

# Climate Diagnostics Center

## Laboratory Accomplishments

List 3-5 major accomplishments for your laboratory. If accomplishment occurred more than 2 years ago, cite recent progress. Please specify importance of accomplishment, who have been the major users and what has been the benefit to the taxpayer.

### 1) Advancing NOAA seasonal-interannual climate forecast capabilities.

- Improved skill of climate forecasts and estimates of forecast uncertainties/predictability through increased understanding of the mechanisms that produce climate variations, and development and transfer of new forecast products into NOAA climate services.
- **Experimental forecasts of ENSO and related climate responses developed at CDC are now routinely incorporated into NOAA-Climate Prediction Center (CPC) expert assessments and used in projecting SST variations and associated climate responses over the next few seasons.**
- **CDC provides to CPC real-time updates of diagnostic and experimental prediction products and guidance prior to the issuance of NOAA ENSO diagnostic discussions, monthly and seasonal climate outlooks, and drought monitor and outlooks.**

#### Users and benefits

- ❖ NOAA seasonal-to-interannual climate forecasts and related products are used extensively by the public and a wide range of decision-makers, especially in agriculture, water and energy resources management. Improvements in NOAA's seasonal to interannual climate capabilities benefit taxpayers by contributing to better informed and more efficient resource management decisions. Other payoffs include an improved ability to anticipate and respond to high-impact climate events (e.g., to a developing ENSO event) and increased understanding and capabilities to project the regional impacts of climate events, which provide a sounder scientific basis for developing strategies to minimize potential vulnerabilities.

### 2) Improving NOAA forecast capabilities within a season.

- Development and implementation of an experimental reforecast product to improve Week 2 (forecast days 8-14) probabilistic surface temperature and precipitation forecasts.
- Improved ability to identify how changes in tropical rainfall distributions **affect the risks of heavy rainfall along the US west coast.**
- **Improved understanding and assessments of predictability of extreme events (e.g., droughts, floods) contributing to improvements in the CPC U.S. "Hazards Assessment" product.**
- **An experimental reforecast product developed at CDC has resulted in a 2-4 day advance in lead time for medium-range forecasts, with the skill of the CDC 8-14 day experimental forecast product superior to the current CPC 6-10 day operational product for both temperatures and precipitation. The CDC research product will be transitioned to operational status at NWS/NCEP over the next year.**

- **Experimental CDC web-based tools have been developed for monitoring and predicting tropical Pacific rainfall variability on intraseasonal time scales (e.g., associated with the Madden-Julian Oscillation) for use by CPC and other operational and research centers throughout the world.**

Users and benefits

- ❖ Forecasts within a season support a wide range of decision-makers across public and private sectors, such as reservoir water management (e.g., to reduce flood risks) and energy planning. Through the hazards assessment product, this information also serves as long lead guidance for emergency managers. Research in this area also directly addresses a gap in NOAA forecast capabilities, and serves the NOAA NWS in achieving its strategic goal of providing a seamless suite of forecast products from minutes to years in advance. An important payoff is a more efficient and rapid transfer of research results into NWS operations. Benefits to the nation include increased lead-times for guidance on potential high impact weather and climate events to support improved planning and resource management decisions.

**2) Increasing understanding of the links between decadal-to centennial climate variations and shorter-term climate variability, and implications for high-impact climate events**

- Improved understanding of the effects of the ocean's role in forcing multi-year climate anomalies. Collaborative work between CDC and CPC has shown that warm sea surface temperatures in the western tropical Pacific and Indian Oceans combined with persistent La Niña conditions over the period 1998-2002 contributed to wide-spread drought in mid latitudes, including large portions of the U.S., Mediterranean, and southwest Asia.
- Enhanced understanding of the atmosphere-ocean coupling as a mechanism to explain the role of the tropics in Pacific decadal climate variability.
- **Improvements in understanding the causes of major climate phenomena such as drought are leading to the development of new diagnostic or 'climate attribution' capabilities in NOAA, and also provide a scientific basis for developing drought forecasts.**

Users and benefits

- ❖ Public benefits will be achieved through an improved ability to explain observed climate events and to provide more reliable and useful climate prediction products. Such information is essential in supporting U.S. and international decision makers across a wide spectrum of public and private sectors (e.g., risk and emergency management, energy and natural resources, agriculture, transportation, homeland security). For example, drought leads to an estimated \$6-8B in average annual economic losses to the United States, and has profound social and economic impacts worldwide, so that even modest improvements in drought prediction capabilities carry enormous potential for economic and societal benefits.

**2) Increasing understanding of causes of 20<sup>th</sup> Century regional climate changes**

- Improved understanding of the relevant external forcings of 20<sup>th</sup> century regional climate changes and trends.

- **Increased capability to assess the roles of natural variability and anthropogenic forcing on regional climate changes.**
- **Collaborative CDC/NCAR research has shown that changes in North Atlantic/European climate since 1950, including the drying in the Mediterranean region, have been forced by a progressive warming of the distant tropical Indian Ocean, which is in turn a response to increasing greenhouse gases.**
- **Attribution research indicates the observed climate changes such as winter warming and summer cooling over North America, increased precipitation over the U.S. Great Plains, and drying across Africa are a response to changing ocean conditions, and that these changing ocean conditions are in part a response to anthropogenic forcing.**

Users and benefits

- ❖ The public and policymakers benefit from improved expert assessments and explanations for current and evolving changes in climate, and refined estimates of uncertainties in climate change projections and potential impacts of climate change at regional scales. Research in this area contributes to the IPCC assessment, enables the delivery of new services and products required by the Climate Change Science Program, and addresses the ultimate objective of the United Nations Framework Convention on Climate Change.

**4) Accelerating the expansion of NOAA climate services by developing, evaluating, and disseminating a broad range of experimental climate products, improving links between NOAA research, operations, and end users, and providing educational training for NWS field personnel.**

- Developed, evaluated, and provided experimental climate products to better address user needs (water supply, energy, agricultural, wildfire management, education).
- **Collaborated with NOAA regional integrated science assessments (RISAs) to identify current uses of climate information and develop new operational and experimental climate products that better address customer needs and promote the development of NOAA climate services.**
- **Developed experimental climate diagnostics and web-based analysis tools to provide information at spatial resolutions needed by decisionmakers (e.g., regional, state, river basin, etc.).**
- **Supported NOAA climate services by co-leading with the NWS Climate Services Division an educational and training program on *Climate Variability* for NWS personnel.**
- **CDC provides access to a wide range of research and experimental products via its website, which is extensively used by the public and private sectors. For example, in the most recent month for which statistics are available, July 2003, CDC web pages were visited over 2 million times by over 120 thousand distinct users, with over 150 Gigabytes (GB) of data downloaded directly from the web site. Over the first seven months of the calendar year, the CDC website has averaged over 1.5 million accesses per month from nearly 110,000 distinct users, and about 130 GB of data downloaded directly from the site per month. In addition to the direct web transfers, over 1.6 Terabytes (TB) of climate data were**

downloaded from CDC via file transfer protocol (FTP) in July, with the monthly average for this year being approximately 2 TB/month.

- **CDC works with NWS regional offices and NESDIS regional climate centers to develop new climate products, such as new climate divisions that better represent patterns of climate variability in seasonal precipitation and temperatures, and develops climate analysis tools to improve access to information at resolutions that meet user-defined needs.**
- **CDC co-developed and co-leads a semi-annual “Training Workshop on Climate Variability” to provide NWS forecasters with the scientific training to understand NOAA climate forecasts and other operational and research climate products, and to enable them to adapt and interpret these products for their area.**
- **CDC provides regular briefings of the regional implications seasonal climate outlooks and other experimental climate forecasts to the Colorado Water Availability Task Force and other user communities, such as water resource managers.**
- **CDC developed an ensemble regression modeling technique to estimate past hydroclimatic variability from tree-ring that describes and to quantify uncertainty in the reconstructions. This technique was developed to meet the needs of regional water managers, who wish to incorporate extended climate records derived from tree ring reconstructions of annual streamflow into their planning and decision processes.**
- **CDC is the NOAA research representative on an interagency core team that provides scientific expertise to the Western Governors’ Association in developing plans for a National Integrated Drought Information System.**

#### Users and benefits

- ❖ Broad public benefits will be derived from expanded and more effective uses of NOAA climate products and services, leading to better informed public and private sector decisions (e.g., proactive planning, impact mitigation and improved responses). This knowledge is essential to developing and sustaining effective NOAA climate services on both regional and national scales. This work is also contributing to a more rapid and efficient transfer of research results into applications and NOAA climate services.