



# EARTH SYSTEM MONITOR

## International Collaboration of Climate Systems

*A guide to  
NOAA's data and  
information  
services*

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U.S. Department  
of Commerce  
National Oceanic  
and Atmospheric  
Administration

*Dr. William J. Brennan, Deputy Assistant Secretary for International Affairs and Acting Director of the Climate Change Science Program*

**C**limate varies over a wide range of geographic areas, extending beyond national boundaries and requiring international coordination and cooperation. In addition, climate change research must span long periods of time and include a wide range of variables, such as chemical composition, important for characterizing the state of the global system. Therefore, national and international observing systems are needed to develop a consistent, high-quality record of changes in the Earth's atmosphere, oceans, and land. This can work only if interagency and international facilities and mechanisms are in place to process, archive, and distribute the data collected and to generate useful products.

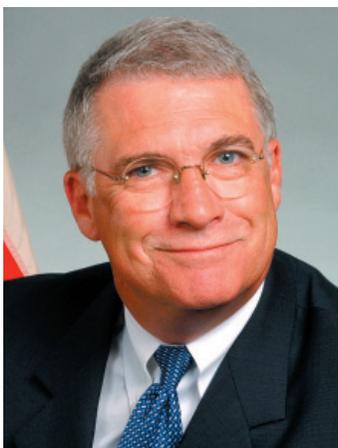
NOAA has provided key leadership to the intergovernmental Group on Earth Observations (GEO), a partnership of over 70 countries, the European Commission, and numerous intergovernmental organizations, which is developing the Global Earth Observation System of Systems (GEOSS). GEOSS will provide a comprehensive and coordinated set of Earth observations (i.e., from air temperature and ozone to ocean temperature and waves) from multiple platforms, such as the Global Climate Observing System (GCOS) and the Global Ocean Observing

System (GOOS). GEOSS will also transform these data into vital information—agriculture production, transportation, and severe weather information—to be used by decision makers, industries, and the public.

Although policymakers are now debating how to slow climate change, the Intergovernmental Panel on Climate Change (IPCC) found that even if all greenhouse gas emissions are held constant at year 2000 levels, the climate will warm approximately 0.1°C per decade over the next two decades. This is due in large part to the slow response of the oceans; latent heat of water is very high so it takes a lot of heat energy to increase the ocean temperature. Because climate change is inevitable, understanding the potential impacts of climate change and possible ways to adapt is essential. NOAA's mission and unique assets place NOAA as one of the primary entities to provide

and help coordinate this information.

As the push to understand and predict climate change impacts moves forward, NOAA must continue to lead the effort to share climate data internationally and to focus on the needs of the global community. Global data management is challenging because climate data are complex and often obtained in a variety of ways by a diverse set of organizations and disciplines, such as atmospheric physics. Progress is being made through the U.S. GCOS program and the Global Observing System Information Center (GOSIC). ■



▲ Dr. William J. Brennan



For more information about GCOS, GOOS, and GOSIC, visit [www.ncdc.noaa.gov/oa/usgcos/index.htm](http://www.ncdc.noaa.gov/oa/usgcos/index.htm), [www.ioc-goos.org](http://www.ioc-goos.org), and <http://gosic.org>.

## Note from the Acting Director Terrance Tielking

Another fall season is upon us. As we enjoy the countryside scenery and begin preparing for the holiday season, it is time for another edition of the *Earth Systems Monitor (ESM)*. This issue of *ESM* focuses on climate. This topic has been in the news for many years, but was recently reemphasized with the awarding of the Nobel Peace Prize to the Intergovernmental Panel on Climate Change (IPCC) along with former Vice President Al Gore. This edition provides information on the climate on three levels—global, national, and local.

On the global level, the international perspective provided by Dr. William Brennan, NOAA Deputy Assistant Secretary for International Affairs, describes the proactive efforts of NOAA to work with other countries to determine how best to plan for the future with climate change. Nationally, the NOAA National Data Centers archive environmental data that enable the development of detailed analyses of how the climate has changed since records have been kept. Data archeology to discover ancient environmental records for comparison is time consuming, but is critical to understanding what has happened over the years. The National Data Centers, together with environmental data centers all over the world, cooperate to find and share these records to help create more comprehensive climate analyses. Properly resourced data management efforts are needed to ensure environmental data are available for scientists to complete their research.

At the local level, NOAA has defined “Climate” as a major strategic goal and

has created an organizational cross-cutting team to work issues associated with this goal.

In this climate focused issue of *ESM*, Dr. Margarita Gregg provides an overview of the NOAA Climate Goal programs. Historical atmospheric data is very important, and the articles from the National Climatic Data Center



▲ Terrance Tielking

(NCDC) introduce key themes in the weather climate record. Ocean climate data also continues to be a national treasure for researchers and climate professionals. The National Oceanographic Data Center (NODC) holds the most comprehensive set of ocean

climate records in the world, and its staff has published important conclusions from the holdings.

NODC is currently working on a strategic plan to be more proactive and engage its data users, ensuring easy access to data that meets their requirements. NODC is also committed to education and the NOAA initiatives for environmental literacy and outreach. The article by Frank Niepold highlights the diversity of activities in climate literacy. Finally, please enjoy the poster on page 11, a vision of Deborah Riddle, Visual Information Specialist, at NCDC.

Please forward any comments and recommendations for improvement to us. We want to ensure *ESM* serves your needs. Finally, I want to wish everyone a safe and joyful holiday season. ■

Cheers,  
Terry

### EARTH SYSTEM MONITOR

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**Questions and comments should be directed to the Editor, Michael Crane.**

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#### National Oceanic and Atmospheric Administration

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# NOAA's Climate Goal

*Dr. Margarita Gregg, Acting Deputy Director, Climate Program Office*

The impacts of climate change are felt across society, challenging NOAA's ability to design and implement adaptive and mitigation strategies and create new opportunities. The world is facing rising temperatures that, along with potential changes in precipitation and sea-level rise, will have important consequences for the environment and economy. The economic impacts of climate change in the United States include:

- Drought causes approximately \$6-8 billion in losses per year.
- Coastal erosion due to storm surges and sea-level rise will claim roughly 1,500 homes each year for several decades, at a cost of \$530 million/year, and direct damages from erosion of the coastline will be approximately 5 percent.
- Climate change will cause changes in fish stock, including shifting populations toward the polar regions of commercially important species.
- The 1997-1998 El Niño is estimated to have had total U.S. economic impacts on the order of \$25 billion.

Improving the climate science used for policy and decision making can be valued at more than \$100 billion for the United States alone, and relatively small increases in the accuracy of climate measurements can yield substantial benefits. NOAA created the outreach portion of the Climate Goal program in order to support the decision making process for policy makers and the public; they can incorporate the information and products into their decisions. This program is focused on providing information about the global climate to society through a global observing system, targeted research to understand key climate processes, improved modeling capabilities, and the development and delivery of climate information services.

Specific objectives of the Climate Goal program are:

1. Describe and understand the state of the climate system through integrated observations, analysis, and data stewardship.
2. Reduce uncertainty in the information on atmospheric composition and feedbacks that contribute to changes in Earth's climate.
3. Provide climate forecasts for multiple time scales to enable regional and national managers to better plan for the impacts of climate variability, and climate assessments and projections to support policy decisions with objective and accurate climate change information.
4. Understand and predict the consequences of climate variability and change on marine ecosystems.
5. Provide information and tools to support decision makers in improving management of risks to the U.S. economy in sectors and areas that are sensitive to impacts from weather and climate.

The Climate Goal program is the foundation for NOAA's participation in the interagency U.S. Climate Change Science Program (CCSP). CCSP is a nationwide initiative to integrate Federal research on climate and global change. These efforts are built on NOAA's ongoing expertise and capabilities in observing systems, data management, climate analysis, and applied research. Within NOAA, several offices contribute to these efforts.

- NOAA's Office of Oceanic and Atmospheric Research (OAR): Responsible for conducting climate observation research.
- NOAA's National Environmental Satellite, Data, and Information Service (NESDIS): Responsible for the National Climatic Data Center (NCDC) and the Office of Research and Applications (ORA), which conducts research on the use of satellite data.
- National Weather Service (NWS): Operates several key observation systems and is responsible for the Office of Climate, Water, and Weather Services and the National Centers for Environmental Prediction (NCEP).
- NOAA Observing Systems Council (NOSC): Provides strategic direction for the NOAA Observing System Architecture project and data management.
- NOAA's Ocean Council: Provides guidance and recommendations regarding national ocean issues and other ocean related activities, including global ocean observations.
- Office of General Counsel: Provides legal services necessary to enable the program to discharge its duties.

*(continued on page 4)*

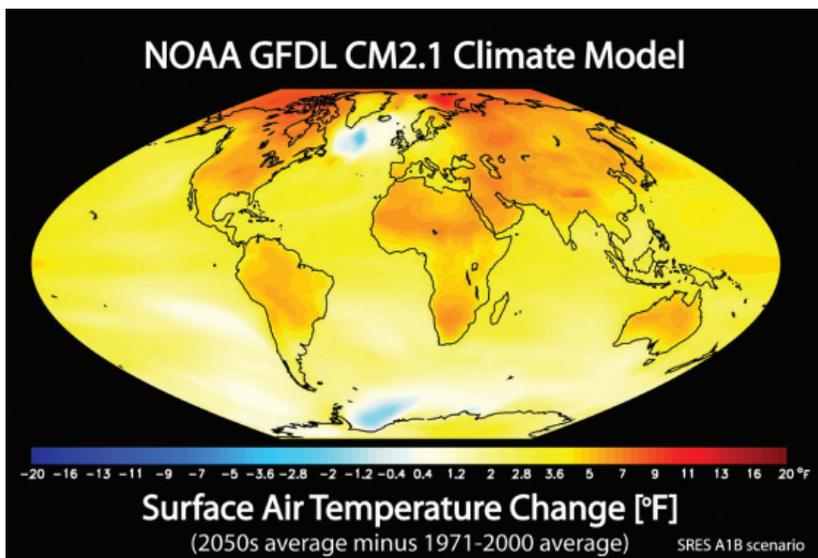
(NOAA's Climate Goal continued from page 3)

The Climate Goal program is also partnered with climatologists who operate state observing systems that fill in monitoring gaps, perform quality control, provide access to data, and conduct assessments and analysis; regional associations (public and private), such as the Western Governors Association, that provide a focal point for drought conditions and other water management issues; and other Federal agencies, such as the U.S. Geological Service, U.S. Forest Service, U.S. Department of Agriculture, and Department of Transportation, that contribute observations within their legislative mandate. The Climate Goal program also needs participation from foreign and international institutions that are connected by treaty or formal agreements. International partners include the International Council for Science (ICSU), the World Data Center (WDC), and the World Meteorological Organization (WMO). ■

## Some Accomplishments in FY 2007 for the NOAA Climate Program

In 2007, NOAA's Climate Goal program accomplished several goals, and many NOAA components contributed to these successes.

**NOAA Made Major Contributions to IPCC Reports:** NOAA individuals and technology made major contributions to the Intergovernmental Panel on Climate Change (IPCC). The depth of NOAA's contributions in this international effort includes providing observations, data, model simulations, and analyses.



### First-of-Kind Buoy to Monitor North Pacific

**Acidification:** The first buoy to monitor ocean acidification, a result of carbon dioxide absorbed by the ocean, was launched in the Gulf of Alaska. This new tool helps researchers examine how ocean circulation and ecosystems interact to determine how much carbon dioxide the North Pacific Ocean absorbs each year.

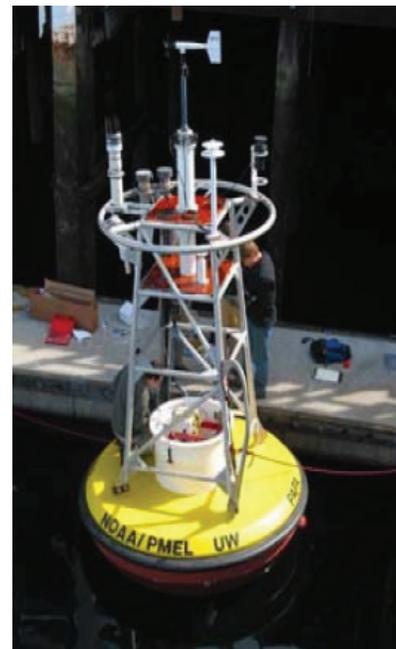
### National Plan for Managing Drought

**Released:** NOAA led the creation of "The National Integrated Drought Information System (NIDIS) Implementation Plan: A Pathway for National Resilience." This plan was released in June. NIDIS will enable users to determine the risks associated with drought and provide supporting data and tools to inform drought mitigation.

**NOAA Provides the Nation with an Annual State of the Climate Report:** The *State of the Climate in 2006* report, published as a special supplement to the *June 2007 Bulletin of the American Meteorological Society*, provides a summary of global climate conditions for the year. The report's goal is to routinely analyze and report on atmospheric, ocean, and terrestrial climate "state" variables.

**NOAA Made Major Contributions to IPCC Reports:** NOAA individuals and technology made major contributions to the Intergovernmental Panel on Climate Change (IPCC). The depth of NOAA's contributions in this international effort includes providing observations, data, model simulations, and analyses.

**New Climate Observatory in Russia Closes Gap on Arctic Research:** This summer the NOAA Earth System Research Laboratory expanded its Arctic observation with the construction of a new location in Tiksi, Russia. This effort joined five existing laboratories placed internationally along the Arctic rim. It will be an important component of the NOAA Arctic Atmospheric Observatory Program, closing a significant gap in vital Arctic atmospheric research. This new observation station is an example of increasing international cooperation in Earth observation around the world. ■



## Changing Needs in a Changing Climate

Peter Steurer, Operations Planning Officer, and Tim Owen, Executive Staff Officer, National Climatic Data Center

Over 100 million people living within the U.S. coastal zone could be dramatically impacted by erosion, inundation, and sea level changes over the next century. Billions of dollars of existing and future societal infrastructure are at risk. Extreme weather- and climate-related events create huge challenges for communities, businesses, and ecosystems in coastal regions. A traditional climatological analysis, based solely on atmospheric parameters, does not fully account for the complex weather and ocean patterns that contribute to the climate-related risk observed in the coastal zone. As our climate changes, issues such as sea level rise, endangered polar bears, and pests in Alaska will drastically affect our planet.

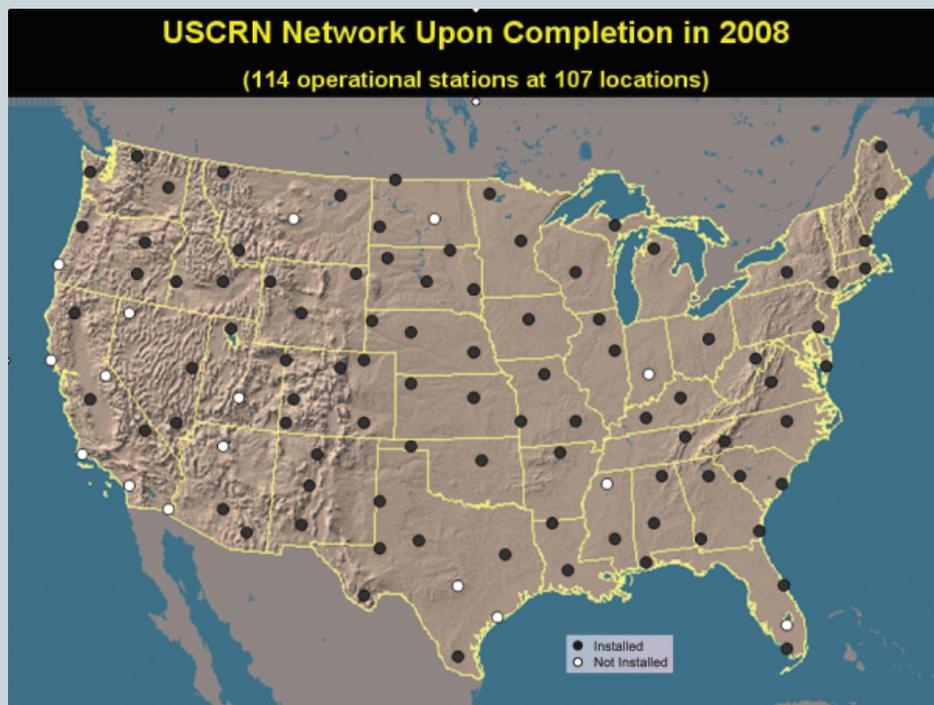
Other climate change issues include the increasing frequency of extreme weather events, such as heat waves, droughts, and heavy precipitation. Extreme events are part of the natural cycle of our climate, but changes in the historical range of these extreme events will increase the vulnerability of our ecosystem and society.

NOAA must ensure climate data and products are available to assist investigations of the potential consequences of climate change. The level of sophistication of NOAA's climate data and products must be continuously updated and improved. National and international scientific assessments on climate change have been released, and public interest is evident in daily articles and editorials in the news. The public now has an increased awareness of the impacts of climate on humans and the impacts of human activity on the climate.

It is necessary to integrate data and analyses across multiple disciplines (atmospheric, geophysical, oceanic, and socioeconomic) and time scales (hours to decades) to produce accurate and accessible climate data. NOAA products form the basis for making decisions that have far-reaching economic and social impacts at local, regional, and global levels. Weather- and climate-sensitive industries directly and

indirectly account for about one-third of the Nation's Gross Domestic Product or over \$4 trillion (in 2005 dollars); these industries include finance, insurance, real estate services, retail and wholesale trade, and manufacturing. Decision makers, scientists, and business owners are better prepared to make informed assessments and decisions because of easily accessible and reliable climate data and information.

NOAA's U.S. Climate Reference Network (USCRN), a network of climate stations, ensures quality, regionally-



▲ Map of USCRN Network.

representative *in situ* temperature and precipitation measurements for both real-time and future assessments of the U.S. climate. Data from USCRN will be used in operational climate monitoring activities and for placing current climate anomalies into historical perspective. In 2008, 114 CRN stations will be fully deployed in the United States. The density of observations from the CRN stations will increase significantly so the regional granularity of climate change can be verified. Heating and cooling costs will depend on this regional signal.

In a changing climate, coping and adapting will become a profound challenge to the Nation and world. There are more observing systems for climate than ever before, and the integration of data from multiple sources is needed to answer multidisciplinary economic and social issues. NOAA will take on the challenge to translate this information into easily accessible products that can be used by everyone. ■

<sup>1</sup> Economic Statistics for NOAA, April 2006 (Fifth edition), [www.economics.noaa.gov/library/documents/economic\\_statistics\\_and\\_methodology/NOAAEconomicStatistics-May2006.pdf](http://www.economics.noaa.gov/library/documents/economic_statistics_and_methodology/NOAAEconomicStatistics-May2006.pdf) (accessed October 30, 2007).

<sup>2</sup> New Priorities for the 21st Century – NOAA's Strategic Plan, Updated for FY 2006-FY 2011, April 2005, [www.ppl.noaa.gov/pdfs/STRATEGIC%20PLAN/Strategic\\_Plan\\_2006\\_FINAL\\_04282005.pdf](http://www.ppl.noaa.gov/pdfs/STRATEGIC%20PLAN/Strategic_Plan_2006_FINAL_04282005.pdf) (accessed October 30, 2007).

<sup>3</sup> National Research Council, Committee on Climate Data Records from NOAA Operational Satellites, *Climate Data Records from Environmental Satellites: Interim Report*, Washington, D.C., National Academies Press, 2004.

## Working toward Climate and Weather Literacy

Frank Niepold, Education Coordinator, Office of Global Programs

NOAA believes a public that is informed about environmental issues is an integral part of the success of the NOAA mission. This “environmental literacy” is critical to all of NOAA’s long-term goals. A well-informed public will provide improved environmental stewardship (taking care of the Earth, air, and water) and will be able to use and respond to the information NOAA provides. To achieve a high level of environmental literacy, NOAA is focusing on public outreach and education.

Key requirements for explaining literacy to the public include: ensuring coordination between developers of educational products and those partners responsible for establishing educational standards; overcoming barriers to influencing formal educational curricula that existed because historically education standards did not adequately reflect Earth system and climate science; and deploying strategic approaches to environmental and climate literacy.

In April 2007, the NOAA Climate Program Office and the American Association for the Advancement of Science (AAAS) Project 2061 worked to define specific climate literacy goals during a Climate and Weather Education workshop in Washington, D.C. This workshop was attended by representatives from numerous NOAA programs, other Federal science agencies, formal and informal educational institutions, nongovernmental organizations, and other vested institutions involved in climate research, education, and outreach.

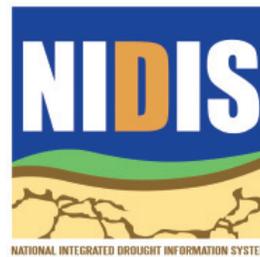
The attendees developed the initial framework through an iterative process rooted in scientific research, including education and social research, on weather and climate related topics. The workshop focused on natural and human-induced climate processes and sought to identify the key concepts that a climate literate person should know. The AAAS Project 2061 developed the educational research and science and technology education benchmarks to define climate and weather literacy for the Nation. These benchmarks were selected due to their considerable leadership in science literacy. AAAS Project 2061 also completed considerable work focused on weather and climate with their NOAA partnership. ■

## The New U.S. Drought Portal

Tim Owen, Executive Staff Officer, National Climatic Data Center

Drought, the creeping disaster, can be hard to identify because drought impacts typically unfold over weeks, months, and even years. Some of the direct impacts of drought can be reduced if they are recognized early. However, many indirect impacts are difficult to measure as they percolate through the economy, communities, and environment.

In the late 1990s, a National Drought Policy Commission (NDPC) was established, under the National Drought Policy Act of 1998, to ensure collaboration among different government agencies on drought-related issues. NDPC issued a



groundbreaking report, *Preparing for Drought in the 21<sup>st</sup> Century*, in 2000. On the basis of NDPC’s recommendations, the National Integrated Drought Information System (NIDIS) was envisioned in a *Western Governors’ Association Report* (2004). The NIDIS Act was introduced in the U.S. Congress and signed by the President in 2006. This fast action

by the Government mobilized Federal agencies and resulted in the creation of the drought portal.

NIDIS is a broad warning and monitoring system for droughts in the United States. The newly released U.S. Drought Portal is a one-stop internet resource under NIDIS to:

- Provide early warning about emerging and anticipated droughts
- Assimilate and quality control drought data and models
- Provide information about the risks and impacts of droughts to different agencies and stakeholders
- Provide information about past droughts for comparison and understanding current conditions
- Explain how to plan for and manage the impacts of droughts
- Provide a forum for different stakeholders to discuss drought issues ■

# Adding Value to the Nation through NOAA's New Website

Adam Smith, Physical Scientist, National Climatic Data Center

NOAA's environmental observations, analyses, data products, and services provide valuable information that is routinely used in decision making by consumers, industries, and policymakers. For instance, NOAA weather and climate data are used in countless industries, including agriculture, utilities, transportation, construction, engineering, health care, insurance, manufacturing, education, and tourism. In fact, the Department of Commerce's Bureau of Economic Analysis estimates that at least one-third of the U.S. Gross Domestic Product is climate sensitive.<sup>1</sup>

As NOAA continues to use increasingly sophisticated data observing systems and scientific analyses, the value of environmental data for general and specific decision making purposes will also be enhanced. However, in order to make optimal use of these data and demonstrate their relevance to users, NOAA must improve its ability to articulate the socioeconomic value of agency data products and services.

NOAA's National Climatic Data Center has developed and coordinated a socioeconomic website initiative with NOAA's Office of Program Planning and Integration. This prototype website presents a centralized, organized, and searchable source of information about the economic and social value and application of NOAA's data products, as well as the economic costs of extreme events on the environment and society. The website is intended for a general audience and provides a clear, accurate, but not overly academic explanation of NOAA's economic and social value.

The socioeconomic information contained on this website is synthesized from over 125 peer-reviewed sources and is organized by data users, such as industries, academia, and Federal agencies; extreme environmental events, such as hurricanes, drought, and coral bleaching; and NOAA observation systems, such as land surface, marine surface, and satellite.

As of September 2007, the website incorporates:

- **76** subject overview narratives, which provide information on the value of NOAA data and products to society, as used in business, personal and policy decision making, etc.
- **125** peer-reviewed sources, 110 are linked directly to the document
- **115** economic benefit summaries
- **150** economic cost/extreme event impact summaries
- **900+** data user application examples
- **Hundreds** of links to NOAA datasets/products and NOAA program missions and responsibilities

This website will be updated often, but one challenge will be keeping this socioeconomic information up-to-date and relevant by keeping track of new activities and advances made by NOAA. To accomplish this, a password-protected online web module has been developed, which allows NOAA personnel to submit additions or edits to economic benefit summaries, extreme event impact summaries, data user application examples, general subject overviews, or bibliographic references to relevant literature. NOAA's collective input is necessary to develop a genuinely comprehensive and interwoven socioeconomic footprint of NOAA's value to our Nation, which is a benefit to us all. ■

**Economic and Social Benefits of NOAA Data and Products**  
Climate, Ecosystems, Weather & Water, Commerce & Transportation

The use of NOAA's data products and services provide considerable socioeconomic benefits for our Nation. This website presents a centralized, organized and searchable source of information pertaining to the economic value and application of NOAA's data products within society, as well as the economic costs of extreme events on the environment and society.

As a bureau under the Department of Commerce, NOAA has a broad mission "To understand and predict changes in the Earth's environment and conserve and manage coastal and marine resources to meet our Nation's economic, social and environmental needs." To achieve this purpose, NOAA is organized into four Mission Goals: *Climate, Weather & Water, Ecosystems, and Commerce & Transportation*. Research and operational programs are performed in each of these Goals to produce new geophysical observations, analysis, scientific reports and data products, which are used by individuals, businesses, researchers, and policy-makers in a wide range of decision-making.

**The website provides four types of socioeconomic information:**

- 1 - **Subject Overview** - (A general socioeconomic perspective on the value of NOAA data and products to society)
- 2 - **Economic Benefit Information** - (net economic gain)
- 3 - **Home Page of the New Website.**

For more information, visit [www.ncdc.noaa.gov/oa/esb](http://www.ncdc.noaa.gov/oa/esb) or contact Adam Smith, [Adam.Smith@noaa.gov](mailto:Adam.Smith@noaa.gov), or Jesse Enloe, [Jesse.Enloe@noaa.gov](mailto:Jesse.Enloe@noaa.gov).

<sup>1</sup> Dutton, J.A., "Opportunities and Priorities in a New Era for Weather and Climate Services," Bulletin of the American Meteorological Society, 83(9), 1303-1311, 2002.

## News Briefs

### Arctic Regional Sea Ice to Decline 40 Percent Before 2050

A new study by NOAA scientists shows that sea ice coverage of the Arctic Ocean will decline by more than 40 percent before the summer of 2050. These findings are based on a study of national and international computer models that closely match the observed sea-ice extent over the 20-year baseline period of 1979-1999 and then project forward in time to determine any changes. This work was



▲ View of polar bear on Arctic sea ice.

done by James Overland, an oceanographer at NOAA's Pacific Marine Environmental Laboratory in Seattle, and Muyin Wang, a meteorologist at NOAA's Joint Institute for the Study of the Atmosphere and Ocean at the University of Washington in Seattle. The findings were published in *Geophysical Research Letters*, in an article titled "Future Regional Arctic Sea Ice Declines."

Projections in the Intergovernmental Panel on Climate Change (IPCC) report show summer sea ice loss throughout the Arctic Ocean north of Alaska, Canada, and Asia. Sea ice loss is also predicted during winter in the seasonal ice zones of the more southern Bering and Barents seas and the Sea of Okhotsk. Models show no ice loss in the Baffin Bay region, west of Greenland.

Overland and Wang note that loss

of ice has major impacts on marine ecosystems, transportation, and feedbacks to the larger climate system. For example, light-colored ice reflects the sun's hot rays; dark water absorbs heat. Therefore, less ice to reflect heat means more water to absorb the warmth.

"These seasonal ice zones have large variability on annual and decadal time scales," said Wang. "Projections of sea ice are important as there will be impacts on humans and other ecosystem components."

### Digital Elevation Model Discovery Portal

The National Geophysical Data Center (NGDC) created an ArcIMS map interface for locating digital elevation models (DEMs) on the web. The DEM Discovery Portal makes it easier for researchers to locate, preview, and download DEMs, which can be bathymetric, topographic, or a combination of both. They also range from high-resolution coastal DEMs for local studies to coarser DEMs with global coverage. DEM users range from ecologists mapping fish habitat to hurricane modellers estimating coastal storm-surge inundation.

### NOAA Hourly Air Quality Ozone Forecasts Now Available Coast to Coast

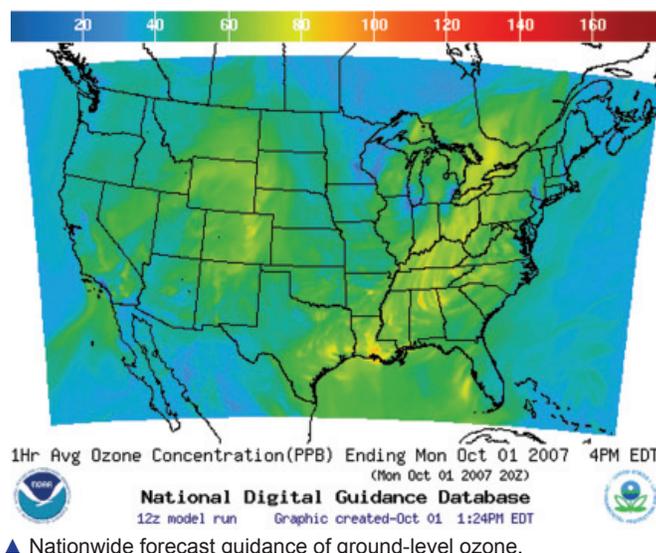
Ground-level ozone forecasts, key predictors of air quality in major U.S. cities, are now available throughout the contiguous United States. NOAA's National Weather Service, in partnership with the U.S. Environmental Protection Agency, extended its operational ozone forecast guidance

to 11 western states and expanded the service in six other states. These forecasts ensure that the most populous cities throughout the country will have access to the information on a daily basis.

"Poor air quality is a silent killer, responsible for tens of thousands of premature deaths each year in the continental United States," said Jack Hayes, Ph.D., Director of NOAA's National Weather Service. "Weather and air quality are strongly linked. Temperature and lack of wind can create and trap harmful ozone where we work and play. Our ozone forecasts will enable city and state air quality managers to look ahead, see trouble brewing, and issue next-day alerts for poor air quality."

Hour-by-hour ozone forecasts, through midnight of the following day, are available online, providing information for the onset, severity, and duration of poor air quality for more than 290 million people from coast to coast.

States added to the expanded ozone forecast area are Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, and Wyoming and the western portions of Kansas, Nebraska, North Dakota, Oklahoma, South Dakota, and Texas. ■



▲ Nationwide forecast guidance of ground-level ozone.

## The Melting of the Arctic Sea Ice

*Florence Fetterer, Program Manager, and Walt Meier, Research Scientist, National Snow and Ice Data Center*

Several years ago, any mention of the NOAA Sea Ice Research Team's work would often elicit a blank look. Now, most people seem to be familiar with sea ice, and, more importantly, most know that it is shrinking because of global warming. The NOAA Sea Ice Research Team studies and measures sea ice and how it is changing. The scientists use a combination of data from satellites orbiting Earth and data taken from Arctic and Antarctic field expeditions to track the changes.

Sea ice is frozen seawater that floats on the ocean surface, and it is found in remote polar oceans. On average, sea ice covers about 25 million square kilometers (9,652,553 square miles) of the Earth or about two-and-a-half times the area of Canada. Sea ice forms and melts with the polar seasons, affecting both human activity and biological habitat (for example, the sea ice provides a dry rest area and a hunting surface for surprising prey in the water spaces between ice sections). Although the condition of sea ice may not directly affect those of us who do not live next to it, this ice is a critical component of our planet; it influences climate, wildlife, and people who live in the Arctic.

Sea ice affects and is affected by climate in several ways. The ice-albedo feedback, the reflection of sunlight back into space, is perhaps the most significant effect. Ice cover, especially thick ice or snow-covered ice, has a high albedo. This means it reflects most of the Sun's radiation back into space. On the other hand, the ocean has a lower albedo and absorbs the Sun's heat, causing water to get warmer. Warmer water melts the ice creating more ocean water to absorb the heat and less ice to reflect it. Once this cycle of melting begins, it cannot be stopped. Therefore, subsequent generations will continue to see dramatic changes in Arctic ice cover.

The observed reduction in Arctic sea ice area is greater than that predicted by most computer models that forecast the impact of heat on ice; the ice environment is more sensitive to heat than predicted. Recent work by scientists at the National Snow and Ice Data Center (NSIDC) and the National Center for Atmospheric Research (NCAR), both

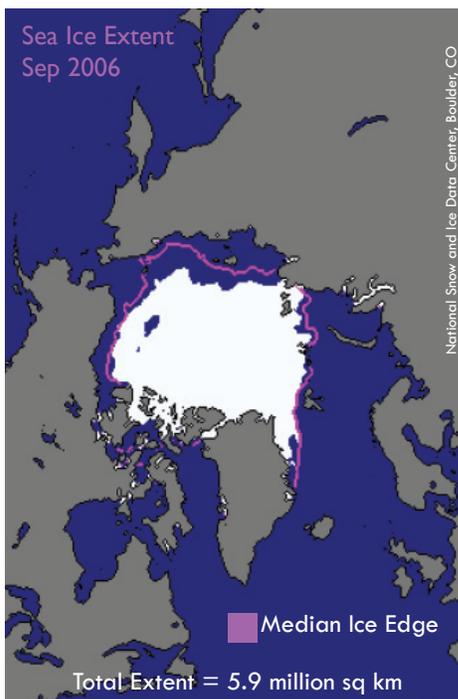
in Boulder, Colorado, found that Arctic sea ice is retreating more rapidly than estimated by any of the eighteen computer models that the Intergovernmental Panel on Climate Change (IPCC) used in preparing its 2007 assessments. IPCC is an international clearinghouse for science ideas on climate.

More and more people around the world are coming to understand the changes that our planet's cold regions are undergoing. They are looking for information that is easy to access and understand. To meet this need, NSIDC created the Arctic Sea Ice News Fall 2007 website to help journal-

ists, decision makers, and the public follow the waning of the sea ice as the melt season reaches its peak (late summer) and draws to a close (early fall). NSIDC also created an online Education Center that includes an educational resource called All About Sea Ice and The State of the Cryosphere: Sea Ice. These resources offer in-depth information on the interaction between sea ice and climate. This information also offers a glimpse of the characteristics and different forms of sea ice, why it is so important to our environment, and popular scientific methods for studying it.

Satellite passive microwave data are the basis of most studies that center on sea ice and climate. NSIDC distributes a number of sea ice data sets, including the Sea Ice Index, which includes monthly updates for monitoring both Arctic and Antarctic ice cover. NSIDC also offers operational ice charts from the National Ice Center. These charts are based on

many data sources and are useful in checking the accuracy of passive microwave-based records. In addition, NSIDC has observational data of sea ice thickness from submarines, available through work with the United States Navy Arctic Submarine Laboratory and collaborators. ■



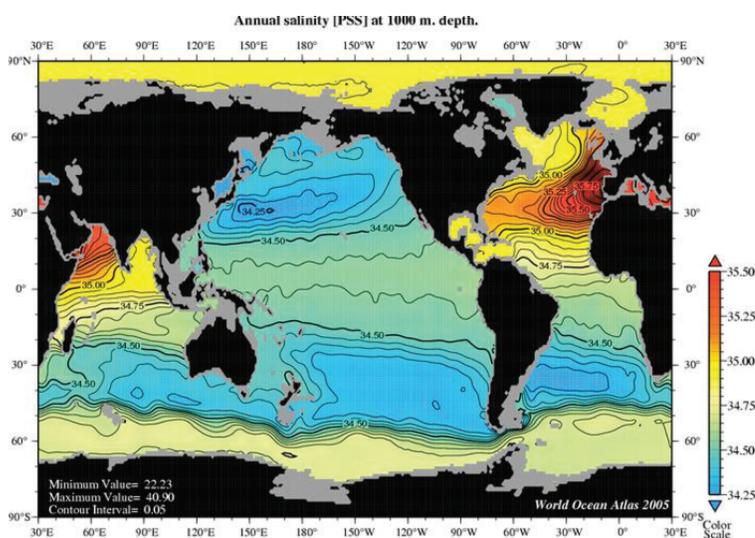
▲ Over the past several years, the Arctic sea ice area during the summer melt season has trended downward at a rate of more than 8 percent per decade. The magenta line indicates the median September sea ice area from 1979 to 2000, as compared to the September 2006 sea ice area.

For more information on sea ice data, e-mail [nsidc@nsidc.org](mailto:nsidc@nsidc.org) or visit the following websites, <http://nsidc.org>, <http://nsidc.org/cryosphere>, and [http://nsidc.org/news/press/2007\\_seaiceminimum/20070810\\_index.html](http://nsidc.org/news/press/2007_seaiceminimum/20070810_index.html).

## Online Access to Foreign Climate Data from 59 Countries!

*Diana Abney and Doria Grimes, Librarians, NOAA Central Library*

To support climate data research, the NOAA Central Library has imaged and placed online the official climatological records for 59 countries and colonies from the 1800s through the 1970s. Access to this information is available three ways: 1) search for the country through the library's online catalog (NOAALINC); 2) search WorldCat (a database used by 75,000 libraries and their patrons); and 3) access the records directly from the library's home page at [www.lib.noaa.gov](http://www.lib.noaa.gov). A pull down menu labeled Imaged Documents and Maps directs the user to the website Climate Data Imaging Project ([http://docs.lib.noaa.gov/rescue/data\\_rescue\\_home.html](http://docs.lib.noaa.gov/rescue/data_rescue_home.html)). PDF and TIFF images for each country and former colonial governing body are available online. During the formative years of maintaining climate data in printed format, prior to today's standardized computer and satellite data, the country's parameters are varied and, in some cases, unique. Examples of the parameters include surface temperature, precipitation, atmospheric pressure, wind speed and direction, soil temperature, radiation, cloudiness, and geomagnetism. ■



## World Ocean Atlas 2005 Presents New Ocean Climatologies

*Sydney Levitus, Tim Boyer, Hernan Garcia, Ricardo Locarnini, and Alexey Mishonov, Ocean Climate Laboratory, National Oceanographic Data Center*

The Ocean Climate Laboratory of NOAA's National Oceanographic Data Center has published new ocean climatologies of temperature, salinity, oxygen, apparent oxygen utilization, percent oxygen saturation, phosphate, silicate, and nitrate. Collectively these new climatologies are known as World Ocean Atlas 2005 (WOA05). These new climatologies are based on data from the World Ocean

▲ Climatological annual salinity produced by the World Ocean Database 2005.

Database 2005 (Boyer, et al. 2006), which contains approximately 900,000 more temperature profiles than its predecessor. Many of these additional profiles are historical and were acquired as part of the Global Oceanographic Data Archaeology and Rescue project sponsored by the Intergovernmental Oceanographic Commission (Levitus, et al. 2005).

WOA05 consists of objectively analyzed, gridded fields (one-degree) at up 33 standard depth levels between the sea surface and 5500 meter depth for the following climatological compositing periods—annual, seasonal, and monthly. Also included in WOA05 are various statistics of the unanalyzed data at standard depth levels some of which served as input to the objective analyses. These statistics include, but are not limited to, the number of observations, mean, standard deviation, and standard error of the mean. Similar statistics are available by five-degree squares.

The gridded fields in the WOA series are used frequently by the climate research community in diagnostics studies for validating ocean models, e.g., computing ocean heat content, and as “sea-truth” for satellite measurements of the Earth system, e.g., sea level. ■

WOA05 is available at [www.nodc.noaa.gov](http://www.nodc.noaa.gov).

<sup>1</sup> Boyer, T. P., J. I. Antonov, H. Garcia, D. R. Johnson, R. A. Locarnini, A. V. Mishonov, M. T. Pitzer, O. K. Baranov, and I. Smolyar, 2006. World Ocean Database 2005. S. Levitus, Ed., NOAA Atlas NESDIS 60, Washington, U.S. Govt. Print. Off., pp. 182.

<sup>2</sup> Levitus, S., S. Sato, C. Maillard, N. Mikhailov, P. Caldwell, and H. Dooley, “Building Ocean Profile-Plankton Databases for Climate and Ecosystem Research,” NOAA Technical Report NESDIS 117, Washington, U.S. Govt. Print. Off., 2005, pp. 29.

# CLIMATE DATA ARE USED IN EVERY ASPECT OF OUR NATIONAL ECONOMY... AFFECTING EVERYONE IN MANY WAYS



## Library Project: Climate Change Portal for Pacific Islands

Mary Lou Cumberpatch, Librarian, NOAA Central Library

The NOAA Central Library, in cooperation with the National Ocean Service, other NOAA offices, and national and international partners, is developing a *Virtual Library* of climate change resources for coastal managers in the Pacific Islands. The *Virtual Library* will contain websites, reports, data sources, geospatial tools, and other decision support resources to help coastal managers effectively use climate information to make decisions.

The project's initial phase targets the information needs of managers in two Pacific Islands, with the intention of expanding the scope to other islands and coastal areas. The Pacific Islands are already facing and beginning to address the impacts of climate change. Factors such as sea level rise, ocean temperature change, intensified storm activity, and ocean acidification will greatly impact coral reefs, the safety of communities, the health of natural resources, and the growth of local economies. The Climate Change Portal *Virtual Library* will help decision makers understand the potential impacts of climate variability and change, and implement adaptation strategies that will increase the resilience of communities and coasts to the impacts. The *Virtual Library* will be completed in October 2008. ■

For more information, contact [Mary.Lou.Cumberpatch@noaa.gov](mailto:Mary.Lou.Cumberpatch@noaa.gov), NOAA Central Library, [Carrie.Hall@noaa.gov](mailto:Carrie.Hall@noaa.gov), NOAA Office of Coastal and Resource Management, or [Stephanie.Fauver@noaa.gov](mailto:Stephanie.Fauver@noaa.gov), NOAA Coastal Services Center.

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