U.S. Senate Committee on Commerce, Science and Transportation Hearing on "A Time for Change: Improving the Federal Climate Change Research and Information Program"

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Testimony of
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Chairman Inouye and members of the Committee, I am Donald F. Boesch and am pleased to appear before you today to address improving the Federal climate change research and information program.

By way of background, I am a marine environmental scientist who has conducted research along our Atlantic and Gulf coasts and in Australia and the East China Sea. Although not a climate scientist, I have been engaged in several assessments of the environmental consequences of climate change. Notably, I served as co-chair of the Coastal Areas and Marine Resources Sector Team for the U.S. National Assessment of Climate Variability and Change[1] and I participated in workshops and consultations that contributed to the Governmental Accountability Office's (GAO) report on addressing the effects of climate change on Federal land and water resources. As a member of the Ocean Studies Board of the National Research Council, I am engaged in various evaluations of the consequences of climate change for oceans and coastal zones and, currently, I am serving as chair of the Scientific and Technical Working Group of the Maryland Commission on Climate Change that is responsible for preparing a Comprehensive Climate Change Impact Assessment for Maryland. From these multiple perspectives, I offer the following observations on improving the Federal climate change research and information program.

Integrated Assessment of Climate Change Effects

The National Assessment of the Potential Impacts of Climate Change in which I participated was conducted pursuant to the requirements of the Global Change Research Act of 1990 and produced Overview and Foundation reports[2] published in 2000 and 2001, respectively. In addition to these integrated assessments of diverse consequences over the entire nation, the National Assessment produced separate in-depth reports for five sectors (agriculture, water, health, forests and coastal areas and marine resources) and nine regions of the nation. The process that produced these reports involved hundreds of scientists and stakeholders inside and outside of the Federal government, was unwieldy at times, and was definitely under-resourced. However, it focused on developing an integrated assessment, not of the state of science, but of

what could be reasonably concluded about the potential consequences of climate change on the United States from available knowledge and understanding.

It is distressing to me as a *pro bono* contributor to see how the 2000 National Assessment, an "inconvenient assessment" as it has been called[3], has been suppressed and marginalized when it should have been built and improved upon. As the Committee is aware, a Federal District Court recently issued a finding that the Administration has failed to produce another National Assessment as called for by the statute. Rather, the Climate Change Science Program has undertaken to produce 21 Synthesis and Assessment Products (SAPs), the majority of which are oriented to knowledge related to the past and present climate, quantification of forces bringing about changes, and reducing uncertainty in projections of how climate may change. Seven of the SAPs address the sensitivity and adaptability of ecosystems and human systems to climate change and three explore the uses of evolving knowledge to manage risks and opportunities. Although, as originally scheduled, the synthesis and assessment process was to have been completed by now, presently only three of the 21 SAPs are fully completed.[4] Of the 10 SAPs that address sensitivity, adaptability and managing risks and opportunities five have progressed to the point of public review drafts.

Significantly, there does not appear to be a strategy of producing integrated assessments, either across systems (natural, managed or human) or within regions. Yet such integrated, regional assessments are critical to communicating to citizens and decision makers at the state and local levels the impacts of climate change where they live and over timeframes they can understand, and what they will be required to do to deal with those impacts. As an excellent example of such an integrated regional assessment I point to the recent reports of the Northeast Climate Impacts Assessment (NECIA)[5], a nongovernmental collaboration between the Union of Concerned Scientists and a team of independent scientific experts, chaired by Dr. Peter Frumhoff. The NCEIA developed and effectively communicated an assessment of climate change and associated impacts on key climate-sensitive sectors in the northeastern United States in a way that provides thought leaders, policy makers, and the public a basis for informed choices about climate change mitigation and adaptation.

The process of developing the CCSP's 21 separate SAPs is much more formally structured than that of the 2000 National Assessment. While peer review, including the National Academies, and the opportunity for public comment are laudable, it seems that this elaborate design has slowed down the process. Colleagues within my Center who have contributed to the SAPs have found the process constraining and inefficient. It is notable that the Intergovernmental Panel on Climate Change has been able to complete its reports on a timelier basis, even though that involved global collaboration, a much larger number of volunteer scientists, peer review, and

extensive negotiation. And, the IPCC delved deeper into adaptation and vulnerability (Working Group 2) than the CCSP and addressed mitigation, a topic not covered by the CCSP.

Federal Lands and Water Resources

In response to a request by Senators Kerry and McCain, the GAO released its report[6] in August 2007. It found that Federal land and water resources are vulnerable to a wide range of effects from climate change and some of these climate-related effects have already been observed. In spite of the observed and projected impacts of climate change on land and water resources, undertaking activities that address the effects of climate change is not currently a priority within resource management agencies and is not specifically addressed in planning agencies. Furthermore, resource managers have limited guidance from their agencies about whether or how to address climate change in management activities and planning efforts. Moreover, these managers do not have sufficient site-specific information to plan for and manage the effects of climate changes on federal resources that they oversee.

My own impression and that of some my scientific colleagues who participated in GAO-convened workshops was that the resource managers with whom we interacted had serious concerns about their ability to meet their responsibilities in a world where climate is obviously already changing and were frustrated by the lack of substantive support from their headquarters. The GAO report underscores the deficiency in the CCSP synthesis and assessment approach, because such site or even region-specific information is not forthcoming in the SAPs, which also stop short of offering specific guidance or even general direction for managing resources through anticipated climate changes.

NRC's Preliminary Assessment of Climate Change Science Program

The National Research Council (NRC) of the National Academies is assisting the CCSP in evaluating progress toward its program goals and in a report released in September presented a preliminary assessment of progress.[7] The NRC is also providing detailed reviews of some of the SAPs. Six main findings were presented in this preliminary assessment as indicated in the following box. The NRC found that discovery science and understanding of the science of the global climate system are proceeding well, keeping the United States appropriately at the forefront of this fast moving field. However, future progress is threatened as many existing and planned observing systems have been cancelled, delayed, or degraded.

National Research Council's Preliminary Assessment of Progress in the Climate Change Science Program

1. The separation of leadership and budget authority presents a serious obstacle to progress in the CCSP.
2. Discovery science and understanding of the climate system are proceeding well, but use of that knowledge to support decision making and to manage risks and opportunities of climate change is proceeding slowly.
3. Progress in understanding and predicting climate change has improved more at global, continental, and ocean basin scales than at regional and local scales.
4. Our understanding of the impact of climate change on human well-being and vulnerabilities is much less developed than our understanding of the natural climate system.
5. Science quality observation systems have fueled advances in climate science and applications, but many existing and planned observations have been cancelled, delayed, or degraded, which threatens future progress.
6. Progress in communicating CCSP results and engaging stakeholders is inadequate.

If these observing systems are not maintained and upgraded, not only will the U.S. lose its position as a world leader in climate science, but information critical to responding to climate change at regional and local scales will be lacking as climate change impacts worsen. Another recent NRC study[8] documented a reduction in the purchasing power of NASA's Earth Science Program, which constitutes half or more of the total budget of the Global Change Research Program (GCRP), by about 30% over the past seven years and prioritized the national imperatives that should be addressed. The GCRP budget is now about $1.7 billion, down from $2 billion in 1992. When inflation is taken into account, U.S. investments in science to address what is arguably the grand challenge of our time, have actually declined some 42% over the past 15 years!

In contrast to progress on understanding the global climate system, the NRC report concluded that progress in understanding and predicting climate change and attendant impacts at regional and local scales has lagged, thus limiting the information most relevant for state and local resource managers and policy makers, as well as for the general public. Improving this understanding would require expanded and improved integrated modeling, regional-scale observations, and the development of scenarios of climate change and impacts, in addition to socio-economic evaluations, in order to achieve improvements in adaptation responses.

Consistent with my earlier remarks on integrated assessment and with the GAO findings, the NRC found that progress in synthesizing research results or supporting decision making and risk management and in communicating CCSP results and engaging stakeholders has been inadequate. While there have been some successes interacting with scientists, federal agencies and water resource managers, "efforts to identify and engage in a two-way dialogue with state and local officials, nongovernmental organizations, and the climate change technology community have been limited and ad hoc." Consequently, the program is not gaining the input required and missing opportunities to inform decision makers.

State Needs as Exemplified by Maryland

In the absence of federal policy for mitigation of and adaptation to climate change many states are charting their own course, most famously California, but also my own state of Maryland. More than 24 states have either adopted or are in the process of developing goals to reduce greenhouse gas emissions. Governor Martin O'Malley established the Maryland Commission on Climate Change[9] in April and charged it with developing a Plan of Action to address the drivers and causes of climate change, to prepare for its likely consequences and impacts to Maryland, and to establish firm benchmarks and timetables for implementing the Plan of Action. Due to be completed in April 2008, the Plan of Action will include a comprehensive climate change impact assessment, a comprehensive greenhouse gas and carbon footprint reduction strategy, and a comprehensive strategy for reducing Maryland's climate change vulnerability. Because our state has extensive low-lying lands and wetlands on the Eastern Shore and around the Chesapeake Bay, particular emphasis is being given to assessing and reducing vulnerability to sea-level rise and coastal storms.

I lead the working group responsible for the climate change impact assessment, which must be based on reliable and current scientific information in order to inform the Governor, the General Assembly, and the citizens of Maryland about the likely consequences of climate change on our environments, natural resources and people. As was done in the Northeastern Climate Impacts Assessment, we are conducting this assessment based on both business-as-usual and mitigated emission scenarios. This will allow our decision-makers and citizens to understand the consequences of climate change that would be experienced regardless of what actions are taken to control greenhouse gas concentrations in the atmosphere and the potential benefits of global action to stabilize those concentrations. Our assessment is a very challenging one because regional scale climate projections are not readily available and the relationship of climate to ecosystem processes and societal requirements are not always clear. We would be a ready user for information of this sort if it was provided by the CCSP.

The complexity of the understanding of the effects of global warming that is required is exemplified by the nearby Chesapeake Bay, the topic of a recent hearing by the Senate Committee on the Environment and Public Works at which I was a witness.[10] In response to a follow-up question from Senator Cardin, I offered the following list of key questions that should guide a science program for Chesapeake Bay climate change. These questions could be addressed through a regional center representing a Federal-State-university partnership, much like the Climate Impacts Group[11], based at the University of Washington, which engages in climate science in the public interest, working to understand the consequences of climate variability and climate change for the Pacific Northwest. The Climate Impacts Group is one of six Regional Integrated Sciences and Assessments (RISA) programs, which support research that addresses complex climate sensitive issues of concern to decision-makers and policy planners at a regional level. The RISA programs receive some of their funding from NOAA's Climate Program Office and involve university scientists and information users at regional, state and local levels. RISA is a useful model to consider for expanding regional climate change research and assessment to meet the deficiencies in CCSP identified by the NRC.

Key Questions for Understanding Climate Change Impacts on the Chesapeake Bay

1. How will likely changes in precipitation and evapotranspiration interact with projected land use changes to affect the flow of fresh water, nutrients and sediments into the Chesapeake estuary?
2. How will likely sea-level rise and the resulting deepening of the Bay affect circulation, the distribution of salinity, groundwater intrusion, stratification, hypoxia, and sedimentation?
3. How will tidal wetlands and shorelines respond to likely acceleration in sea-level rise and what are the most effective measures that can be taken to avoid or minimize negative impacts to natural environments and human infrastructure?
4. How will likely increases in temperature and its seasonal timing affect ecologically and economically organisms, potential invasive species and key biogeochemical processes in the Bay?
5. To what degree will increased CO_2 concentrations in the atmosphere result in acidification of Bay waters and what will be the ecological consequences of such changes?

Global Change Research Improvement Act

Senators Kerry and Snowe have introduced S.2307, the Global Change Research Improvement Act of 2007, which in my opinion, addresses many of the shortcomings of the Climate Change Science Program identified by the NRC. If these needs were filled this would go a long way to providing pertinent information for Federal resource managers, regional and state decision-makers such as those in Maryland and the Chesapeake Bay region, and informing citizens about the risks and opportunities presented by climate change.

In particular, S.2307 makes it clear and explicit that the purpose of the Global Change Research Program (GCRP) encompasses not only observation and research, but also assessment and outreach to better understand, assess, predict, mitigate and adapt to the effects of global change. It requires Strategic and Implementation Plans that provide information relevant and readily usable by local, State, and Federal decision makers and includes research and assessments to identify and describe regional consequences. The bill elevates the responsibility and accountability for the GCRP, including budgeting of investments across agencies and authorizes research grants to universities and other nongovernmental organizations. It explicitly requires "a single, integrated, comprehensive assessment" not less frequently than every four years, which given the urgency and magnitude of the decisions and actions that lie ahead seems most appropriate. The bill provides specific authorization for studies of the status of ice sheet melt and movement and hurricane frequency and intensity, both topics of great significance and uncertainty.

To ensure its overall effectiveness in integrated assessment activities, further reorganization of the GCRP would be useful. In particular, greater budgetary control of assessment activities under the central office rather than in the individual participating agencies would increase the likelihood that the assessment agenda can progress as intended. Also, a regional component of GCRP structure would improve stakeholder input and enhance communication with users of assessment information. The latter could take advantage of an expansion of NOAA's RISA network or similar federal-state-university partnerships.

S.2307 also authorizes a National Climate Service within the National Oceanic and Atmospheric Administration to include a national center and a network of regional and local facilities. While there are already programs and assets that address climate science and applications within NOAA, I support the creation of the NCS to bring focus and additional financial, material and intellectual resources to this area of unparalleled national and global significance. As the bill indicates there is an urgent need to improve observations and "integrated modeling, assessment and predictive capabilities needed to document and predict climate changes and impacts and to guide national, regional, and local planning and decision making." For the NCS to achieve these objectives it will be necessary to reallocate and closely integrate and coordinate activities within the other NOAA line offices (NWS, NOS, OAR, NMFS, NESDIS) and with key programs in other agencies (NASA, NSF, EPA, DOI, USDA and others). In addition, it will be important that the contract and grant authority is used to develop effective partnerships with universities, states and other entities to implement effectively regional applications in the context of the environmental and social challenges that are being and will be addressed.

Summary

Based on the findings of the GAO and NRC reports and my own experiences with the 2000 National Assessment and Maryland Commission on Climate Change I offer the following summary suggestions for improving the Federal climate change research and information program:

1. The Global Change Research Program requires significantly increased financial support, more effective budgetary and programmatic coordination and accountability among Federal agencies, urgent attention to critical observations system requirements, and more focus on providing information to users.
2. Research on climate change and its attendant impacts at regional and subregional scales should be greatly expanded in order to provide information relevant for state and local managers and policy makers and the general public. This requires integrated modeling, regional-scale observations, and scenarios of climate change and impacts. Partnerships among the Federal government, states and universities are the most effective means to accomplish this.
3. More informative and effective products and services should be provided to decision makers to inform policies and actions for mitigation and adaptation to the risks and opportunities.
4. Regular, fully integrated assessments of the consequences of climate change and variability should be conducted at national and regional scales. This is especially important now as our society struggles to become better aware of the likely consequences of climate change as it makes critical decisions during what increasingly appears to be a narrow response window for mitigation options.
5. The Global Change Research Improvement Act (S.2307) addresses the above four requirements and establishes a National Climate Service that would bring focus and financial, material and intellectual resources to bear on this issue of unparalleled national and global significance.

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[9] Information on the Maryland Commission on Climate Change is available at http://www.mdclimatechange.us/

[10] D.F. Boesch testimony at hearing of U.S. Senate Committee on the Environment and Public Works on "An Examination of the Impacts of Global Warming on the Chesapeake Bay," September 26, 2007 http://epw.senate.gov/public/index.cfm?FuseAction=Hearings.Testimony&Hearing_ID=23a539ea-802a-23ad-45fd-606dcd273a3a&Witness_ID=72fbe039-bd13-439e-9348-9951f808a982

[11] Climate Impacts Group at the University of Washington; http://cses.washington.edu/cig/