

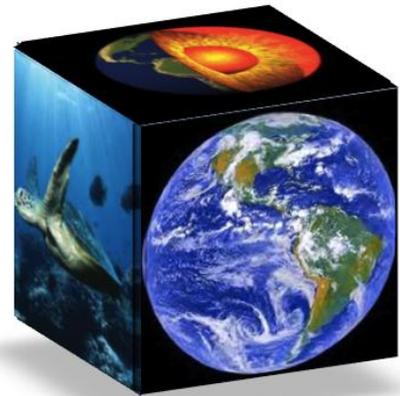
# Advisory Committee for Environmental Research and Education (ERE)

Report on the Meeting of Sept. 12-13, 2012



# ACERE History

- Founded in 2000. Up until 2010, primary job interpreted to be “advocacy” for the topics it deals with.
- *Now, with substantial new initiatives at NSF on environmental research and education, the role of the ACERE is moving from advocacy to implementation. The Committee provides advice, recommendations, and oversight for NSF’s environmental research and education portfolio.*
- This was NSF’s first multidisciplinary AC and now reflects a growing movement toward multidisciplinary at NSF.



# ACERE History

- The major NSF Initiative *SEES* (Science, Engineering & Education for Sustainability) has become a highly visible and significant part of the NSF endeavor – and this puts a new responsibility on the ACERE.
- SEES includes emphasis on knowledge base, workforce, and partnerships (linking existing projects and new participants in the sustainability enterprise).
- FY13 has major new SEES programs planned.

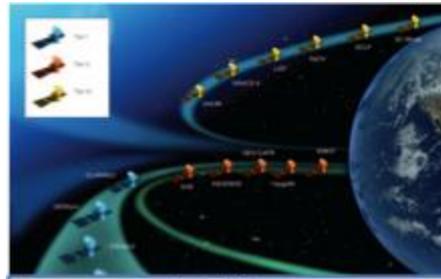


# ACERE History

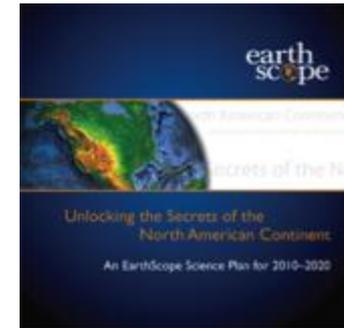
- ERE closely tied to “big data” and the “age of observation”



Oceans



Satellites



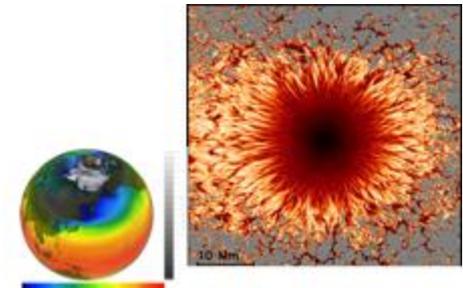
EarthScope Observatory Network



Water



Arctic Sea Ice



Earth System Modeling

# International Global Environmental Change Research

- Environmental issues are a global concern.
- Environmental problems don't know national boundaries.
- Increasingly, environmental science is an international activity.



# International Global Environmental Change Research: The Belmont Forum

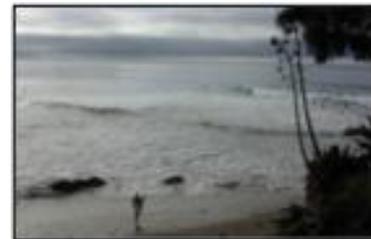
- The Belmont Conference: In 2009, NSF and UK Natural Environment Research Council held conference to identify global change research priorities and catalyze international collaboration.
- Created Belmont Forum, consisting of key international players.
- US cochair: Tim Killeen, former AD GEO
- Now 16 members, including China, India, Brazil, South Africa, etc.
- Led to the “Belmont Challenge”





# International Global Environmental Change Research: The Belmont International Opportunities Fund

- Enables international research community to rapidly propose ideas.
- Joint call mechanism with broad thematic areas; single website for submission
- Current themes: coastal vulnerability and freshwater security; scoping workshops on these topics were held
- Belmont Forum members funding their eligible researchers
- 20M Euros committed so far
- Full proposals due December 2012
- 137 preproposals from 37 countries



# International Global Environmental Change Research: The Belmont International Opportunities Fund

- Next IOF themes under discussion.
- Potential themes:
  - Food security and energy usage
  - Arctic science
  - e-infrastructure (for collaboration)
  - Hazards and extreme events
- Belmont: small grants to help bring existing projects to international level.



# INSPIRE/CREATIV

- *INSPIRE* = Integrated NSF Support Promoting Interdisciplinary Research & Education
- *CREATIV* = Creative Research Awards for Transformative, Interdisciplinary Ventures (acronym going away)
- Themes in line with ERE initiatives: interdisciplinary, transformative, innovative, “outside the box” research
- Responsive to National Academies reports and NSB comments
- Goals: Provide resources to enable cross-cutting collaborations and risk-taking.
- FY12 \$20M, FY13 request \$63M
- New INSPIRE will be bigger projects

# INSPIRE/CREATIV

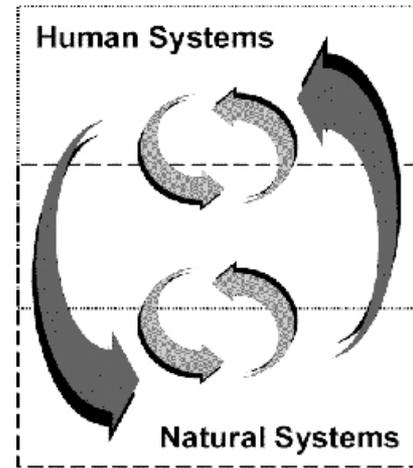
- Must have at least two PDs from different disciplines
- Cannot fit into existing programs.
- CREATIV had 400 inquiries, 50 proposals authorized, 40 awarded.
- Textual analysis of inquiries. Included:
  - Climate/water/ocean
  - Materials/sensors/devices
  - Social/data/sustainability
  - Decision/ecosystem
- Understated roll-out (worried about overwhelming response)
- Attracted out of the box projects with unusual interconnections

# INSPIRE/CREATIV

- INSPIRE expects out of the box projects and expects failures. “If all are successful, we have failed.”
- Internal review of INSPIRE/CREATIV at OIA
  - What worked and what didn't
  - Interview PIs
  - Internal NSF issues (workload)
- Later, follow-ups to see what worked
- Bottom line: how to encourage pathways to interdisciplinary work.

# SEES: Science, Engineering, & Education for Sustainability

- SEES integrates issues of environment, energy, and economics.
- SEES is concerned with the 2-way interaction of human activity with environmental processes.
- SEES established in FY10
- Cross-directorate NSF investment
- Portfolio of existing, new, and upcoming programs
- Encourage systems-based approaches
- Highlights NSF's unique role



# SEES: Science, Engineering, & Education for Sustainability

- Mission: Advance science, engineering, and education to inform the societal actions needed for environmental and economic sustainability and sustainable human well-being
- Goals:
  - Building the knowledge base
  - Growing the workforce of the future
  - Forging critical partnerships



# SEES: Science, Engineering, & Education for Sustainability

- A foundation-wide initiative
- NSF-wide implementation group
- *Remarkable: Over 100 program officers and support staff from all directorates involved in SEES.*
- Moved to true multidisciplinary collaborations



# SEES: Science, Engineering, & Education for Sustainability

- Year 1 & 2 (FY10&11) Activities:
  - Ocean Acidification
  - Climate Change Education
  - Decadal and Regional Climate Prediction using Earth System Models
  - Dimensions of Biodiversity
  - Water Sustainability and Climate (WSC)
  - Research Coordination Networks – SEES track (RCN-SEES)
  - Dynamics of Coupled Natural and Human Systems (CNH)
- 719 proposals, 113 awards, \$99M



# SEES: Science, Engineering, & Education for Sustainability

- Year 3 (FY12) Activities:
  - SEES Fellows (182 proposals, 20 awards)
  - Sustainability Research Networks (205 preproposals, 36 proposals, 2-4 awards expected)
  - Sustainable Energy Pathways (435 proposals, 20 awards)
  - SEES focus in PIRE (180 preproposals, 51 invited proposals, expect 12 awards)
  - RCN SEES track continues
  - CNH SEES track continues (132 proposals, 19 awards)
  - Climate-related competitions continue



# SEES: Science, Engineering, & Education for Sustainability

- Year 4 (FY13) Focus Areas (new)
  - Chemistry, Materials, Engineering: Renewable, non-toxic materials, process improvements
  - Coastal and Arctic Regions: vulnerability, resilience, cultural impacts
  - Hazards and Disasters: science, engineering, risk assessment, decision making
  - Information Science and Engineering: energy consumption, clean computing



# SEES: Science, Engineering, & Education for Sustainability

- ~1200 proposals in past year, 140-150 awards, \$280M funding
- Many partner agencies: NASA, DOE, USDA, NSFC (China), FAPESP (Brazil), USGS, US Fish & Wildlife, etc.
- SEES in its 4<sup>th</sup> year
- Strategic planning
- Some of the 16 SEES programs will end
  - Decisions: which end, which combine
  - Is this a critical mass of programs?

# SEES: Science, Engineering, & Education for Sustainability

Comments about selected SEES programs:

- ***PIRE***
  - 2012 competition was for sustainability
  - Reflects international nature of ERE
  - 180 preproposals, 51 invited, 12 awards
- ***Water, Sustainability & Climate***
  - Understand and predict interactions between water system and changing climate
  - \$26M in 2012
  - Runs one more time in 2014.

# SEES: Science, Engineering, & Education for Sustainability

Comments about selected SEES programs:

- *Decadal & Regional Climate Prediction Using Earth System Modeling*
  - Models interconnecting natural and human systems
  - Maximize model utility for vulnerability, resilience, risk assessment
  - Translate climate predictions (and uncertainties) into scientific basis for policy and decisions
  - 2010 large awards & exploratory ones; 2012 only large (felt already built a community)



# SEES: Science, Engineering, & Education for Sustainability

Comments about selected SEES programs:

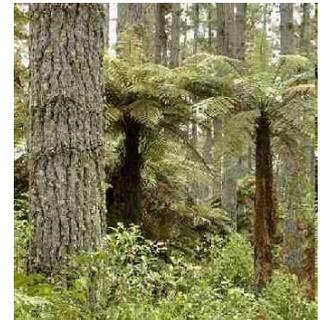
- ***Ocean Acidification***

- Geochemical & biochemical basis of OA, how OA interacts with bio system, how things change over time
- 78 proposals, 16 funded, \$11M
- Future of program being discussed



- ***Dimensions of Biodiversity***

- 10 year campaign to characterize dimensions of biodiversity: genetic, functional, taxonomic, phylogenetic



# SEES: Science, Engineering, & Education for Sustainability

Comments about selected SEES programs:

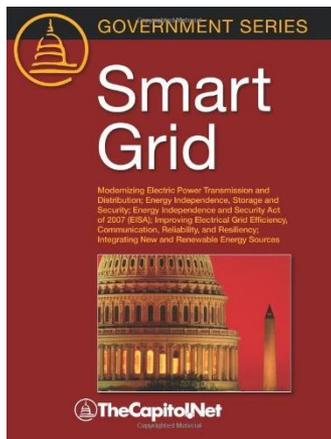
- *Coupled Human and Natural Systems*
  - Topics and themes include ecosystem services, health (disease and climate), agriculture and fisheries, resilience, vulnerability, ancient societies and landscape and practice
  - 2012: 132 proposals, 19 awards, 14 with strong international component



# SEES: Science, Engineering, & Education for Sustainability

## Comments about selected SEES programs:

- *Sustainable Energy Pathways*
  - Energy harvesting, conversion, & storage
  - Energy transmission, distribution, & use
  - Proposals cannot fit core programs
  - 2012: 435 proposals, 20 awards, \$37M
  - No FY13 solicitation, returns in FY14



# SEES: Science, Engineering, & Education for Sustainability

## Comments about selected SEES programs:

- *SEES Fellows*
  - Designed to build scientific workforce of the future in sustainability
  - Postdoc-type award
  - Two mentors needed (one should be industry, government)
  - Very interdisciplinary
  - 2012: 182 proposals, 20 awards, \$8.8M

# SEES: Science, Engineering, & Education for Sustainability

Comments about selected SEES programs:

- *Research Coordination Networks (RCN-SEES)*
  - Opportunities to foster new collaborations, international partnerships, interdisciplinary research
  - Supports groups of researchers to communicate and coordinate their research, educational, and training activities across disciplines and international boundaries
  - Funds are for coordination and communication

# SEES: Science, Engineering, & Education for Sustainability

Comments about selected SEES programs:

- *Sustainability Research Networks*
  - Large projects with multidisciplinary teams, partnerships with industry & govt & NGOs, integrating science & eng & educ
  - 2012: 205 preproposals, 36 full, 2-4 awards
  - 4 to 5 year awards, \$12M each
  - Some hope that this may become a widely-accepted way of doing science.
  - Such programs have an impact on universities, with changing attitudes toward how science is done. NSF a philosophical leader in how it should be done.

# SEES: Science, Engineering, & Education for Sustainability

## SEES Evaluation

- OMB mandates evaluation for SEES
- Evaluation of increasing interest throughout NSF
- Three goals of SEES being evaluated:
  - ***Multidisciplinarity***: Support multidisciplinary research & education to move toward global sustainability
  - ***Linkages***: Build linkages between projects and partners
  - ***Workforce***: Develop workforce needed to address these complex issues
- Weekly SEES implementation meetings include discussion of evaluation

# SEES: Science, Engineering, & Education for Sustainability

## SEES Evaluation

- Utilizing workshops and PI meetings.
- Analyzing proposals, awards, annual and final reports
- Using document clustering tools
- Goal 1 (*Multidisciplinarity*) (Short-term Evaluation):
  - What were emerging themes?
  - How multidisciplinary (people, topics)?
  - Would ideas submitted have been submitted to a traditional NSF program?

# SEES: Science, Engineering, & Education for Sustainability

## SEES Evaluation

- Goal 2 (*Linkages*) (Short-term Evaluation):
  - New partnerships?
  - Integration of social, natural, & engineering sciences? With education?
  - Would partnerships have resulted without SEES?
- Goal 3 (*Workforce*) (Short-term Evaluation):
  - Early indicators of success such as SEES fellows?

# SEES: Science, Engineering, & Education for Sustainability

## SEES Evaluation

- Goal 1 (*Multidisciplinarity*) (Long-term Evaluation):
  - Filling of gaps in sustainability knowledge
  - Findings that would not have arisen without SEES?
  - New multidisciplinary tools, data sets, models, frameworks?
  - Infiltration of multidisciplinary projects in other fields?
  - Informing public policy makers and other decision makers

# SEES: Science, Engineering, & Education for Sustainability

## SEES Evaluation

- Goal 2 (*Linkages*) (Long-term Evaluation):
  - New and unexpected participants in the sustainability enterprise
  - Collaboration lasting beyond the award; new networks of researchers, educators, and practitioners that become self-sufficient
  - Has the private sector become engaged?

# SEES: Science, Engineering, & Education for Sustainability

## SEES Evaluation

- Goal 3 (*Workforce*) (Long-term Evaluation):
  - New ways in which to educate future researchers, technical workers, students, general public about complexity of sustainability issues
  - Measurable impact on hiring trends?
  - How have career pathways and trajectories for SEES people differed?
  - Have academic institutions been influenced to create new programs?

# SEES: Science, Engineering, & Education for Sustainability

## SEES Discussion with the ADs

- How do you get the public to buy into ideas that come from science?
- How do you handle scientists who say you are pushing them to do applications?
- How do you integrate programs of EHR with programs of other directorates?
- Already there are over 1800 sustainability degree programs in US. What do the graduates of these programs do?
- How do you know our programs are preparing people well?



# SEES: Science, Engineering, & Education for Sustainability

## SEES Discussion with the ADs

- How do you get research results to form the basis for evidence used in policy making?
- Is there curriculum for training people to work in new areas?
- When is the best point at which to introduce multidisciplinary training?
- How do you evaluate multidisciplinary programs?
  - Do you know what the desired outcomes are?
  - Do people get jobs?



# ENG's Environmental Sustainability Cluster

- In Division of Chemical, Bioengineering, Environmental & Transport Systems
- Cluster of 4 programs; 5% of ENG budget; each between \$5M and \$12M
  - Energy for Environmental Sustainability
    - ✓ Biofuels, wind & wave energy, etc.
  - Environmental Engineering
    - ✓ Fundamental research on liquid & gaseous releases to environment, watershed mgt, etc.
  - Environmental Health & Safety of Nanotechnology



# ENG's Environmental Sustainability Cluster

- Environmental Sustainability
  - Engineering research to advance sustainable engineered systems: green eng., ecological eng., earth systems eng., industrial ecology, sustainable manufacturing



# Social Sciences in ERE

- Many social science problems of decision making, human responses, fair allocation, etc. are intimately related with environment, energy, and climate change.
- More than a decade of papers in coupled human natural systems.
- Topics like climate change, desertification, biodiversity, ocean acidification, sustainable foodstuff
- There are clearly opportunities for MPS/SBE interconnections here.



# Social Sciences and ERE

- SBE science is multi-disciplinary, data-intensive.
- Many environmental problems are result of human behaviors
- Need to identify questions in the social sciences that are relevant to environmental issues, e.g., markets, land use
- Computational social science is very relevant
- Good examples already exist of use of social science methods in ERE questions:
  - Biodiversity measures use economic inequality concepts
  - Bioconsensus a new discipline based on social choice and group decision making

# Social Sciences and ERE

- Some specific social science challenges related to MPS:
  - Adaptation science: how do individuals or communities respond to abrupt or slow change?
  - Development of rigorous metrics
  - Behavioral responses to environmental change
  - Analysis of social networks
  - Precise modeling of social influence
  - Climate and health
  - Economics and epidemiology

# Social Sciences and ERE

- An ACERE-inspired workshop on Social Sciences in Sustainability Research & Education was planned to investigate connections between social sciences and other disciplines.
- (Workshop was held in Chicago in October 2012. Keynoter was SBE AD Myron Guttman.)

# Some Issues Discussed by ACERE

- New BIO experiment to deal with proposal pressure and staff workload:
  - Single cycle of submissions per year
  - Preproposal 4 pp. in June, full proposal in August
  - Individual PI in at most 2 proposals
  - ACERE expressed concern about this
  - New investigator, pre-tenure: only a few shots at a successful proposal
  - Limit on 2 proposals per PI discourages collaboration, reduces interdisciplinarity
  - Frustration of getting good reviews, minor changes could make proposal competitive, need wait a year.

# Some Issues Discussed by ACERE

- “Unsustainable” success rates
  - Especially so in SEES, but not just in SEES
- If NSF didn’t want to publicize INSPIRE too much because it was worried about getting too many proposals, something is wrong.

# Key Points from Meeting with Subra Suresh Make a Good Summary of ACERE Themes

- *How do you evaluate a multidisciplinary program like SEES?*
  - Interdisciplinarity is becoming “the norm” – it should not be thought of as different or an exception
  - Evaluation over the long-term is a complex problem.
- **INSPIRE**: Would early career people be able to benefit from this?
  - Under discussion by INSPIRE working group

# Key Points from Meeting with Subra Suresh Make a Good Summary of ACERE Themes

- *How do you overcome the frustration young people express with the current economic climate, with some dropping out of academia or industrial research?*
  - NSF's commitment to new investigators (CAREER, GRFs, postdocs).
  - Exploring ways to have global programs for new investigators, e.g., NSF puts CAREER awardees in touch with European facilities

# Key Points from Meeting with Subra Suresh Make a Good Summary of ACERE Themes

- *Diversity: How does NSF address involvement of underrepresented groups in programs like SEES?*
  - \$1B across federal govt in diversity programs
  - Hypothetical challenge to an NSF committee: If you had \$100M for broadening participation, how would you spend it?
- *Proposal Pressure, Staff Workload: BIO is experimenting with 1 year cycle for proposals, limit # proposals per PI, require preproposal. Is this healthy?*
  - Under evaluation

# Key Points from Meeting with Subra Suresh Make a Good Summary of ACERE Themes

- *Engagement of the Public*: It is easier to talk to the public about race than about climate change. How do you engage the public and educate them?
  - Look to public events celebrating science
  - See what places like Singapore (#1 in test scores) are doing, e.g., compensating science teachers highly
  - Utilize all kinds of communication devices.

# Concluding Thoughts

- ERE challenges cut across all areas of science
- They cut across all of NSF
- The Administration recognizes the importance of these topics.
- NSF has made these challenges a priority.
- The international community is ahead of us in recognizing the problem and massing resources to address it.
- We have made a lot of progress, but let's not begin to think we have made enough.
- A sense of urgency is missing: This is really critical for humanity