that information is certainly available but perhaps not in the form that you and your colleague are requesting.

 DR. KILLEEN: Maybe I could add a little bit to that, because you're exactly right, Dave. The STEM undergraduate is actually a presidential goal that we're tying into there. If you look at the total retention across all of America’s postsecondary setting, there's less than 50 percent. The students that go into a STEM course, fewer than half of them make it through to get a baccalaureate. There are, in fact, best practices. If it's just visiting university, where it's 83 percent and there are other universities where it's 45 percent or 40 percent of the incoming STEM graduates actually make it through to. So in fact, we see this as actually low hanging fruit, because if you want to increase the STEM graduate population, retention and reduction and attrition is actually a fairly easy way to get to the presidential goal.

 And there are some really interesting best practices, that our universities now recognizing that it's the freshman and sophomore years that many people get turned back from furthering their STEM. There are universities that have deans of the first year experience, for example. Not a dean of geology or a dean of earth sciences, but a dean of first year experience, which is wholly catering to that first year experience in STEM where retention. So this is actually an opportunity for geosciences, too, in my view, worldview, and we have lots of experts working on this in different universities around the table, because we have such -- and that's why engagement, empowerment, energizing are critical labels in the E Squared because our fields are exciting, interesting. Obviously they have significant mathematics to get into and work through, but the action orientation, the fieldwork is very appealing to young minds and young people. So maybe we can create some paradigms within the geosciences that can address this issue of attrition in STEM undergraduate schools, and then somehow scale that up. There's a scalable hypothesis at the very least.

 DR. JAMES: I would add that there are two programs that are focusing in addition to the expedition -- focusing on undergraduate education -- there are two programs in division of undergraduate education that are looking at this particular area. One is WIDER. It's a new program currently under development, widening implementation and demonstration of evidence-based reforms. It's going to fund research and demonstration projects to hopefully focus on implementation of evidence-based undergraduate instructional practices to improve student outcomes.

 And the other one is a program that has already been in place; TUES, Transforming Undergraduate Education in STEM. That is tapping into the presidential goal that was mentioned that's responding to PECAST, Presidential Council of Advisors on STEM On Science And Technology, that indicated there was a need for investment -- continued investment in certain areas to address undergraduate education efforts.

 DR. SCHIMEL: I want to be really clear. I think this group is incredibly excited and is really looking for guidance and partnerships to be more effective in furthering these goals. And I think that all of the comments are in that spirit. This group has always been extraordinarily committed to using the earth sciences to improve STEM education and to engage more young people in STEM. And I think we’re looking to a maturing NSF education research program to provide input on how best we can direct our efforts so that we're not just mentoring people one by one.

 DR. HORNBERGER: Marge and then Roberta.

 DR. CAVANAUGH: I'm sorry about this, John, but I wanted to ask a little more about the Department of Education plans. When you showed the graph from the inventory --

 DR. JAMES: Yes.

 DR. CAVANAUGH: -- you indicated, I thought, that the two at the far left -- learning and engagement -- were the two areas where I think you see --

 DR. JAMES: There’s potential.

 DR. CAVANAUGH: -- more potential for working with the Department of Ed.

 DR. JAMES: No, that was not the intent. They were two areas where NSF is not overlapping with the Department of Ed, where we can establish more leadership. I think that's one source of confusion. I didn't say that those were designed -- those were areas where there was potential for working with the Department of Education.

 DR. CAVANAUGH: Oh, okay. Well, that's what -- thank you for clarifying that.

 DR. JAMES: Sure.

 DR. HORNBERGER: Roberta.

 DR. RUDNICK: Well, first of all, it's a -- coming from an institution inside the Beltway, I have to take exception to John’s little comment about partners, but regarding my institution, there's been talk, and this is a question for Sylvia, but also everybody around the table. There's been talk about having differential tuition whereby STEM students pay more because STEM costs more, and apparently this is a common phenomenon now and we haven't done it yet. I don't know if it’s going to happen but it's seen as big revenue-raising initiative for the university, so I'd be interested to hear comments about that and, you know, is that the way to go when we're trying to get more STEM students? Will it have an impact on whether students decide to choose STEM?

 DR. JAMES: I think that would probably be a question that someone in Division of Graduate Education or Undergraduate Education might address. I really am familiar with that but I can't say just on a basic level how that would increase --

 [laughter]

 DR. JAMES: -- the number of students if they're already issues with attrition and retention in STEM majors, if it almost seems like a penalty if they have higher tuition rates.

 DR. KILLEEN: I can tell you that President Obama is very concerned about tuition hikes across. And you just have to read the State of the Union speech to see the tie-in with tuition hikes and taxpayer revenue going to university settings. So this is -- I mean I think there’s a lot of boiling frustration in the room ---

 DR. JAMES: I'm sensing that. [laughs]

 DR. KILLEEN: I personally would encourage you to take David's comments seriously. This is a community that cares deeply about STEM education.

 DR. JAMES: Yes.

 DR. KILLEEN: Wants to find, not the magic bullet but the pathway to do it at a level that really engages our communities, attributes and capabilities to further the national effort and -- we're all, I think, looking for the path forward. And maybe expeditions in education is an interesting opportunity for us to do a little bit of experimentation, not to assume that we can actually solve the problem overnight, but to do a little bit of experimentation on some of these, and really evaluate it for scalability and for whether it's working or not.

 And I also have to push a little bit at John because the Department of Education got a really negative review down there, and we've had several meetings very recently with Arne Duncan, who visited here, and is also expressing some of the frustration, particularly about the national metrics on STEM education and looking to the National Science Foundation to come up with some opportunities or approaches that they can work with us on. So I think there’s willingness on many sides of this problem to break out and so we shouldn't assume that the past is prologue to a dismal future. I think we should all kind of have a little bit of optimism.

 DR. SNOW: I'm sure there are good people in the Department of Education. The thing is this country is not designed -- the federal education system is not [inaudible] have an impact -- I just don't think [inaudible] Department of Education is the right way to do it. They are not well regarded by a lot of state organizations. They’re regarded more as a nuisance than anything else. But they still want the money. The state's no different than anybody else, but the state -- the state Department of Education [inaudible] have a lot more influence. You're a lot closer to where you're trying to make the impact, and I think we've had more opportunities [inaudible].

 DR. KILLEEN: I can just say I'm not here to defend the Department of Education. That's not my role, but I'm here for GEO. But in our conversations with the leadership of the Department of Education, they also make the same case you're making here, that the vitality is out in the states and in the communities and the school districts, and they're building up their interfaces where the leadership at those school districts and they have offered to us to use those linkages and the common interfaces they have with exactly those folks in a way that is scalable. So I think -- I sort of don’t want to leave it on the table that it's hopeless to work with this federal agency because I think we've got a real opportunity there.

 DR. HORNBERGER: Peggy.

 DR. DELANEY: So one comment about differential tuition by major, it's a budget solution that gets proposed from a marketing perspective. Students seem willing to pay more so we could charge them more. In the UC system we debate differential tuition by campus and then differential tuition by major. I will say that in any of the instances where I've seen it discussed, it has come again from the budget side. It hasn't begun to consider what the impact is on diversity in the field. And it hasn't begun to consider what it means for majors like the geoscience majors, which are not as well represented in high school education as being a biologist. And I'm not convinced that what we need to do is each turn out hundreds more moderately educated biology majors as much as high quality, and many biology majors are high quality, but we produce hundreds of students that are not going to go on in the STEM workforce, so -- just at our own institution. But my question was, because this phrase got used yesterday, too, and you used it -- when you say, "define bold learning objectives," can you give me an example -- it's obviously something that's being repeated. That these programs need to define "bold learning objectives." And I'm not clear of an example or what's meant by that.

 DR. JAMES: Because the programs are under development, I don't have a specific example in terms of what might be proposed in the -- or encouraged, I would say in the solicitations -- and I shouldn’t say "solicitations" because I'm not sure if all of them will be solicitations. And we tend not to be very prescriptive when it comes to our request for proposals. But I think it sort of means going beyond some of the learning objectives that are represented in some of the existing large-scale efforts. Just being very clear about what the STEM learning goals are for the students, I think sometimes people say that in the standards, they tend to be a little bit fuzzy in terms of -- because they try to cover so much ground, they try to cover everything. And so the result is, I guess, some of the -- it's not we -- we don't really get where we want in terms of the students learning as measured in a number of ways by standardized tests, by enrollment in -- continued enrollment in STEM courses, by the number of students who elect to select STEM majors and so on.

 So I think that's something that is really sort of going beyond the learning objectives that are in standards and frameworks that have been proposed to something that is definitely more measurable and -- I guess I would say that research supports can be obtained through the program's design. One thing I would like to say in closing [laughter], is that while it's true that NSF investments in education have been significant, and just as Secretary Duncan expressed in a recent town hall meeting here with Dr. Suresh, education overall -- not just STEM education -- we're not where we want to be in terms of our goals and objectives for students. The NSF investment, that 1.17 billion that I mentioned from the inventory, is less than 1 percent of the overall federal investment. So the overall federal investment in education is about one trillion dollars. So in terms of what we can achieve through our investments -- and I'm not using this as an excuse to say that, you know, all of our efforts should have been able to go to scale, because, again, as I said, they aren't designed for that purpose. We need to keep in mind that we're just -- what portion of that education pie -- NSF's education budget -- represents.

 Also, I would say in terms of the great work that GEO is doing, I saw that in an inventory that we did internally in response to a GPRA goal that we had to address last year in terms of NSF efforts, focusing on public understanding and engagement of science. Next to EHR, I believe, and this is from memory, our research in terms of what programs that have been funded -- programs as well as individual projects that have been funded -- I think it's in terms of individual projects -- GEO, I believe was the second to EHR in terms of education-related investments. So I think that's a great starting point to think about is, as you mull over what the possibilities are with the expeditions and other creative types of collaborative efforts that you might propose in helping to address some of these serious challenges that we're facing in STEM education.

 DR. HORNBERGER: Thanks very much, Sylvia. Just one comment that I have in listening to everything, it strikes me that universities should have an obligation. I'm struck by -- talking to a colleague, Ira Harkaby [spelled phonetically], from the University of Pennsylvania. He's an historian, so it's not strictly STEM education, but he's a strong believer in Dewey's view that universities should not be ivory towers but should be responsible to the communities in which they exist. And Ira had a program that I was quite impressed with, several years ago, anyway, where he had worked with the, I guess, West Philadelphia schools, which were not top-notch schools, but he had gotten a medical school and the education school, and he'd gotten everyone involved -- because there was a payoff, okay, the medical school got involved because they were interested in doing research in diabetes, the education school got involved because there were research objectives that they could have, and then he really engaged the public school district in West Philadelphia and got the parents involved, and it strikes me -- it's a case where the university, itself, was really committed to an involvement, and this expeditions possibly could lead to such things in the future, and in that sense, I think there is a chance it could be scalable.

 DR. KILLEEN: Just to add little something on the expeditions. I think there is an opportunity to help us define what they are right now, because it's an element of the FY ‘13 budget. You saw the three categories. We have an internal working group of program offices that's just kicked off their first meeting last week, so this is a really important seminal time in determining what it is. Our own Marge Cavanaugh is co-chairing that internal working group, so she was taking very careful notes of all the comments here. And all three of the items, all three themes pertain to our interests: undergraduates, which we talked about; people on the planet clearly related to SEES and sustainability and all of our divisions; and cyber-learning, which is also, I think, directly relevant to what we're thinking about doing with Earth Cube and other assets in connecting our resources. I very much enjoyed your comment, Karen, about have we connected the dots sufficiently well. So this might be an opportunity. It's not a huge amount of money in the scheme of things but we have an opportunity within the geosciences to really shape what these things are and look like to support our communities that practice. So, help us. Give us some guidance.

 DR. HORNBERGER: We really do have to take a break, [laughs], okay. I know everyone wants to keep talking. We may have time to come back to this after lunch, when we revisit it, but we -- now, let's take a 15-minute break.

 [break]

Update on U.S. Global Change Research Program (USGCRP)

 DR. HORNBERGER: Okay. We’re going to reconvene. Okay. Different telecom, okay. So our next item is going to be an update on USGCRP, and Craig is going to do that.

 DR. CRAIG ROBINSON: Okay. Thank you. So for the new members, what if the U.S. government had a program to coordinate --

 [laughter]

 DR. CRAIG ROBINSON: -- climate and global change research across 13 agencies, and what if that responsibility to its member agencies was to collectively set priorities, advise on OMB and OSTP, budget request, assess the state of the nation every four years, and write a global change research plan every 10 years? Well, then you’d have the responsibilities of the USGCRP. So this began as a presidential initiative in the January 1989 Presidential Budget Request to Congress. It was codified in law in 1990, under the Global Change Research Act. You can see some of the language here. Very broad for this program as far as its extent and responsibility, but mainly the words bolded to understand, assess, predict and respond to human induced and natural processes of global change.

 The program has been around, as you can see, for over 20 years. Most of the time was spent on understanding and, to some degree, assessing those areas. We heard from the National Research Council many times, especially in America’s climate choices, that we need to focus on an end-to-end program. That we need to go all the way from the fundamental research that we have to make sure is strengthened and continues all the way to informing decision makers, using the assessments to feed back into the science, and communicating global change and climate change, and educating both the public and the next generation of scientists, engineers, and educators.

 So there are 13 departments involved and agencies: Agriculture, Commerce, Defense, Energy, HHS, Interior, State, Transportation, EPA, NASA, NSF, Smithsonian, and USAID. The big players in this are NASA that funds more than half of this $2.5 billion attributed to the program. NSF and NOAA each a little over $300 million, then Department of Energy, USDA, and the rest of the departments and agencies as you see here. The Department of Education is not part of this, but as we developed the strategic plan we included them in the development. So the program supports and coordinates the Federal global change research, assesses the state of scientific knowledge, and the nation’s readiness to respond as part of the mandate, and communicates research findings to inform, educate, and engage the global community.

 The governing structure, it is for this program, is from the National Science Technology Council. There’s a subcommittee, committee on -- there’s a committee on environmental natural resources and now sustainability as part of that, which Norine chaired many years ago when the program was especially active. There’s a subcommittee on global change research that has the 13 agencies and departments and that runs the U.S. Global Change Research Program. Tim serves as the vice-chair for strategic planning. All the agencies have a principle to this. Joann Roskoski, the Deputy ADM Bio, serves as the NSF principle. So now the major agencies involved essentially have two representatives to the subcommittee: one at the vice-chair level, one at the principle level. But all the agencies are involved. It works by consensus, which when you’re trying to go and, for example, put together a decadal strategic plan, 13 agencies reaching consensus is not always the easiest thing to do. But we were able to do it because it’s an important issue and people involved took off their agency hats. The important thing for how USGCRP really functions is the inner agency working groups or IWGs. They’re comprised of members of the different agencies and programmatic activities and they truly represent a collaborative effort because the IWG, is the interagency working groups, do work across the agencies. That’s where the work really gets done, with the strategic priorities set up by the -- at the principles level. So it’s critical. These IWGs are changing as far as their structure based on the new strategic plan and that’s something I’ll discuss in a few minutes.

 So there are three principal responsibilities for broad publications for the USGCRP, an annual report on our changing planet; a national climate assessment, supposed to be every four years, it will be every four years, the last one was 2009, the next one will come out next year; and a global change research plan every 10 years. The last one was completed in 2003, after a three-year process. So the deadline to get the next one done is next year, but we have it completed, it’s just going through a final clearance now, and hopefully it’ll be out very soon. So our changing planet, there’s a -- I include a link in your PowerPoint set to the 2012 version that’s out. The 2013 version is expected to come out actually soon. So soon after the president’s budget new cycle, the -- our changing planet will come out. It summarizes program achievements over the last year, it talks about near-term plans, and especially going forward what you will see is progress on long-term goals. The strategic plan that I’ll be discussing has four goals, multiple objectives under them, and there is an implementation team. So the agreement was, we’ll have a strategic plan at high level. We will have an implementation plan to follow with metrics following on those objectives, and Pam Stevens who is here in the audience is the representative for NSF on that planning team.

 The national climate assessment, very briefly, was last produced in 2009. This report global climate change impacts in the United States. The next version is far along. It will be ready in 2013. It’s supposed to integrate, evaluate, and interpret the findings of the program based on regions and sectors and discuss the scientific uncertainties of the findings. The important part, in addition to analyzing trends, analyzing the effect of global change, is how we then used the assessment to go on feedback on the science that needs to be done going forward and how we make sure these things are linked, because they haven’t always been linked very well in the past. The assessment report will have these different sections, a scientific basis for climate change that Bob Correll, former AD of GEO, will be a leading, Tim is on that group; then sectors and regions; mitigation and adaptation; an agenda for climate change science; and the long-term process. The administration’s goal for the assessment is to develop a continuous assessment process so that you don’t build up a group to do an assessment, involve the community just once every four years in this major process, but think about, what’s the information systems, what’s the cyber-infrastructure needed to keep this going? To make the information available to inform decision makers, as far as the information that they need and in the formats they need to be able to make decisions. Whether you’re a water resource manager in Arizona, a city planner in New York City, you’re in the insurance industry, whether you’re in Congress. So it’s an ambitious goal and it’s going to take some time to get there, to have this continuous assessment capability and reporting capability, but this next report is scheduled to come out next year.

 I’m going to talk a little bit more since NSF led the national global change research plan. It’s a strategic plan for the USGCRP. It contains the goals and priorities for Federal global change research and it is for 2012 through 2021, so for 10 years and it’ll be updated every three years. We will follow along with an implementation plan, which is critical when you do a strategic plan to make sure that you’re continuing in the process. So this will actually be useful and used. So the plan talks about directions for the next 10 years. It’s guidance for USGCRP to be integrated and then programmed, as I said, continue the basic fundamental research, work on the fundamental use-inspired research, but also look at different areas informing decision makers, the assessments, and communication in what we heard, education as well. And it emphasizes, and you see this throughout the plan, the draft plan has been out for a while, you see this in the final version, understanding human natural systems in addition to that end-to-end science from basic research to decision support.

 So let me talk to you a little bit about the process in getting [unintelligible] and the community involvement. So there was a multiyear process from 2007 to 2009. USGCRP held over 20 listening sessions around the country, both regions and in different sectors, with a variety of stakeholders. And these workshops had anywhere from a couple of dozen scientists to hundreds of participants. The -- we did get a draft done and took about six months to get that done from the time we stood up writing teams with over 100 scientists from the agencies to the time we put out a draft for public comment through October and November. And we had a variety of comments from organizations and individuals. The draft went through two reviews from the National Research Council, an informal review before it went out for public comment, and then an extensive review. Their review is online and available since January. They did tell us a variety of things; make sure we’re emphasizing integration, integration with the biological sciences, integration with the social behavioral economic sciences. We -- in our goal for communication and education, they said you’re very broad here. We included K-12 education, undergraduate education, graduate education. Make sure you’re focusing. You can continue to talk about some of these issues in formal education for example, with Smithsonian being a member of USGCRP. They said make sure you focus on the interdisciplinary scientific workforce necessary to do the interdisciplinary work needed going forward in global research. So we made a lot of changes based on the public comments and the NRC review. Again, it’s going through final clearance and will be available soon on the globalchange.gov website.

 There was -- there were four goals. We had writing teams for each of the four goals. There was an integration team that NSF was asked to chair. I led that integration team, but NSF also co-chaired an advance science writing team, and that should say 30 members, that was our largest team, and an education and communication writing team. We had members, I’ll show you, on all the writing teams except for sustained assessment from NSF. So there was an informed decisions writing team led by NOAA/NASA; sustained assessment led by National Climate Assessment team; and the Bureau of Land Management that brought an interesting perspective. So you see some discussion there about, looking at wildlife migrations, corridors [spelled phonetically] variety of different things. So it was very good to have the Bureau of Land Management as part of that. And our communication and education team worked well together with representatives from NSF, NASA, and USGS, with strong components from NOAA and Smithsonian as well. And we had a natural coordination office that helped us, led by Julie Morris, who was the former OCE division director here, so she was fantastic in her work on this as well.

 So as far as NSF contributors, we had four from Geosciences but we also had four representatives from SBE, some are from Engineering, from the HR Maryland suitor was a co-lead for communicate and educate and from -- Bio loaned us someone for a year to also work with us on the process, and Cheryl Dybas from OLPA who specializes in GEO areas. So, well represented from throughout NSF and OPP as well; I should have mentioned Erica Key. So, this was a really collaborative effort with many throughout NSF in the 13 agencies. And as I said, we also brought in some other agencies outside of the USGCRP members, including Department of Education to look at this, the Army Corps of Engineers, and others.

 So the strategic plan itself is divided up into the vision and mission, these four goals and objectives: advanced science, informed decisions, sustained assessment, communicate and educate. Now, the advanced science section is a large as those other three goals combined. These other three goals are new to USGCRP, but it’s a balance. The advanced science section, as you see, sets up the science needed to inform decisions, to do the assessments, and some of the research and communication and education needed to reach the goals the program has going forward.

 There’s an international section, and you’ll hear more about international broadly in the next talk, and then implementation planning. We want to give confidence to the community that the strategic plan isn’t going to be the end of this process but there is a planning process. There will be an implementation plan to follow as well; and then a three-year update, so in three years an update to the plan.

 The vision and mission was set a year ago by the principles. The vision is aspirational, a nation globally engaged and guided by science meeting the challenges of climate and global change. You’ll notice the mission focuses on to build a knowledge base that informs human responses to climate and global change. So the NSF fits well in both of these areas, and the concern of the community that by, from some, and we heard in public comment, by looking at informing decision makers, by looking at the assessments, by communicating and educating are -- is the program moving away from science research and particular fundamental research. And I think I’ll -- you see both in the draft plan and one again I show you here that the program’s not doing that, but looking at engaging in all these different areas and building that up over time over the next ten years.

 So advanced science, and I’ll spend a little bit of time talking about this. The goal itself, as you can, see is to advance scientific knowledge of the integrated natural and human components of the Earth’s system. That language fits NSF very well. The bullets I’ll show on the next four slides are of the objectives, the objective language has not changed depreciatively from the draft plan that’s out there and available. But let me just say that to ensure that NSF had a strong place in the program, the first objective, this Earth science -- Earth system understanding led the way and it has -- and this is the only one I included the different sections we have. It includes climate change and global change section and by that, what do we mean by climate change versus global change? Global change was defined for us by Congress. It’s actually a pretty good definition: changes in the global environment that may alter the capacity of the Earth to sustain life. And climate change, while we use the IPCC definition of that and look at it as a subset of global change, it doesn’t include ocean acidification, land use, land cover change. The program has spent a lot of time on research in climate change. We’re looking at a little bit broader research now and integrating that across the program.

 We also heard very clearly from the NRC in America’s climate choices and in their review, that we need to focus on integrating the biological sciences, integration of social behavior on economic sciences. So there are sections on each of those, and then multiple space and time scales, natural variability and extremes. And we give -- and so as an example there, but also looking at for local, regional, national, global, various time scales from seasonal to decadal. So the -- we’re very broad there with some specific examples of areas that we need to work on across agencies. Then complexities, thresholds, and tipping points, also getting into a little bit hazards and extreme events there.

 The next objective in advanced science talks about then the science for adaptation and mitigation, which really sets up the informed decisions goal I’ll get to next. It’s a little bit more of the implied research that needs to be done and that involves some of the research that NSF is doing, by bringing in USGS, NOAA, and some of the other agencies more specifically. Integrated observations is dominated by a lot of what NASA is doing with their satellite programs. Integrated modeling, NSF has a major role there as does DOE, NOAA, and others. And in information management sharing; this is one of the areas that we couldn’t reach agreement on using cyber-infrastructure is the wording here. Not all the agencies would buy into that, but this gets into not only the data but also the high performance computing necessary to support the research under Earth system understanding as well.

 Getting to the next goal -- let’s see, informed decisions. This work was led by NOAA and NASA with a lot of input from our social, behavioral, and economics researchers here. Both how we inform appropriately the research necessary for adaptation decisions and mitigation decisions, was a critical piece of this. Not only that and through the assessments, but how do we feed back that information then for the program to be able to make future research decisions? And then how do we enhance our global change information to include a global change information system, but beyond that to make that information broadly useful to decision makers. So what information do they need to be able to make decisions? In what format can we provide that, especially across agencies to make this actually useful, the research that’s being done, and build on what we’re going to talk about in communicating and educating? Conduct sustained assessments, I mentioned this before. This is primarily the national climate assessment but not only that. It’s national assessments, Arctic assessments, international assessments as well, and their components on scientific integration. How do we make sure the sciences integrated well into the assessments; that the researchers are involved in that; that we develop an ongoing capacity for the nation; that we inform responses? So, again, we have a feedback mechanism from the assessments to make sure decision makers are being reached and the scientific research is informed by what the assessments are determining. And then we evaluate the progress of the -- progress that we’re making in these initial goals of understanding, assessing, predicting, and responding to human induced and natural processes of global change.

 The fourth goal in communicate and educate is a -- not a new topic for the program but certainly a new goal for the program. So, “to advance communications and education, to broaden public understanding of global change, and to empower the workforce of the future.” So we talk about a significant area for SBE and HER, strengthening communication and education research. What’s the research needed to be able to effectively communicate climate and global change, and to educate in that area, both informally and formally? How do we reach diverse audiences, whether through a variety of means, also informally and formally? How do we increase engagement with the broad community in climate change? And how do we cultivate, as the NRC, said please concentrate on this, “the scientific workforce needed to do the interdisciplinary research for global change in the future?” So this has been a significant area of discussion. This was our second largest working group and we reached out to the Department of Education as part of this to make sure that they were involved as well, even though they’re not a partner in USGCRP. But that’s an important part of what we’re doing throughout this. We have 13 agencies engaged. We need to think about how to, especially in social, behavior, and economic sciences, and some of the education components, and some of the informing decision maker components, how do we leverage other agencies in the federal government on that?

 International partnerships, you hear more about international partnerships, but there are various aspects of this that the program needs to think about, everything from international cooperation for science capabilities, to how we coordinate with other nations, and how we help developing nations, as part of our mandate in this program. How we help developing nations cope with, deal with, and improve their research on, and their capabilities for incorporating data into the global data network on climate and global change. So, promoting international cooperation as a mechanism through science, but also making sure we’re engaging developing nations and working very broadly, making sure we have global assets for research as well. So this is a significant component of the program. There isn’t a goal specifically associated with international partnerships and informed decisions. We do have an objective, talking about international, but it is a whole chapter now in the plan that’s going to come out.

 And we have crosscutting activities both programmatic and societal. Programmatic, anywhere from process research, which includes carbon cycle, water cycle, a variety of different groups, to international, to societal -- we have a climate changing human health group that HHS, NIH in particular’s helped me to lead, that goes across different program areas.

 So next steps. There’s an implementation planning team that’s established. As I said Pam Stevens is the representative for that. The program’s developing an implementation plan for the strategic plan and there’ll be a retreat of the agency principals and vice-chairs May 9th, 10th, to do road mapping three to five years out, and to look at near-term priorities for FY ‘14 to help and foremost OSTP and OMB, especially with the memo they have every year to the agencies on what their priorities are. So, just a few things coming up. The program also has a new resource library, when the strategic plan is finally cleared and released you can find it there, but you can find the strategic plans, technical reports, our changing planet, and a variety of content. This is new, just in the past month making, again, part of the goal to communicate better global change research across the government. And with that, that’s what I have. I’d be -- welcome any questions.

 DR. HORNBERGER: Dan.

 DR. BAKER: In my opinion we’re rapidly losing the spacecraft that are necessary to observe the --

 DR. CRAIG ROBINSON: [affirmative]

 DR. BAKER: -- global system and to assess the effects of policy changing. Even more worrisome is the, losing the prospect of a new spacecraft because of the increasing mission cost. Is that something you address in this report?

 DR. CRAIG ROBINSON: We do and you see that right in the executive summary. But we address very strongly that need to look at observing systems, to look at -- now some of the budgets coming out, at least markups in the last couple of days are promising. But, yes, definitely it’s absolutely critical. We mention it right up front and talked about it in our integrated observations; and we give a -- we talk in particular about the need for long term time series and what having gaps in long term time series can severely affect our ability to understand and to predict global change.

 DR. BAKER: All this monkeying around of handing things back and forth between agencies I think is just going --

 DR. CRAIG ROBINSON: [affirmative]

 DR. BAKER: -- to exacerbate this and --

 DR. CRAIG ROBINSON: Yeah, yeah.

 DR. BAKER: -- once you do break a time series, such as total solar irradiance or so, --

 DR. CRAIG ROBINSON: [affirmative]

 DR. BAKER: -- you’re sort of back to square one in many ways. So you could be losing decades of progress.

 DR. CRAIG ROBINSON: Agreed. I absolutely agree. I think everyone around the table that developed that, there was a strong consensus.

 DR. HORNBERGER: Walter and then Brian.

 DR. WALTER ROBINSON: I guess the question is about the relationship and our articulation with the IPCC process. My particular concern would be in regard to the modeling effort that consumes our climate modeling enterprise at irregular intervals. I literally like this idea of continual assessment. I wonder if this is going to be -- what is the -- is there a conversation going on with the IPCC that they might move in a similar direction?

 DR. CRAIG ROBINSON: I’m not familiar with conversations with the IPCC moving in that direction. I would say NSF is not, because of our role in basic research, is not extensively involved in the sustained assessment effort. But were we do play a significant role is in looking at the cyber-infrastructure needed to do something like what we’re talking about. So there’s certainly an opportunity there. Tim, anything?

 DR. KILLEEN: Well I’ve lived your concern, so I know exactly what it is. There is an NRC report that’s being worked on. It’s a cross-agency report on climate system modeling, and it’s not just computational capacity, it’s the human capacity to actually do it and build these community tools. It’s very much, very much on people’s minds and the IPCC is entirely consuming for a few years. The good news is that the SEEMIC [spelled phonetically] 5 runs are in the cam, so that’s being done, and now the climate system, the earth system modeling groups can be really focused on the next scientific advances.

 DR. HORNBERGER: Brian.

 DR. BRIAN TAYLOR: Craig, what’s the dialogue between this and the President’s National Ocean Policy?

 DR. CRAIG ROBINSON: Well, the advantage is we had several people including Julie Morris who was here, worked on National Ocean Policy years ago. So we first learned a lot of examples from them, how to do this right and in a time manner. Second, we tried to integrate with all of the different components of the science agencies and also the national efforts as part of this process. So we went out, gave talks to the variety of different groups involved both in the Arctic research program that’s coming out with their five-year plan, in addition to the National Ocean Policy and others. Tim.

 DR. KILLEEN: I was on the Presidential Task Force that led to that and then Julie was a major writer.

 DR. CRAIG ROBINSON: [affirmative]

 DR. KILLEEN: The, but I think, so there’s a good connection. David is co-chairing the science committee of the National Ocean Council and we’ve got -- we’ve populated all nine task forces there. I think there’s a subtext though. We talk a lot about workload here. It is, you know, there’s a lot of NSF fingerprints on all of these documents and I think without that, those fingerprints that the emphasis on science would not be there. So this is a role of GEO in particular that’s probably below the radar screen of most people to just bring in the scientific precepts into these national documents. We’ve done it for the National Ocean Council, that’s why it’s science everywhere, and we’ve done it now for the USGCRP, --

 DR. CRAIG ROBINSON: [affirmative]

 DR. KILLEEN: -- but it is taxing. We’re not a huge agency, not a huge directorate either.

 DR. BRIAN TAYLOR: But I have another sub -- another subtext which is that I, you know, personally I don’t believe that the NRP is going to be implementable because of how it’s non-funded and non-structured in some ways. So, in other words I think the ocean part of achieving the global change objectives, --

 DR. CRAIG ROBINSON: [affirmative]

 DR. BRIAN TAYLOR: -- it is in part compromised by issues that have happened on the NRP side, including the political takeover by things like marine special planning and so forth that have, you know, made it as politically unpopular as the climate change that are things on the Hill at the moment as well. So, you know, how does -- I’m frustrated by that --

 DR. CRAIG ROBINSON: [affirmative]

 DR. BRIAN TAYLOR: -- because, I mean the committee put a huge amount of effort in, and Admiral Watkins and Leon Panetta and so forth, into the National Ocean Policy. Bob Correll and everybody since has put a huge amount of effort into this. I’m just, you know, as you go from the strategic plan into the implementation plan --

 DR. CRAIG ROBINSON: [affirmative]

 DR. BRIAN TAYLOR: -- you know, how many things have you got to all have working together for good to actually make it doable, and if some, you know, cylinders aren’t firing in your engine, what’ve you got?

 DR. CRAIG ROBINSON: Right, and not only is that a concern with ocean policy, it’s a concern with a program like this with -- we’re looking out 10 year though, and the opportunities over 10 years. We’ve budget constraints now. We all realize that and we look at a program that’s broadening essentially the scope of the program to follow the mandate that we have for a long time to assess, understand, predict and respond. There’s a concern from the community as well. We heard that, okay, you’re talking here not only about research, it’s a global change research program, you’re talking about informing people, assessing, and educating as well. If you’re going to do that, are you then going to take the basic research that you have and cut into that to do these other things? Before you’re talking about oceans and arctic and incorporating many of the other plans out there. So that’s why we said several things as we developed this. First, it’s a 10-year plan. Second, we’re going to have to phase in an implementation of a variety of these things based upon the budget capabilities of the organizations that we have to prioritize. And that’s why for the first time the program is taking on an annual prioritization process and doing this road mapping that Tim has been calling for to look out three to five years. So not only what they’re going to do next year, but let’s talk about that and prioritize that, but also look out three to five years. Put a roadmap out, look at what you need to do, because if budgets are severely constrained you’re not going to be able to do all of these things. So what’s NASA doing with observing systems? What’s NOAA doing? So, we have a process in place. We put in umbrellas for a future plan like this in place. You put a process in place. Do one year planning, three to five year planning, coordinating across. See what NASA’s timeline is so that we can think about the research that we need to do or the capabilities that scientists will have in three to five years based on those observing assets. Look at the cyber-infrastructure and see what you can do with modeling. So all these things, I think for the first time, you’re seeing this program really ascending. You’re seeing, thinking about a variety of different things on short timescales, on medium timescales, on long timescales. Is there a solution to doing all the things we need to do with no budget increases? That’s a short-term view and we need to look to the long term. So, that would be the only answer I can give on that. Okay.

 DR. HORNBERGER: Thanks very much Craig. I have fallen down on the job and gotten us far enough behind that we are going to have a slight switch. We’re going to switch the next two presenters and Tim is going to introduce our next guest.

CISE Priorities Related to the GEO Research Agenda

 DR. KILLEEN: I’d like to introduce my colleague, Farnam Jahanian, who will -- is the assistant director for the Directorate for Computer Information, Science and Engineering. He’s been at the NSF for about a year, I think, and Farnam and I go back a ways. We were both on the faculty of the University of Michigan and co-PIs for NSF-funded grants in introducing the first collaboratives really on scale at the time, so it was an interdisciplinary collaboration across computer science and the time space sciences. So I was delighted to see him come to NSF and he’s been very active in his time here, really the architect of the Presidential Big Data Initiative that came out a couple of weeks ago with multiple agencies and so on. And so we’re delighted to welcome Farnam to the AC-GEO, and very interested in his comments on how computer science and geosciences can work even more closely together and some of the exciting things going on in the computer science world. Farnam.

 DR. JAHANIAN: Thanks very much, Tim. It’s a pleasure to be here. Let me get to the podium. And thank you again for the opportunity. I have a bunch of slides that I want to go over with you, but you know what? It’s not as important to go through the slides as sharing with you some of the thoughts about some of the foundational research that’s taking place in computing and communications, broadly speaking, and also how it relates actually to advances in other sciences, in particular to geosciences. So with that, let me just start by -- here we go. With that, let me just start by just giving you a very high level overview of what CISE’s is mission is, the CISE Directorate, Computer Information Science and Engineering. In a nutshell, our goal is to explore the frontiers of computing and communication. Of course, we promote the progress of computer information science and engineering research and education, and promote understanding of principle and uses of advanced computing, communication, and information technology. And probably what’s most important here is that these frontiers have interfaces with almost all sciences, engineering, education, humanities disciplines, and very, very strong emphasis on innovation for society, as I will elaborate on that in a moment. As I’m sure all of you recognize, over the past few decades we’ve seen a breathtaking pace of advancement that has brought the discipline of computing, broadly speaking, into forefronts of science, medicine, business, arts, entertainment, in ways that we couldn’t even imagine at 10, 15 years ago, or 20 years ago. The explosive growth of scientific data, social data, wireless connectivity, broadband scale -- broadband speed I should say. Access to billions of potentially smart devices, access to resources, seamlessly in the cloud are transforming the way we work, we play, we conduct business, we communicate, and we do science. And our biased view in the CISE Directorate is that computing communication discipline forms a pervasive intellectual fabric that connects a wide range of disciplines. This is particularly recognizing that many of tomorrow’s breakthroughs, stuff that you folks have been talking about for the past two days, will occur at the intersection of diverse disciplines. And discoveries, scientific discoveries and engineering innovations are going to be at the core of our response to many of our societal challenges including the ones that Tim talked about yesterday in his presentation, and I had an opportunity to attend that.

 In fact, when we think about our portfolio in the CISE Directorate, we think of it in terms of what are some of the national priorities that we’re addressing. And what a surprise, these overlap significantly with the same priorities that the folks in your discipline, in geoscience, are addressing from dealing with hazards and disasters, dealing with environment and sustainability. Of course, we worry about things such as broadband and universal connectivity, SERC, secure cyberspace which impacts you as well. And we worry about smart systems, and I’m going to come back to that, transportation and energy, and, of course, all of us at NSF now worry about -- are keenly interested in education and workforce development. So this is really at a very high level. This is the way we think about our portfolio, and you see immediately that there’s significant overlap and synergy between what we do in the computer and science directorate and what happens, broadly speaking, in geosciences.

 With that, let me spend the next few minutes talking about some of the research frontiers in computing and communications, broadly speaking. And while I talk about some of these research frontiers, I’m going to connect that to some of the activities that we will fund, some of the programs that we collaborate with GEO and other directorates, and some of the projects that are funded within that context.

 So let me start first with the issue of data. During the last decade we’ve witnessed a dramatic increase in the amount of data that’s generated from scientific instruments, including the ones that you build and operate, from experimental methods, internet transactions, videos, sensors deployed all around us. There’s no question that we’re dealing with tsunami of data. So here’s a fundamental question. We know that computers can search for data, and they can do that fairly effectively and efficiently, but can they understand it and make discoveries of their own? And that’s a fundamental issue that we’re dealing with.

 So with that, let me take us back to the issue of explosive growth that we’ve seen in CISE complexity of data rate. We’re, there’s no doubt, we’re in an era that’s been called the era of data and information. In fact, we’re drowning in data, and we’re drowning in this state of tsunami, so to speak. We’ve seen an explosive growth in CISE complexity and data rates that are generated, as I mentioned by various kinds of instruments, various kinds of observational methods and experimental methods. Today science gathers data at an ever increasing rate at all sorts of scales and complexities, and we need to store, integrate, extract meaning and information from all of these raw numbers and data points. And this is creating enormous opportunities in harnessing large scale data, turning it into information, and extracting knowledge from that. And this is partially enabled by many of the techniques and technologies that are coming from computer science community, of course, from data mining techniques, and machine learning techniques, to new discovery and visualization techniques, to multicore architecture, to new server architectures and so on. But what’s really important to recognize is that it’s not just about storage and accessing data. That’s just the beginning. We’re also talking about going from data to predictive models and to decision, which really connects the whole, the sequence of things that are incredibly important in addressing many of the scientific challenges that we face.

 So with that, of course Tim mentioned that we recently announced the Big Data Initiative. This was a White House Initiative that was announced at AAAS. It’s a cross-foundational activity, involves every directorate in National Science Foundation, and the initial focus is on core technologies and techniques. But, as you can imagine, the connections with all sciences and engineering disciplines and social sciences is very strong. And the goal here is to advance Big Data science and engineering through support of foundational research for managing, analyzing, visualizing, extracting useful information from large, diverse distributed and heterogeneous data sets. And this includes not only all directorates and offices at the National Science Foundation, but there was a recent announcement involving actually NSF and the National Institute of Health. When you think about, in fact, a program that’s close to your heart, to your community, Earth Cube. Of course, Earth Cube played a significant role in the launch of Big Data that was done a couple of weeks ago. I don’t need to tell you about what Earth Cube is, but what we like about Earth Cube, from a perspective of another directorate, particularly folks who are on more of the computer science and communication side, is that it’s truly an innovative model. A community designed, community owned, and community governed; that very much resonates with us in terms of how we think about some of the large infrastructure that the CISE Directorate is involved in. As I mentioned, Earth Cube played a central role in our Big Data announcement that was to be White House Big Data announcement. As I’m sure you’ve been briefed on it over a number of EAGER awards that were announced as part of that White House Big Data launch, which were part of the Earth Cube sponsored by GEO Directorate and OCI. As we think about Earth Cube, there’re some interesting opportunities. I think about interdisciplinary research as building and sustaining new communities, referring to Tim’s collaboration with me 15, 20 years ago at the University of Michigan. It took us a couple of years just to understand each other’s language, I think. So building and sustaining new communities is really important when we talk about interdisciplinary research, and workshops to bring GEO and computer science and information technology folks together to create those communities, I think is important, and also exploring new EAGER awards potentially to seek new research. And what we find exciting about Earth Cube is many of the issues that are highlighted in the Big Data foundational research are core to what you’re trying to do in Earth Cube. Think about a large scale data management analysis, think about collection storage and management of Big Data, integration of data. Think about data analytics bringing together, fusing together disparate sources of information, sources of data that on surface may not be related but when you integrate them together somehow there’s extraction of new knowledge that comes out of that. And the move toward more predictive models, and move toward automatic extraction of knowledge from that data is an important scientific exploration for our community as well. And of course, another element of the Big Data Initiative at NSF has to do with research that we have to do in building tools for sharing and collaborating over these data sets, diverse data sets.

 So that sort of gives a context for some of the work we’re doing related to Big Data. We’ve had a long history of investment in data management and data analytics. I wanted to give you two quick examples of it. One has to do with a new tool for extracting knowledge from large data sets. And it’s a new statistical tool called MINE, can tease out multiple patterns hidden in health information from around the globe; statistics that -- collected from major league baseball for example; data from bacterial biodiversity and much, much more. That’s the one example of it. Another example of it, which involves actually a computer scientist, and Amy McGovern and Kelvin Droegemeier from your community, looks at parallel computing data mining techniques and meteorology and it’s trying to essentially come up with ways of predicting tornado formation and more reliable tornado forecasting. Again, this is truly an interdisciplinary research, and Amy’s a young researcher who’s a career award winner from NSF and, of course, I’m sure you’re familiar with Kelvin’s work, as an example of interdisciplinary research that involves Big Data and computation.

 Another area of research, frontier research that we’re exploring has to do with expanding limits of computation. For the past four decades, I’m sure many of you in your careers have experienced it, that we’ve seen a tremendous growth in computational power that’s been achieved by putting essentially more and more and transistors on chips, microprocessors. However, this trend that’s known as Moore’s Law seems to be reaching its limit. So one of the fundamental computer science questions that we’re trying to deal with has to do with the fact that can we continue the exponential growth in computational power for the coming decade? That’s an important issue for computer scientists and computer architects. So why would you care about this? Well, it turns out, before I get to that, as I’ve mentioned, we’ve seen dramatic exponential growth in this area in what’s known as Moore’s Law, and around 2004 it started to plateauing, and I don’t want to get too technical about why, but it really has to do with limitation of heat density in transistors or CMOS devices. So while transistor densities continues to scale, power has hit a wall, so to speak. So we can’t essentially pack more and more transistors on these chips because we -- essentially the increasing clock frequency that’s led to power dissipation levels leads to essentially the processor performance started to leveling out as a result of it. We just can’t essentially turn those transistors on if you will. So why should you care about this? Well it turns out the exponential growth that we have seen in computational power of systems that we’ve dealt with has had an enormous impact on scientific exploration. Scientists and users have an enormous appetite for speed and performance. This is of course accentuated today by emergence of massive data sets and I think your NCAR-Wyoming Data Center’s a great example of that, where you have essentially two sides of the same coin, which is computation and data is coming together. This will pose problems. It’s not just solving old problems faster; we’re able to solve new problems that we could not have essentially solved before, as a result of access to computation. Of course this impacts physics, material, biology, climate, and so on and so on, and a number of issues having to do with sustainability that your community deals with, of course, are going to require much, much more computational power. There are a number of short-term, medium-term, and long-term solutions that are worth pursuing and it involves interdisciplinary researchers from computer science, computer engineering, material science, electrical engineering, and so on, dealing with this issue. But the one that I wanted to highlight, which is somewhat of an intermediate approach to this, has to do with a research agenda centered around parallelism concurrency for the entire spectrum of computing environment. So there are really two things here. One is we’re trying to reduce the energy consumption and power dissipation of these systems that we built. So that’s one important thing. The other thing is if people are going to continue on this exponential growth, then we’re going to have to build systems such as the NCAR-Wyoming Center that you’ve built, that relies on essentially parallelism and concurrency, clustering a lot of these things together and then having the software that runs on top of it, which means that an interesting research agenda dealing with new programming languages, compilers, operating systems, and so on that support that environment and this is absolutely within -- is an important priority for us within the CIF21, Cyber-infrastructure for the 21st Century framework. And this allows us to focus on limits of essentially computation moving forward and I hope that you see the relationship to some of the scientific work that you do. Another trend that I want to highlight, another frontier that we in the CISE Directorate are exploring, has to do with what I refer to as melding of the cyber and the physical world, a trend that’s going to continue to accelerate in the coming decade with the advances that we’ve seen. This is partially being ushered by widespread deployment of low power sensors from tiny specialized communication processors such as SmartDOS [spelled phonetically], to specialized sensors that we wear on our clothing and our body and so on. And increasingly important to your community, sensors that are getting deployed in environments, in various sort of structural sensors as well as environmental sensors; not to mention, in fact, these little devices. By the way, when I talked about parallelism and concurrency, these have parallel processors in them. In fact, these devices have the same power, as I’m sure all of you know,

the supercomputers of the 1970s that we deal with. So when I talked about the having your research engines or the focus on that on that concurrency, it goes all the way from your cell phones, from your smart devices all the way to the super computers including the NCAR Wyoming supercomputer.

 By the way, Tim, you asked a question yesterday, how many Library of Congress? I did a back of the envelope calculation; I think it's 10,000. Don't quote me on it but I'm going to check on it again and let you know. I think you said 150 petabytes of data store? That's about 10,000 Library of Congress. [laughs] And of course you have one petaFLOP of I think computational power.

 Back to sensors and smart devices. See, I was paying attention, Tim. I took notes. I did my homework. I tried. But let's get back to these smart sensors. These are enabling. These are enabling. Amazing applications in environmental sensing, in emergency response, in people-centric sensing, social networks and so on, as well as a growing large number of application in health care and informatics, which is beyond the scope of my presentation today.

 But, as I said, we're dealing with a tsunami of data. Part of that is enabled. We know it's your observational methods; we know it's your experimental methods, but it also is because of sea of sensors' upward decline. We're swimming in a sea of sensors and are drowning in the data that's generated by that. The ability to analyze data in real time retrospectively is important. Network systems and there was a recent PCAST report on networking information technology that highlighted this, that network systems not only have to scale up, which is what we are worried about, but they have to scale down and they have to scale out. By scaling down we mean miniaturized, low power adaptive self-calibrating instrumentation devices that you can deploy and almost forget about them. And by scaling out, we mean embedded sensors that are going to be distributed everywhere through everything. And in fact, many of the environmental sensing programs or activities that I'm looking at these days, or we're looking at these days, they're talking about hundreds of thousands of potentially small sensors being deployed to monitor things. There are numerous research challenges having to do with algorithms, models and theories that have to be developed. How do we build these systems that combine the cyber and the physical world? We have to be able to model this physical world and abstract representation of the physical world to be able to build these systems. And of course we need to enable the research community and work force that's going to be prepared to deal with these.

 The way we think about it is, how can we build and verify systems upon which people can and will better their lives? It's not just about environmental monitoring, it's also about, for example, sensors that go into bridges and structural monitoring of bridges. Airplanes have them, various kinds of nuclear reactors and so on increasingly, as you have information technology pervading into various sectors in our economy.

 There are a couple of programs that I wanted to make sure that I highlight, which is part of our portfolio. It involves multiple directorates. One is our cyber physical systems, which deals with this very issue of a smart system, deeply integrating computation, communication, and control into the physical world. And there are numerous applications from transportation to energy and industrial automation, health care, critical infrastructure, environmental monitoring and so on. The other program, which we actually were thrilled that President Obama, himself announced last year, got the same kind of attention that the Big Data announcement got, was the national robotics initiative, which is developing the next generation of collaborative robots to enhance personal safety, health care productivity. Again, there are lots of applications having to do with sustainability and also dealing with hazards and potential disasters.

 Just to give you a couple of examples so you see the diversity of the projects that are funded and how interdisciplinary they are as part of our NRI and cyber physical systems program. Assistive medical technologies, these are programmable second skin sensors and they reeducate injured nervous systems. That's an example of cyber physical systems.

Another one has to do with autonomous vehicles, which is development of precision and real-time sensors, smart algorithm verification tools. And I don't have the video to show you because I knew I was going to run out of time but we actually have cars that drive themselves without a driver in it. And there are a lot of interesting things. Again, it's another example of a system with lots of sensors in a cyber-physical system.

 And something else that I'm sure the researchers in your community are aware of has to do with the environmental sensing. Modeling and software allows actuated sensing in dynamic environments such as rivers. And think about scaling this at the national level and the challenges that we face with that.

 Tim, I have, what, 15 minutes left? Ten minutes left? How much time do I have? Ten minutes? Okay, I'll try to get through this in about 10 minutes.

 Another important trend that -- we view it as a frontier for our discipline -- has to do with new breeds of communication. Now all of you recognize the phone on the left. This is a 1988 phone. That's actually -- I'm sure each of us in this room owned a phone that looked like that. Well, these are all the modes of communication that we're dealing with, of course, the next generation of scientists and our kids are dealing with, from social networks to mobile devices to email to Voiceover IP to video and so on and so on. One thing I wanted to mention about, just to give you an anecdotal example of the complexity of these things. Think about Skype, Voiceover IP. As of last year, there were about, I think, 680 million users of Skype. If Skype was a phone company, it would be the largest provider of long‑distance service. If Skype was a traditional phone company, it would be the third largest phone company in the world, not behind AT&T and Verizon, actually behind Vodafone and China Mobile. And this is a system that we sort of take for granted. This is how fundamentally the landscape, the communication landscape, is shifting. What that leads to is -- what we're witnessing, I should say, is an increasingly becoming a networked or a connected society, if you will. Access to technology information is enhancing our cognitive and physical abilities in a number of ways, which is beyond the scope of this presentation. People all over the world are now participating in an astonishing variety of collective distributive tasks, not merely to contribute information about themselves but also about participating global collective causes. And in fact, it's leading to networks of human minds that are taking citizen science to new levels, new methods for problem solving. And that's, again is going to have an impact no doubt on scientific discovery and engineering innovations. And there are a number of trends that are going to accelerate this, from social informatics, assistive technologies, augmented reality robotics, crowdsourcing, and so on and so on. And these are many of the technologies that my colleagues in the CISE directorate work on.

 But an example of that is -- has to do with -- if you think about innovation that leads to access and interaction with information, integration of information. I want to take you back to Vannevar Bush and his vision of what he called was Memex. And I'm going to quote -- and here's what he called Memex. And that's an actual diagram from 1946. And let me quote, "Memex, or memory index, in the form of a desk would instantly bring files and material on any subject to the operator's fingertips. Slanting translucent viewing screens magnify super microfilm --

 MALE SPEAKER: That's wild.

 DR. JAHANIAN: -- yes, filed by code numbers. At left is a mechanism which automatically photographs longhand notes, pictures and letters, and then files bring them in the desk for future reference."

 Well, after about 67 years of federal support of discovery and innovation, Vannevar Bush's vision of a desk‑size, I should say, device to store an individual's information has evolved into a hand‑held device, when connected to the cloud, really acts as a storehouse for the world's information. We have gone -- we've really achieved that vision and have gone far beyond it. And it really truly stores -- it serves as a storehouse for the world's information when you think about connection of these small devices we have with all the resources that are available in the cloud including data centers, including in various kinds of resources that are available.

 Achieving all of this, of course, advancing the frontiers -- research frontiers -- requires the right science at the right scale. One of the programs that I wanted to highlight is the expeditions in computing, which the idea here is to explore scientific foundation -- scientific frontiers that promise transformative innovation in computing, but it's not a small or a medium or large. It's kind of an extra‑large. It's not a center scale activity, but it's $10 million per project, $2 million per year per award for five years. And it has led to some phenomenal interdisciplinary research that we're funding at National Science Foundation. And we announced four of them just recently. This is the original 10. You see that there are two of them having to do with environment sustainability. This again brings people in information technology, computer science, and people in geosciences and in other cases your seeing cases of health care and well‑being, and beyond Moore’s Law, there's a couple of them now in robotics and so on. These are large scale, truly interdisciplinary activities.

 Two examples of that, one has to do with a University of Minnesota led activity called Understanding Climate Change: A Data Driven Approach, which is in its second or third year. And another one is called RoboBees. Robert Wood, in fact, is a Waterman Award winner this year and he's -- it has to do with micro bots, micro robots, tiny robots with real‑time sensing and communication capabilities that has potential for impacting assisted agriculture, search and rescue, and environmental monitoring and so on. He has videos of these tiny micro robots and these tiny things fly all over the place and really have some truly phenomenal applications. And both of these are coming from our Expedition in Computing program.

 I can't give a presentation to the GEO community without mentioning SEES, our investment in SEES. Of course, as all of you know, SEES is a cross‑foundational major activity in science and engineering education for sustainability, and it's truly one of those unique activities that involves not only every directorate in every office. It involves, I don't now, 100 program officers, numerous parallel solicitations that have gone out. As I mentioned at the beginning of the presentation, if you were going to solve societal problems, you're going to have to bring an interdisciplinary team of researchers to address them. I think SEES is a terrific example of how we can achieve that. CISE’s involvement in SEAS is in a number of areas and I can tell you that over the past couple years here as at NSF, it has grown significantly and it has to do partially with a lot of conversations that I've had with Tim over the years, especially over the past couple of years. One of it has to do with rollup information science and engineering and sustainability.

 I look at it in two ways. One has to do -- if you look at data centers, if you look at these large data centers, the estimates are that by 2014 about 3 percent of our electricity usage in this country is going to go to powering and cooling these data centers. That's a staggering number, folks, including your NCAR Wyoming data center. It is a staggering number, and I think that's probably even a conservative number. So at some level we view our data centers, our data centers, to be polluters. So one thread of activity for us has to do with green computing. How do we develop, essentially, low‑power devices? How do we, essentially, reduce the energy consumption of these data centers? This could have a dramatic impact. Another has to do with an area I alluded to. With all these smart devices we're building, these sensors we're building, how can we essentially enable sustainability through deployment of information technology and sensors? And these are really two major threads. And this is just something that is just getting launched in these two activities related to our involvement in SEES. But there is another involvement.

 Oh, by the way, there are two projects that relate to that. One has to do on the left to a new approach to power distribution in mobile devices. It will reduce battery usage up to 20 percent and may actually revolutionize hand‑held -- hand set design. The one on the left has to do with monitoring environments. Sensors -- this is actually deployed -- in autonomous robotic fish monitor, real‑time movement and quality of water in lakes at Kellogg Biological Station in Michigan. But there's another area within the context of SEES that's a huge interest to the CISE community. And it has to do with emergency preparedness but disaster management and what some of the folks in your community have referred to as hazards. Of course, disasters arise from unpredictable acts of nature such as the unfortunate earthquake and tsunami in Japan. Katrina, the hurricane in 2005; or humans, the Deep Water Horizon oil spill in 2010 and other man‑made events. Building on existing investments in SEES National Robotics Initiative, CPS, you see how all of these are inter‑related as far as we're concerned. We believe that there's a tremendous opportunity for the CISE community to participate in emergency preparedness and disaster management and issues having to do with hazards. Having to do with sensors and mobile devices that greatly enhance data gathering. Visualization analysis predictive models are going to be critical for real‑time decision making, communication networks.

 Ad hoc clouds: Think of not the cloud that you're dealing with but think of clouds that are formed in an ad hoc fashion and crowdsourcing enables hazard mitigation and management, and of course autonomous robots aid in search, rescue and recovery. And that's one of our PIs from National Science Foundation with her robot actually in Japan, I believe that this. So this is obviously an important area of research for us and we expect that will be working with GEO, engineering and other directorates related to this.

 The final thing that I want to highlight has to do with education. E Squared, as you know, is an initiative dealing with education, science, and engineering education. Our role in it initially has to do with a program that we've been funding for several years called Cyber Learning, and the idea is to improve learning by integrating emerging technologies with knowledge from research about how people learn. So it's understanding how people learn in technology-rich environments and designing and studying ways in which innovative technologies and tools can promote learning and support assessment. And finally, prototyping these technologies and integrating them into new learning environments. And we're in our second year of funding of Cyber Learning in the new iteration of it. Examples of them include social robots for -- as a mechanism for language instruction, interaction and evaluation with school kids. I think the coolest one is this: it's exploring augmented reality to improve learning by deaf children in museums. Think of it this way: Children who are hearing impaired; when they're watching a -- when they're in a museum or a classroom -- if they're seeing a demonstration, they have to watch sign language and watch a demonstration at the same time. The idea behind is, they're developing a patch that a kid can wear and you can essentially, using augmented reality, watch a demonstration and essentially sign language at the same time. I think it's just really cool.

 And this last one has to do with GEO games, a visual, virtual simulation workbench for teaching and learning through a real world, spatial perspective in GEO sciences.

 That's pretty much all have to say. What I want to say before I wrap up is that I think all of us in the science enterprise recognize that discovery and innovation is a multi-disciplinary, multi institutional, multinational and multi-cultural endeavor, and truly what we're seeing at NSF, and I'm sure Tim has shared this with you, we're seeing increasingly activities that involve multiple directorates, multiple perspectives that are coming together to address some of these important issues. There's no doubt that our investment in research education has returned exceptional dividends to our nation. A thriving, basic research community is the foundation for long‑term discovery and innovation, economic prosperity and national security. Many of tomorrow's breakthroughs, of course as I mentioned, will occur at the intersection of diverse disciplines with enormous possibilities for the change.

 On a very personal note, Tim, I'm going to embarrass you.

 [laughter]

 I want to thank my friend, Tim Killeen, for his leadership of the geosciences at NSF, his relentless pursuit of issues that are so important to the future of our planet. As Tim mentioned, I've known Tim for almost 20 years now, dating back to the mid‑1990s, when he and I were co‑investigators of the UR collaborative at the University of Michigan. It's been an absolute thrill to work with him again here now at NSF for the past year, year‑and‑a‑half. There's no question that he, single‑handedly, more than any other individual on this planet, has shaped my thinking about sustainability, Earth system science, especially over the last few years and that's the kind of impact he's had nationally and globally. There's no question about that. His service at NSF will have a long‑lasting impact on science and engineering for decades to come. Please join me in thanking Tim for his leadership.

 [applause]

 With that, I thank you for your time. I'm sure you will.

 DR. HORNBERGER: That was great. Thanks very much.

 DR. JAHANIAN: It's my pleasure.

 DR. HORNBERGER: We'll take time for just a few questions or comments. Walter and then Dave.

 DR. WALTER ROBINSON: So our young people, some of us, have these super computers in our pockets, but we have -- I at least see a paradox in our students as they have access to more and more computational power, the number of students who are really adept at what we would in the old days call programming, seems to be declining. And the students don't really -- they don't have -- they're not developing the skill set to how to make, for all we hear in the media about the kid who develops the multimillion‑dollar selling app. In general, they don't have the skills to actually make these machines do interesting, scientific things, and I'm wondering if you see that and what you're doing in science about it if you do?

 DR. JAHANIAN: I'll go back to the podium since the microphone's here. I think your highlighting an incredibly important issue here. You're absolutely right. We're not -- we don't want to turn every high school student or every college student into computer scientists, but in this day and age, we need to have scientists, engineers, and citizens that are computationally aware, they're comfortable with data science, because it's not just in scientific endeavors or engineering innovations that they need to have these skills. They need to have these skills for almost every sector in the economy. I could not agree more with you on this. And there's some things actually we're doing within my directorate that has to do with dealing with underproduction, under-representation, and equally important, pipeline issues in terms of, we've got to get to these kids in middle school and high school to get them to become much more aware of computational techniques and data-aware techniques. Again, I want to caution you that I'm not saying let's turn them all into computer scientists; we just need to have public citizens who have these skills and these skills are going to be incredibly important for the future. So that was one of my hot buttons. Thank you for pushing it.

 [laughter]

 DR. HORNBERGER: Dave.

 DR. SCHIMEL: Well, I just had a point of edification -- information. According to my Memex here, there are 10 terabytes of printed material in the Library of Congress.

 DR. JAHANIAN: Okay, so I have to go back and...

 DR. HORNBERGER: Okay, last comment, Brian.

 DR. JAHANIAN: Tim, I'm going to get back to you on that data. Don't quote me on that.

 DR. BRIAN TAYLOR: I found that your presentation was truly exciting, especially because I see so many of these developments as being potentially truly disruptive, which in my mind is beyond transformative, for that old word. Particularly some of these cyber physical systems, distributed sensor systems, I mean in our GEO field, this is the way. This is the way.

 DR. JAHANIAN: Absolutely. I agree.

 DR. BRIAN TAYLOR: But not only are we not necessarily training the people to write the new programs, I wonder if in part of -- the data part of your slides, are people -- as the explosion of capacity storage as well as computing capacity, we used to sweat blood about a line that was too long in the code and now we just have codes that are a bazillion lines long. As a start hitting the limits in some ways, are people going back to think about reducing the flood --

 DR. JAHANIAN: A good question.

 DR. BRIAN TAYLOR: -- in which we are immersed? And constraining this, what has previously been sort of an unlimited growth? You know what I'm getting at?

 DR. JAHANIAN: Absolutely, yeah, absolutely. I'm of the same generation where we used to write assembly code and we would be worried about essentially how many bytes it took in execution and optimizing and so on. In fact, we've taken that for granted, I think, for the past two, three decades because the computational power keeps doubling as a result of Moore's Law and so on. And in fact the point I was trying to make is in fact we can't take that for granted any more. But it doesn't mean we have to go back to the old ways, trying to optimize our programs the way we did it. I think parallels and concurrency is going to be critical to this. We know how to write sequential programs. What we really need to figure out, how to essentially harness the parallel, essentially, capabilities of the kind of super computers that are being developed? Which is not spending hundreds of millions of dollars trying to essentially just advance the process architecture, it's lashing together to some extent commodity, essentially, infrastructure. But we don't really know how to write programs for those efficiently. And that's going to be something that's going to require a lot of work. Because if you can't just take your -- a problem that you've written a program for and just run it on these massively parallel systems. Some of these problems are embarrassingly paralyzable, so those are easier to do, I'm sure you know that, but others, it's an art. And that's something that requires a lot of work.

 I'm well over my time, I'm sure.

 DR. BRIAN TAYLOR: And not only on the programming side but even on the data compression side --

 DR. JAHANIAN: Absolutely.

 DR. BRIAN TAYLOR: -- extracting the most important part of it and throwing the rest of it away.

 DR. JAHANIAN: Absolutely. I cannot agree more.

 DR. HORNBERGER: Okay, last comment to Tim and then we're going to move on.

 DR. KILLEEN: Really great. One of the issues we're dealing with, with Earth Cube is this inhomogeneous data and how to combine it. And you know, Watson won at Jeopardy and now apparently IBM is putting Watson to cure diseases and things like that in some massive new task. Is there a kind of oncological revolution taking place too, in terms of machine to machine as opposed to grad student to machine and back and forth? People -- can people get out of the way in some ways?

 DR. JAHANIAN: I think -- you're raising an important point. It really has to do with -- I think of it in two ways. I don't want to get philosophical about it. One is that, one has to do with automatic extraction of knowledge which means, we're kind of out of the way. And that involves computers working together, sensors, devices, databases and so on. I think that is definitely an amazing area of exploration and we're going to see more of that. Another area has to do with, I think, people in artificial intelligence have been talking about for a long time and I think they were wrong in a sense that it's not about mimicking human intelligence. It's not about that. It's about augmenting our physical and cognitive capabilities. And I don't mean just in terms of assistive technologies for elderly. Think of search. What search really does is it does a lot of things for us automatically but then it creates a context for us to make a decision, which would be really, really hard to do if you didn't have the technology underneath, creating the context and essentially narrowing it down. I think that's an area that we're going to see a lot of advances, and I refer to that as augmenting physical and cognitive capabilities, not mimicking human intelligence.

 With that, thank you so much for your time.

 DR. HORNBERGER: Thank you.

 [applause]

 Okay, Maria has been very gracious and postponed, and I'm going to ask her for one more favor. Our lunch is out there. And so what I'm going to propose is that we go and retrieve some lunch and come back and chew quietly while we listen to Maria's presentation. Okay? So if everyone can line up and be back here in no more than 10 minutes.

 [break]

Update on GEO International Activities

 DR. HORNBERGER: We're going to go ahead and start. I think we've lost a couple people but I think the bulk of us are here. And again, my apologies to Maria for being late and thanks for putting up with us. Please.

 DR. UHLE: Great. Thank you for having me here this afternoon. So I'm just going to give you a quick overview of what we've been doing in terms of environmental change research activities. So in the front office, we kind of do the global environmental change, whereas each of the divisions has their own international program. So Ocean Science has the international ocean drilling program and I don't get really involved in too much of that. So this really focused global environmental change activities.

 So, quick rundown: I'm just going to talk about Belmont Forum and a quick introduction to that for new people; a new initiative called Future Earth; the International Group of Funding Agencies for Global Change Research, or IGFA. Some exciting things have happened at our most recent Planet Under Pressure meeting which was held in London, and some interactions with our global -- our regional global environmental change research networks. And then some of the things that we're doing with the EU in terms of E‑infrastructure. If you have any questions on that you can ask Dave Schimel. He knows everything.

 [laughs]

 So our current membership of Belmont Forum is actually sort of the NSFs of these various countries and we've come together in a likeminded way to promote the mobilization of international resources to support global environmental change research. We also have the International Council for Science, or ICSU, as part of this, as well as the International Social Sciences Council. And I think the way that we like to think of Belmont is that it's a bit different in terms of we're trying to natural and social science and have co‑development or co‑production of research co‑design right from the beginning, so instead of just keeping natural science. And then, as we all know, if we're looking at doing some sustainability research, a lot of times it's, I need to find a social scientist -- oh, here. This is a concerted effort to promote the design right from the beginning. And that kind of sets Belmont Forum apart from, I think, a lot of the other initiatives that are out there.

 In its first meeting, the Belmont Forum came together to establish what we call the Belmont Challenge. And it's really to set the stage for science to deliver knowledge for decision making. And so we wanted to look at things like detrimental environmental change, extreme hazards, and we thought that this really needed to be based on information from the state of the art through advanced serving systems, a lot of risks and impacts and vulnerabilities, through regional and decadal analysis and predictions. So again, taking the science and making it applicable to the decision makers. So this is, if you want to think about this, an international SEES initiative. So sustainability, this is very much along those same lines.

 So interdisciplinary right from the start. We want a couple natural, social and economic systems right from the beginning. And really to -- the big thing that we've been working on is to develop a mechanism where we can coordinate and marshal international resources to make this all happen. So we have come up with what we're calling the International Opportunities Fund. So based on the G8 countries' heads of research councils, there's a mechanism out there that we've adopted to basically put out a single call for proposals with 11 different countries. It will be one proposal with three -- minimum of three partnering countries, so PIs from each of those. It will be one review process and each of the countries will support their own researchers. And so we've put money basically on the table. For our first call we've focused on coastal vulnerability and freshwater security, and the reason for that was we had compared our planning and our priorities and we all noticed that they overlapped quite a bit and we felt that coastal vulnerability and freshwater security were ripe for international collaboration, and we decided to start with those. This is not the only thing that we'll be doing. In fact, I'll spend a little bit of time telling you what we're spinning up next year or so.

 So again, this will be a single website for submission. We're going have two theme program offices to run the peer review, the Natural Environment Research Council in the U.K. will handle coastal vulnerability and NSF is going to handle freshwater security.

 We also have commitment from 11 countries. There's about 20 million euros on the table right now, but there's also two other programs in Canada. So NCIRCS [spelled phonetically], their climate change and atmospheric research program has a focus right now for coastal vulnerability that we're going to be able to tie into. And the EC has in their framework seven coastal vulnerability theme that will come in and that's put on the table about six million. So we'll be able to leverage some of that as well.

 MALE SPEAKER: Has that come out?

 DR. UHLE: Which one?

 MALE SPEAKER: Come out Monday?

 DR. UHLE: What, the theme? Yes. Yes. It went out on Monday, April 16th. And so it's on the website.

 DR. DELANEY: That’s not the due date.

 DR. UHLE: No, hang on. I'll get to that.

 [laughs]

 So it went live April 16th. But the -- it's on the Belmont website. NSF is still, believe it or not, looking at our "Dear Colleague" letter, so we haven't officially advertised it but it is on the website. And no one could do anything with it until after that anyway. So it's sort of a pre-advertisement for all of this, but these are the work packages. So if you deal with the European community a lot, you'll hear work packages. It's kind of two sections of the proposed work.

And so for freshwater security, we're looking at identifying projects that will characterize and identify interactions between natural and human practices that start to govern water budgeting in various areas. We're also going to be looking for projects that will develop approaches that support evolution of resilient communities and regions and focusing on seasonal forecasting of droughts and basically those that take into the natural and socio economic drivers that are associated with that.

 For coastal vulnerability, again we're going to be looking at two separate work packages: characterization of natural processes and human interactions that govern coastal vulnerability and resilience, and then also the development of predictive frameworks that will hopefully help provide information for adaptive coastal management strategies and support the evolution of resilient coastal communities. And again, these are going to be tied into the EC and the Canadian call.

 So here's your time line. So the call opened. The deadline for pre‑proposals is actually four months away, so July 20th. September 20th, we will provide information on the feedback to the PIs of who's going to be invited to submit a full proposal. Those full proposals will be due December 20th and hopefully our funding decisions will be done in April and May. And we have everything on board for the Belmont Forum right now, all the call text is there. So it's our opportunity to start building some international initiatives. But also we have on this site a research matching site. We're kind of calling it -- it's a little dating service -- and people can, if they're interested in doing this but they don't know exactly who they want to partner with in these -- in different countries, they can register, say what they're interested in, and that will provide contact details to get them talking. So that is the big exciting thing that we've done basically in the past year and it was an inordinate amount of work to get this done.

 What we're also thinking that obviously we don't want to stop here so we -- the way that Belmont is working is, a couple of the members will come together and think about some new exciting opportunities and research directions and propose it to the group. And so at our last meeting in Kyoto we had three that were put on the table: Food Security and Energy Usage by Brazil. And they wanted to look at the interplay between food security, sort of the wicked problems, the tradeoffs that you have between looking at food security and biofuels.

 Canada put on the table Arctic Science, and looking at how to develop strong northern communities, the unique challenges that are associated with those, and how would you start to look at sustainable development of local cultures and what basic science needs to be done to help make those decisions. And then we put on the table, research and e‑infrastructures, so think Earth Cube. So this is kind of the first attempt to take Earth Cube as more toward an international approach. And so the way that we typically work this is we have a scoping workshop for each of these. Right now, this week actually, at the IPY conference in Montreal, Canada is getting together some like‑minded Belmont Forum people to figure out how we think the call should be constrained. And we will be doing one on the research and the infrastructures in October, and I believe Brazil is shooting for September timeframe. Those then will be kind of scoped out, calls will start to develop, and we'll take that information to the Belmont Forum principals in January and hopefully we will have our pledging around there. Basically, people go around the table and say how much money they can throw into the pot and we move on from there.

 So these are the next stages and we'll be looking to get input from you guys on what you think, within these particular focus themes, what we should be looking at. That would be greatly appreciated. Plus, if there are things that you think we should be starting to look at in the future, that would be greatly appreciated as well.

 So if we move one step further, so a lot of this is actually going to be put into a larger global context or global framework, and we have been working with -- so through the Belmont Forum we've been working with ICSU, International Council for Science, International Social Sciences Council, UNEP, UNESCO and the United Nations University in a thing that we're calling the Alliance. And basically this is a strategic partnership where we're trying to get the funders, operational service providers, users of global environmental change science together to create a framework where we can actually start to address things like the Belmont Challenge. We are also going to be expanding our membership, most likely to include international business councils for sustainability and then several others that the group is exploring.

 And one of the things that underneath this is this new initiative called Future Earth, and it is the global environmental change programs of ICSU, and they're heavily involved in this, and we're trying to create this framework where we can move things much more coordinated, in a much more coordinated fashion and provide a framework for where all the user needs can start to influence research and research being able to take that to help decision makers. So we’ll be looking at providing interdisciplinary and transdisciplinary research, collaborative research, building on our existing and current capabilities but also looking to improve the capabilities and capacity building in developing countries with an emphasis on regional networks. We want to look and take the regional networks that we have and help link those together a little bit better and provide opportunities for that kind of knowledge to go from the from the local to the global scale and then global to the regional scale. Also, to look at ways to develop the next generation of sustainability scholars. We all know that's an important aspect of this. And then also to work on our transnational funding, and Belmont is happy to be part of this to do that.

 And that's actually -- this whole initiative is being developed by a transition team and there they are. So it's -- you might recognize some faces. It's being co-chaired by Diana Lieberman and Johan Rockstrom, and then the folks on the bottom there are the Alliance members. So we're all kind of trying to push this forward. They've had a couple of different meetings and we're starting to develop a framework, some science priorities, and building on what we have already and trying to better coordinate things for the future.

 So the critical endeavors that they're looking at -- this will seem fairly familiar -- looking at how to reorganize the global environmental change research structure so that it is really responsive to this end to end type approach. So think again, sustainability, SEES, and an USGCRP. So these are things that we're taking internationally. We all realize that this endeavor is going to require a very large step change in research funding and coordination. At present, the traditional funding groups cannot do this next step. Our budgets are limited. So we're going to need to, in my mind I like to call it, diversify our portfolio funding; so we're going to need to bring in new avenues, new partners. So that's why we're looking at ways to involve the development aid agencies in some of this. And then also business councils, also with private sector funds and foundations. And really what we're trying to do here is to take this natural social science integration and make it applicable to decision making.

 So here's the Future Earth website. It's hosted at ICSU so if you're interested you can kind of peruse that and see where we are moving forward. As I said, IGFA is the International Group of Funding Agencies. This is the group that Belmont kind of came out of. And this group is stepping up to the plate to provide that new -- hopefully that new avenue of funding. So we're working very hard with our development aid agencies to start this dialogue of how can the global environmental change funding agencies and the development aid agencies work together. There's been a few attempts at this. There was a workshop in 2005 and there was little bit of limited success with that, but actually we've -- our AAAS fellow from here, Erika von Schneidemesser and Lexi Hanson from USAID, another AAAS fellow, actually got together and at the Planet Under Pressure meeting put together a symposium for just this. And we're planning two workshops. We are working with our counterparts in other countries. So SETA is the development aid agency for Sweden, NORAD in Norway, and then DIFID in the U.K., and then USAID is on board with this as well.

 So we're looking to make that into a case study of how to do this using Africa. And so there will be two separate workshops, one where the development aid agencies kind of get together with the global environmental change group to see how we can move things forward, but prior to that we're going to focus our efforts on figuring out what is going to need to be done to actually implement this African‑esque science plan that has been established.

 So at Planet Under Pressure, it was held in the U.K. -- or in London from the 26th through the 29th, we had a lot of activities going on. We had a Future Earth key event where it was an open up, meet the people that are doing this, provide an opportunity for the community to provide feedback. And then we also had a town hall event that we followed with that so that they could provide a little bit more input into that.

 On our Belmont Forum key event, this is actually where we announced the International Opportunities Fund and kind of stepped through how the process was going to work. And there was about a hundred and something people in the room, so there was -- it was much appreciated and a couple of the comments were, thank you for finally doing this. We're tired of double jeopardy. So now we can go to one place, one time, and get this done. And then we also, again -- it was our AAAS fellows that developed this roundtable and dialogue between environmental change and development aid agencies. So those were the main activities that we had at Planet Under Pressure.

 So, to wrap up, we have been working with our global environmental change, our regional networks really to look at building capacity in these different eight areas and to really push this end-to-end type approach where we're taking science to decision making. And our key partners that we've been working with are the Inter‑American Institute for Global Change Research, or IAI, and START. And START's been focusing on Africa and the Asia‑Pacific, and Latin America is through IAI. And so we've been kind of moving those things forward and we're working with the IAI right now to set up a tri‑partite directorate. There has been some issues with Brazil where the directorate is hosted, so we're looking at a way to kind of diversify that portfolio between Uruguay, Argentina and Brazil.

And we have been pretty successful on extending our reach into the EU. In terms of our infrastructure, e‑infrastructures especially, the EU in their Framework 7 put out a call for proposals that encouraged collaboration with the NSF. And through Office of Cyber Infrastructure, Math and Physical Sciences, and GEO, we put out a "Dear Colleague" letter in December that basically provided the opportunities for -- once the EU had been funded then we were able to open that up to our U.S. PIs to collaborate with them. And we've actually gotten a few nibbles on this and we're starting to move things forward. The EU found out one of their major things got funded, and so actually all the way in the back, Greg Anderson is going to be working with this group, and we've had a few others that have looked to start to use our new mechanism called a SAVI, Science Across Virtual Institutes, to leverage the existing programs that we have and to work with the EU on this.

 So, that's it. And I'd be happy to take any questions.

 DR. HORNBERGER: That's great. Thank you, Maria. Questions for Maria. Walter?

 DR. WALTER ROBINSON: This looks really exciting and very encouraging, and actually when the GEO vision document was being created, some of us had, among drafts, had suggested that international activities be elevated, and they were, and now we see the outcome so it's very encouraging. I guess I have two questions; I'll ask them both. One is, one of the challenges to international collaboration has been transparency, openness, and sharing with the partners, and I'm wondering where that is and are there rules to play and so on? Have you negotiated those things? And the other, maybe shorter question -- I can already sort of tell the answer -- is, I gather that now as opposed perhaps in the past, you're getting a lot of enthusiastic cooperation from the U.S. State department.

 DR. UHLE: Yes.

 [laughter]

 The State Department -- we especially work with them with the IAI. And we are thankful for their support in a lot of the things that we've been doing with them. In terms of the transparency and openness, do you mean in terms of the review process or data or projects or what kind of?

 DR. WALTER ROBINSON: Actually, all of the above. Data has often been the particular issue. Sometimes particular types of data are sensitive --

 DR. UHLE: Right.

 DR. WALTER ROBINSON: -- particularly in a particular nation.

 DR. UHLE: Right. Well we -- what we've done with that is we've set up an MOU. It's an overarching one. We've come up with review criteria. We've come up with a management plan, an implementation plan that all 11 countries have signed to. And so these will require open access to data, publishing. We also will have a peer review process that everyone has signed up to. It will be an international panel. We will have conflict of interest being vetted before -- and let me tell you, that was one of the interesting things to get through -- but we did that. Everyone is happy with the definition of conflict of interest. And I think this first round will be our learning curve, but we are basing our -- this whole mechanism on the G8 heads of research councils. And they've run two calls already. So we're not really inventing the wheel here, we're hoping to just kind of soup it up a little bit.

 DR. HORNBERGER: Other comments or questions? David.

 DR. SCHIMEL: I just had one thought regarding the future of this. I'm not sure whether you were in the room but I think that there's tremendous interest on the advisory committee in the area of global environmental change and natural hazards. And that would seem to be an outstanding area for NSF to bring forward as a future topic area within the international framework. There's incredible support on this committee for doing that within the, if you will, the domestic portfolio. But the international portfolio seems equally appropriate.

 DR. UHLE: Well actually, it's funny you should say that. That is another potential Belmont Forum collaborative research action that we would be kicking around. I know that from our Japanese colleagues, they're very interested in that, obviously, for obvious reasons. But what we'll end up doing is kind of scoping things out and eventually in a call we can do that. I think we have some things we're going to be doing domestically and one of the things we want able to do with that is kind of figure out where we are domestically and then be able to take that to an informed group there and then let the other groups also do the same thing. Because there are a lot of countries that are starting to look at that as well. So I think if we provide a little bit of time and dialogue we'll definitely look at doing something like that. Tim?

 DR. KILLEEN: I think it's a natural -- I think you can already see there's like a one‑to‑one relationship between Belmont Forum, Collaborative Research Actions, and SEES solicitations. And it makes sense that we try to leverage our own activities as best we can. So hazards would be an obvious one. Incidentally, the Arctic Seas solicitation was released yesterday so that's out.

 DR. UHLE: That's great.

 DR. BRIAN TAYLOR: So following that, what's the wiring diagram or -- I don't even know how to call it. What's the relationship between this international thing and the U.S. and NSF? So let's just say, for example, the Arctic. So there's -- through the Belmont system with Canadian leadership, there's going to be this Arctic thing. But SEES just had an Arctic call yesterday. And the U.S. contribution to the international thing is going to be separate from the U.S. thing. How -- I don't get it.

 DR. UHLE: Well, actually it's a good question. In fact, right at this workshop now, we have two people from opposite polar programs participating in the scoping workshop for Arctic. And so on the table will be the Arctic SEES solicitation. So what we can do is look at providing the PIs that are successful within that, potentially some supplements or grants through our science across virtual institutes type thing. To do that we will also provide money within the pot, itself, to move things forward. So what we're trying to do is actually leverage what it is that we're doing domestically by providing a little bit of extra money to encourage international collaboration. And by doing that, we have -- it's kind of the IPY type -- or the thinking, is that a little bit of money already to link some several programs that are already going on is a great way to go. And so for Arctic especially, I think that's what you're going to see. You're not going to see a huge brand‑new set of initiatives coming out of this. We're going to add international value through linking things together.

 DR. KILLEEN: So you're really asking how we actually make sausage in this building, is the question. And I think this is actually a generalizable question because GEO in a flat budget universe is, on many fronts, trying to leverage our resources. You see it at E Squared with EHR at the table. You see it potentially with CISE, with CISE a common interest. You see us doing it on SEES extensively, not just within NSF but with other agencies. And so it makes sense. If we can double our dollars, it's worth pulling out a piece of the resource for that doubling, if it's available on the time scale that's needed or in the next year.

 So I think what you're seeing is what Dr. Suresh would call the leveraging piece of the One NSF. We're leveraging in a purposeful way with good alignment, intellectual alignment, so it's not pushing us into a space that we wouldn't ordinarily go. And that's the whole Belmont approach, so a country can stay out of a particular solicitation if they want to. In each case, it's a coalition of the willing and engaged and interested.

 DR. HORNBERGER: Great. Well, thank you and Maria, you probably have one minute to grab a sandwich to carry with you to your AAAS fellow interview. Thanks very much.

 DR. KILLEEN: Can I just thank the committee before Maria leaves because this really was a product of -- you mentioned GEO Vision, but there was a subcommittee that Norine led that really asked GEO to prioritize and focus in on a few things, not on the 165 elements, and we gave them the --

 DR. NOONAN: That spreadsheet.

 DR. KILLEEN: -- green lights, red lights, and orange light, and so that's what we've been doing. And it is actually amazing to me, to us, I think, how far you can go if you really sort of success orientation, and you run, run hard, so.

 DR. HORNBERGER: Absolutely, well done.

*Working Lunch:* MREFC Update on Regional Class Research Vessels (RCRV)

 DR. HORNBERGER: Okay. Let's see, Bob is up for our working lunch. Where is he? Behind me.

 DR. HOUTMAN: The digestion part of it.

 [laughter]

 DR. HORNBERGER: So this is the MREFC.

 DR. HOUTMAN: Yes, I'll be taking just a couple minutes and give you an update on OCE's MREFC ship project, and the two topics I will cover -- Melissa, this moves forward. Okay. And I'll just cover these two topics. One is, I'll spend most of the time giving you an update on the Sikuliaq construction. I think you've heard of both of these projects throughout your two days here. And then, secondly, just I have one slide on the regional class research vessels. We're a little bit under an embargo still at this point in time, so I'll let you know what we -- where we are with that.

 So, for Sikuliaq, she is moving along really, really nicely. And I've got some slides here, I hope that you can start to appreciate how far along she is: Hull fabrication and equipment and system installations are well underway. She's going to be about 261 feet long, a beam of about 52 feet, and a draft of about 18.5 feet, with about eight feet of freeboard at the water line, which keeps her still close enough for over-the-side handling. Some of our ships in the fleet, like Killum 1 [spelled phonetically], have a pretty high freeboard, and makes over-the-side handling a little bit more difficult, but at eight feet, I think that'll work out very well.

 You may not be aware, but one of the high-risk items in terms of the schedule and moving forward was the Z-drives or the propulsion systems, so up-front we made the concerted decision that this particular piece of equipment or pieces of equipment were not going to be left to the shipyard to actually do the contract and ensure that they were on schedule and on time, so UAF took those under their wing and we put those under the owner-furnished equipment category. And that was a high-risk item because Wärtsilä [spelled phonetically] had gone through some restructuring and had some previous issues. But the really good news is that both of the Z-drives have been delivered, so a huge risk to the project has now been retired with that delivery.

 I'm going to just step you through the last two months, very quickly, of the construction. And what I'd like to do is, here, use this production control department tool, status tool that's used, and I think everyone is aware that most of the shipyards today are using a modular construction approach not unlike in the housing industry, where you build modules of the house, deliver it onsite, and then put it together, as opposed to a stick-built house. So, Marinette Marine does modular, and everything is computer-designed and computer drawing-oriented. And the process that they use is -- here at the bottom, you can see that the various steps are fabrication, into panel, then into the construction stage, then it goes to paint, goes to pre-outfitting, and then it -- these modules get erected.

 So at this particular time, on the 16th of March, here was the status on all of the various modules for the Sikuliaq.

You can see that forward, midships and forward the majority of the ship in the modules have been erected and that aft, a number of the modules are still in construction, but you still see a few panel and there's still some green. So there's still some in fabrication, which is where the sheet of the steel is actually initially cut into its various dimensions, then it goes into panel, and they start forming and welding panels together. Those panels then move into construction and are put together into actual modules and then moved into the paint booth, and then at pre-outfitting those modules then get as much of the electrical and the piping and other structures as possible installed at the module stage and then those modules are moved together and connected or glued together, if you will, in the erection stage.

 So here you can see that the bow module has been glued on, if you will, and we're waiting for the glue to dry, but it's actually now being welded to the other modules up front. You can see that the anchor pocket on the starboard side has been welded in and you can start to get -- you can see the gentleman standing up on the O1 level up there. You can start to see that she's going to be a pretty good sized ship. Here it gives you a little bit of sense -- yes [affirmative].

 DR. BRIAN TAYLOR: Do you know how many tons?

 DR. HOUTMAN: About 300 -- I mean 3,600 long tons, yeah, in terms of displacement. Here you can see a cross section, and you get a little bit of an idea where when you're starting down here and moving up at the various decks -- here's the main deck, which is the deck where the working deck at the aft is on top of the main deck. Then at the O1 level you've got analytical labs and main science laboratories. There are science state rooms. You've got the grand staircase that is being put in and the mess decks or the chow hall at the O1 and then here at the O2 level.

 We'll step through a number of these modules and you can see how they start coming together here. I mentioned that when you're in the pre-outfitting phase this is module 844, the overhead portion of the engine room, so you can start -- you see the light fixtures are installed. You can see the cabling, electrical cabling. You can see piping is installed, ventilation systems are installed, and these are all then specific to that module. So it's very, very critical that as each module is put together -- you can imagine. Two modules come together, the pre-outfitting and piping for either any of the piping or any of the ventilation systems, they have to be right on, because when those pieces come together if they don't line up you've got a big problem.

 Here you can get a feel for -- this is module 852, which is the motor room, and in that process you saw on the status, this is now -- this entire module is moving into paint before it goes into pre-outfitting. And what I'd like to point out here is you can see the entire beam of the ship and you can also see the double bottom, and on a further one I'll talk a little bit more about the port and starboard sides, but you can get a feel for how big these modules are and this double bottom is part of the ice strengthening. It's a PC5 class ship. It will be able to break ice two-and-a-half feet thick at two knots. And one of the other points is double bottom. We're ahead of the game, because double bottom is now one of the requirements that will be called for in the international maritime organization's polar code. So any ships that are operating in the polar regions are going to be required to have double bottom, so...

 Now here you can get a flavor for where that module now is going to sit. Here's the keel. This is the skeg and here's the keel. That module is going to sit right on top and I'll show you another photo as it actually gets placed right on top here. Let's see. Then we'll go -- a lot of the construction ends up being either upside down or right side up depending on where -- how it's easiest to do the welding and getting at the various components. This module will actually be put behind the motor room module. And remember these openings, because these are where the Z-drives, and I'll show you a shot of the Z-drives here later, where the cans for the Z-drives actually get in. This is upside down, so the Z-drive would come in from the top with the propellers up -- sticking up in this particular orientation. Here again, as I mentioned, some are put upside down in terms of welding. This is 845, engine room. It gets fabricated upside down. Much, much easier to do welding on the deck as opposed to being in the overhead, and it's much quicker.

 FEMALE SPEAKER: [inaudible] that is amazing when we first learned this.

 DR. HOUTMAN: Yeah. Oh, yeah, yeah. So here again just -- let me see. Oh, yeah. I want to show this particular -- you might not see it too clearly, but I'll show it in another slide. This vessel, since it's an ice breaker, it has actually -- the design has a reamer design, which means up forward and almost midship the beam is broader than actual aft part of the ship, so it's a little bit wider up front and what that does then is it breaks the ice in a bigger -- in a little wider path so that it gives the ship maneuverability in the ice when it's operating in ice. So that's called the reamer, and you can see that difference. Here's the beam on the aft section of the ship and here's the beam on the forward section of the ship. So we'll see that a little bit later in one of the other diagrams.

 Module 877 is part of the super structure. This is the science control cab. It's being formed out of aluminum, part of the weight reduction issue that we had to deal with earlier on in the design process and it's being fabricated upside down. The ship will have various different components to it here. We'll have a science cargo hold. I mentioned we have stairwells. You've seen this one with the anchor pocket installed and then some of the bowl work that gets put together.

 Here is a little bit of scaling for the size of the Z-drive can and the Z-drive propeller. This is ice-strengthened Z-drives and ice-strengthened propellers to operate in ice. That entire unit then will get placed in that module that I showed you earlier. And here are the motors. These are AC motors, so this is diesel electric so there will be diesel engines that then will operate the motors. The motors then provide the power to the Z-drives and the Z-drives are steerable thrusters as opposed to a shaft with a propeller and rudders.

 Of course the ship also is in operation because of the science, so in parallel there's a significant effort going on in constructing and testing and evaluating and getting ready for installation of the science equipment. Here we have the load handling system that's being tested and the various cranes, et cetera, that will be part of the science outfit for the ship.

 Here's a shot of the fuel manifold that's going into the engine room. Keep this one in mind and you'll see it again here in the next slide set.

 I have just a couple more to show you the progress between March and April. The last -- the March progress report said 37 percent complete. Here you can see we're at 41 percent. The other thing you can notice is you don't see any more green, so that's a good sign. That means that the metal that needed to get cut to start through this process is now beyond that stage, and we still have a few super structure pieces that are in panel, but the majority are now in construction and moving forward. The shipyard's objective is to have 85 percent of the ship put together by launch time. So we're tracking this particular percentage very closely and it will speed up here significantly as now we're moving into the construction and the erection phase.

 The other thing you'll note here is here is the O2 level, and I'll show you another thing -- just remember about that O2 level and as we move to another slide. So, module 852, in March, was heading to the paint booth. It's out of the paint booth now and it's now in the erection hall and being installed. So you can see the difference there. Again, there's that double bottom. And here, this is that same module and you can see that here it's being now connected to the rest of the modules that are already in place and in order to ensure that's perfectly lined up, they use lasers and the auto lights to make sure that everything is absolutely lined up.

 So I mentioned a little bit about the reamer. It's a little bit hard to see, but right here is the widest part of the beam and then you can see it slopes back just a little bit to the regular part of the beam right there, so that's kind of that wider part up front to give the ship maneuverability in ice, and you can see that she still -- she's starting to get pretty long. There are two more modules that go behind this, which one is the one with the Z-drives and the other is the steering gear room. And, again, here you can see that similarly. It's -- she's starting to get pretty good length on her.

 I asked you to remember the O2 level on the status chart. Here's the O2 level and you can see, oh, there's really not enough room here to get the rest of the O3 and the O4 level on. So what they end up doing is putting all the modules together up to the O2 level, then they roll her out and then with cranes, external cranes, they put the upper super structure on.

 So very quickly then, the construction is coming along really nicely and you can get a flavor for how big she is and how much progress we've made. At the same time in parallel, we're getting the community energized about the availability and capability of this new research vessel. We've had now a second science planning workshop at Ocean Sciences 12 and hopefully in preparation for proposals to be submitted by the time the ship is ready to begin operation -- it's funded and ready to go by the time she's in operations in '14. So, I think Tim has mentioned we have the launch, big day, Saturday, the 13th of October. After she's launched then she'll be alongside over the wintertime. They have bubbler systems because the river freezes up and during that time period they finish. They try to get her from 85 percent complete up to 100 percent complete. At the same time then we start doing some dock trials and builder's trials. As soon as the river then is open, the science outfitting then gets done, and then a preliminary acceptance by UAF in about next year, a little bit more than a year from now. So, exciting times ahead for Sikuliaq.

 Any questions on Sikuliaq? I'm going to take just one quick slide --

 DR. BRIAN TAYLOR: Just congratulations. As one who has built ships with you before, and for those of you who don't know, this is spectacular.

 [laughter]

 [applause]

 DR. HOUTMAN: So launching off on the successes in terms of the structure of the project and the approach to the project, we have now applied that same approach to the regional class research vessels, which has four phases: the design refresh phase, then we go into the shipyard phase, we go into construction, and then we go into transition to operations. So, just from a high-level perspective, RCRV, we're planning to work in the cold cycles similar to our success here with Sikuliaq. So, we feel very confident in the approach that we've taken with Sikuliaq and we're going to apply all of the lessons learned on Sikuliaq to RCRV.

 I think it was also mentioned that we took -- I mean, RCRV as the first project through the revised NSF MREFC review process, and at this point in time, the director has now given us authorization to advance it to the next stage and that next stage is that phase one design refresh and it takes us up through the preliminary design review. But that first step ends up being the solicitation for design and construction. That particular solicitation is going through internal NSF clearance at this point. We hope that that will be completed here very shortly. Once that completion is done, it'll be announced and then we'll be accepting proposals. We expect then that those proposals we're expecting due in by September, an award probably early 2013, and then we followed that process. Again, that first step will be the conceptual design review. There are multiple off-ramps for the project if we end up for some reason finding that things aren't going the way that we planned. So I think there's a lot of good program management decisions and stop points if required. Our current thinking is three vessels for, as we've talked about, in terms of East coast, West Coast, and the Gulf Coast, the exact number will depend on the funding availability and also in parallel, as we're doing all of this, we're highly involved in the interagency working group for facilities and infrastructure that is looking at the entire academic research fleet and doing an update to the status report, which will also be coming out here shortly. And that interaction with other agencies like NOAA and NOAA's needs for mid-size vessel refreshment or recapitalization, and we're having those dialogues practically on a weekly basis. So that's moving forward and I think that's all I have for, you subject to your questions. Please.

 DR. RUDNICK: What's the total projected cost for this vessel?

 DR. HOUTMAN: The RCRV project is -- between $330 and $340 million is our current estimate.

 DR. RUDNICK: And is it expected that the future research vessels will benefit cost-wise based upon what's happened with this one in terms of, you know, what you've discovered in the process of making this one?

 DR. HOUTMAN: We certainly have been applying all of our lessons learned from Sikuliaq into the RCRV process. The value that we're taking and the RCRV project is three vessels that are of common design and very, very closely in terms of time. So, we'll start the lead ship. Six months later the exact same team at the shipyard will start the second ship. Then that second -- that third ship will start six months after that. So there are significant cost savings that we can in fact realize within the RCRV project. At this point in time, we have no other ship construction projects on our plate from the NSF side of the house.

 DR. BRIAN TAYLOR: Just a clarification to you, too. I think you answered a question she didn't -- you were asking how much the Sikuliaq costs or --

 DR. RUDNICK: Yeah, that was my first question. Yeah.

 DR. HOUTMAN: Two hundred million.

 DR. BRIAN TAYLOR: You answered the question for how much the three RCRV cost?

 DR. HOUTMAN: I'm sorry. I think you were asking for RCRV. Two hundred million for Sikuliaq. Three hundred and thirty to $340 for three regional class research vessels.

 DR. RUDNICK: And the first one of those three is costing more. If you stop it wouldn't cost more if you stopped --

 DR. HOUTMAN: Right. Yeah, there are cost savings by doing multiple ship buy.

 DR. HORNBERGER: Okay. Thank you.

 DR. CONOVER: I might just add one thing that's really important about building off the Sikuliaq and that is that any MREFC project that's closely monitored by OMB, by Congress, you're under a microscope when you're in the process of fulfilling the plans for an MREFC project. Having such great success on the Sikuliaq gives us incredibly high credibility that we can continue that level of success on the RCRV. On the flip side of that, if we were behind schedule and over cost, it would be really hard to get any additional ships through the whole process. So that's the most important part about having this be so -- going so well.

 DR. SCHIMEL: [inaudible] Sikuliaq.

 [laughter]

 DR. KILLEEN: In taking that further we wouldn't have been able to get Sikuliaq without having delivered on EarthScope or on Hyper [spelled phonetically] or on other GEO facilities.

 DR. CONOVER: And we're under the same pressure with OOI. We happened to deliver that as a success. Anytime you don't have a success it hurts you down the road many times over.

 DR. HORNBERGER: Great. Thank you very much, Bob. That really is exciting to see the Sikuliaq coming forward. It's -- yeah, it's great.

Meeting Wrap Up: Action Items, Meeting Evaluation

 DR. HORNBERGER: Okay, well, as we have been for the whole meeting, we're five minutes ahead of schedule. [laughs]

 [laughter]

 And we do have -- this final session is really important because we do have to decide several things, action items included. And most importantly we have to, I think, make a decision. We sometimes write a letter report to the director. If we want to do that we have to identify the messages for the letter. Also, the director from CISE --

 DR. KILLEEN: Farnam.

 DR. HORNBERGER: Farnam Jahanian, right. I thought that was really spectacular and, you know, Tim mentioned to me, well, maybe we really should think about writing him a thank you letter, but I think more to the point, really articulating that we think that this really does present opportunities. I think as Brian said to me when we were lining up for our sandwiches, this really is the way forward for GEO in many ways, and so I think we should think about that as well. So, with that I'll just open it up for ideas. You know, what are the main messages that we take away from this meeting and do we want to write a letter report?

 DR. DELANEY: I have -- I think it could be particularly useful. George asked me earlier what we did after the meeting and I said, "Louise does it. I don't know." And I thought about it more and realized we did often write a letter, but I also think because of the transition in Tim's position that it could be particularly helpful to write a letter. and one of my reflections of this morning through Farnam's talk and the earlier global change talk; On the global change talk there was the mission and vision, the vision and mission that we'd have an educated nation that could make sensible decisions about global change topics and then the mission of how they were going to do that. And that really related to CISE saying, here's how we help scientists and people deal with all this data complexity. But the other piece that struck me, and Tim has helped drag my thinking in this direction, is in a sense, there's sort of a bewildering array of new acronyms for the geoscientists. SEES and ICSU and Belmont and all of -- right -- all of these things, and what I fully comprehend better after this meeting than ever before is that Tim's activities in having us be major players -- Tim, and the program officers, and the directors, everybody here -- having us be major players in these efforts is absolutely critical to our scientific health in this division. And without that, I don't think we get to continue really playing the role we want to in the U.S. and international scientific community. And it's very hard, because you know, it's even bewildering to me and I get to hear about it in detail twice a year and see all the updates. But I think it's critical, and so somehow capturing that the essence of our science has to drive our participation in those things, but that participating in them is absolutely critical to accomplishing our scientific goals. And I can't make it more comprehensible than that, because I'm afraid I'll be asked acronyms and, you know, can't go back there into SEES and all those other -- I mean, there's a lot and trying to make sure we grasp that complexity and influence the directions they go in is so critical.

 DR. HORNBERGER: Other comments?

 DR. SPENCE: Just to sort of jump on the last comment, I think also underscoring the strength of the geosciences in propelling NSF into this leadership sort of position across these various programs, it's not just involvement in the programs, it's actually leading so many of them and it really puts, I think, us at a very high place at the table, not only in the national, but the international landscape that we heard about today, too.

 DR. BRIAN TAYLOR: So in the scale of those two comments, this is minutia maybe, but actually I'd come back to a comment I made on the first day to Tim. Many of these things, the cross directorate stuff and some of the international stuff, some of the education activity are -- I mean, we're doing this as a whole directorate, but also part of this are in this [unintelligible] thing, you know, the ICER piece, and as we see the importance of this I would repeat what I said individually before, that I think there's some subgroup of this committee looking at ICER specifically, especially in this interrelationship to some of these things would be a good thing to have. We've got subcommittees for the three other pieces, but we don't have somebody looking at that per se. We've had -- we've done a cross cut with it. We've had people looking at education and infrastructure and facilities and -- but we haven't looked at the thing, which is ICER.

 DR. HORNGBERER: Tim.

 DR. KILLEEN: Budget flow down is --

 DR. HORNBERGER: You're not on the microphone.

 DR. KILLEEN: We've got three divisions and then we've got a virtual division, which is called ICER, interdisciplinary collaborative education and research is what it stands for, and it's the GEO-wide resource. It's about $90 million, $91 million, and it supports all of our centralized education activities, a lot of the cost-sharing for some things that are One NSF contributions and so on, and so that's what ICER is. It's a budget -- it's a line item in the budget.

 DR. BRIAN TAYLOR: But because it's that interdisciplinary thing and the cost-share thing, and the partnering thing, I mean, that's what we've just been highlighting as something that we're emphasizing, so I'm just putting a spotlight on exactly that and saying why don't we look at it?

 DR. CAVANAUGH: But, you know, this committee has always taken on those sorts of things as a whole, and you established the four subcommittees that I think you actually still have: one on education, one on infrastructure, one on facilities, one on international. So it pretty well covers all the things in the -- the funds that are in that account. I guess there are some other things that, you know, that the divisions think about, but I can't think of anything that you don't think about. Now, you might want to organize differently or whatever, but you already have organized -- I'm just pointing out that you already have organized in one way to cover it.

 DR. BRIAN TAYLOR: But Marge, we don't see -- we don't get a budget presentation on ICER. We don't -- those four little subgroups don't talk about across something -- I mean, maybe we could -- if you want to elevate it to a committee of the whole and have an ICER discussion at the level of all of AC-GEO, that's possible, too. But we're not getting some of that.

 DR. HORNBERGER: So, well, just to throw out an idea. Perhaps we could have an ad hoc committee perhaps made up of either the chairs of our individual four, because it is integrative, and have that committee do some preliminary work for us for the next meeting where we could have a broader discussion. Does that make sense at all to you, Brian?

 DR. KILLEEN: I just want to make one comment about this. What we need from this committee, I think, is not so much review.

 DR. HORNBERGER: Right.

 DR. KILLEEN: We need guidance, advice, direction setting. I think it would be a mistake to plunge into reviewing budget categories. Personally, the new AD may feel completely differently, but I think what we need is guidance and suggestions and advice on balance, approaches, partnerships, et cetera. I think if the advisory committee starts to become a COV, then that -- it would lose a little bit of its influence, frankly, because you've influenced what we've done through GEO Vision, through the four strategic plans, through these kinds of conversations. And so I just am a little hesitant about going down the path of management on budgetary, budgetary issues. There's our OMB example.

 DR. HORNBERGER: I do agree with that, but just before we go to Norine, but is -- are there program elements? I think -- I'm not sure that Brian wanted to review the budget or anything category, but are there things done under ICER programmatically that are somehow integrative and not covered if we just look at the pieces?

 DR. KILLEEN: That's a good question. I think -- I think that the four that Marge covered speak for most of the structural pieces of ICER.

 DR. CAVANAUGH: Well, we could look. I think that's about it.

 DR. KILLEEN: Education --

 DR. CAVANAUGH: Is a chunk.

 DR. KILLEEN: -- is a chunk. I mean, there is some flexibility held in there for end-of-the-year crises. I think that those four pretty much cover it. Our international programs, Maria is in the front office, as you've seen, so those programs that support the secretariats and the regional activities are all in there. Some of the Cyber infrastructure seeding was done in there.

 DR. CAVANAUGH: Some SEES things are in there, but you -- anyway. But you've heard a lot about that. That comes through the division, so I don't know. The only other thing I would mention is that, and I think I'm agreeing with you mainly, George, and if I sort of missed some of this I'm sorry, but the budget things that you would see would all be after the fact, you know, whereas where you want to have your influence is in the front end.

 DR. HORNBERGER: No, I definitely agree with that. I mean, I've just heard that what Brian was suggesting is that if we're looking at these four pieces there might be some advice we wouldn't want to give that is somehow integrated across those four pieces that we're not seeing because we're looking just to the trees and not the forest. At any rate, I'm sorry. Norine.

 DR. NOONAN: So, I'm thinking more about our letter potentially, and it seems to me that what I heard certainly in our subcommittee meeting and what I heard from the other two subcommittee chairs is that the issue of balance between facilities and core science is going to continue to be a major challenge for everyone. And I think we need to raise that issue at the NSF level, because in some cases this might not only be a directorate challenge, this might be an NSF challenge. And to the extent that there are bright, shiny objects out there that people want others, be that Congress or whoever, want NSF to undertake that end up essentially influencing that balance one way or to the extent that investments that NSF feels that it needs to make or that the directorate feels that it needs to make to address that balance, I think the director, himself, and certainly, Tim, your, I won't call it -- it's just your successor, because there's no replacing you -- needs to be aware of that. I mean, everyone in the, you know, kind of in the thick of it is, but I don't think it hurts to remind people that this is going to be an ongoing issue, that this isn't going to be a this-year issue or a this-month issue, this is going to be something that's going to -- that's going to go on for some time given the budget scenarios that you all are anticipating facing. So it doesn't hurt to remind people of that and especially the director.

 DR. HORNBERGER: Yeah, Tim is going to respond and then we have Harlan and David.

 DR. KILLEEN: Absolutely. That's our biggest headache.

 DR. NOONAN: Absolutely.

 DR. KILLEEN: It's an ongoing headache.

 DR. NOONAN: It's the long pole in the tent.

 DR. KILLEEN: The only good news is it used to be worse than it is now, I think, prior to, you know, recent budgetary growth and the stimulus package, it was actually almost impossible to thread the needle. Now we're halfway out of the hole, but we're still -- we've still got some climbing to do. And it's absolutely worth bringing that to the attention of the director, because you know, a director who is smart, hearing those kinds of things might say you're getting Sikuliaq. Yeah.

 DR. HORNBERGER: Harlan.

 DR. SPENCE: One item that Walt discussed in this panel that we had yesterday was the creative program and there were some, I think some concerns, some discussion that ranged from, oh, it's not working well at all to no, it's working just as intended maybe. And so I think even within our group there was some maybe uncertainty on that. We also did hear that the next component of INSPIRE will be a little bit different, and so I guess I'd be interested in hearing from the other groups as to whether that came up in those discussions and if there's something that we should be providing input for guidance and, you know, coming back to Tim's comment about the INSPIRE, the next year's solicitations and how they look.

 DR. HORNBERGER: Walter.

 DR. WALTER ROBINSON: This is an issue we dealt with before. I think it's broader, and that is how do we -- maybe not AC-GEO, but how does the directorate -- how do you effectively communicate and get information out? And since I've become a department head I deal with all that all the time. If I sent out a message to everyone, nobody reads it. FEMALE SPEAKER: Nobody reads it, right.

 DR. WALTER ROBINSON: So you have to -- so it’s the question of how to intelligently target communications, but that's a challenge because you can't exclude people. I mean -- I don't know what fraction of people are signed up to My NSF and get targeted communications, but I think the -- what I heard was the relatively low participation on the atmospheric side or the AGF side in CREATIV was just people that know about it and, yeah, it was a communication thing. So we talked about this communication problem before. I don't know if we came up with any solutions. Are there some innovative models out there for how funding agencies, or people like funding agencies, communicate with the scientific community?

 DR. SPENCE: Twitter.

 DR. WALTER ROBINSON: I'd be interested to see. Well, but you know, something has a lot of glitz and then it gets saturated and then people stop looking at it. You know, email was really cool once, remember? [laughs] So I don't have an answer, but I think that's an ongoing problem and, you know.

 DR. HORNBERGER: Dave. Dave Schimel, did you have something?

 DR. SCHIMEL: I did. One issue that really struck me at this meeting compared to -- or that has evolved over my time on the committee is the treatment of what I will call interdisciplinary science within the directorate. Probably most of what we heard about today and yesterday, five years ago would've been considered interdisciplinary. And the very definition of the disciplines and what our colleagues are doing really bends the definitions of the disciplines that constitute this directorate as we might have thought about them five or 10 years ago. And this is -- you know, it seems to me what I heard in the full committee and in the atmospheric subcommittee is that the proposal pressure is pushing this as much as anything, that people are tackling broader, more complex, more integrative science challenges and they're not really thinking of them as disciplinary or interdisciplinary anymore. They're proposing them because that's the science that they do. And I think in light of -- you know, there was a comment within one of the groups about, you know, how often do you look at how you're organized to best serve your scientific communities? You know, and I think the comment was made that, you know, that stability over a decade is fine, but what would it mean if you were stable over 40 years? And probably the way GEO is organized is approaching its 40th anniversary, because the disciplines go back into the 19th Century. But I wonder if it wouldn't be worth this committee actually looking at the nature of the science enterprise that the directorate supports. Because I think it's -- I think it's transformed over the last five or six years and I don't think that -- I think one of the reasons for the interest in the ICER portfolio is -- and the great interest in the SEES activities is that those actually seem like the way forward for the core as much as for the noncore programs that a lot of the energy in the, what you might call the core community, is in these innovative areas. And the hazards one is the one that I think is maybe the furthest along in that where there, you know, everybody who's working on severe weather, whether they think of themselves as a geophysical fluid dynamacist or an applied meteorologist is kind of talking and walking the walk of these issues flow all the way into societal resilience and response.

 And I wonder if it's worth thinking about at a very high level how GEO thinks of itself and the relationship between its internal communities and then increasingly this critical role for PIs on GEO proposals who are not geoscientists. I mean, I think this is an incredibly exciting and -- exciting development, because it's the basic science that has transformed itself. It's not about applications. It's about a new intellectual vision for how we think about the planet that is really breaking down a lot of our boundaries. And I think, you know, we could pick away at the way the money is labeled and budgeted and handled, but I think what might be more useful would be to think about this at a high level.

 DR. KILLEEN: I can tie that -- thank you for that comment. I can tie that with Peggy's comment. She's left the room now, but about -- her earlier comment about maybe, you know, GEO Vision redux almost, it's what have we done and what have we learned and where have we come, where's the journey taken us? This might be a time for a committee product like that. After all, GeoVision was yours, and it has been for four years and there has been a lot of effort and our divisional reviews, it was striking. Jim can -- I think he agrees. It's striking how much we -- even the program officers embedded in programs really came forward with the hazards and the cross cuts and it was quite, I think, a lot of resonant reiteration of the GEO Vision themes. I mean, maybe they're rearticulated in a slightly different way, recapitulated, but maybe that might be a helpful thing combining Peggy's comment and your comment on maybe a short note to EOS or something GEO Vision four years later or something like that and pointing out some of the things that -- I mean, you are actually a privileged group having sat through the last day and a half. It's very hard to communicate the richness of what you've just heard between Sikuliaq and E squared and Earth Cube and, you know, CISE options and educational engagements and where we're going internationally, it's actually hard. Divisions do a great job with their newsletters. I think that is something that gets read and, you know, they're pretty new and very informative. But I think a committee product would -- might be very helpful, also to an incoming AD to get a sense of where you all are that's sort of refreshed in a way. It wouldn't have to be a long document.

 DR. SCHIMEL: One thing that really struck me was how organic a lot of the interest in the cross cuts felt relative to top-level initiatives that we've seen three and five and 10 years ago. I mean, many of the SEES focus areas are of intense interest in all of our disciplines and so it feels like a more organic way of integration and broadening than a lot of other approaches I've seen in the foundation.

 DR. KILLEEN: Well, I do think we, within SEES, have pioneered a new approach. I mean, the previous cross foundation initiatives have sort of been monolithic, big solicitations like CDI 3000 proposals or like ITR or before that biocomplexity in the environment. SEES, you know, it's a plus and a minus because it's a workload issue, but it is 12 things that are, you know, 150 proposal kind of numbers, which is more manageable than say the GRF, which is 12,000 proposals where we have to rent a whole hotel and book PCs down the corridor. So I think it is a new model, actually, for cross foundation work that is discretized in a different way and maybe there are some reflections on that as well that would be worth making.

 DR. HORNBERGER: That actually struck me, Dave, Harlan's comment on CREATIV and then your comment that some of the reason that we might not get as much participation in CREATIV is that we're already doing interdisciplinary things within --

 DR. SPENCE: That's exactly one of the comments --

 DR. SCHIMEL: That point was made in atmospheric science, through [inaudible], being funded as a matter of course.

 DR. HORNBERGER: And because you're not involving different units you can't even participate, right?

 DR. SPENCE: But we’re offering up a significant amount of money to a school that doesn’t have access to it.

 DR. HORNBERGER: Joe.

 DR. WHITTAKER: Well, since this is my first GEO meeting, one of the reasons I'm sitting here actually, I have to go back to CEOS, which is the committee on equal opportunity in science and engineering, and tell them all the wonderful things you're doing about broadening participation. And to kind of follow up on this intellectual vision and Tim's comments earlier, in terms of what's cross cutting and how do you go forward and make sure you reflect all the things that you've done before, one of the surprising things for me was, I mean, somehow education and broadening participation piece, someone gets buried or lost somewhere in all the discussions. Since I had some options yesterday of choosing which subcommittee to go to I went to the AGS and when that budget came up it was a huge cut looking forward on the education piece. And I think it's like 22 point something percent based on what was laid out there for 2013. You can check, but something like that.

 DR. KILLEEN: Well, there's a relabeling of education funds showing up in E squared, so that may be, but I wouldn't worry about 20 percent cuts on education.

 DR. WHITTAKER: But anyway, it kind of --

 DR. KILLEEN: We'll give you the number.

 DR. WHITTAKER: -- it kind of sends a little funny message when, you know, there are lots of comments about well we're not sure what we're doing in terms of getting more people engaged in studying in these areas and going forward and where -- and then looking at the dollars, but this morning you heard that it doesn't matter really how much money you throw at this thing. If you're still doing the same things it doesn't matter. And so where the innovation -- where is the innovation and where are the plans going forward in terms of making sure you engage at the right level? So from the discussion of where the Department of Education engagement and partnership, I'm sure you can do all of these things. If you look at the pattern that's taking place now in early education, we talk about where do you have the intervention? Where do you start? But if you look in most of those systems, especially those funded by the Department of Education, it's very rare that you find colleges at the table after the money gets distributed, and so the school systems are doing one thing and the colleges are doing another. There's nobody at the table that says well, this is what we expect you to have when you cross that bridge. But the bridge seems to be doing, our chasm is getting wider in terms of that. And so on both sides of the fence I think there are some conversations that need to take place and some new ideas or initiatives that need to come to the table, something out of the box. So if you're talking about create, this is probably one way to force people to come with something out of the box with very little pre-positions or something as to what it should look like and allow people to come up with far new creative and better things. There are little things that's working and there are divisions here at NSF that's doing some very interesting things, but in very small ways, and maybe it's time to look -- get a comprehensive look to see what's scalable, what you can adapt for each one of these areas, and see how effective that can be. I just wanted to -- you can correct me if I'm wrong about any of these things.

 DR. KILLEEN: No. Can I just comment? I mean, that last sentence that you said I think would be great in a letter to NSF, because as we said, you know, GEO’s investment is [unintelligible] to $10 million for education, and we do have a track record of success that's not national scalable, it's not being scaled to full national level. This discussion, as I said, is going on furiously within NSF. There's almost $700 million in the CEOS category in the cross cut and so really systemically figuring out what's worked, why it's worked, what we need to know about what might be working, you know, going through the portfolio and then taking things that do work to the next level is really -- that's where we want to go where we are going and an advisory committee statement along those lines would be welcome.

 DR. WALTER ROBINSON: Yeah, actually, I was looking at metrics for my department sent by the university and one of the metrics in which we did not do very well was a number of minority students, and this is a geosciences department, so it just maps on to NSF very nicely. So the excuse we could make, and I went back and found out things that Jill Karsten had written was that our discipline -- it reflects the discipline. That's pretty lame. And actually in our department, I'll say for our defense, we do have some ideas which we think are good to address this. But we keep coming back to this and this discipline, these sets of disciplines are, even though we've made progress and SOARS is great, you know, SOARS is fantastic, even though we've made progress we still do lag behind the other disciplines. So even -- I don't know. If there were some examples, not only within our discipline, but outside where people have really made some big steps that we can draw on, this might involve some digging and some research that we could adapt because we've been having these conversations for almost as long as I've been in the discipline and, you know, I haven't seen -- my favorite story -- is Michael here? No, Michael's gone. The first time I met Michael Morgan he was a grad student at MIT. I looked behind me. There was this African-American guy sitting behind me at a workshop in NCAR. He was the only African-American in the room until later when Warren Washington came in to give a talk. And it was a pretty big room. [laughs] And I'm not sure I would go to -- maybe it will be a little better now, but not -- there hasn't been an utter magnitude transformation.

 So this is something that -- it's proving to be tough, but I think we want to continue to pay it attention and, again, I don't have the answer. Maybe there are some good models out there we could draw on.

 DR. HORNBERGER: Joe and then Jill and then David.

 DR. WHITTAKER: Sorry. I think I just wanted to follow up, because I guess I've been in this a little while now, but -- and we hear that all the time. Whether or not the field is reflecting the, you know -- I don't even know how you said that, but the real issue is it's clearly not working. You heard that people are leaving STEM and all this stuff. It's not -- but the environment outside, it's changed. It's evolving. The demographics are changing. So it's not about that. It's about the universe. It is in the programs evolving along with the environment or whatever changes are going on in the environment; that needs to be reflected in your programs, not necessarily the other way around. So people can argue one way or the other, but the bottom line is now that there's this push for STEM, everybody now defaults to numbers rather than quality. And then there's the argument of whether or not -- who's better at this or who can do it. When I started in, you know, I'm a trained neuroscientist, by the way, it seems an odd fit here, but when I got in neurosciences it was the same thing. Most of the time I was the only person in the room. On my study section at NIH it was the same thing. It hasn't changed much. And so the same question is, can these individuals do science or do brain research or geosciences and so on? The question is they can, but do they get the exposure and the opportunity and get it at the right time and for the right reason, to keep them engaged. That's the question, and nobody's answering those questions. And so, you know, we can go back and forth about this all the time, but the capacity is there. The resources are there. It's a matter of identifying the right touch points and areas where we can make that difference and...

 DR. HORNBERGER: Okay, Jill and David and then Peggy.

 DR. BANFIELD: Actually, my comment was on a different topic, so if you want to continue this discussion you have such --

 DR. HORNBERGER: Are there follow-ups?

 DR. DELANEY: I think it's a really good point. It's still a field that's not particularly hospitable to white women, and so we're way behind on every realm of diversity and it has changed relatively little, even in my time in becoming a senior scientist in the field. I think one thing we could comment on, and I don't know how to make this comment politely, which is it's very difficult to understand that EHNR presentation in terms of making substantive progress for our science. That's about as politely as I can -- I mean, I don't want to take a swing at them, but the gap of, wow, this isn't going to really help us as a field, and the connection just really wasn't there. And I don't know how to put that in a constructive way for --

 DR. HORNBERGER: So is there -- yeah, I would hate to just let it at that. Is there something positive? Is there something that we could say that GEO needs to take a lead role to help that?

 DR. KILLEEN: One thing, I mean, that presentation was about E Squared. E Squared is not formed yet. GEO has money on the table for E Squared. EHR has money on the table for E Squared. We need bold action that moves the dial. You heard her talk about moving the dial. Everyone wants to move the dial and then they're welling up with frustration of how difficult it's been, how challenging it's been, you know, but I think -- personally I think we need to work with EHR. We're at NSF. We can't just give up on them. We need to have an authentic partnership and that's the way this was so -- let's make it work. Let's make it work on our terms, actually on GEO's terms, and on the Department of Education side, let's make it -- let's try out something that would be bold, hypothesis-driven, and what actually -- maybe it found us, but it's certainly not going to be worse than what we're doing now, which is treading water and actually subsiding a little bit on some of these metrics.

 DR. DELANEY: So maybe we have to be the ones that define what the bold learning objectives are. I mean, I wanted a tangible --

 DR. KILLEEN: Yes, absolutely.

 DR. DELANEY: Yeah.

 DR. KILLEEN: It's our responsibility.

 DR. FISCHER: So I mean, there are obviously different strategies. There's a strategy of you have widely dispersed activities and you reach as many people as you can and you get people excited, but maybe it's a relatively minimal contact. And clearly a lot of that has to happen. There is also the view, and it seems like perhaps the SOARS program has been successful in this regard, you take a cohort of people, and it's more time intensive, it's more dollar intensive, but you define a cohort of people and you carry them through the educational process. And it really seems like you need to do a combination of both. And so maybe from a GEO perspective we should experiment a little bit more with a larger cohort and an integrated series of activities that, you know, span all of the fields represented in GEO, and just sort of throw that out there as an idea to try.

 I mean, it just, you know, anecdotally when I sort of reflect back on all the people I've worked with in my career, the people who have been able to persist in the face of adversity on all sorts of levels are the people who had multiple sources of encouragement along the way and so building programs that provide that encouragement consistently, I mean, it just seems like something that needs to be tried on a somewhat larger scale.

 DR. HORNBERGER: Okay, I think we -- we're not going to exhaustively cover that topic, but I think I have enough to at least get us started. Jill. Thank you.

 DR. BANFIELD: Okay, I actually want to address a comment you made about areas not sufficiently covered, and I guess I was asked to be on this committee to represent biological sciences in earth science and I do think that there is a problem in this area. Obviously the big development in NSF in the last decade was the creation of a geobiology program, actually, and this has been very successful in various departments around the country where we have young geoscientists going into this field. At the same time this has happened, this field of microbial biology in the environment and microbial roles in geochemical cycling of every kind you could possibly imagine has gone into explosive growth. It's revolutionary what's happening at the moment, and I just get the feeling that this program is not positioned to take advantage of that in the way it should be. And I think specifically the lack of any recognition of this area -- significant recognition of this area in this document is really a very unfortunate omission.

 DR. HORNBERGER: David.

 DR. CONOVER: I wanted to just connect a few dots perhaps between what David was talking about in terms of this new intellectual vision for how we think about interdisciplinary science and some of the conversations we had earlier about the importance of integrating social science into the geosciences; because I think that's a problem area that's relatively new and maybe we could actually make some progress on it, particularly if this group spent some time delving into that. As much as I loved Farnam's presentation about the interface between computer science, information science, and geoscience, I would actually much rather see Myron Gutmann from SBE talk about how we build the bridge between social science and geosciences, because that's a much more difficult interface. You know, I think a decade ago when -- and in ocean sciences in particular, which is my background, we've always been interdisciplinary and up until a decade ago humans were not part of the interdisciplinary system, and now we understand that we really can't talk about the dynamics of this planet without including humans, and to include humans we need the scientists that study human behavior, and that's what social scientists do. So I think it's a really important interface. It really is a new definition of what's interdisciplinary and we're not making good progress. We put out RFPs that require our PIs to have a social science context, but to find those people and actually have a fully integrated project that fulfills the vision, I think we're not making as much progress and maybe that's something we could work on in the future.

 DR. HORNBERGER: Okay, that's good. We're going to really have to break off here. Let me --

 DR. KILLEEN: Could I just say something before Jill leaves? Because she made something -- it'll take a second. I think that's very important, and one of the axes or actually tripods that we've been trying to build here is actually the geo-bio-socio tripod. If you think about modern science you've got math, chemistry, physics at the bottom, but I think geo-bio-socio really covers a lot of the ground of what our society is going to have to live through and work with in terms of -- so we have on the sixth floor, one floor down, we have a place where we intermingle program offices in bio and geo, and I'd like to invite you back to give a brown bag talk to that group on what might be missing in terms of the microbial perspectives and see if we can energize some discussion inside of NSF. And likewise I think we've got, as you know, David, what we've been -- we did have Myron here and he did talk about that at a previous meeting, but there's a lot of work to do on that. But I just wanted to get that out before you just depart thinking that we all didn't hear you.

 DR. BANFIELD: Great. I appreciate that. Actually, the reason I'm rushing out is I made an appointment to go down to the sixth floor to talk to them right now, so I'm late.

 DR. KILLEEN: There you go. Check out that space that we have.

 DR. CONOVER: And we do find an enormous amount of microbial work in ocean sciences. It may not be in earth sciences, but it's a long tradition of microbial influences on biogeochemistry in the ocean.

 DR. HORNBERGER: Okay, yeah. We have lots -- we have lots to talk about. All right. Scott or Orlando, before we depart, if you're on the phone, do you have anything to add before I summarize and we break up? Okay, we may not have anyone. So, if I have everything reasonably correct, what I'm going to do is we're going to draft a letter to the director. Basically the points, the strong points, are the strengths of GEO in leading a lot of these interdisciplinary, cross-disciplinary leaders, remarking that Tim has really -- it's been critical leadership. We will mention also that there are some areas that, of course, need attention like education, and we look forward to GEO leading in some of these initiatives because we really need hard work. I'm not sure what -- that I heard correctly what I want to say about the balance between core and -- core programs and facilities. It's a problem.

 DR. CAVANAUGH: No, just that -- the balance.

 DR. HORNBERGER: It's a problem.

 DR. CAVANAUGH: Figuring out the balance.

 DR. HORNBERGER: Figuring out the balance.

 DR. FISCHER: Can I say something really quick?

 DR. HORNBERGER: Go ahead.

 DR. CAVANAUGH: This is just a reflection from listening to some of the discussions. I mean, old doesn't necessarily mean outdated or not useful. So I guess in -- this is my first meeting, and so with that caveat, I think when some of these discussions about how to evaluate existing facilities and sort of weigh them against new facilities and perhaps this happens and I just didn't see it in detail, would be to have measures or metrics of who those facilities serve and how they relate to the different sort of aspects of the strategic plan. You know, how they relate to cutting edge science, obviously, but also how they relate to the social application of the science, how they relate to, you know, data sharing and integration, how they relate to education and the human workforce. I think from the perspective of a new person on the committee, having some data where you can evaluate those facilities against our goals would be enormously useful.

 DR. HORNBERGER: Yeah, and I think that that's right, and I think that's part of the balance that people have to figure out, but of course it's not up to us to do the reviews, it's just to point out the balance needs to be struck when the evaluations are done. In terms of things that I would then pass on to Louise to think about doing, it would be what Dave Schimel discussed, that it's time to think about what has been accomplished with GEO Vision and Tim suggested that perhaps an EOS article produced by the committee would make sense. And if Louise wants to consider that, then she would, of course, appoint someone. I'm rapidly losing people. We're rapidly losing people. I'm now 10 minutes late after starting five minutes early. [laughs] I want to be sure to thank Melissa who, again, has of course done an outstanding job.

 [applause]

 And, of course, thanks to Tim and to Marge and really to the entire -- all of the people at GEO for really promoting this and making this such a pleasant stay and, again, we heard perhaps enough thanks of Tim, but again, just a concluding remark, I started out with an initial remark. Tim, thanks very much for your leadership.

 DR. KILLEEN: And thank you for stepping in and helping out at the last minute and running a great meeting. FEMALE SPEAKER: Yes, thank you, George.

 [applause]

 [Whereupon, at 2:12 p.m., the meeting was concluded, and the Advisory Committee for Geosciences meeting was adjourned.]

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