STATEMENT OF
DR. THOMAS R. ARMSTRONG
SENIOR ADVISOR FOR GLOBAL CHANGE PROGRAMS
U.S. GEOLOGICAL SURVEY
U.S. DEPARTMENT OF THE INTERIOR
BEFORE THE HOUSE APPROPRIATIONS SUBCOMMITTEE ON INTERIOR, ENVIRONMENT AND RELATED AGENCIES
REGARDING CLIMATE CHANGE
APRIL 26, 2007

Mr. Chairman and Members of the Subcommittee, thank you for the opportunity to participate in today's hearing on climate change and particularly to discuss its impacts on public lands. My name is Thomas R. Armstrong, and I am the senior advisor for global change programs at the U.S. Geological Survey (USGS). I also represent USGS and the Department of the Interior (DOI) as a member of the U.S. Climate Change Science Program (CCSP) and am the U.S. Head of Delegation to the Arctic Monitoring and Assessment Program, a working group of the Artic Council.

Global climate change is one of the most complex and formidable environmental challenges facing society today. While climate change is a natural, continuous Earth process, changes to the Earth's climate are related to human activities as well. Whether the causes are natural or from human influence, our focus is on understanding the impacts of climate change and the potential adaptive strategies for managing natural resources and ecosystems in the face of these changes.

Climate change affects biota, water, ecosystems, cultures, and economies. In order to effectively manage its lands and trust resources, the Department of the Interior, working within the broader U.S. interagency climate change science framework, has a responsibility to further the scientific understanding of climate change processes and impacts. The USGS has a long and distinguished history of conducting research, monitoring and modeling of climate change and its physical and biological impacts. The USGS strives to understand how the earth works and to anticipate future changes. We conduct scientific research to understand the likely consequences of climate change, especially by studying how climate has changed in the past and using the past to forecast responses to shifting climate conditions in the future; distinguishing between natural and human-influenced changes; and recognizing ecological and physical responses to changes in climate. These strengths allow USGS to play a critical role in conducting climate change science across the Nation's terrestrial, freshwater, and coastal systems and in providing objective science to assist decision-makers.

The United States and other nations will be challenged to develop adaptation and mitigation strategies that will anticipate the effects of a changing climate and its impacts on humans and ecosystems. The USGS provides on-the-ground scientific information from its numerous observation and monitoring networks and research activities. These observations and related research efforts are important components for building climate models, especially those that deal with the impacts of climate change to terrestrial,

freshwater, and marine ecosystems. The ability to provide ground-truthing across multiple scientific disciplines in a wide variety of spatial and temporal scales enables USGS to play a key role within the climate science community as nations strive to develop adaptation and mitigation measures.

USGS findings and data provide critical information to decision-makers regarding many important climate-related issues, such as:

- Future availability of water for people and ecosystems. The USGS climate change science program has resulted in several scientific findings regarding how streamflow has been changing in recent decades. In particular, these studies point to significant shifts in the timing of snowmelt runoff in New England, and throughout the mountains of the western United States. These studies are crucial for informing operations and planning for water resources.

- Current and future trends of climate warming in the Arctic and resultant permafrost degradation and impacts on energy and transportation. USGS is conducting several coordinated studies on the North Slope and Yukon Basin of Alaska. Emphasis is on permafrost and climate effects monitoring and related ecological and socio-economic changes. This work is a partnership with the U.S. Forest Service, the U.S. Fish & Wildlife Service, the Bureau of Land Management, the National Park Service, the University of Alaska, Alaska State agencies, and various Native communities.

- Impacts of climate change on land use and landscape change. In partnership with NASA and NOAA, USGS is involved in a variety of activities that are critical to understanding the impacts of climate change on public lands. These include monitoring of coastal zone topography and bathymetry; the production and distribution of national topography data; and improving our knowledge of topographic surface change through Landsat, and Light-Imaging Detection and Ranging (LIDAR) and radar imaging of the U.S. national land surface.

- Proliferation of invasive species and impacts on biodiversity, habitat, and ecosystems. USGS is conducting several major studies throughout the United States looking at the evolution of forest and rangeland communities as a response to warming climate and changes in precipitation. The U.S. Forest Service, several land resource bureaus of the Department of the Interior, and numerous State resource agencies are important stakeholders.

short- and long-term strategies for protecting the public welfare and maintaining healthy and viable ecosystems and natural resources. For instance, studies conducted by USGS and others show that sea-level rise will continue to impact coastal zones throughout the world. Present and future resource managers can take into consideration this scientific conclusion when developing adaptive management strategies for restoration and long-term stewardship of land, water, and biological resources in coastal areas.

Scientific findings related to climate change must be delivered in a timely manner so that decision-makers are informed by the most relevant, up-to-date, objective information possible. Furthermore, scientists must provide this information with accurate estimates of uncertainty so that conclusions and recommendations drawn from scientific studies can be properly evaluated. The Climate Change Science Program (CCSP), of which USGS and DOI are members, is actively involved in developing a more effective decision support strategy for stakeholders.

Although science has come far in understanding the impacts of climate change on humans and ecosystems, many significant challenges and unique opportunities to better understand the long-term climate future for our planet remain. These include:

- Developing a holistic, earth-systems science approach to help communities and natural resource managers prepare for climate change impacts;
- Better distinguishing natural climate change from that imposed upon the natural system through human activities so that effective mitigation strategies can be developed and implemented by decision-makers;
- Developing a better understanding of how the earth and its physical and biological processes interact, and with this understanding respond to climate change over the short-term and well into the future;
- Forecasting climate-related impacts for physical and biological systems;
- Forecasting precipitation changes as a consequence of changing climate;
- Determining how global warming may affect the frequency, intensity, and paths of strong storms, including hurricanes;
- Understanding effects of climate change on ecosystems.

There is increasing consensus that these climate change effects must be monitored and the impacts on the Nation's resources must be managed. DOI has a natural role among Federal agencies to address climate change on Federal lands and can bring all of its resource management, science, and information capabilities to bear in accomplishing that goal. Initiatives such as the Healthy Lands Initiative, the Healthy Forests Initiative, and the U.S. Ocean Action Plan, which are highlighted in the Department's fiscal year 2008 budget request can assist DOI land managers in the management of lands and resources.

Areas where DOI has expertise or activities underway include:

1. Studies of large watersheds to monitor and investigate climate change effects on the landscape. The study of large watersheds provides data that can be used to better understand the processes involved in climate change and to improve

climate models that depend on this data to make accurate predictions of climate change.

2. Monitoring networks focused on water, biota, and permafrost to establish a stronger basis for future detection and definition of climate change impacts at a national and regional scale.
3. Ongoing land remote sensing programs of the United States to track changes on the earth's surface at regional to global scales.
4. The collection of paleo-environmental and instrumental information for a continuous long-term record of past and present climate change and its impacts.
5. Geospatial climate information management system for decision support for resource managers building on existing data systems such as The National Map, National Biological Information Infrastructure (NBII), National Water Information System (NWIS), National Phenology Network, and the NPS Vital Signs Network.
6. Decision support tools and products to assist decision-makers in the management of wildfire, water resources, ecosystems, and coastal and wetland landscapes in the future.

Thank you, Mr. Chairman, for the opportunity to present this testimony. I will be pleased to answer questions you and other Members of the Subcommittee might have.