

The Challenge of Understanding, Monitoring, and Managing the Health of Our Planet

Berrien Moore III¹

The world faces profound environmental challenges: shortages of clean and accessible freshwater, degradation of terrestrial and aquatic ecosystems, increases in soil erosion, declines in fisheries, modifications in the chemistry of the atmosphere, and above all, rapid and substantial changes in climate. These changes are not isolated; they interact with each other and with natural variability in complex ways that cascade through the Earth's environment on local, regional and global scales.

Information from NASA and the National Oceanic and Atmospheric Administration (NOAA) environmental satellites is critical in addressing these challenges, and the record is rich with progress. The NASA Earth science program, part of the NASA Science Mission Directorate, has been a source of some of NASA's greatest contributions to the nation — from the detection and unraveling of the Antarctic ozone hole to measurement of global sea-level rise with extraordinary precision and accuracy. NOAA's research and satellite programs have led to dramatic improvements in weather forecasting and important advances in the understanding of Earth's climate system.

Thanks to the increasing strength of Earth science, and to NASA's and NOAA's ongoing Earth-observing capabilities, the scientific community now can state that global warming is "unequivocal."² This remarkable record of scientific progress must now extend to address the challenges that climate change will invariably present. We need the capability to monitor sources and sinks of greenhouse gases through this century and beyond. Concurrently, we need the capability to project — with a quantitative understanding of the uncertainties — the characteristics of climate change at least to the regional level and with far better temporal resolution than is currently available. Such projections are essential to help decision makers mitigate the many impacts of climate change on local and regional environments and populations.

Unfortunately, at the very time that more is needed from the Earth science community, NASA's Earth Science Division is reeling from the dramatic budget losses that occurred during the administration of President George W. Bush. In real terms (accounting for budget structural changes), the National Research

¹ Berrien Moore III is executive director of Climate Central and was co-chair of the National Research Council's first decadal survey on Earth Science and Applications.

² "Warming of the climate system is unequivocal, as is now evident from observations of increases in global average air and ocean temperatures, widespread melting of snow and ice, and rising global average sea level." Fourth Assessment Report (Working Group One) of the Intergovernmental Panel on Climate Change

Council's Earth Science decadal survey³ documented that between 2000 and 2006 the NASA Earth science budget was reduced by more than 30 percent (Figure 1).

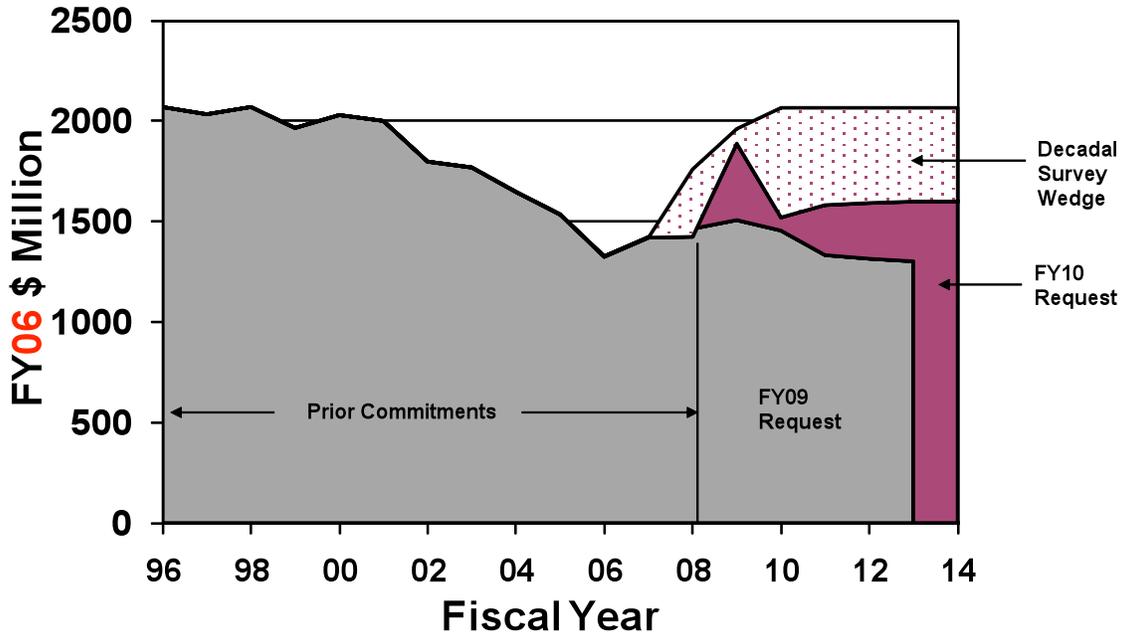


Figure 1. Comparison between the President's FY10 NASA request and the NRC Decadal Survey recommendation. The spike seen in 2009 is due to the Recovery Act, which allocated \$400M to NASA Science with direction to accelerate the Tier I Earth science Decadal Survey missions and increase the agency's supercomputing capabilities.⁴ The Figure reflects that of this total, \$325M was allocated to Earth science and \$75M (in FY 2009 dollars) was loaned from Earth science to Astrophysics. Cross-disciplinary programs re-categorized in the FY09 Earth science budget have been added back into FY09 & FY10 requests for consistency.

Although the budget for NOAA's National Environmental Satellite, Data, and Information Service has increased significantly in recent years, the robust National Polar-orbiting Operational Environmental Satellite System (NPOESS) program that was originally envisioned has yet to be realized.⁵

Taken together, significant cuts over several past budget cycles, growth in the cost of accessing space, substantial escalation in the cost to develop instruments, and inflation, we now find ourselves with a significant mismatch between needs and resources.

³ *Earth Science and Applications from Space, National Imperatives for the Next Decade and Beyond*. National Research Council (NRC). 2007.

⁴ The American Recovery and Reinvestment Act of 2009 included one-time additions to NASA, with \$400 M specifically directed to NASA Earth Science. See: <http://tinyurl.com/nfsvem>.

⁵ <http://gop.science.house.gov/Media/hearings/oversight09/june17/young.pdf>

For NASA, the Earth science budget in the president's 2010 request is a marked improvement over recent years' budgets and Earth science received an additional one-time \$400 million of stimulus monies in 2009; however, the budget remains inadequate, particularly in the out-years, and well below the recommended profile from the decadal survey.

Even with the stimulus monies, on the current path, only four (the Soil Moisture Active and Passive mission, the Ice, Cloud, and land Elevation Satellite-2, the Deformation Ecosystem Structure and Dynamics of Ice mission and the Climate Absolute Radiance and Refractivity Observatory) of 15 NASA missions recommended by the Earth Science decadal survey would be launched before 2020 at best. This unacceptable mission backlog has been exacerbated by the recent loss of the Orbiting Carbon Observatory and continuing delays in NPOESS Preparatory Project.

Furthermore, there are other significant issues facing NASA and the country. A recent report⁶ by the Congressional Budget Office warns that cost estimates for NASA's Constellation Program through the first manned lunar landing have risen from \$57 billion to \$92 billion, and may reach \$110 billion. Moreover, the country and the world are in a significantly challenging economic environment, and there are severe constraints on future budgets.

The times call for careful setting of priorities.

In July 2009, the National Research Council released a new report, "America's Future in Space: Aligning the Civil Space Program with National Needs," which sets forth six strategic goals for guiding program choices and resource planning for U.S. civil space activities. The first of these is: "To re-establish leadership for the protection of Earth and its inhabitants through the use of space research and technology."

The report notes that the global perspective enabled by space observations is critical to monitoring climate change and testing climate models, managing Earth resources, and mitigating risks associated with natural phenomena.

In pursuit of this first goal, the report recommends that NASA and NOAA lead the formation of an international satellite-observing architecture capable of monitoring global climate change and its consequences and support the research needed to interpret and understand the data in time for meaningful policy decisions.

Unfortunately, neither NASA nor NOAA is currently in a position to respond adequately. If these agencies are to successfully lead in the formation of an international satellite-observing architecture capable of monitoring global climate

⁶ The Budgetary Implications of NASA's Current Plans for Space Exploration, April 2009, Congressional Budget Office.

change and its consequences, then fundamental changes are needed. For NOAA, it means a significant change in the NPOESS program management and budget; for NASA, the budget damage inflicted during the Bush administration must be addressed directly by re-baselining the Earth science budget.

Interestingly, if the full \$400 million in stimulus monies were applied to NASA's Earth science budget and made permanent and not simply one-time, then the out-year budget envelope in the 2010 budget would nearly realize the budget wedge recommended in the Earth science decadal survey.

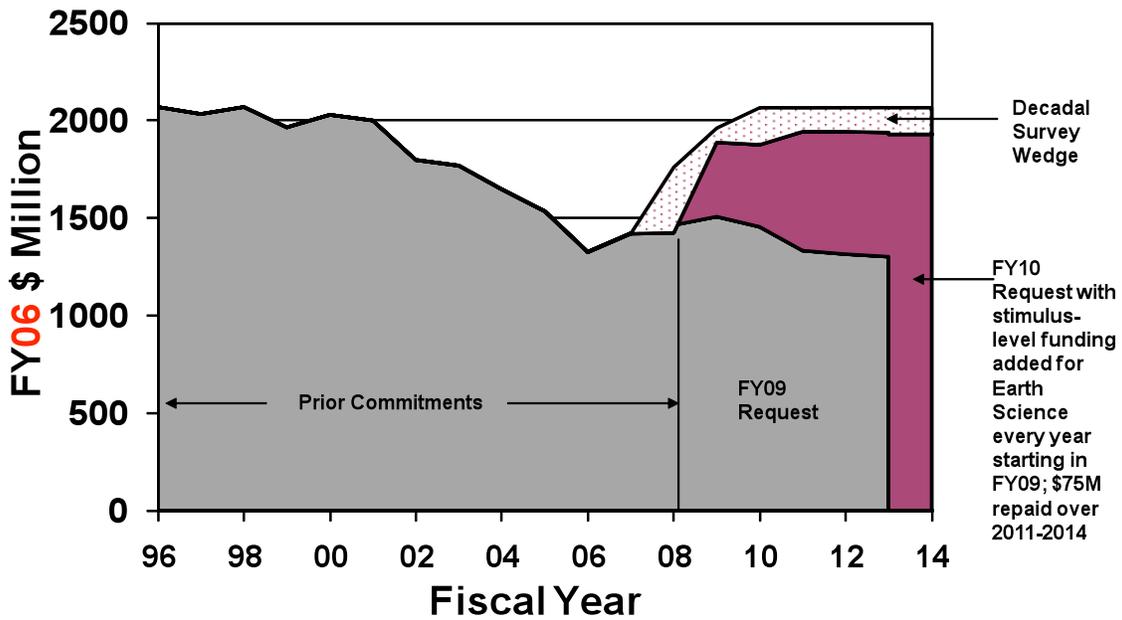


Figure 2. Effect of adding continued \$400M (RY\$) stimulus-level funding to out-years in President's FY10 NASA request and repaying Earth science \$75M (RY\$) over 2011-2014 vs. NRC recommendation. Cross-disciplinary programs re-categorized in the FY09 Earth science budget added back into FY09 & FY10 requests for consistency

The challenge of climate change is growing and will not go away; it is not a "problem du jour." Sustained and aggressive actions are needed. Commensurate funding is required to meet the climate challenge.