Message from the Chair

The Board on Atmospheric Sciences and Climate, as its name implies, transcends a number of disciplines across a range of time scales. At the intersection of weather and climate is the subseasonal to seasonal time scale. This past June, at the 64th session of the WMO Executive Council, the WMO directed its members to focus attention on this key time scale as it provides a unique opportunity to capitalize on the expertise of the weather and climate research communities, and to bring them together to improve predictions on a time scale of particular relevance to the Global Framework for Climate Services. From the end-user perspective, the subseasonal to seasonal time range is a very important one, as many management decisions in agriculture and food security, water, disaster risk reduction, and health fall into this range. Forecasting for the subseasonal time range has so far received much less attention than medium-range and seasonal prediction as it has long been considered as a "predictability desert."

However, recent research has indicated important potential sources of predictability for this time range, which can be realized through better representation of phenomena such as the Madden Julian Oscillation (MJO) and improved coupling with, and initialization of, the land-ocean-cryosphere and stratosphere. Better understanding of these potential sources of predictability, together with improvements in model development, data assimilation, and computing resources, should result in more accurate forecasts. In particular, the representation of the MJO in models has improved substantially in recent years and some models now have skill beyond 20 days. This has important implications globally due to links between this tropical phenomenon and major modes of variability, such as the El Nino-Southern Oscillation and the North Atlantic Oscillation.

An obvious illustration of the importance of this time scale is this summer's widespread drought. Currently, 63 percent of the land area of the lower 48 states is affected by some level of drought, a greater extent than any drought since the 1950s. The USDA considered 52 percent of the 2012 corn crop from the biggest-producing states to be in poor or very poor shape. In addition, the warm and dry weather created ideal conditions for wildfires in much of the country: The 2.01 million acres burned by wildfires in July was the 4th most on record.

Via the National Integrated Drought Information System, great strides have been made in monitoring drought within the United
States and the provision of accurate and timely information about the risk and impacts of drought. On July 25, the U.S. House of Representatives Committee on Science, Space, and Technology held a hearing on Drought Forecasting, Monitoring, and Decision-making: A Review of the National Integrated Drought Information System. There was broad bi-partisan support for the continuing and improving need for such information. However, the Nation's ability to predict operationally the scope and severity of drought on the subseasonal to seasonal time scale is not very good. Considerable focused and dedicated research is required to better understand the mechanisms leading to the initiation and amplification of drought, the limits to predictability of drought within the coupled atmosphere-land-ocean system, and ultimately, to transition this knowledge from research to operations.

As to the broader issue of climate prediction, as highlighted below, the NRC has just released a new study under the auspices of BASC that takes on the challenge of A National Strategy for Advancing Climate Modeling. In response to its charge, this study has developed a strategy for improving the Nation's capability to accurately simulate climate and related Earth system changes. The committee's report takes the form of a high level analysis, providing a strategic framework to guide progress in the Nation's climate modeling enterprise over the next 10-20 years. I encourage all of you to give this comprehensive and deliberate study a good read.

Antonio J. Busalacchi
Chair, Board on Atmospheric Sciences and Climate

New Report: A National Strategy for Advancing Climate Modeling

As climate change has pushed climate patterns outside of historic norms, the need for detailed projections is growing across all sectors, including agriculture, insurance, and emergency preparedness planning. A National Strategy for Advancing Climate Modeling emphasizes the needs for climate models to evolve substantially in order to deliver climate projections at the scale and level of detail desired by decision makers, this report finds. Despite much recent progress in developing reliable climate models, there are still efficiencies to be gained across the large and diverse U.S. climate modeling community. Evolving to a more unified climate modeling enterprise—in particular by developing a common software infrastructure shared by all climate researchers and holding an annual climate modeling forum—could help speed progress.

Throughout this report, several recommendations and guidelines are outlined to accelerate progress in climate modeling. The United States supports several large global climate models, each conceptually similar but with components assembled with slightly different software and data output standards. If all U.S. climate models employed a single software system, it could simplify testing and migration to new computing hardware, and allow scientists to compare and interchange climate model components, such as land surface or ocean models. A National Strategy for Advancing Climate
Modeling recommends an annual U.S. climate modeling forum be held to help bring the nation's diverse modeling communities together with the users of climate data. This would provide climate model data users with an opportunity to learn more about the strengths and limitations of models and provide input to modelers on their needs, as well as provide a venue for discussions of priorities for the national modeling enterprise, and bring disparate climate science communities together to design common modeling experiments.

In addition, A National Strategy for Advancing Climate Modeling explains that U.S. climate modelers will need to address an expanding breadth of scientific problems while striving to make predictions and projections more accurate. Progress toward this goal can be made through a combination of increasing model resolution, advances in observations, improved model physics, and more complete representations of the Earth system. To address the computing needs of the climate modeling community, the report suggests a two-pronged approach that involves the continued use and upgrading of existing climate-dedicated computing resources at modeling centers, together with research on how to effectively exploit the more complex computer hardware systems expected over the next 10 to 20 years.

Learn more about A National Strategy for Advancing Climate Modeling at a free webinar on September 28 at 1:30 pm EST, where you'll be able to watch live presentations by the report's authoring committee and ask questions about the report's findings. Register here.

Along with its new report about advancing climate modeling, the Board on Atmospheric Sciences and Climate has just released Climate Modeling 101, a website designed to help the public learn more about the basics of climate modeling – how they work and why they are important. The site features short videos and animations that explain everything from the difference between climate and weather to how climate models are built and verified.

Read/Purchase the report at the National Academies Press.

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New Report: Weather Services for the Nation: Becoming Second to None

During the 1980s and 1990s, the National Weather Service (NWS) undertook a major program called the Modernization and Associated Restructuring (MAR). The MAR was officially completed in 2000. No comprehensive assessment of the execution of the MAR plan, or comparison of the promised benefits of the MAR to its actual impact, had ever been conducted. Therefore, Congress asked the National Academy of Sciences to conduct an end-to-end assessment. That report, The National Weather Service Modernization and Associated Restructuring: A Retrospective Assessment, concluded that the MAR was a success.

Now, twelve years after the official completion of the MAR, the
challenges faced by the NWS are no less important than those of the pre-MAR era. The three key challenges are: 1) keeping pace with accelerating scientific and technological advancement, 2) meeting expanding and evolving user needs in an increasingly information centric society, and 3) partnering with an increasingly capable enterprise that has grown considerably since the time of the MAR.

*Weather Services for the Nation: Becoming Second to None* presents three main recommendations for responding to these challenges. These recommendations will help the NWS address these challenges, making it more agile and effective. This will put it on a path to becoming second to none at integrating advances in science and technology into its operations and at meeting user needs, leading in some areas and keeping pace in others. It will have the highest quality core capabilities among national weather services. It will have a more agile organizational structure and workforce that allow it to directly or indirectly reach more end-users, save more lives, and help more businesses. And it will have leveraged these capabilities through the broader enterprise. This approach will make possible societal benefits beyond what the NWS budget alone allows.

[Read/Purchase the report](https://press.nap.edu/) at the National Academies Press.

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Many glaciers and snowpacks around the world are receding. The rates and timing of glacial wasting (the volume of ice melt that causes a net loss of glacier volume) vary, and the causes are complex. In most instances there are multiple influences that interact in complicated ways. Wherever glaciers are wasting continuously, there are concerns about the consequences for available water supplies.

The glaciers of the Hindu Kush-Himalayan (HKH) region are among the largest and most spectacular in the world. Although there is some scientific knowledge and information about the state of the glaciers of the HKH region, with implications for future water supplies, there is also significant uncertainty. Concern has been heightened by several highly visible pronouncements which upon examination proved to be highly qualitative, local in scale, or to lack any credible scientific basis. *Himalayan Glaciers: Climate Change, Water Resources, and Water Security* seeks to describe and analyze the scientific knowledge about the glaciers of the region, their impact on regional waterscape, and likely impacts of changes in the glaciers on the population of South Asia. More specifically, the report addresses the following questions:

- How sensitive are the Himalayan glaciers to climate and other environmental factors?
- What are the potential impacts of changes in climate and glaciers on the timing and volume of river flows in the regions
and what are the likely implications for water supplies and extreme climatic events such as floods?
- What water management systems are in place to help adapt to changes in regional hydrologic systems and how might those systems be strengthened?
- What are the main vulnerabilities of downstream populations to changes in water supplies, what are the prospects for conflict and/or cooperation, and what are the implications for national security?

The report addresses these questions from several perspectives: the physical geography of the region, the human geography of the region, and the environmental security of the region. The Committee also identifies additional scientific and data needs as well as possible means of adapting to changes in water security, and draws a series of conclusions.

Read/purchase the report at the National Academies Press

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**Estimating the Ecosystem Benefits of Urban Forestry: A Workshop**

*October 29, 2012 - October 30, 2012*

*National Academy of Sciences Building*
*2101 Constitution Ave NW Washington DC 20418*

The National Academy of Sciences / National Research Council will organize a workshop to examine the following:

- Current capabilities to characterize and quantify the benefits ("ecosystem services") provided by trees and forest canopy cover within a metropolitan area, including air pollution mitigation; water pollution mitigation; carbon sequestration; urban heat island mitigation; reduced energy demand from shading of buildings. The discussions may also consider benefits to public health and well-being.
- Key gaps in our understanding, and our ability to model, measure, and monitor such services; and improvements that may be needed to allow tree planting to be sanctioned as a "creditable" strategy in official regulatory control programs (i.e. for air quality, water quality, climate change response).
- Current capabilities for assigning quantitative economic value to these services, and strategies for improving these capabilities (in order, for instance, to allow for rigorous cost/benefit analyses, and for policies that compensate land owners for good forestry conservation and planting practices).
- The challenges of planning/managing urban forests in a manner that optimizes multiple ecosystem services simultaneously (e.g. synergies, trade-offs in selecting tree species, determining planting locations).
- Opportunities for enhancing collaboration and coordination among federal agencies, academic researchers, and other stakeholders.

See the BASC Website for more information.
Climate Change Science: He'll Drink to That

"[BASC Chair] Antonio 'Tony' Busalacchi leads a double life -- much of the time he's a prominent climate scientist, investigating the potential impact of manmade global climate change, publishing studies, and teaching earth science at the University of Maryland in College Park.

But he has some other titles, all of which are singularly unique in the climate science world. How many climate scientists can say they are also a 'Certified Specialist of Spirits'? Sure, climate researchers like to have fun at happy hour from time to time, but this is an actual credential. And how many other climate researchers can lay claim to holding a position as a visiting lecturer at the University of Gastronomic Sciences in Bra, Italy?"

Read more at Climate Central.

Recent Reports

**Urban Meteorology: Forecasting, Monitoring, and Meeting Users' Needs**

According to the United Nations, three out of five people will be living in cities worldwide by the year 2030. The United States continues to experience urbanization with its vast urban corridors on the east and west coasts. Although urban weather is driven by large synoptic and meso-scale features, weather events unique to the urban environment arise from the characteristics of the typical urban setting, such as large areas covered by buildings of a variety of heights; paved streets and parking areas; means to supply electricity, natural gas, water, and raw materials; and generation of waste heat and materials.

*Urban Meteorology: Forecasting, Monitoring, and Meeting Users' Needs* is based largely on the information provided at a Board on Atmospheric Sciences and Climate community workshop. This book describes the needs for end user communities, focusing in particular on needs that are not being met by current urban-level forecasting and monitoring. *Urban Meteorology* also describes current and emerging meteorological forecasting and monitoring capabilities that have had and will likely have the most impact on urban areas, some of which are not being utilized by the relevant end user communities.

*Urban Meteorology* explains that users of urban meteorological information need high-quality information available in a wide variety of formats that foster its use and within time constraints set by users' decision processes. By advancing the science and technology related to urban meteorology with input from key end user communities, urban meteorologists can better meet the needs of diverse end users. To continue the advancement within the field of urban meteorology, there are both short-term needs—which might be addressed with small investments but promise large, quick returns—as well as future challenges that could require significant efforts and
A Review of the U.S. Global Change Research Program's Strategic Plan

"Global change research" engages agencies and departments across the federal government in many diverse activities, coordinated by the U.S. Global Change Research Program (USGCRP). The USGCRP is developing a 10-year Strategic Plan to strengthen the Program's role in sustaining a strategically-driven, coordinated national effort. As independent advisor to the Program, a National Research Council committee has reviewed the draft Plan. The committee encourages the Program's intent to broaden its focus, to address not only climate change, but also climate-related global changes, and the committee identifies a number of key issues regarding the Program's scope, goals, and capacity to meet those goals over the coming 10 years.

The National Weather Service Modernization and Associated Restructuring: A Retrospective Assessment

During the 20th century, the National Weather Service was unable to keep up with the pace of technological advances and as a result was nearly obsolete by the 1980s. Between 1989 and 2000, the nation invested an estimated $4.5 billion to modernize and restructure the National Weather Service. Efforts to modernize the National Weather Service succeeded in achieving major improvements for the weather enterprise. This report assesses the modernization effort and identifies lessons learned from the process.

America's Climate Choices

Climate change is occurring. It is very likely caused by the emission of greenhouse gases from human activities, and poses significant risks for a range of human and natural systems. And these emissions continue to increase, which will result in further change and greater risks.
America’s Climate Choices makes the case that the environmental, economic, and humanitarian risks posed by climate change indicate a pressing need for substantial action now to limit the magnitude of climate change and to prepare for adapting to its impacts. Although there is some uncertainty about future risk, acting now will reduce the risks posed by climate change and the pressure to make larger, more rapid, and potentially more expensive reductions later. Most actions taken to reduce vulnerability to climate change impacts are common sense investments that will offer protection against natural climate variations and extreme events. In addition, crucial investment decisions made now about equipment and infrastructure can “lock in” commitments to greenhouse gas emissions for decades to come. Finally, while it may be possible to scale back or reverse many responses to climate change, it is difficult or impossible to “undo” climate change, once manifested.

Current efforts of local, state, and private-sector actors are important, but not likely to yield progress comparable to what could be achieved with the addition of strong federal policies that establish coherent national goals and incentives, and that promote strong U.S. engagement in international-level response efforts. The inherent complexities and uncertainties of climate change are best met by applying an iterative risk management framework and making efforts to significantly reduce greenhouse gas emissions; prepare for adapting to impacts; invest in scientific research, technology development, and information systems; and facilitate engagement between scientific and technical experts and the many types of stakeholders making America’s climate choices.

- See report findings.
- Read/Obtain at the National Academies Press.
- America’s Climate Choices: Report in Brief
- Press Release

Other titles in the America's Climate Choices suite of studies:

- Informing an Effective Response to Climate Change
- Advancing the Science of Climate Change
- Limiting the Magnitude of Future Climate Change
- Adapting to the Impacts of Climate Change

Climate Stabilization Targets: Emissions, Concentrations, and Impacts over Decades to Millennia

Emissions of carbon dioxide from the burning of fossil fuels have ushered in a new epoch where human activities will largely determine the evolution of Earth's climate. Because carbon dioxide in the atmosphere is long lived, it can effectively lock the Earth and future generations into a range of impacts, some of which could become very severe. Emissions reductions decisions made today matter in determining impacts experienced not just over the next few decades, but in the
coming centuries and millennia.

According to Climate Stabilization Targets: Emissions, Concentrations, and Impacts Over Decades to Millennia, important policy decisions can be informed by recent advances in climate science that quantify the relationships between increases in carbon dioxide and global warming, related climate changes, and resulting impacts, such as changes in streamflow, wildfires, crop productivity, extreme hot summers, and sea level rise. One way to inform these choices is to consider the projected climate changes and impacts that would occur if greenhouse gases in the atmosphere were stabilized at a particular concentration level. The book quantifies the outcomes of different stabilization targets for greenhouse gas concentrations using analyses and information drawn from the scientific literature. Although it does not recommend or justify any particular stabilization target, it does provide important scientific insights about the relationships among emissions, greenhouse gas concentrations, temperatures, and impacts.

Climate Stabilization Targets emphasizes the importance of 21st century choices regarding long-term climate stabilization. It is a useful resource for scientists, educators and policy makers, among others.

- Read/Purchase at the National Academies Press
- Download Warming World: Impacts by Degree, a booklet based on this report (pdf)

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Studies in Progress


Understanding and Monitoring Abrupt Climate Change and its Impacts. This study will address the likelihood of various physical components of the Earth system to undergo major and rapid changes (i.e., abrupt climate change) and, as time allows, examine some of the most important potential associated impacts and risks. This study will explore how to monitor climate change for warnings of abrupt changes and emerging impacts.

Visit the BASC Website at http://dels.nas.edu/basc.

The nation turns to the National Academies-National Academy of Engineering, Institute of Medicine, and National Research Council for independent, objective advice on issues that affect people's lives worldwide.