

*Development of the Earth System
History (ESH) competition*



ESH Review
October 16-17, 2006

I. What was the overall vision for the ESH competition?

“The Earth System History (ESH) competition is a coordinated paleoscience research initiative of the **U.S. Global Change Research Program (USGCRP)** that is supported by the National Science Foundation (NSF)...ATM, EAR, OCE ... and the National Oceanic and Atmospheric Administration (NOAA).”

“The goals of ESH research were to “understand the natural variability of the Earth system through **records preserved in geo-biologic archives** and to contribute to a comprehensive understanding of climate change with **annual to millennial resolution, including the forcing mechanisms, interactions and feedbacks among its components.**”

[NSF 96-142; NSF 97-161; NSF 00-11; NSF 02-005; NSF 02-191; NSF 04-597]


How did this vision originate?



“The USGCRP was established by the **Global Change Research Act of 1990** to enhance understanding of natural and human-induced changes in the Earth’s global environmental system; to monitor, understand, and predict global change; and to **provide a sound scientific basis for national and international decision making.**”

[<http://www.climate-science.gov/infosheets/factsheet1/default.htm>]

Climate Change Science Program (CCSP) Guiding Vision



“A nation and the global community empowered with the science-based knowledge to manage the risks and opportunities of change in the climate and related environmental systems.”

[<http://www.climate-science.gov/infosheets/factsheet1/default.htm>]

Why this vision now?



“Over the past 15 years, the United States has invested heavily in scientific research, monitoring, data management, and assessment for climate change analyses to build a foundation of knowledge for decision making. The seriousness of the issues and the unique role that science can play in helping to inform society’s course give rise to CCSP’s guiding vision.” [\[http://www.climate-science.gov/infosheets/factsheet1/default.htm\]](http://www.climate-science.gov/infosheets/factsheet1/default.htm)

How is this vision implemented?



- “Fundamentally, the CCSP integrates U.S. Government-supported research on climate and global change, as conducted and sponsored by 13 departments and agencies.”
- “The CCSP adds significant integrative value to the individual Earth and climate science missions of its participating agencies and departments, and their national and international partners. **A critical role of the interagency program is to coordinate research and integrate and synthesize information to achieve results that no single agency, or small group of agencies, could attain.**”

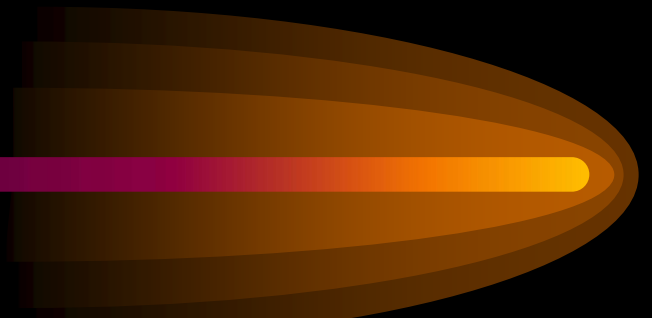
[<http://www.climatescience.gov/infosheets/factsheet1/default.htm>]

II. How did the program directors develop the ESH solicitation?



- Early on, ESH research grew out of NSF divisional strategic plans that had some form of community input.
- Around the mid-1990s, a small group of scientists were formed into the ESH Steering Committee and they wrote the ESH solicitations and served on ESH review panels.

January 15, 1997 [NSF 96-142]

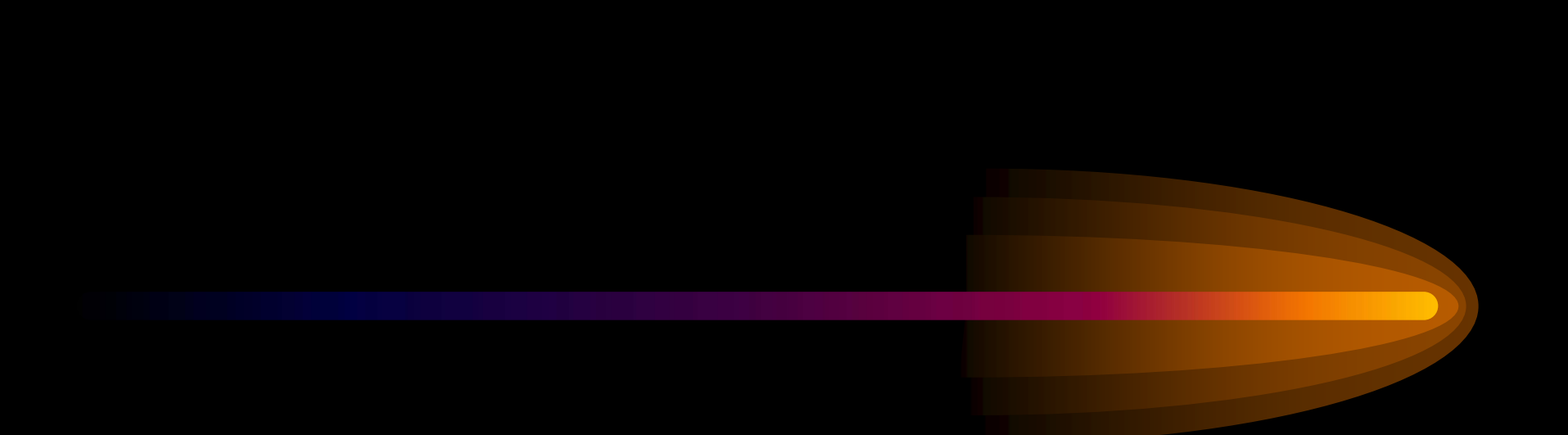
- 1. Paleoclimate Variability**
 - 2. Terrestrial Earth System Science**
 - 3. Indo-Pacific Circulation and Climate**
 - 4. Continental Drilling for Global Change**
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January 15, 1998 & January 15, 1999 [NSF 97-161]

- 1. Paleoclimate Variability**
- 2. Terrestrial Earth System Science**
- 3. Arctic Paleoclimate**

February 14, 2000 & February 14, 2001 [NSF 00-11]

- 1. Paleoclimate Variability at Annual-Decadal Resolution**
- 2. Rapid Climate Change**
- 3. Extreme Warm Conditions**
- 4. Spatial Patterns and Continuous Records of Climate Change**
- 5. Arctic Paleoclimate Studies**
- 6. Modeling of Past Change**

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- In early **2001**, the **ESH Call For Comments** was used to receive **wide community input** into the science directions for ESH.
 - Smaller workshops were organized to develop science plans from the ESH Call For Comments to comport with USGCRP/CCSP.
 - ESH solicitations beginning in January 15, 2002 were based on the **ESH Call and subsequent workshops**.



January 15, 2002 [NSF 02-005]

1. Holocene Climate Variability, Forcing Mechanisms, and Impacts
2. Regional Patterns and Phasing of Climate Change
3. Rapid Climate Change
4. Modeling of Past Change



January 15, 2003 & October 15, 2003 [NSF 02-191]

1. Holocene Climate Variability, Forcing Mechanisms, and Impacts
2. Modes of Arctic Variability and Warmth
3. Rapid Climate Change
4. Regional Patterns and Phasing of Climate Change

October 13, 2004 & October 13, 2005 [NSF 04-597]

1. Holocene Climate Variability, Forcing Mechanisms, and Impacts
2. Abrupt Climate Change
3. Regional Patterns and Phasing of Climate Change

Why was this research important?

“Assessment of future climate changes and their effects requires understanding the full range of the Earth's variability and how the **interlinked systems of ice, ocean, atmosphere, continents and biosphere** respond to changing climate conditions.”

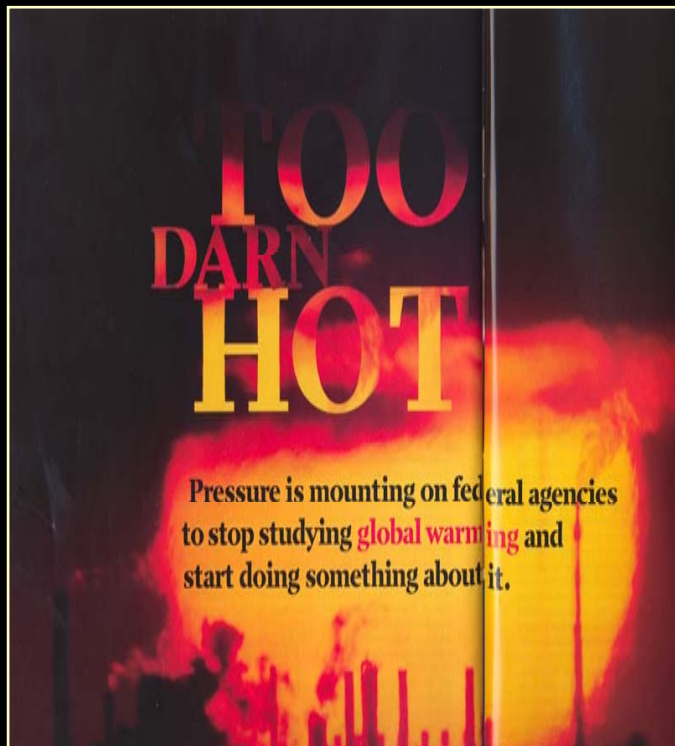
“**Integrated responses of the Earth system** to climatic perturbations are preserved in natural archives of many types including: **tree-rings, ice cores, corals, ancient soil deposits and marine, lake and terrestrial sediments**. These records provide the data needed to understand the natural behavior of the Earth system and provide the **temporal perspective for evaluating more recent human-induced impacts**.”

[NSF 96-142; NSF 97-161; NSF 00-11; NSF 02-005; NSF 02-191; NSF 04-597]

Where is USGCRP headed?

- Post-2002 ESH science questions were the basis for the upcoming CCSP assessments: **1) Past Climate Variability and Change in the Arctic and at High Latitude** and **2) Abrupt Climate Change.**
[<http://www.climatescience.gov/Library/sap/sap-summary.htm>]
- Potential for accepting the premise of global warming due to human and natural causes and shifting towards **how best to respond** (i.e., **Impact, Adaptation, Mitigation**).


“... the fair characterization is, there’s actually a raging amount of consensus...humans are a big part of the problem and we need to just get on with it.” James Connaughton, Chair, White House Council on Environmental Quality.






“I say the debate is over. We know the science. We see the threat. And we know the time for action is now.”

Arnold Schwarzenegger, Governor of California.



“The major outstanding question about global warming is not whether adding large amounts of new carbon to the atmosphere will tend to increase temperatures further. It is how sensitive the climate will be to what mass of additional carbon over time -- and how bad the practical consequences of that sensitivity will be.”

Editor, Washington Post, August 3, 2006.



Invitation from **Dr. John Marburger**, Director of OSTP, to brief him on abrupt climate change because he “*was seeing papers in the science journals about abruptly occurring environmental events that appear to be a surprise to the science community and raised concern in my mind.*”

➤ **Abrupt Climate Change, Briefing at White House, May 8, 2006**

Briefers: Dave Anderson (NOAA), Jack McGeehan (USGS), Dave Verardo (NSF),
Howie Spero (NSF)

Audience: **OSTP & CEQ**

“... the paleoclimate perspective gives the climate debate a bandwidth of climate science and impacts that we had not previously heard. We need to hear more.” **James Connaughton, Chair, White House CEQ, May 8, 2006.**



➤ **Abrupt Climate Change, Briefing at White House, May 25, 2006**

Briefers: Dave Anderson (NOAA), Jack McGeehan (USGS), Dave Verardo (NSF),
Howie Spero (NSF)

Audience: OSTP, CEQ, NSC, CEA, Office of the Vice President

➤ **Abrupt Climate Change, Briefing at White House, September 7, 2006**

Briefer: Richard Alley, Pennsylvania State University

Audience: OSTP

➤ **What are the key accomplishments of the ESH program? Have transformational discoveries resulted from ESH research?**



✓ **To have transformational research requires transformational program management.**

➤ **Has ESH produced significant cross-divisional interdisciplinary research efforts that might have not otherwise occurred?**

✓ **ESH provided a framework for researchers to organize into collaborative projects (i.e., 53%, 60%, 64% are collaboratives).**