Whither (wither?) climate science?

Michael C. Morgan
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Full disclosure

• I am not a “climate scientist”
• I study the analysis, diagnosis, prediction, and predictability of mid-latitude and tropical weather systems that exist on time scales of several hours to a few weeks.
• I will address what drives agencies’ budget priorities, discuss NSF’s support of climate science, and describe some big challenges
Considerations

- Obscurity is not necessarily bad; the science would be well-served if it were not politicized.
- 1990’s to present, a boom period? Where’s the data?
- Climate science is much more than climate change science; support for climate research has gone up – both in basic research and “impacts”
- What question was answered? What basic R&D questions of climate science remain?
- Issues of attribution of the changing climate remain as well.
The Budget Cycle

1. OSTP & OMB issue guidance memorandum on R&D priorities
2. Agencies prepare and submit proposed budgets to OMB
3. Passback, negotiations, & appeals between agencies and EOP
4. President makes final decisions and sends Budget Request to Congress
5. Congress reviews, considers, & approves overall Budget Request
6. Appropriations hearings with agencies & EOP on individual programs
7. Congress marks up & passes agency appropriations bills
8. President signs or vetoes appropriations bills
9. Agencies make decisions on allocation of resources consistent with enacted appropriations and program plans
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7. Congress ????
Administration priorities

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From 23 June 2006, OMB/OSTP memo M-06-17 (Bush administration)
ADMINISTRATION PRIORITIES FY 2012

EXECUTIVE OFFICE OF THE PRESIDENT
OFFICE OF MANAGEMENT AND BUDGET
WASHINGTON, D.C. 20503

July 21, 2010

M-10-30

MEMORANDUM FOR THE HEADS OF EXECUTIVE DEPARTMENTS AND AGENCIES

FROM: Peter R. Orszag
Director, Office of Management and Budget

John P. Holdren
Director, Office of Science and Technology Policy

SUBJECT: Science and Technology Priorities for the FY 2012 Budget

Scientific discovery, technological breakthroughs, and innovation are major engines for expanding the frontiers of human knowledge and are indispensable for promoting sustainable economic growth, improving the health of the population, moving toward a cleaner energy future, addressing global climate change challenges, managing competing demands on the environment, and safeguarding our national security.

This memorandum follows up on OMB Memorandum M-10-19 by outlining the Administration’s science and technology (S&T) priorities for formulating FY 2012 Budget submissions to the Office of Management and Budget (OMB). These priorities for research and development (R&D) investments and other S&T investments build on priorities already reflected in the American Recovery and Reinvestment Act, the FY 2010 and 2011 Budgets, and key Administration policy guidance such as the President’s Strategy for American Innovation. This memorandum also provides program guidance for S&T activities in Executive Departments and Agencies.

Prioritizing key S&T activities

Agencies should explain in their budget submissions how they will direct available resources, as appropriate, and consistent with their mission, from lower priority areas to S&T activities that address six challenges and strengthen six cross-cutting areas (outlined in Attachment A) that underlie success in addressing all of these challenges. Agencies should describe expected outcomes from these S&T investments, providing quantitative metrics where possible.

Program Guidance

The President has a long-term goal that the R&D investment (both private and Federal) in the United States should reach three percent of the Gross Domestic Product (GDP). In order to understand the status of the Federal share of this goal, agencies are expected to work in close collaboration with OMB and OSTP to accurately classify and report R&D investment activities.

Agencies should pursue transformational solutions to the Nation’s practical challenges, and budget submissions should therefore explain how agencies will support long-term, visionary thinkers.

APPENDIX A

Challenges and Areas to be Strengthened

In the 2012 Budget, agencies should focus resources on addressing these six challenges:

Promoting sustainable economic growth and job creation

• Support R&D in advanced manufacturing to strengthen U.S. leadership in the areas of robotics, cyber-physical systems, and flexible manufacturing.

• Support research to establish the foundations for a 21st century “bio-economy.” Advances in biotechnology and innovations in our ability to design biological systems have the potential to address critical national needs in agriculture, energy, health, and the environment.

• Support two specific areas within existing interagency efforts: the National Nanotechnology Initiative’s signature initiatives and the Networking and Information Technology Research and Development (NITRD) initiative’s focus on research to improve our ability to derive value and scientific inference from enormous quantities of data.

Defeating the most dangerous diseases and achieving better health outcomes for all while reducing health care costs

• Prioritize research investments in technologies that have the potential to accelerate the pace of discovery in the life sciences, especially imaging, bioinformatics, and high-throughput biology.

• Prioritize investments to reduce the time needed to develop vaccines for future pandemics, consistent with the President’s Council of Advisors on Science and Technology’s recommendations on Influenza Vaccines.

Moving toward a clean energy future to reduce dependence on energy imports while curbing greenhouse gas emissions

• Prioritize investments in the research and development of clean energy technologies, especially solar energy, next-generation biofuels, and sustainable green buildings and building retrofit technologies.

• Prioritize R&D on advanced vehicle technologies, particularly modeling and simulation of lightweight materials and their manufacturing processes, batteries, and hybrid power trains, and systems integration and demonstration of advanced vehicle platforms.

Understanding, adapting to, and mitigating the impacts of global climate change

• Support, within coordinated interagency investments in the U.S. Global Change Research Program, an integrated and continuing National Climate Assessment of climate change science, impacts, vulnerabilities, and response strategies, including mitigation and adaptation.

• Prioritize research for measuring, reporting and verifying greenhouse gas emissions.

Managing the competing demands on land, fresh water, and the oceans for the production of food, fiber, biofuels, and ecosystem services based on sustainability and biodiversity

• Support research on integrated ecosystem management approaches that bring together biological, physical, chemical, and human uses data into forecast models, assessments and decision support tools.

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Within the U.S. Global Change Research Program, agencies should give priority to new activities identified in the recently released 2012 Strategic Plan. Particular emphasis should be given to research that advances understanding of vulnerabilities in human and biogeophysical systems and their relationships to climate extremes, thresholds, and tipping points. This will require integrated cross-sectoral, biogeophysical, and socioeconomic observations as well as improved simulation and modeling. Specific areas where progress is needed include observations to detect trends in extremes; integration of observation into models; attribution of change to human or natural causes; integrated research on Earth and human systems; simulation and prediction at spatial and temporal scale conducive to decision making; and adaptation responses to changing frequency and intensity of extreme events.
Science, Engineering, and Education for Sustainability (SEES)

- 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 FY2010
- Cross-NSF investment
- Portfolio of existing and new programs
- System-based approaches
New SEES Focus Areas

• **Arctic regions (“ArcSEES”)**
  – Vulnerability, resilience, cultural impacts
  – *funding began in FY 2012 (NSF 12-553)*

• **Sustainable Chemistry, Engineering and Materials (“SusChEM”)**
  – Renewables, non-toxic materials, natural resources
  – *funding to begin in FY2013 (NSF 12-097)*

• **Coastal regions (“CoastalSEES”)**
  – Vulnerability, resilience, cultural impacts
  – Solicitation deadline: 17 January 2013
  – *funding to begin in FY2013 (NSF 12-594)*

• **Hazards and Disasters (“HazardsSEES”)**
  – Prediction, risk assessment, decision-making
  – Solicitation deadline: 4 February 2013
  – *funding to begin in FY2013 (NSF 12-610)*
Administration priorities dictate research opportunities

• Yes, the climate science budget has received increases due to concerns over climate change.
• This has led to modest increases in core activities, but more notable increases in funding from solicitations
NSF, broadly

• The National Science Foundation Act of 1950 (Public Law 81-507) set forth NSF's mission and purpose:
  – To promote the progress of science; to advance the national health, prosperity, and welfare; to secure the national defense....

• The Act authorized and directed NSF to initiate and support:
  – basic scientific research and research fundamental to the engineering process,
  – programs to strengthen scientific and engineering research potential,
  – science and engineering education programs at all levels and in all the various fields of science and engineering,
  – programs that provide a source of information for policy formulation,
  – and other activities to promote these ends.
Climate and Large-scale Dynamics

The CLD program supports research on the climate and large-scale atmospheric circulation of the Earth. Research topics include:

• General circulation of the stratosphere and troposphere;
• Synoptic to global scale weather phenomena;
• Processes that govern mean climate, climate variability, and climate change;
• Development and testing of physical parameterizations for use in large-scale weather and climate models;
• Data assimilation
CLD support to CESM

CLD has a long tradition of involvement with the CESM effort, and was involved in the establishment of the Scientific Steering Committee, the CESM Advisory Board, and the Working Group structure for model governance and community input.

CLD supports the annual CESM workshop, which provides a venue for communication between NCAR, the community, and CLD program managers.

CLD also supports the CESM tutorial workshops.
From climate to earth system models
CLD program activities

Most of the program’s science activities occur through regular, unsolicited proposals. However, there are a few special projects including:

1. DYNAMO: a large, multi-agency, multi-national field campaign currently in the field which relies heavily on EOL.

2. VOCALS: in the field in 2008, and we expect to receive proposals for data analysis on a continuing basis.

3. Climate Process Teams: teams of climate modelers (at NCAR), process modelers, and observationalists to improve physical parameterizations in climate models.

4. CMMAP: the CMMAP STC is developing SP-CCSM and GCRMs, to be used by the CLD community.

5. IPCC CMIP5 analysis: CLD has had several projects and expects more.
(some) Remaining Challenges

Some of the key near-term science challenges are:

1. Modeling and prediction of organized tropical convection (MJO, ISO ...)
2. Tropical-extratropical interactions; storm tracks and moisture transports.
3. Role of atmosphere-ocean interactions in intraseasonal variability.
5. Predictability of tropospheric wave guides and baroclinic wave packets.
6. Troposphere-stratosphere interactions; modeling and potential predictability.
7. Variability of climate modes beyond ENSO and MJO.
8. Effects of global ocean conditions, e.g., tropical Indian and Atlantic Oceans.
10. Warm season climate system and its predictability.
11. Potential implications of climate change.
Attribution problems remain

• Type 1: How do you disentangle natural variability of the climate/earth system from ‘forced’ change?
• Type 2: Given that the climate system is changing due to anthropogenic effects, how do you attribute particular events to that change? What are the conditional PDFs?
Questions remain . . . from means to extremes

- We have answered the question about globally averaged temperatures
- “GHG forcing has very likely caused most of the observed global warming over the last 50 years . . .” TS.6.3
- More “answers” inevitably lead to more focused questions – what’s happening locally? What about the extremes? temp? precip?
- What’s the science of extremes?