



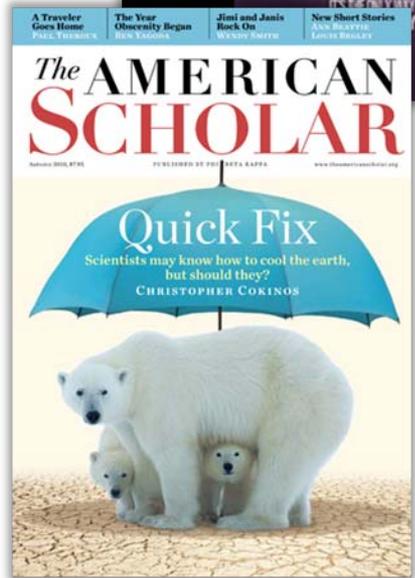
# Rapid, multifaceted global change is challenging human well-being



*Ships take to Arctic Ocean as Sea Ice Melts. Journey time between Europe and China can be reduced by half.*  
*MSNBC.com*



# Sustainability issues remain at the forefront



# Meeting Sustainability Challenges...



...requires multifaceted approaches and research at the nexus of societal needs and behavior, environmental impact, and economic demands.



# NSF's Science, Engineering and Education for Sustainability (SEES) Portfolio

**Science, Engineering and Education for Sustainability (SEES)**

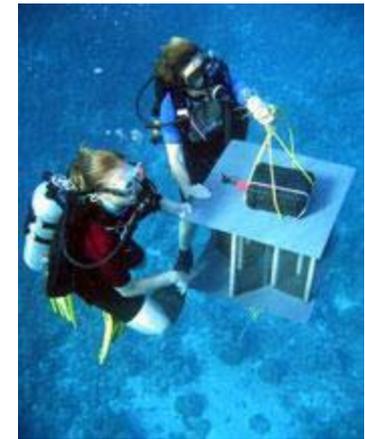
To advance science, engineering, and education to inform the societal actions needed for environmental and economic sustainability and sustainable human well-being.



# SEES Overview

Mission: *to advance science, engineering, and education to inform the societal actions needed for environmental and economic sustainability and sustainable human well-being*

- Established in Fiscal Year 2010
- Portfolio of existing and new programs
- All NSF Directorates and offices involved
- Partnerships



# SEES Goals

1. **Interdisciplinary research and education...towards** global sustainability
2. Link projects and **partners** and add **new participants** to sustainability endeavors
3. Develop the **workforce**...to address...sustainability



# SEES Characteristics



## **System Thinking**

- Holistic approaches that link human, built and natural systems, and reach across disciplines

## **Partnerships & Networks**

- Connect intellectually and spatially disparate communities, institutions and organizations

## **Workforce & Education**

- Development and education of new researchers and students on critical aspects and issues of sustainability



# SEES Themes

- Natural Systems
- Human Systems
- Built Systems
- Energy and materials
- Adaptation and Resilience

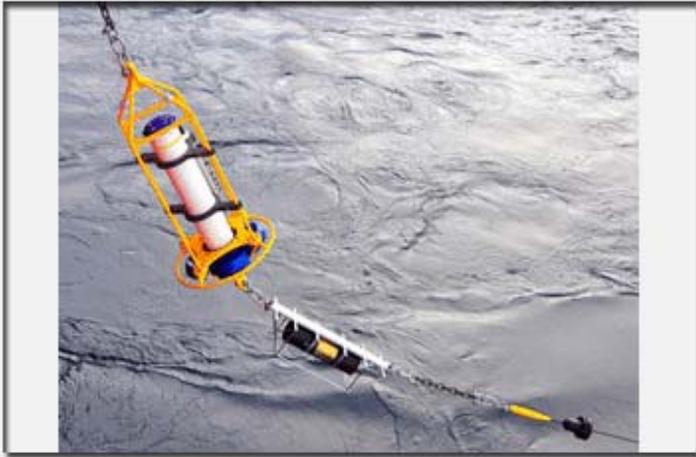


# SEES Programs - FY2010/2011

- Ocean Acidification (NSF 12-600)
- Dimensions of Biodiversity (NSF 12-528)
- Decadal and Regional Climate Prediction using Earth System Models (NSF 12-522)
- Water Sustainability & Climate (NSF 11-551)
- Climate Change Education (NSF 12-523)
- Research Coordination Networks – SEES track (NSF 11-531)
- Dynamics of Coupled Natural and Human Systems – SEES track (NSF 10-612)

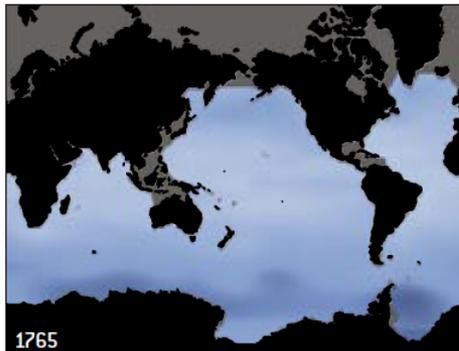


# Ocean Acidification (NSF 12-600)

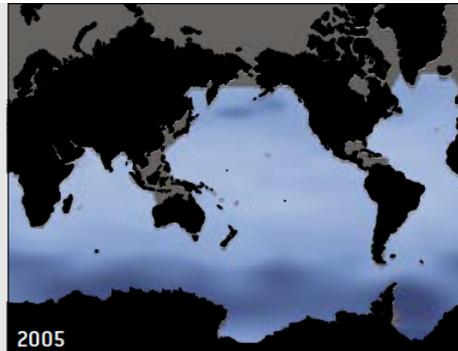


Credit: Rachel Fletcher

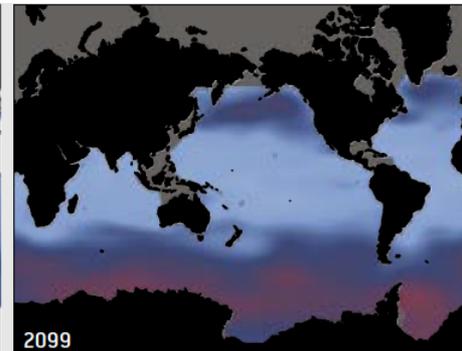
- **Goals:** To understand geochemistry biochemistry of ocean acidification; how ocean acidification interacts with biological and physical processes at the organism level; how earth system history informs our understanding of the effects of OA.
- NSF Directorates: GEO, BIO, OPP
- Next Deadline: December 4, 2012



1765



2005



2099

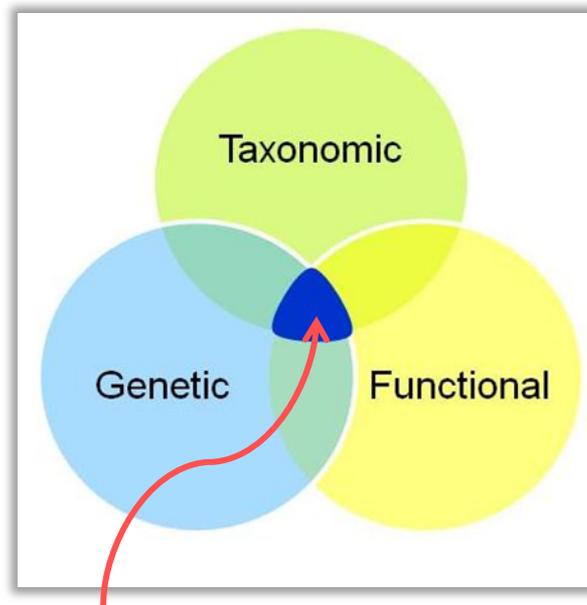
Saturation State of Aragonite



# Dimensions of Biodiversity (NSF 12-528)

**Goal:** A 10-year campaign to characterize the dimensions of biodiversity on Earth

**Purpose:** to support research that characterizes biodiversity on Earth through the use of integrative and innovative approaches to develop an understanding of key dimensions of biodiversity



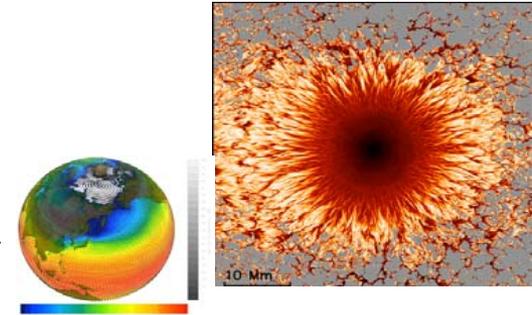
*Solicitation targeted areas where three dimensions of biodiversity overlap*

- NSF Directorates: BIO, GEO, OPP
- Additional partners: NASA, China (NSFC), Brazil (FAPESP)
- Next Competition: FY13



# Decadal & Regional Climate Prediction using Earth System Models (EaSM) (NSF 12-522)

- Goals
  - Reliable global and regional predictions of decadal climate variability and change
  - Quantify impacts of climate variability and change on natural and human systems
  - Maximize model utility for vulnerability/resilience and risk assessments
  - Translate climate predictions (& uncertainties) into scientific basis for policy and decisions
- Interagency: NSF, DOE, USDA
- NSF Directorates: GEO, MPS, SBE, OPP
- Next Competition: FY14



Earth System Modeling

# Water Sustainability & Climate (NSF 11-551)

- **Goals:**
  - How Earth's water system is linked to climate change, land use, ecosystems and the built environment
  - Enable a new interdisciplinary paradigm in water research
- Interagency: NSF, USDA/NIFA
- NSF Directorates: GEO, ENG, SBE
- Next Competition: FY14



Scott Simpson

Synthesis of behavioral and ecohydrologic models for dryland rivers



Bryce Richter

Climate change, land use, and urbanization in a Midwestern agricultural landscape



# Climate Change Education Partnership

- **Goal:** Connects (1) climate scientists, (2) experts in theories on how people learn science, and (3) formal and informal education experts, with the goals of increasing public understanding of global climate change and preparing the next generation of scientists and educators.
- **NSF Directorates: EHR (DUE & DRL), GEO, BIO, OPP**

## FY 2009

10 CCE awards in response to Dear Colleague Letter

## FY 2010

15 CCEP-I awards (110 proposals): 2 years, up to \$1M

## FY 2011

12 supplements: Up to \$250,000 each

## FY 2012

6 CCEP-II awards 5 years, \$5-6M



FY 2013:  
\* Establish a CCEP Alliance Office  
\* Initiate Program-Wide Evaluation



# Research Coordination Networks (NSF 11-531)

- SEES-RCN track: Advance sustainability science, engineering & education as an integrative systems approach
- Interdisciplinary teams; encourage diverse stakeholder participation
- Up to 5 years at \$150k per year
- NSF Directorates: All
- Next Deadline: February 4, 2013



# Dynamics of Coupled Natural and Human Systems (CNH) (10-612)

- Standing, interdisciplinary NSF program
- Quantitative, interdisciplinary analyses of human and natural system processes and complex interactions at diverse scales
- CNH encourages SEES themes; adds support for exploratory & new team awards & research coordination networks
- NSF Directorates: GEO, BIO, SBE
- Next Deadline: November 20, 2012



Credit: J. Brashares



Credit: I. Peralta, USFS



Credit: S. Perz



# SEES Programs - FY2012

- SEES Fellows (NSF 12-601)
- Sustainability Research Networks (SRN) (NSF 11-574)
- Sustainable Energy Pathways (SEP) (NSF 11-590)
- SEES focus in Partnerships for International Research and Education (PIRE) solicitation (NSF 11-564)
- RCN – SEES track continues (NSF 11-531)
- CNH – SEES track continues (NSF 10-612)
- Climate-related (CRI) competitions continue



# NSF SEES Fellows (12-601)

## Support

- Up to 36 FTE months support over max 4 yr period
- Up to \$264K for Fellow's salary plus fringe (for 36 FTE months)
- Up to \$60K for research expenses
- Up to \$30K for projects proposing international partnerships
- Indirect costs to grantee institution

## Eligibility

Grant to US institution. PI must:

- US citizen, national, or permanent resident
- Have or will receive PhD by start of award
- Not have worked more than 36 FTE months in positions requiring PhD
- Not be employed in tenure-track (or equivalent) position

**To create the necessary workforce to enable discoveries leading to environmental, energy, and societal sustainability**

- **The Fellow's proposed research should:**
  - **Cross traditional disciplinary boundaries**
  - **Go beyond his/her current core disciplinary expertise**
  - **Address issues of sustainability through a systems approach**
  - **Build bridges between academic inquiry, economic growth, and societal needs**
- **Must develop a research partnership that will advance and broaden the impact/scope of the proposed research**
- **Must present a professional development plan**
- **Teaching is limited to one course per term and no more than 3 courses during award period**

**Next Deadline: November 21, 2012**



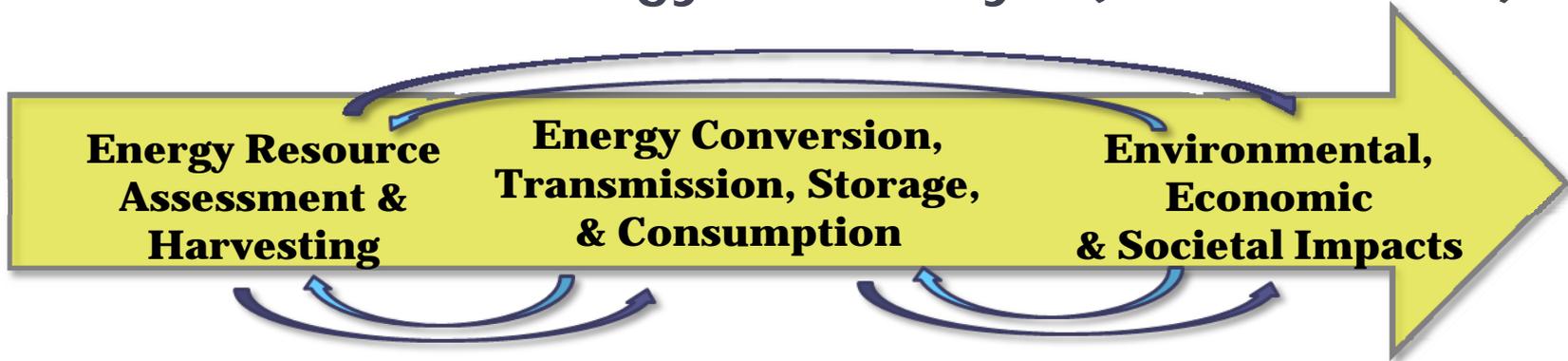
# Sustainability Research Networks (NSF 11-574)



- SRNs will connect interdisciplinary teams of investigators focused on performing cutting-edge research and education relating to the challenges of sustainability.
- Links scientists, engineers and educators at existing institutions, centers and networks, and develop new nodes of research
- NSF Directorates: All
- Up to \$12M over 5 years
- Next Competition: FY14



# Sustainable Energy Pathways (NSF 11-590)



## Key components:

- Sustainability - from resource to realization
- Interdisciplinary and system approach
- Addresses science and engineering Challenges, informed by the environmental, societal, and economic aspects

NSF Directorates: MPS, ENG, CISE, SBE, GEO, BIO, OISE, EHR

Next Competition: FY14



# Partnerships for International Research & Education (NSF 11-564)

- Build research & education **partnerships** with foreign counterparts (in sustainability: 2012);
- Support **science and engineering** research excellence;
- Provide strong international research experiences for U.S. **students**;
- Engage resources, catalyze change within and across **institutions**;
- 2012 competition had exclusive sustainability focus



# SEES Programs - FY2013

- Arctic SEES(NSF 12-553)
- Coastal SEES(NSF 12-594)
- Hazards SEES(NSF 12-610)
- Cyber SEES (NSF 13-500)
- SuSChEM (NSF13-501)
- STTR SEES (NSF 13-501)
- RCN – SEES track (NSF 11-531)
- CNH – SEES track (NSF 10-612)
- Climate-related (CRI) competitions continue



# ArcSEES

(NSF 12-553)

Proposals are due on September 14, 2012.

Research projects will focus on one or more thematic areas related to Arctic sustainability:

- the natural and living environment
- the built environment
- natural resource development
- governance

Seven directorates, five US agencies, and one international consortium will be jointly reviewing and funding meritorious proposals in FY13.



Photo credits: Steve Hillebrand, USFWS; STG Incorporated/NREL; Peter West, NSF; Lars Poort, Institute of Learning Processes, University of Greenland; Thinkstock



# COASTAL SEES (NSF 12-594)

- Multi-directorate program that seeks to:
  - Enable place-based system-level understanding of coastal systems on variety of spatial & temporal scales
  - Yield outcomes with predictive value in coastal systems
  - Identify pathways by which outcome could be used to enhance coastal sustainability
- Two tracks
  - Incubator proposals (Track 1) --200 to 600K over 2 yrs (strongly encouraged in 1<sup>st</sup> round to build capacity)
  - Research Proposals (Track 2) -- up to \$3M over 5 yrs
- NSF Directorates: GEO, BIO, SBE, ENG, OPP
- Deadline: January 17, 2013



# Interdisciplinary Research in Hazards and Disasters (Hazards SEES) (NSF 12-610)

## Goals

- advance understanding of fundamental processes associated with specific natural hazards and technological hazards linked to natural phenomena, and their interactions
- better understand causes, interdependences, impacts and cumulative effects of hazards on individuals, natural and built environment, and society as a whole
- improve capabilities for forecasting or predicting hazards, mitigating effects, and enhancing capacity to respond to and recover from resultant disasters



## Awards

- Type 1: forge new or emerging interdisciplinary teams (up to \$300K, 2 yrs)
- Type 2: major new integrated hazards research (up to \$3M, 4 yrs)

NSF Directorates/Offices: CISE, ENG, GEO, MPS, OCI, SBE

Deadline: February 4, 2013



# Cyber SEES (NSF 13-500)

## Cyber-Enabled Sustainability Science & Engineering

**Goal:** To advance sustainability science via interdisciplinary research enabled by innovations in computing & information sciences.

The proposed research under this solicitation must be well-grounded in at least one concrete sustainability problem facing the planet, but applicable more generally. The sustainability challenges associated with computing itself are also covered by the solicitation.

### **Award Types:**

Type 1: Small, proof-of-concept, capacity building, or exploratory research projects (up to \$300K, 2 yrs)

Type 2: Regular projects (up to \$1.2M, 4 yrs)

### **Deadlines:**

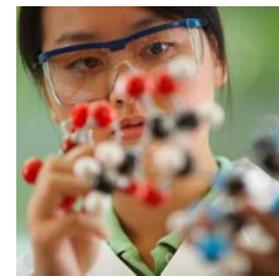
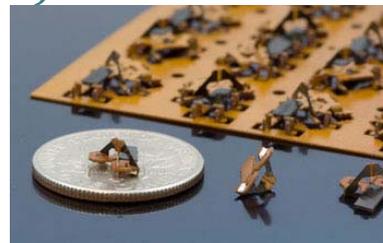
Letters of Intent (required): Dec 4, 2012;

Proposals: Feb 5, 2013 (at most 2 per PI)



# Sustainable Chemistry, Engineering & Materials (SuSChEM) (NSF 12-097)

- DCL: Opportunities for interdisciplinary research & education in chemical sciences & engineering related to sustainable synthesis, use and reuse of chemicals & materials
- Advance science, engineering & education to inform societal actions aimed at environmental & economic sustainability
- Partnerships and educational experiences to train workforce strongly encouraged
- Existing programs with co-review & co-funding involving:
  - Chemical, Bioengineering, and Transport Systems & Civil, Mechanical and Manufacturing Innovation (Engineering)
  - Chemistry & Materials Research (MPS)
  - Earth Sciences (Geosciences)



# Small Business Technology Transfer (STTR) (NSF 13-501)

- Stimulates technological innovation in private sector by strengthening role of small business concerns in meeting federal research and development needs
- Requires researchers at universities & other non-profit research institutions to play significant role in STTR project
- Current Phase I solicitation has exclusive focus on technologies aimed at attaining environmental & economic sustainability
- **Deadlines:**
  - Letters of Intent : January 8, 2013
  - Full proposals: February 6, 2013



# SEES Takes the Long View

Sustainability requires long-term perspectives, emphasizing:

- Integrated approaches across disciplines
- Developing systems-level models
- Realizing data-enabled science
- Linking observational networks
- Exploring linkages between technological solutions and environmental effects
- Communicating research findings to decision-makers and the public



Eos, Vol. 93, No. 1, 3 January 2012

# A Focus on Science, Engineering, and Education for Sustainability

## Science, Engineering and Education for Sustainability (SEES)



National Science Foundation

Mission: to advance science, engineering, and education to inform the societal actions needed for environmental and economic sustainability and sustainable human well-being



A sustainable world is one in which human needs are met equitably without harm to the environment, and without sacrificing the ability of future

generations to meet their needs. Meeting this formidable challenge requires a substantial increase in our understanding of the integrated system of society, the natural world, and the alterations humans make to Earth. NSF's Science, Engineering and Education for Sustainability (SEES) program aims to address this need through interdisciplinary research and education.

Under SEES, NSF employs a systems approach to understanding the link between the natural and built environment. SEES supports the entire range of scientific research and aims to:

- 1) Build the knowledge base through interdisciplinary research and education



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- About Funding

- Proposals and Awards
- Proposal and Award Policies and Procedures Guide
- Introduction
- Proposal Preparation and Submission

### Crosscutting/NSF-wide

## Science, Engineering and Education for Sustainability NSF-Wide Investment (SEES)

### SEES Mission Statement

To advance science, engineering, and education to inform the societal actions needed for environmental and economic sustainability and sustainable human well-being.

### CONTACTS

For general inquiries about SEES related activities: [nsf-sees-info@nsf.gov](mailto:nsf-sees-info@nsf.gov). For program or discipline-specific questions, please see the full list of contacts at: [http://www.nsf.gov/geo/sees/sees\\_contacts.jsp](http://www.nsf.gov/geo/sees/sees_contacts.jsp)

### SYNOPSIS

Science, Engineering, and Education for Sustainability (SEES) is a portfolio of activities that highlights NSF's unique role in helping society address the challenge(s) of achieving sustainability.

A sustainable world is one in which human needs are met equitably without harm to the environment, and without sacrificing the ability of future generations to meet their needs. Meeting this formidable challenge requires a substantial increase in our understanding of the integrated system of society.



<http://www.nsf.gov/sees>

