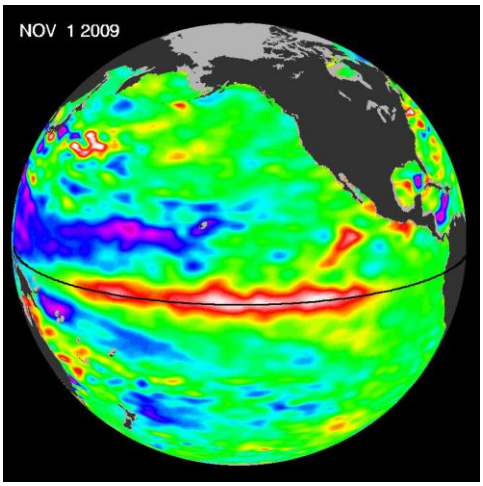
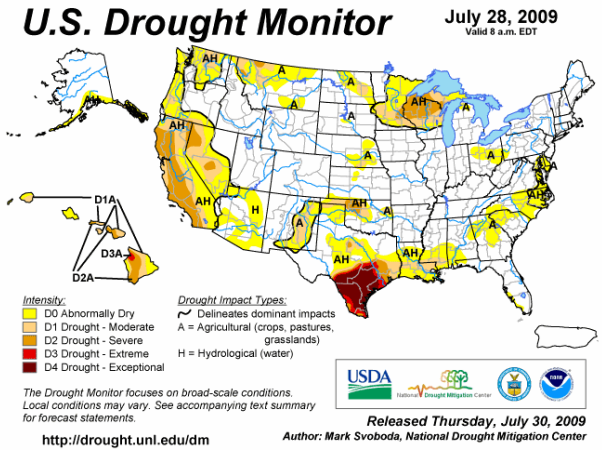
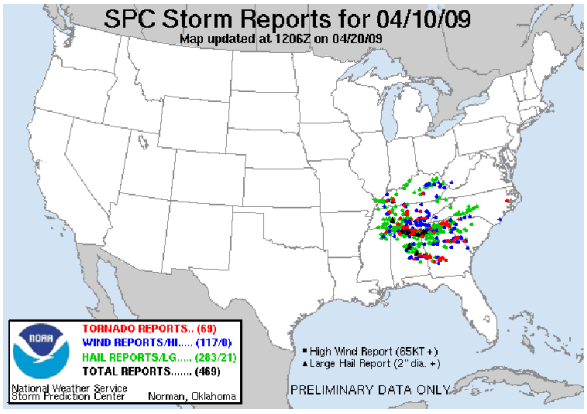
THE STATE CLIMATOLOGIST

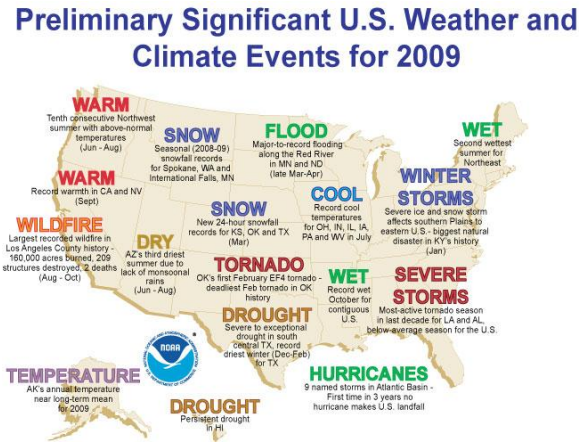
2009 Annual Summary

Volume 28, Issue 1









***The State Climatologist* is a publication of the American Association of State Climatologists**

Editor's Note

The State Climatologist is an annual report of the activities of the members of the American Association of State Climatologists. It has been a pleasure to be the editors of this year's edition spanning the period of January – December 2009 (with some reports also extending into early 2010).

We would like to express appreciation to all of the state climate offices, regional climate centers, AASC partners and others who contributed to this year's edition.

Mathieu R. Gerbush
Office of the NJ State Climatologist
Rutgers University

July 8, 2010

Table of Contents

Summer, 2010

Dear Fellow Climatologists, Partners and Friends of the AASC,

It is my great pleasure to share the following annual climate reports with you. This document outlines and highlights the broad spectrum of work done across the country. Our offices, institutions and responsibilities differ from place to place across the country just like the climate differs; yet we are similar in our goals to teach, to share and to lead. Despite budget cuts in many states, furloughs in others, and other handicaps brought on by our the recent global economic crisis, State Climate Offices continue to work creatively, skillfully and passionately to meet the climate information needs of our respective states. Knowing the relatively small amount of funding available at the state level in so many states, it is amazing to see what we are able to accomplish.

It is truly an honor to be a part of this fine organization -- the American Association of State Climatologists. Please contact any or all of us to learn more about our efforts and their important impacts at the state and local level.

Sincerely,

Nolan J. Doesken
State Climatologist (Colorado)
Outgoing President, American Association of State Climatologists

About the American Association of State Climatologists

The American Association of State Climatologists (AASC) is a professional scientific organization composed of state climatologists (one per state), directors of the six Regional Climate Centers and associate members who are persons interested in the goals and activities of the Association. State Climatologists are individuals who have been identified by a state entity as the state's climatologist and who are also recognized by the Director of the National Climatic Data Center of the National Oceanic and Atmospheric Administration as the state climatologist of a particular state.

State Climatologists currently exist in 47 states and Puerto Rico. They are typically either employees of state agencies or are staff members of state-supported universities. Associate members may be assistant state climatologists or other climatologists under the employ of the state climatologist, representatives of federal climate agencies, retired state climatologists, or others interested in climate services. The total membership of the Association is approximately 150. For more info, see

http://lwf.ncdc.noaa.gov/oa/climate/stateclimatologists.html.

ARSCO

A state climate office may gain status as the AASC-Recognized State Climate Office (ARSCO) by providing:

1. A document detailing current and planned activities meeting ARSCO requirements;
2. A letter of support from the state's Regional Climate Center Director;
3. A letter of support from at least one National Weather Service Forecast Office serving the state.

Candidate offices must demonstrate the following capabilities:

- Communication capabilities – the office must be able to communicate with its clientele via multiple media, including telephone, Internet, mail, E- mail, and fax;
- Information services – the office must be capable of providing a range of data and information;
- Research – the office must conduct research on climate and human activities;
- Outreach – the office should design products and services for education, climate information, awareness, and the media;
- Monitoring and assessments – monitoring climate conditions, evaluating future impacts, and providing historical context to events are activities conducted by ARSCOs.

Upon receipt of the materials and approval of the AASC Executive Board, a Memorandum of Agreement (MOA) with the National Climatic Data Center shall be issued. Currently, 38 states have received ARSCO status.

L. Dean Bark Obituary

L. Dean Bark
MANHATTAN- L. Dean Bark, 84, died Tuesday, May 4, 2010 at Meadowlark retirement community in Manhattan. Professor Bark was a 43-year member of the faculty of the Department of Physics of Kansas State University where he was Professor of Climatology from 1967 until his retirement in 1999. He was named Professor Emeritus at his retirement. He joined the KSU staff as an Associate Professor of Physics in 1956 and was the Acting State Climatologist for Kansas from 1973-1990. Professor Bark earned his doctorate from Rutgers University in 1954 and then worked as a Bioclimatologist at the U.S. Weather Bureau in Washington D.C. in 1955. He was an Army veteran of World War II and was awarded the Purple Heart after being wounded near Strasbourg, France. Professor Bark was born March 18, 1926, at Chanute, the son of Reuben Oscar and Elsie Bark. He graduated from Chanute High School and attended Neosho Community College and Kansas University. He earned B.S. and M.S. degrees from the University of Chicago in 1948 and 1950, respectively. He was a member of numerous honorary and professional societies and had many publications to his credit. Following his retirement, Professor Bark contributed many hours of community service in assisting senior citizens in the preparation of their IRS tax returns and at the Manhattan Public library in repairing audio tape players. He was married to Donna on August 22, 1964 at Manhattan. Survivors include three sons, Steven Bark, Lenexa, Kansas; Stanley Bark, Crans-pres-Celigny, Switzerland and Stuart Bark, Dallas, Texas, four grandchildren and three great grandchildren. Professor Bark was preceded in death by his parents, one brother Chet, and one grandson, Andrew Worthington Bark. Funeral services will be at 2 p.m., Friday, May 7 at the St. Paul Episcopal Church at 601 Poyntz Avenue, Manhattan, with The Reverend Thomas D. Miles officiating. Cremation will follow the service with inurnment will be at a later date in Sunset Cemetery in Manhattan, KS. Online condolences may be left for the family through the funeral home website at www.ymlfuneralhome.com. Memorial contributions may be made to Meadowlark Hills Good Samaritan Fund. Contributions may be left in care of the Yorgensen-Meloan-Londeen Funeral Home, 1616 Poyntz Avenue, Manhattan, KS 66502.

Published in Topeka Capital-Journal on May 6, 2010

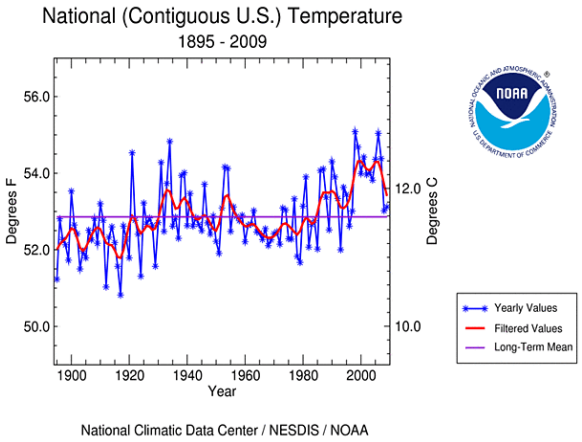
2009 SUMMARY OF THE UNITED STATES CLIMATE

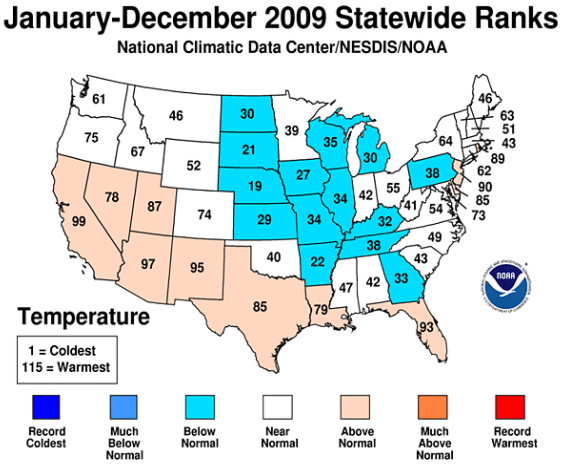
Compiled from reports by the National Climatic Data Center

Editor's note: The following report is preliminary. A final version will replace this initial version around the end of July.

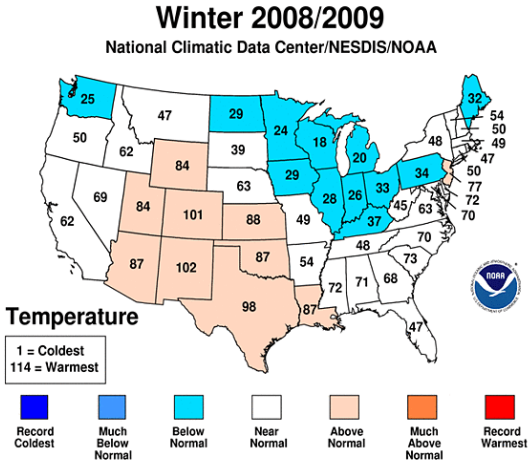
National Temperatures

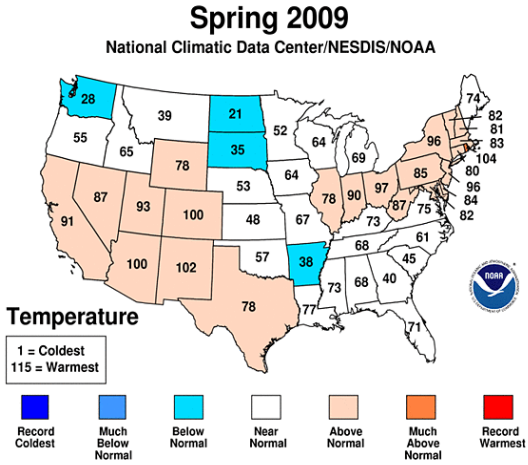
Based on data from January through December, the average annual temperature for the contiguous U.S. was 53.1 degrees F (11.7 degrees C), which is 0.3 degrees F (0.2 degrees C) above the 20th Century average.





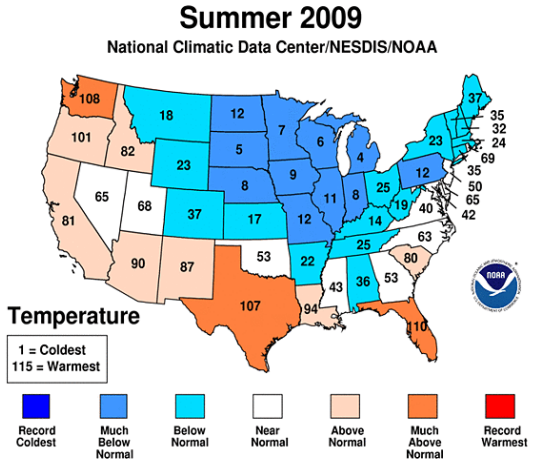
As with most seasons, winter December-February 2008-09 featured regional variations in temperature, but the overall average temperature for the contiguous United States was officially "near-normal", or within the middle third of historic winter temperatures. The season was the 40th warmest such period on record (1896-2009), with above-normal temperatures across parts of the South and Southwest. Both the Central and East North Central regions experienced cooler-than-normal temperatures during the period. The monthly variations are illustrated in the statewide rank maps for December, January, and February.



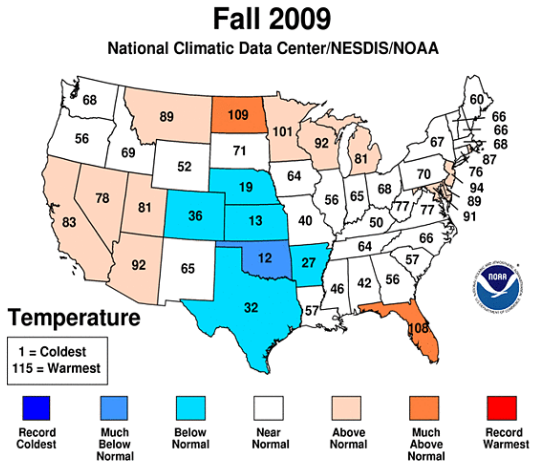


The warm anomalies strengthened in the spring (March-May) period, ranking the contiguous U.S. 29th warmest overall. The warmer-than-average temperatures that were seen in the South and Southwest regions during the winter shifted to the West and Southwest regions during the spring.

Based on NCDC's ranking methods, the contiguous U.S. experienced a summer (June-August) that ranked 42nd coolest since 1895. A recurring upper level trough in the Central U.S. filtered in Canadian air that created below-normal temperatures throughout the Central and northern Plains, Midwest and Great Lakes areas. The cool anomalies peaked in July, when six states (Ohio, Indiana, Illinois, Iowa, Pennsylvania, and West Virginia) experienced record cool temperatures for the month. This sharp cool feature was partially balanced by warmth in the South and West. For the summer period, the temperature averages in Florida, Texas, and Washington were much above normal. It is noteworthy that an El Niño emerged during early summer 2009. Preliminary attribution exercises performed by NOAA scientist indicated that cooler-than-normal temperatures in the central U.S. during summer and early autumn are not inconsistent with expectations during a developing El Niño episode.

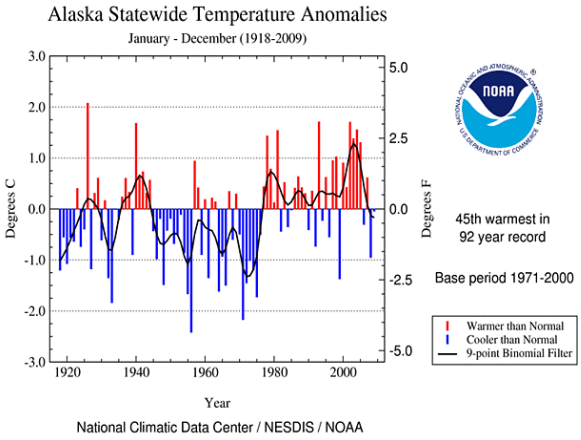


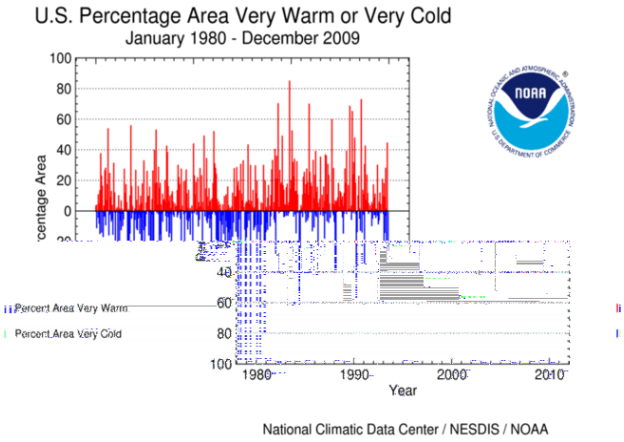
Fall 2009 was a season of extremes for the contiguous United States. While September was about 1 degree F (0.6 degrees C) above the long-term mean (LTM), October was marked by an active weather pattern that reinforced unseasonably cool air behind a series of cold fronts, creating an average temperature that was 4 degrees F (2.2 degrees C) below the LTM and ranked the nation as the 3rd coolest, based on preliminary data. In October, 42 of the lower 48 states averaged temperatures that



were below-normal. Florida was the only state with an above-normal temperature for October. The following month was something of a mirror image, becoming the 3rd warmest November on record, 4 degrees F (2.2 degrees C) above the LTM. Overall, the nationally-averaged temperature for the three month autumn period was above-normal, as the 31st warmest on record.

Annual averaged temperature for Alaska during 2009 was near the long-term mean. Winter temperatures in 2008-2009 were 1.9 degrees F (1.1 degrees C) below average. Spring temperatures were 0.7 degrees F (0.4 degrees C) below average, summer was 0.7 degrees F (0.4 degrees C) above average, and fall was 1.4 degrees F (0.8 degrees C) warmer than the 1971-2000 average. The Alaska data in this report is a composite of several preliminary datasets at NCDC.



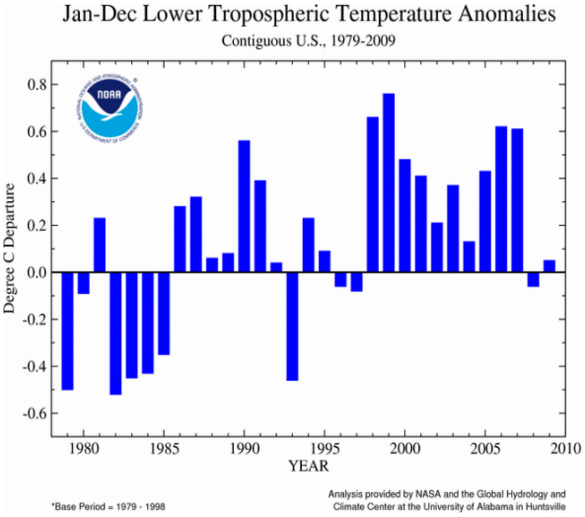


One way to assess the magnitude of warm and cold episodes is to compute the percent area of the contiguous United States that was "very warm" and that which was "very cold". A figure that depicts these values for each month in the past 30 years is provided to the left. These percentages are computed based on the climate division data set. Those climate divisions having a monthly average temperature in the top ten percent (> 90th percentile) of their historical distribution are considered "very warm" and those in the bottom ten percent (< 10th percentile) are "very cold".

The U.S. experienced several warm and cold outbreaks during 2009. The first occurred in July, when 39 percent of the contiguous U.S. was "very cold". An abnormally strong and persistent upper-level pattern during the month helped produce a large number of record low temperatures east of the Rockies. In October, an active weather pattern reinforced unseasonably cool air behind a series of cold fronts. As much as 54 percent of the contiguous U.S. was "very cold". November was on the other end of the scale, when 45 percent of the U.S. was "very warm", according to the definitions provided above. The huge swings in variability continued in December when 36 percent of the contiguous U.S. experienced "very cold" temperatures. According to the National Snow and Ice Data Center, these cooler-than-normal temperature anomalies resulted from a strong negative

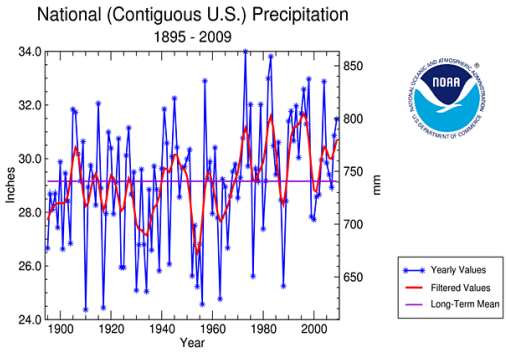
phase of the Arctic Oscillation (AO), the strongest negative phase of the AO since 1950. A negative phase AO is often associated with a warm Arctic region and cooler conditions in the mid-latitudes of the Northern Hemisphere.

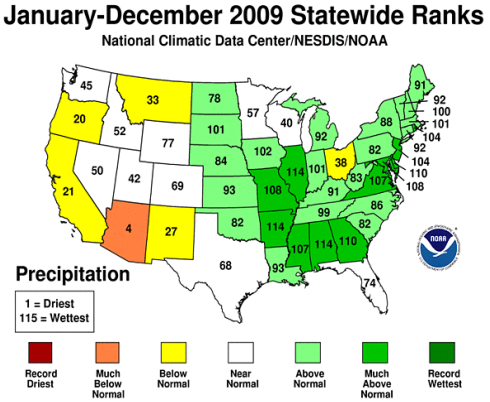
Based on data through December, above-average temperatures were measured in the lower troposphere during 2009. Data collected by NOAA's TIROS-N polar-orbiting satellites and adjusted for time-dependent biases by NASA and the Global Hydrology and Climate Center at the University of Alabama in Huntsville indicate that temperatures in the lower half of the troposphere (lowest 8 km of the atmosphere) over the U.S. were slightly warmer than the 20-year (1979-1998) average.

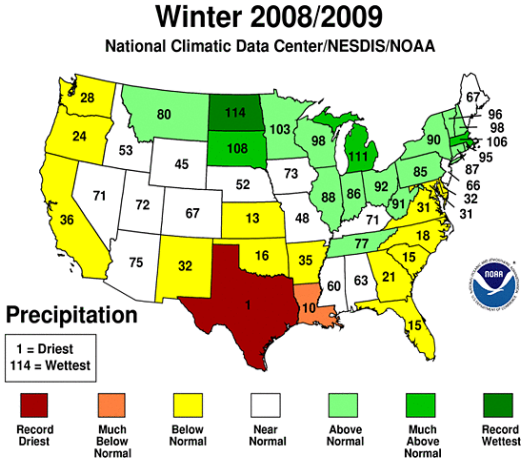


National Precipitation

Based on data from January through December, the average annual precipitation for the contiguous U.S. was 2.33 inches above the long-term average with a final annual amount of 31.47 inches. It was the 18th wettest in 115-years of record keeping.

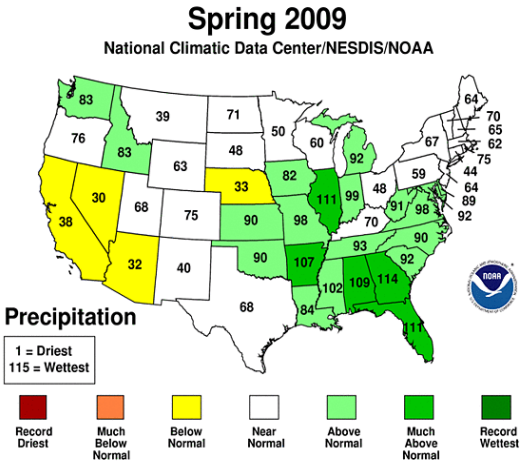




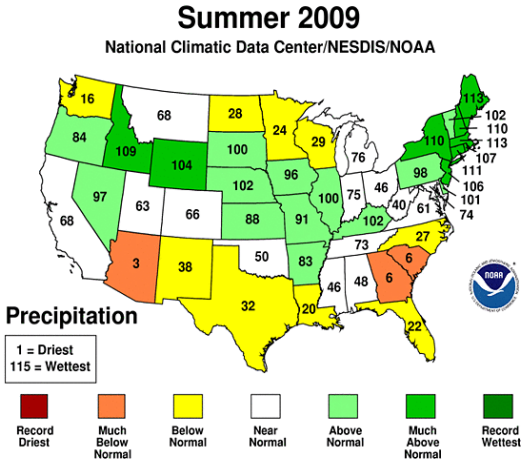


Nationally, this was the 22nd driest winter (December-February) in the 1895-2009 record. Texas recorded its driest winter on record, while the state of North Dakota experienced its wettest winter on record. The contrast in rankings were the result of an active upper level pattern that shuttled systems rapidly across the northern tier states, while bypassing the deeper south. Some locations in North Dakota received more than 400 percent of their normal precipitation, breaking snowfall records

not only for the month of December, but for any single month. Meanwhile, the persistent dry pattern in Texas led to further expansion of drought conditions.

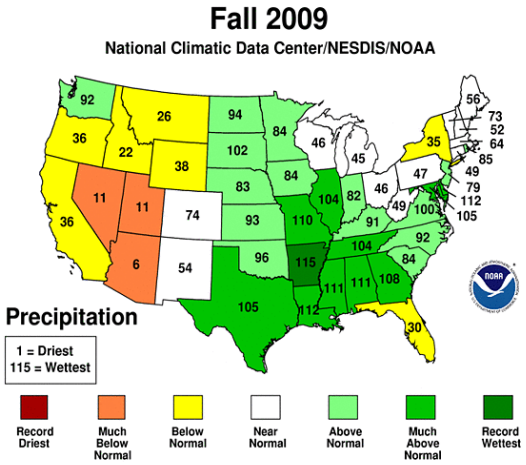


It was the 18th wettest spring for the contiguous U.S. in 2009. Stagnant surface storm systems and surface fronts across the southern U.S. led to the above normal precipitation averages across the southeastern half of the United States and much-above-normal precipitation in the Southeast Climate Region in particular. Georgia experienced its second wettest such period. Several other states experienced a spring period that saw above average precipitation: Florida (5th wettest), Illinois (5th), Alabama (7th), and Arkansas (9th). The spring season was characterized by several extreme climatic events. In March, record breaking flooding occurred in parts of Minnesota and North Dakota along the Red River. The flooding was preconditioned by copious winter precipitation coupled with persistent precipitation-producing storms in the spring. Record-high flows were recorded along the Red River with peak levels exceeding the 500-year return interval. In late March, a blizzard in the Southern Plains was responsible for three new state record 24-hour snowfall values in Texas, Oklahoma, and Kansas. During the same time, drought in southern Texas was at its peak. Much of the state was suffering from the lack of precipitation which led to 85 percent of Texas experiencing moderate-to-exceptional drought conditions during March and April.

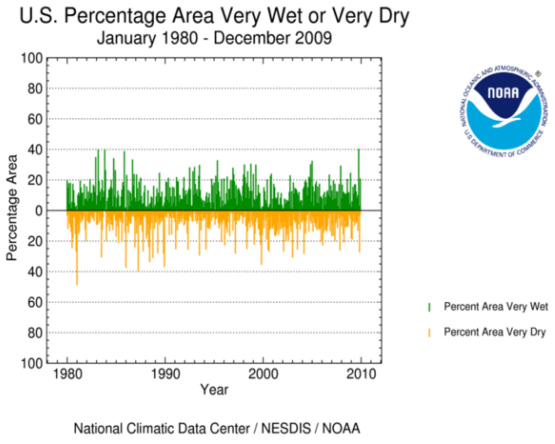


Summer (June-August) precipitation was variable in 2009, which is typical for the season, but overall near normal, ranking 54th wettest out of 115-years worth of records. Regionally, the Northeast had its 2nd wettest summer ever, continuing a string of abnormally wet summer periods. Both the Southeast and Southwest were below normal. On the state level, the lack of monsoonal rains in the Southwest contributed to Arizona's 3rd driest summer. Precipitation averages in Georgia and South Carolina were also much below normal. Conversely, both Maine and Massachusetts experienced their 3rd wettest summer period.

It was the 13th wettest autumn on record for the contiguous United States. Regionally, dry conditions continued in the West and Southwest where Arizona, Utah, and Nevada averaged much-below-normal precipitation for the three-month (Sep-Nov) period. This contrasted with the South, Southeast, and Central regions where precipitation averages were above normal to much above normal. Anomalously wet conditions in October led to a record wet month for the nation as a whole. The nationwide precipitation of 4.15 inches was nearly double the long-term average of 2.11 inches. Persistent precipitation during September and October made Arkansas' autumn precipitation its greatest ever. This punctuated the state's remarkable run of wetness in 2009, with four months of top three precipitation ranks (May, 1st wettest; July, 3rd wettest; September, 2nd wettest; October, 1st wettest). Ten other states were much above normal in terms of precipitation for the autumn season. Interestingly, these high precipitation anomalies occurred despite only two tropical cyclones (Tropical Storms Claudette in August and Ida in November) making landfall during the Atlantic Hurricane season. Variable climatic extremes continued in the fall when, in November, the nationally-averaged precipitation ranked 18th driest, continuing the run of below-normal November precipitation in the contiguous United States.



Like similar values for temperature extremes (see above), the percent area of the contiguous United States considered "very wet" and "very dry" is based upon tenth percentile placement (i.e., those areas with the wettest or driest ten percent of precipitation for a period). The size of the footprint of "very wet" and "very dry" conditions during each month in the last 30 years is depicted in the adjacent figure. These percentages are computed based on the climate division data set.

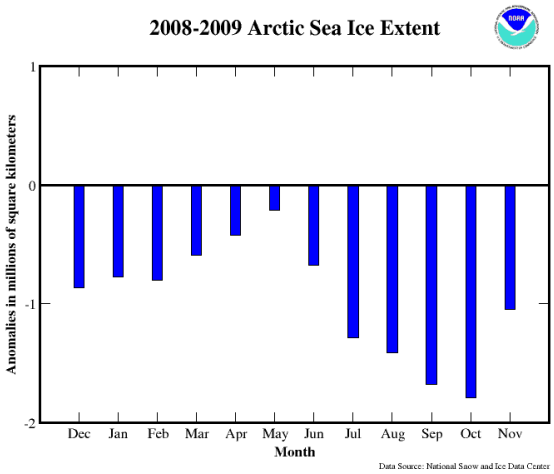


During 2009, there were back-to-back months that had precipitation extremes of more than 25 percent. The first was October, as 40 percent of the U.S. was very wet. During October, substantial precipitation, nearly double the long-term average, created record wet conditions in contiguous divisions throughout the South and Midwest states. Iowa, Arkansas, and Louisiana all experienced their record wettest October. Fourteen other states had precipitation readings ranking in their top five. On the other hand, 27 percent of the country was categorized as very dry in November. The upper level jet stream was

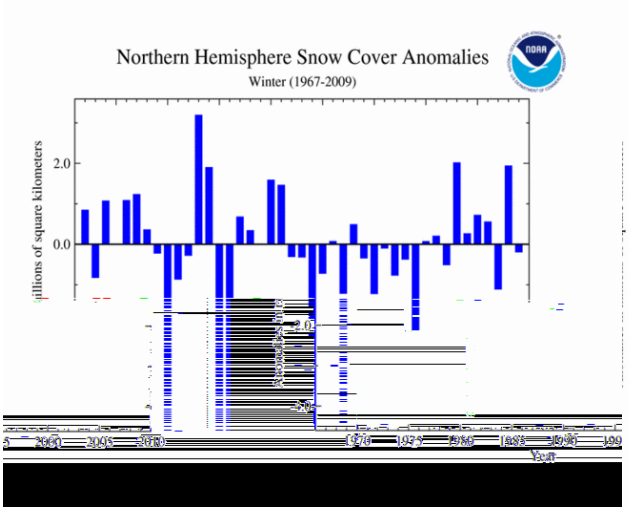
confined to the higher latitudes of North America, holding at bay major weather systems. Meanwhile, high pressure systems, which typically deliver very little precipitation, dominated much of the Western U.S. and Gulf states.

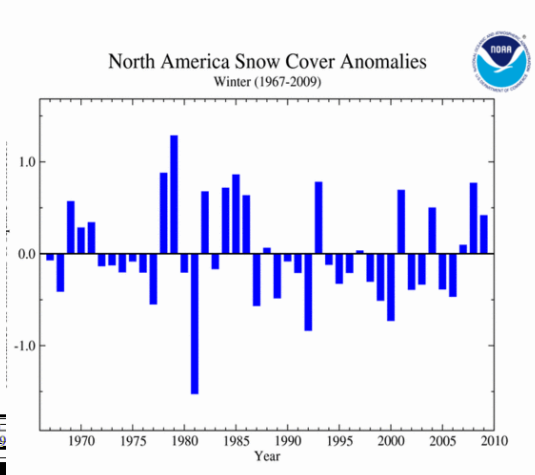
Snow and Ice

The Arctic sea ice reached its annual maximum extent on February 28, 2009, at 15.14 million square kilometers (5.85 million square miles). This is 720,000 square kilometers (278,000 square miles) below the 1979-2000 average of 15.86 million square kilometers (6.12 million square miles), marking the fifth-lowest maximum extent in the satellite record. The six lowest maximum extents have all occurred in the last six years (Source: National Snow and Ice Data Center). The Arctic sea ice reached its annual minimum extent on September 12, 2009, at 5.10 million square kilometers (1.97 millions square miles). This marks the third-lowest recorded extent since 1979, larger than the minimum extents of September 2007 and 2008. The 2009 minimum extent is 1.61 million square kilometers (620,000 square miles) below the 1979-2000 average minimum. The sea ice began its annual growth in autumn, but at a slower rate compared to previous years. For the first weeks of November, the sea ice extent dropped below the 2007 record low extent, setting a new record for the month. However, by month's end the sea ice had grown above 2007 levels.



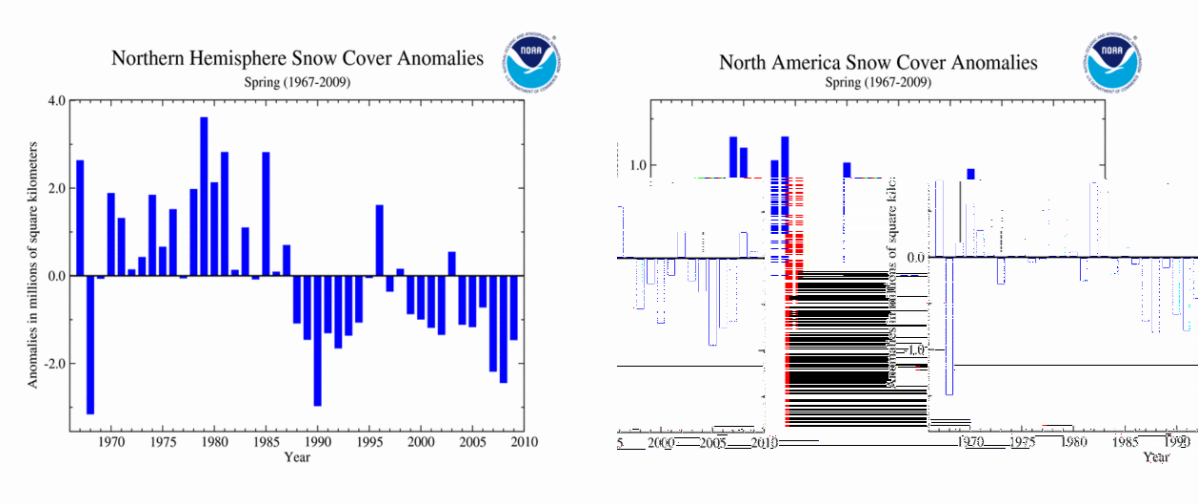
For the 2008-09 winter (Dec-Feb) the Northern Hemisphere experienced slightly below average snow cover, and had the 20th lowest snow cover extent on record. The 43-year mean Northern Hemisphere winter snow cover extent for the 1967-2009 period of record is 45.5 million square kilometers (17.6 million square miles).





Across North America, snow cover for the 2008-09 winter was above average, with the 12th largest extent since satellite records began in 1967. The 43-year mean North America winter snow cover extent is 17.1 million square kilometers for the 1967-2009 period of record. A series of large snow and ice storms struck the U.S. during the winter months. The 2008-09 snow season brought numerous daily, monthly, and seasonal snowfall records across the contiguous United States.

Snow cover extent during spring 2009 was the sixth-lowest spring snow cover extent on record. The 43-year average Northern Hemisphere spring snow cover extent for the 1967-2009 period of record is 30.8 million square kilometers (11.9 million square miles).



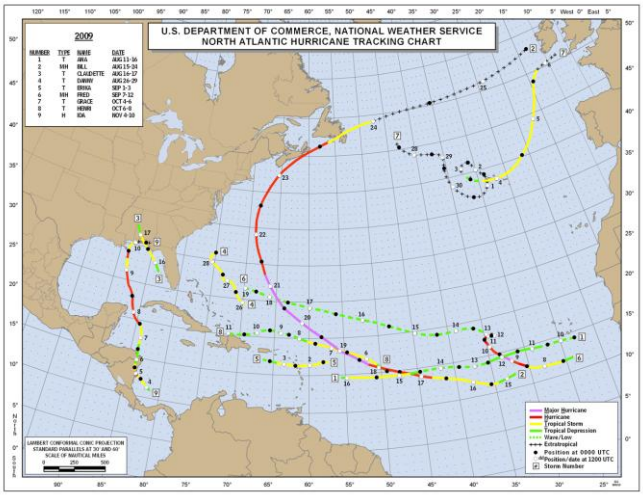
Across North America, snow cover for spring 2009 was the 17th largest extent since satellite records began in 1967. The average North America spring snow cover extent is 12.9 million square kilometers (5.0 millions square miles) for the 43-year period of record.

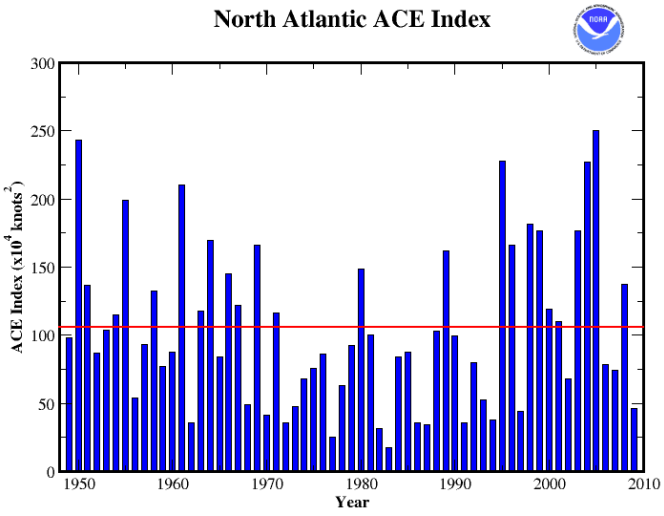
In 2009, the contiguous U.S. experienced nearly the same amount of snowfall for the month of October as the month of November. October 2009 ranked as the snowiest such period for the contiguous U.S. with 538,000 square kilometers (207,720 square miles) of snow cover extent, 385,000 square kilometers (148,650 square miles) above the long-term mean. The U.S. in November observed 585,000 square kilometers (225,870 square miles) of snow cover extent, 512,000 square kilometers (197,680 square miles) below the long-term mean. November 2009 ranked as the 6th smallest snow extent since the satellite record began in 1965. Cool temperatures in October and warm temperatures in November contributed to the snow cover extent anomalies across the contiguous United States.

(Analysis provided by the Global Snow Laboratory, Rutgers University.)

Hurricanes and Tropical Storms

The 2009 North Atlantic hurricane season had nine named storms, three hurricanes, and two major hurricanes. This is the fewest number of hurricanes for a North Atlantic season since 1997. An average season has 11 named storms, six hurricanes, and two major hurricanes. Only two tropical storms and no hurricanes made landfall in the U.S. for the season. This is only the 13th time that no hurricanes have struck the U.S. during a hurricane season (June-November) since 1943.

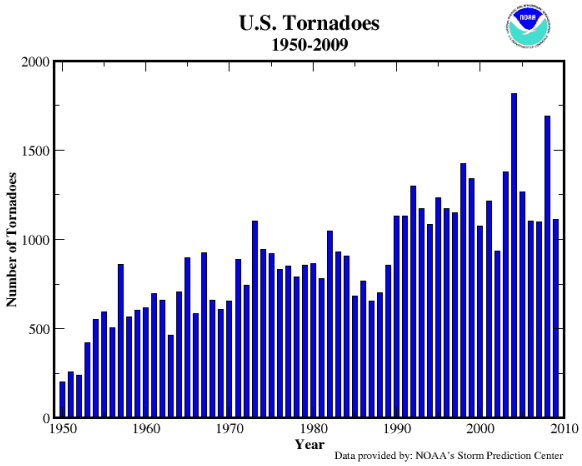




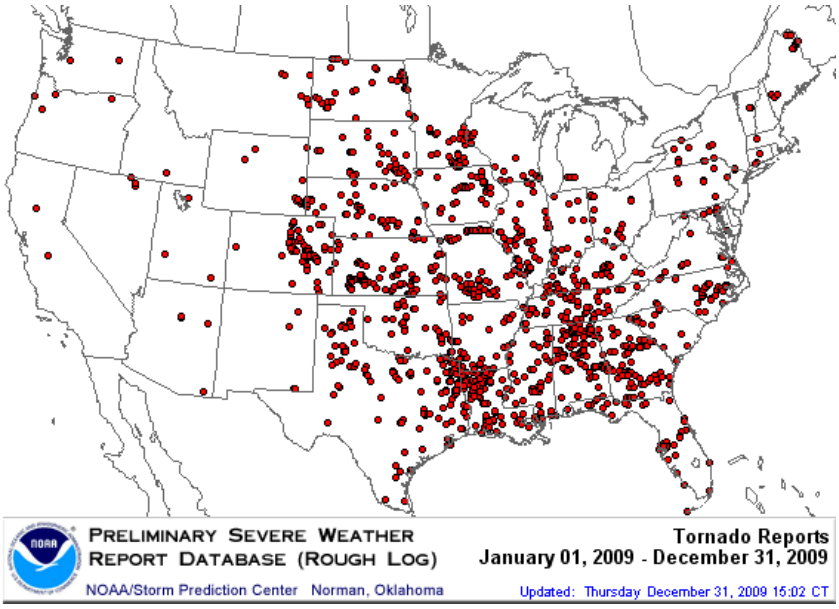
The ACE index of hurricane activity also indicated a below-average season, with a preliminary value of approximately 46×10^4 knots^2. The 1949-2008 ACE average is 106×10^4 knots^2, with 2009 having the 12th lowest ACE since 1949. The below-average conditions are attributable to higher than average wind shear and lower than average relative humidity in the middle atmosphere suppressing tropical cyclone development across the basin. These conditions are expected during an El Niño, similar to the one that developed over the course of the 2009 hurricane season. Of the 11 seasons with a lower ACE index, nine occurred during El Niño events.

Tornadoes

The 2009 tornado count at the end of December was 1,156. June was the most active month of the year with 268 confirmed tornado reports. This ranks 2009 as the 9th quietest month since 1990 and the 5th quietest month this decade. The only months to experience more tornadoes than the past 3-year average was April, June, July, and December.



The highest concentrations of tornado reports were clustered in the Southeast and into the Midwest. The Plains States and "Tornado-Alley" had a relatively calm tornado year relative to their historical records. 2009 was the busiest year of the decade for Louisiana and Alabama in terms of the number of tornadoes, with 82 and 103 tornadoes, respectively. Conversely, Texas and Kansas had their second calmest year of the decade with 108 and 87, tornadoes respectively. According to the SPC, November 2009 had only 4 preliminary tornado reports marking the calmest November since 1980, and the 3rd quietest (tied: 1950, 1962, 1969) since extensive records began in 1950. November, in the past, has been a fairly active month for parts of the southeastern United States.



Natural Resources Conservation Service

National Water and Climate Center
1201 NE Lloyd Blvd, Suite 802
Portland, OR 97232
http://www.wcc.nrcs.usda.gov

National Water and Climate Center Overview

The National Water and Climate Center (NWCC) is part of the Natural Resources Conservation Service within the United States Department of Agriculture. The Center's mission (http://www.wcc.nrcs.usda.gov/about/nwcc-function.html) is to "*lead the development and transfer of water and climate information and technology that support natural resource conservation*." The primary goal of the NWCC is to be "*a globally recognized source for a quality snow, water, and climate information and technology*."

Staffing

The NWCC consists of three branches under the Center's Director, Mike Strobel; Mary Greene, Water and Climate Services (WCS), Garry Schaefer, Water and Climate Monitoring (WCM) and Laurel Grimsted, Information Systems Branch (ISB). Water and Climate Services has two main functions: produce water supply forecasts for the western U.S. and provide climate services for the NRCS and other cooperating USDA agencies nationwide. The key climate staff members of this Center are:

- Jan Curtis, Applied Climatologist, jan.curtis@por.usda.gov, 503-414-3017
- Jim Marron, Resource Conservationist, jim.marron@por.usda.gov, 503-414-3047

Hydro-Meteorological Networks

- SNOTEL: About - http://www.wcc.nrcs.usda.gov/snow/about.html, Sensors, Data, and Products - http://www.wcc.nrcs.usda.gov/snow/, http://www.wcc.nrcs.usda.gov/reports/SelectUpdateReport.html (new: Update Report Generator), http://www.wcc.nrcs.usda.gov/nwcc/inventory (new: Station Data Inventory)
- Snow Course: http://www.wcc.nrcs.usda.gov/snowcourse/
- SCAN: http://www.wcc.nrcs.usda.gov/scan/

Climate Products

- Soil Narratives and Tables: http://www.wcc.nrcs.usda.gov/cgibin/soil-nar.pl, http://www.wcc.nrcs.usda.gov/climate/climate-map.html
- Wind Rose Graphs: ftp://ftp.wcc.nrcs.usda.gov/downloads/climate/windrose
- Adjusted Daily Wind Database: ftp://ftp.wcc.nrcs.usda.gov/downloads/climate/windrose
- PRISM (Spatial Climate): http://www.wcc.nrcs.usda.gov/climate/prism.html

Western Water Supply Forecasts

- Monthly, between January and June, this Center produces reports, maps, and graphs, with explanations on how to interpret these products at: http://www.wcc.nrcs.usda.gov/wsf/wsf.html.
- Experimental daily water supply products have been developed for water resources managers: http://www.wcc.nrcs.usda.gov/wsf/daily_forecasts.html.

Other Projects

QC of SNOTEL Data Completed

These datasets can be access via the SNOTEL QC data server: http://gisdev.nacse.org/prism/snotelqc/

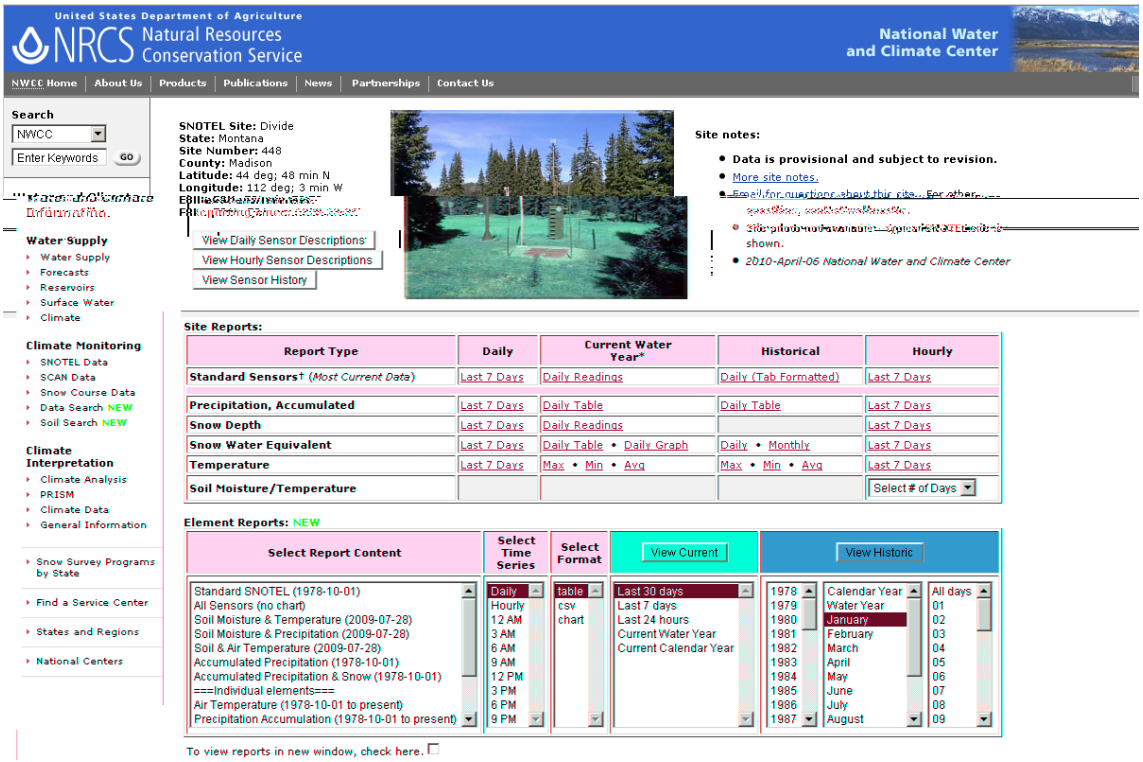
Seamless Daily PRISM Maps

The final set of daily US climate maps at a 4 km x 4km resolution for Tmax, Tmin, and Precip from 1960-2001 have been completed and can be acquired by contacting Jan Curtis above. These data are in GIS format. The related seamless COOP dataset by state is available at: http://avenger.wrds.uwyo.edu/Seamless-Coop/

New Maps of SNOTEL Data

NWCC continues to add to its GIS-based products. The maps are available from - http://www.wcc.nrcs.usda.gov/gis/index.html.

Here is an example of the new SNOTEL Element Reports webpage: http://www.wcc.nrcs.usda.gov/nwcc/site?sitenum=448



High Plains Regional Climate Center

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http://hprcc.unl.edu

Martha D. Shulski, Director

The High Plains Regional Climate Center (HPRCC) was established in 1987 and represents one of the six federally-funded Regional Climate Centers in the United States, operating within a three-tiered system of climate services (state, regional, national). HPRCC encompasses a six-state area of North Dakota, South Dakota, Nebraska, Kansas, Colorado, and Wyoming. The Center is part of the School of Natural Resources at the University of Nebraska-Lincoln. The mission of the Center is to increase the use and availability of climate data with long-term objectives to 1) provide climate services in the High Plains region, 2) develop improved climate information products, and 3) carry out applied climate studies. The Center serves clientele across a broad spectrum, however, agriculture is the dominant economic influence in the region and many products and services are tailored to this sector. HPRCC personnel work closely with scientists from other regional and federal climate centers on services and programs to *provide a regional structure for climate applications*.

Climate Services and Products

Representatives from a variety of sectors have contacted the HPRCC to seek expert advice on the data available and how it can be summarized. Over the past year, the center has received more than 800 direct customer contacts. These contacts include applications such as engineering, legal, insurance, education, transportation, agricultural and other decision-makers. Repeat users have found the self-service interfaces, such as CLIMOD (Climate Information for Management and Operational Decisions) very helpful. Key service activities include:

- a collection of a *quality set of near-real time data* for decision making situations, available 5-6 months before the official federal data
- development of a *framework for climate data distribution and management (ACIS)*, in conjunction with other Regional Climate Center staff
- maintenance of web-based sites and interfaces for *user-defined climate information requests* relevant to recent and historical climate data (> 450,000 web hits per year)
- generation of *graphical climate monitoring products* at the local, regional, and national level (38 updated daily, 14 updated monthly and seasonally)

- development of software specific to *evaluating the risks associated with climate events* (freeze, drought, and extremes of cold, heat, precipitation).

Regional Mesonet

The HPRCC maintains a network of more than 200 weather stations in the region through the Automated Weather Data Network (AWDN). Data from this network have been the *basis for real-time decisions* in various sectors like agriculture and water management. Figure 1 illustrates a routine product based on AWDN data. In agriculture, decisions on planting, fertilizing, disease treatment, irrigation, insect scouting and harvesting are supported by this information. In water management, the data have been used for management of urban runoff control during extreme rainfall events. Within the boundaries of the HPRCC lies 70% of the irrigated corn acreage in the nation. When using a scientific approach to the decision of whether or not to irrigate, the benefit to cost ratio based on saving on irrigation is estimated at 195/1. Most recently, HPRCC staff has teamed up with agronomists to design a web tool for water management of soybean fields (http://www.hprcc3.unl.edu/soywater). The tool is based on automated weather data from the HPRCC network and crop models to let producers know when it is time to irrigate.

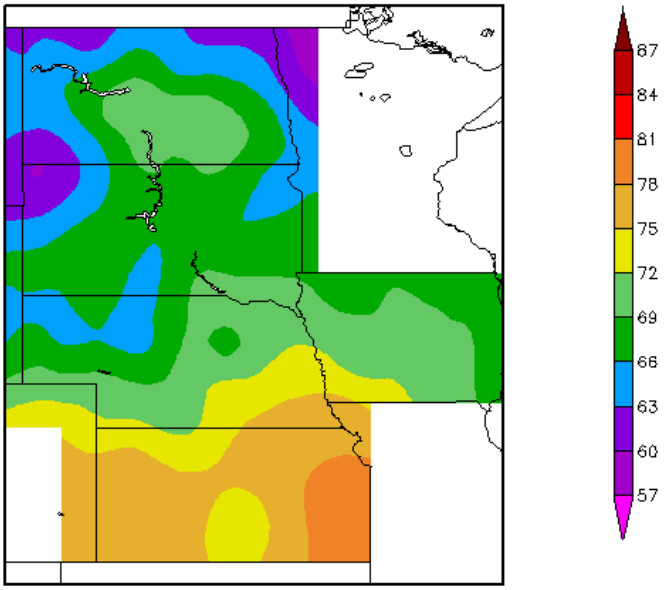

Figure 1: Soil temperature (°F) at 4 inches (10 cm) depth for June 9, 2010. Maps are also available for a one-week time interval.

Applied Climate Research

Staff at HPRCC have produced more than 40 peer-reviewed journal articles in the last five years. Advancements in data quality control and automated sensor performance have led to national standards being set in this area. The identification of climatic trends is critical to understanding climate change and variability and these have been examined regionally and nationally. A soil moisture index (SMI) to help monitor local drought conditions in Nebraska has been developed using data from the HPRCC weather data network. An SMI map and short discussion is produced weekly to inform clients of potential drought or flooding issues. Many other research activities have resulted in an *enhanced understanding of various climate processes* as well as *improved decision-making tools*.

Education and Outreach

HPRCC is actively engaged in various types of education and outreach activities across

the region. These range from assisting local girl scouts earn weather badges by teaching about weather instruments, maps and games, participating in tribal climate change and impacts workshops, and hosting National Weather Service employees in a day-long workshop about our Center and the products and services we offer. Clientele from a wide range of *sectors continue to be served with their climate education and outreach needs* by HPRCC staff.

Midwestern Regional Climate Center

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Steve Hilberg, Director

Becky Obrecht was hired as Assistant Climatologist beginning in December 2009. She is working as one of our Service Climatologists and is also working on the Climate Data Modernization Program (CDMP). Zoe Zadoulek, a GIS specialist, is working part-time at the MRCC developing GIS-based maps. The remainder of her time at the ISWS is spent working on the Map Modernization Program, a program to develop fully digital floodplain maps nationwide, funded by FEMA.

Data, Data Systems, and Data Management

On December 10, 2009, the MRCC's online data system, the **Mi**dwestern **C**limate **I**nformation **S**ystem (MICIS), was decommissioned and was replaced by the **M**RCC **A**pplied **C**limate **S**ystem, or MACS. MACS is an ACIS-based client that duplicates many of the products from MICIS, but access the data from ACIS. The changeover was accomplished without any major problems, thanks to the hard work and dedication of the MRCC staff. Customer feedback has been very positive, and work continues to refine existing products and add new products to the system.

This year the CDMP Forts Project has been concentrating on the quality control of the daily data from the early keyed stations that contain the longest and more complete data, as well as keeping up with the newly keyed daily data. To date, we have completed the quality control on more than 160 stations across the contiguous United States and Alaska. These data are available in the 3200 format on a secure FTP site. They are also available in a more compacted form containing only the date, and various types of temperature, precipitation, and snow observations.

To obtain the data contact Nancy Westcott (nan@illinois.edu) or Leslie Stoecker (lensor@illinois.edu). For more information the CDMP data set, the quality control processing steps, and for station histories of more than 70 sites, see the web page at http://mrcc.isws.illinois.edu/research/cdmp/cdmp.html.

Climate Services and Collaborations

At the request of the NRCC, the MRCC produced maps of degree days in the Midwest for the monitoring of Emerald Ash Borer by entomologists at Cornell and the State of New York. The NRCC is providing higher resolution data for New York, and the MRCC maps are used to provide a general picture of what is happening "upstream"

At the request of a local NWS office, the MRCC created and made available a First Fall Freeze map on the Midwest Climate Watch page in September 2009. This map shows the locations where 32°F and 28°F have been recorded in the Midwest so far in the season. There was considerable attention on the potential for an early freeze last year as in some areas the corn crop is 4 weeks behind schedule and the soybean crop one to two weeks behind. In response to a follow-up request from NWS Central Region we added the High Plains states to the map (in consultation with the HPRCC). The First Fall Freeze map was receiving more than 2000 views a day in the first two weeks of operation.

The MRCC continues to cooperate with the NWS on a variety of issues. The MRCC hosted a Regional Climate Services workshop September 8-10, 2009 in Champaign. This workshop was held by the NOAA Central Regional Collaboration Team and included staff from NOAA (NWS, CPC, NCDC, CPO), Illinois-Indiana Sea Grant, USDA-CSREES (Extension Services), academia, state climate offices, and the Regional Climate Centers. The purpose of the workshop was to understand the climate information priorities within the agricultural community so NOAA can determine where effort and support should go to address the gaps.

MRCC Director Steve Hilberg is participating on the Design Team for the NOAA National Climate Portal, and is serving as RCC representative to the NOAA Great Lakes Regional Collaboration Team. Steve is also chair of the Data QC subcommittee of Technical Committee WERA 2012, Managing and Utilizing Precipitation Observations from Volunteer Networks, sponsored by the Western Association of Agricultural Experiment Station Directors.

Applied Research

Nancy Westcott continued her work on high-resolution precipitation gauge networks, and evaluation of radar/rain gauge blend products and their use in river forecasting. Nancy Westcott and Steve Hilberg are continuing to work on research into the climate related development of mosquitoes in relation to the West Nile Virus predictive models developed by Ken Kunkel.

Southeast Regional Climate Center

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Tel: 919-843-9721
http://www.sercc.com/

Charles E. Konrad II, Interim Director

The service mission of the Southeast Regional Climate Center (SERCC) continued unchanged throughout 2009. Continuous minor improvements were made to the response system for individual enquiries and to the range of information available on the Center's web page (http://www.sercc.com). Center personnel participated in several user-oriented meetings and workshops, which pointed the way to some web developments either already implemented or under consideration. Four of these are highlighted in the summary report.

The first was the annual meeting of the Technical Advisory Committee of the Center. This Committee consists of the State Climatologists in the region and, currently, representatives of the National Climatic Data Center (NCDC) and of the National Weather Service (NWS). The meeting was held in the spring at the University of Virginia in Charlottesville VA, hosted by Jerry Stenger, Director of the State Office of Climatology. The venue, the Rotunda located in the center of Mr. Jefferson's University, ensured stimulating discussion, mutual cooperation and considerable progress. Discussion were wide ranging, from ideas for acquainting and involving our political leaders with climate services to technical discussions of merging local data sets with the regional database. One major area was an assessment of communications between the State Climatology Offices and the Regional Center. Several strategies for avoiding duplication and fostering cooperation were discussed. As a result a monthly teleconference, with the option of a full webinar, was initiated. NCDC fostered and supported this. This has proved very fruitful in stimulating the smoother operation of the three-tiered climate service within the region. One ongoing activity is the development by SERCC of a set of web-based tools to provide "climate perspectives" placing the current weather and climate conditions into the context of the longer-term climatology of the region. Several iterations of tool development have occurred, each prototype being thoroughly dissected at one of the monthly teleconferences. A robust, useful and interesting product is anticipated to be launched in 2010.

Further collaboration between the State Climatologists and the Regional Center occurred as a result of the AASC-led grants program, in this case for rapid monthly state-of-the-climate reporting from the states, to be synthesized by the regional center and transmitted to NCDC for national distribution. In the southeast several states joined in a combined and successful proposal to AASC, and the other states participated using funds provided

locally. The monthly conference calls proved invaluable in discussing not only what had gone on climatologically in the previous month, but also what was of national interest and importance. The discussions also helped increase awareness of the importance of indicating the economic or social context of the recent climate. This is an ongoing process, both for the reporting itself and for learning what is significant to report.

One well-known link between climate anomalies and their impacts involves drought. SERCC hosted a working-level meeting of the National Integrated Drought Information System (NIDIS) to set priorities for a range of investigations in the southeast. NIDIS-sponsored activity is already underway in drainage basins involving Alabama, Florida and Georgia. The discussion centered on the identification of a basin in the Carolinas which had a complementary set of drought-related problems. Work is due to start in 2010.

Since SERCC moved to North Carolina in 2007 it has been increasingly involved in activities linking climate and human health. In 2009 SERCC sponsored a relatively small, high-level workshop designed to identify research needs and opportunities in areas where climate services could be especially beneficial. Sponsoring agencies included the US Environmental Protection Agency, the Centers for Disease Control and Prevention, the National Center for Environmental Health Statistics, and the National Oceanic and Atmospheric Administration/NCDC. Participants from the sponsoring agencies interacted with professional climatologists from the region and with health professionals from around the nation. A research agenda was informally developed, and is currently being formalized. An extended report, highlighting the agenda, is being prepared for publication in the *Bulletin of the American Meteorological Society*.

Alabama Office of the State Climatologist (AOSC)

University of Alabama in Huntsville
Cramer Hall, Room 4040
320 Sparkman Drive
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http://vortex.nsstc.uah.edu/aosc

John Christy, Alabama State Climatologist
Bob Clymer, Assistant State Climatologist

It is the role of the Alabama Office of the State Climatologist to provide weather and climate information to public and private interests to improve decision-making activities that affect environmental quality and the economic efficiency of the state. Activities include providing specific weather data for the state and for the world, developing plans to mitigate the economic impacts of weather and climate variability and providing consultation on the use, interpretation and availability of weather and climate information. The Alabama Office of the State Climatologist also directly engages in important societal debates such as global warming through workshops, congressional testimony and educational activities.

2009 Conditions wetter and cooler

The drought of record for several locations in north and central Alabama in 2007 (with some dryness extending into 2008) succumbed to the second wettest statewide total on record, 74.76". The final four months of the year were easily the wettest such period. Thus water resources recovered completely from 2007. Providing this type of information to several stakeholders was mostly good news. However, the AOSC worked with the State Emergency Management Authority to propose for stimulus funding for road repair. The excessive rains of 2009 followed by severe cold in early January 2010 caused so much damage to rural roadways that many emergency routes had become hazardous and needed repair. In terms of temperature, the summer was cooler than average, which led to abundant harvests for most crops except corn which was burned by a 3-week hot/dry spell in the critical month of June. However, other crops fared no better in the end as the very wet Sep-Dec period, noted above, caused crops to spoil and/or prevented harvesting.

Historical Climate Network upgrades

The AOSC continued to work with the NWS and NCDC to establish a robust climate monitoring network in Alabama. All but one of the 15 HCN stations are now HCNM, being modernized to the CRN-lite status.

CoCoRaHS

On 1 November 2007, Alabama became an official member of the CoCoRaHS network. As of 12 March 2009 there were 670 stations registered and as of 21 April 2010 there were 742. The AOSC is the state coordinator with each NWS WFO serving as Regional

Coordinators for their appropriate counties. Again, the cooperation with the NWS WFO's and Southern Region HQ has been superb in promoting this very public service activity. A few media stories still appear in which we ask for volunteers. During the year, one CoCoRaHS member reported a 24-hour total of 10.44", highest in the state. Of great interest too are the snow reports which are much more dense than the NWS network and we nearly always are able to find stations with reports greater than the sparse NWS network.

NIDIS

The AOSC is participating in the early-drought warning pilot program established by NIDIS for the Apalachicola, Chattahoochee, and Flint River basins. We met three times in 2009 and had several conference calls. The thrust of this effort is to bring all stakeholders together and provide a system by which early warnings for droughts can be developed.

AWEP Program

With efforts from the AOSC and the Alabama Universities Irrigation Initiative, the USDA budgeted over $60M for farmers to develop better water resources. In Alabama, over 20 projects were funded, mostly to build irrigation ponds. The AOSC was involved in pond sizing based on climatological rainfall estimates.

Economic Development

The AOSC was again contacted by several industries wanting climate information necessary to make decisions about locating in Alabama and what their facilities might expect from various weather events. The AOSC continues to be heavily involved in the agricultural community by assessing water resources and the potential for irrigation expansion. The AOSC is involved at the state and federal level on water policy formulation.

Various economic interests contacted the AOSC in 2009 for information and speaking engagements related to climate change legislation. Because Alabama is a manufacturing and industrial state, the prospect of paying higher prices for energy (fuel, electricity, etc.) has caused considerable concern among those who have established our economic base. Alabama is one of the few states which produces more electricity than it consumes, exporting over 45 million MWt-hrs (30%) out of state. This "product" is in jeopardy if rates are forced to rise. As a result of research on climate-change issues and impacts of legislation, the AOSC was able to provide hard metrics for business and congressional leaders, including congressional testimony, for the development of policy.

Alaska Climate Research Center

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http://akclimate.org

Gerd Wendler, Director and Professor Emeritus
Heather Angeloff, Research and Service Climatologist
Blake Moore, Systems Analyst
Nick Toye, Student Assistant

The Alaska Climate Research Center is a service and research organization at the Geophysical Institute of the University of Alaska Fairbanks. Its primary mission is to respond to inquiries regarding the meteorology and climatology of Alaska at the request of public, private, and government organizations as well as researchers within Alaska and across the globe. Recently, the number of requests from the media has increased with greater coverage on recent temperature trends in Alaska. We are ideally located, with access to resources from the Geophysical Institute, the International Arctic Research Center, and the National Weather Service.

The Center maintains and operates a web site, which receives an average hit rate greater than 35,000 per day. The site features climate summary statistics, information regarding the observing network in Alaska, regional climate summaries updated monthly, links to weather and climate resources, information regarding past and present research, and a section for the many tourists that visit our state. Also online, users can see a display of current weather conditions updated every 5 minutes from a station maintained and operated by the center. In addition to a basic weather station, center maintains and operates a suite of radiation instrumentation and observations include incoming shortwave, longwave, and ultraviolet radiation.

The center keeps an active climate information page featured on the website that gives summary statistics updated monthly for the different climate regions of Alaska. Summary graphics and narratives are also printed in newspapers around the state. In cooperation with the National Weather Service Fairbanks Forecast Office, the center creates a statewide summary that appears in Weatherwise magazine.

Besides service responsibilities, the center also conducts research on a number of high latitude meteorological and climatological topics. An article by G. Wendler and M Shulski (2009) appeared in September issue of the journal ARCTIC entitled: *A Century of Climate Change for Fairbanks, Alaska.*

Over the last century a temperature increase of 2.5°F was recorded (Figure 1), about twice the global value, clearly demonstrating the well-known temperature amplification for Polar Regions. The temperature increase over the century was not uniform and in 1975/76 a major temperature increase was observed due to the PDO changing from a predominantly negative regime to a positive one. Also noted during the last century was the change in length of the growing season in Fairbanks by an increase of 45%, one of the positive results of the observed warming trend.

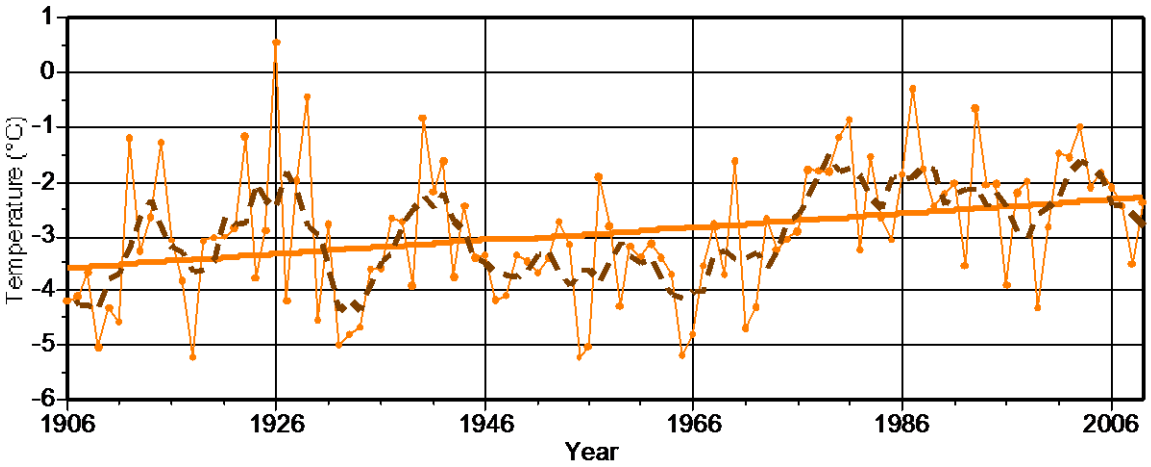

Figure 1. Statewide temperature in Alaska from 1906-present.

In another publication: *Changes in Climate of the Alaskan North Slope and the Ice Concentration of the adjacent Beaufort Sea* (Wendler, Shulski, Moore, THEORETICAL AND APPLIED CLIMATOLOGY), we studied the climate and sea ice of the North Slope. Over the course of a 36 year study period the temperature increased by 5.2°F, while the mean annual amount of open water more than doubled. This is a positive development for the international shipping, marine supply of the North Slope and oil exploration, but negative for the survival of sea mammals such as polar bears, seals and walrus. In addition, the coastal erosion currently being experienced along the northern coasts will be accelerated due to enhanced wave actions caused by the water being open for longer periods.

A summer intern was employed last summer and another one will work with us this coming summer. For the coming year we plan to update our radiation station, investigate the increase of wild fires in Alaska and analyze historic data of Alaska and add them to our database. Several speaking engagements were done in 2009, both at scientific meetings and in more informal settings. One of our staff, Wendler, participated at several meetings of the State of Alaska Governor's Sub-cabinet on Climate Change as a member of the Natural Systems Technical Work Group. Regrettably, Dr. M. Shulski left us to take the directorship of the High Plains Regional Climate Center in Lincoln, NE.

Though the center is in part funded by the State of Alaska, additional grant funds have been obtained through various sources and include: the Joint Fire Sciences Program, British Petroleum Corporation, the Minerals and Management Service (MMS), the University of Alaska Foundation and Conoco Phillips.

Office of the Arizona State Climatologist (ASCO)

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Nancy J. Selover, State Climatologist

The Arizona State Climate Office (ASCO) is located within the Office of Climatology of the School of Geographical Sciences & Urban Planning (SGSUP) at Arizona State University (ASU) in Tempe, AZ. Currently, the office includes the State Climatologist, Dr. Nancy J. Selover, one part-time student worker, and three affiliated faculty in SGSUP. The purpose of the program is to: (1) manage and disseminate climatological information about the State of Arizona, (2) monitor the climate of Arizona and the region, (3) collaborate with state agencies in need of climate data and advisement, and (4) conduct research aimed at an improved understanding of the spatial and temporal variability of the climate of Arizona.

In addition to serving as a link to established climate data resources, including NCDC, the WRCC, NRCS, the office receives and archives data from the Phoenix Real-time Instrumentation for Meteorological Studies (PRISMS) station network (17 stations across the Phoenix metropolitan area maintained by a local utility company). We also archive data from the Phoenix NWS ASOS site; the Arizona Meteorological Network (AZMet) operated by the University of Arizona Agricultural Extension; the Flood Control District of Maricopa County (FCDMC) and NWS Coop data, including our own site, Tempe ASU (028499), where we operate a Class A evaporation pan, and train students in climate observation and data issues.

The Arizona State Climatologist is currently a co-Chair of the Governor's Arizona Drought Task Force Technical Monitoring Committee, which generates monthly short-term and seasonal long-term drought status reports (available at www.water.az.gov/dwr/drought/DroughtStatus.html). We are currently starting our 15th year of long-term drought. The State Climatologist also serves on the Arizona Flood Warning System task force, a multi-agency group of flood control district and emergency managers established in 1994 to provide real-time information on flooding and weather conditions that may lead to flooding (http://www.afws2.org/). In 2009, the State Hazard Mitigation Task Force began updating the State Hazard Mitigation Plan, and the State Climatologist provides hazard profiles and climatology of weather related hazards within the state.

While currently funded at 50% FTE, due to statewide budget shortfalls, the State Climatologist position is divided between outreach and applied, stakeholder research, making numerous presentations to community and educational groups. The State Climatologist also maintains the field equipment for meteorology/climatology in the School of Geographical Sciences and Urban Planning, and teaches the Meteorological Instruments and Measurement course.

Research activities focus on hydroclimatology, including the North American monsoon, precipitation variability, and drought monitoring; and study of surface-atmosphere interactions involving the urban heat island and microclimates. The office continues to work with Decision Center for a Desert City (an NSF research center studying water issues in arid urban locations) on impacts of urban and global warming on water resources, and with the Power System Engineering Research Center on impacts of climate change on power demand, generation, and transmission.

The Arizona State Climate Office is a designated ARSCO, committed to supporting the objectives of the AASC. Below is a brief description of the activities of the Office over the past year that addresses each of the ARSCO qualifications:

Communication Capabilities

- Developed a new ASCO web page (http://azclimate.asu.edu/) to improve navigation, provide more real-time weather data with a climate context, and provide climate products online. The website includes general climate and real-time weather information, statewide monthly temperature and precipitation maps used in the drought status report, the monthly Arizona Climate Summary, daily rainfall and evaporation tables, daily North American Monsoon updates (in summer), and links to climate education information and other climate data resources.
- Maintain a voicemail system to take data and information requests when the office is not physically staffed. All calls are answered or returned within 24 hours. Most data requests come through the phone or e-mail, generated by forms available on the website. The data are served back through the phone, fax, e-mail, postal service, or the Internet, depending on the user's needs. We maintain ties to radio, television, and newspaper media statewide through interviews and workshops.

Information Services

- In 2009 (relative to 2008), we filled 251 (+67%) e-mail requests for data or information, and 171 (+20%) voicemail requests for data. We also had 17,346 (+116%) hits on our new website in just 8 months. The most popular products downloaded from the webpage were the Phoenix rain day table, Tempe daily evaporation table, and the monthly climate calendars for six Arizona cities. Two percent of our users make their request by voice mail, 3% by e-mail and 94% (downloads) by Internet. Users, other than the web hits, include university researchers (13%), government agencies (6%), the public (59%), commercial (10%), and legal (12%) communities. We did 13 media

interviews, including 1 television, 2 radio, 2 researchers, and 8 newspaper, and were involved in 4 legal cases as consultants or expert witnesses. The trend this year is an increase in web, e-mail, and voice mail requests for data or information, with the largest increase over the Internet.

- Archived more than 200 GB of national and Arizona data annually, through an LDM server. A local database has been implemented this year to increase the efficiency of data retrieval for answering climate questions. The database has not yet been linked directly to the web for user access.

Research

- In 2009, we completed a sensitivity analysis of our current drought status methodology to determine which precipitation stations in each watershed are the most important to calculating monthly SPI, and which SPI periods are most important for both short and long term drought status. Although the results indicate that the maximum number of stations required in any watershed is five, the specific stations are critical, and in most cases, when we are missing stations, they include some of the critical stations. For short-term drought, the one- and six-month SPI were the most important intervals. For long-term, the 21- and 24-month SPI were the most important intervals. However, the assumption of watershed average SPI or drought generalization is not realistic in light of the variable terrain across Arizona. The analyses need to be repeated using gridded data that are now available. We continue to use the original method of 3, 6, and 12-month for short-term, and 24-, 36-, and 48-month for long-term drought status. In 2010 we are shifting to weekly advisory to the USDM for short term, and calculating a long-term status on a seasonal basis.
- Developed a hydroclimatic index for drought patterns in the Colorado River Basin: Ellis, A.W., Goodrich, G.B., and G. M. Garfin. 2010. "A hydroclimate index for examining patterns of drought in the Colorado River Basin", *International Journal of Climatology*, **30(2):**236-255. The monthly product will be up on our website by mid-summer.
- Updated and evaluated Jerome Namias' isentropic analysis for drought and wet episode identification: Cerveny, R.S., DeBiasse, K., Pace, M.B., Balling Jr., R.C., and A. W. Ellis. 2010. "Revitalization of Namias' Climatological Isentropic Analysis: Detection and Evaluation of Monsoonal, Severe Storm, Drought and Flood Events", *Annals of the Association of American Geographers*. Under Review.
- Explored the extent of the Phoenix urban heat island with direct measurement and infrared thermometry. Sun, C.-Y., A. J. Brazel, W. T. L. Chow, B. C. Hedquist, and L. Prashad. 2009. Desert heat island study in winter by mobile transect and remote sensing techniques, *Theoretical and Applied Climatology*, **98:**323-335.
- Continuing to work with the Decision Center for a Desert City (DCDC) at ASU on issues of evaporation and water use in an urban desert, and heat island mitigation.

Outreach

- Presentations included "Focus the Nation on Climate Change" at Glendale Community College, the first "NOAA Community Conversation on Climate" at the Arizona Science Center, "Arizona Precipitation Networks" at the AAG, "Precipitation Measurement" at Kyrene del Pueblo elementary school, and guest lecturer on Arizona Climate at ASU.
- Continued work with Engineers Without Borders at ASU on wind power energy project in several locations within Arizona.
- Presented the Navajo Nation climate data to the CDMP and secured another year of funding for digitizing the Navajo data.
- Interviews for feature stories in local newspaper, radio, and television on El Niño and the current drought, the North American monsoon, heat stress, record snow events, climate change, urban heat island, and the seasonal and annual outlooks for temperature and precipitation.
- Service on the Arizona Flood Warning System, Drought, and Hazard Mitigation Task Forces.
- Started CoCoRaHS in Arizona in September. Now have over 600 observers statewide, though concentrated in Phoenix and Tucson. At least one in every county.

Monitoring and Impact Assessments

- Reviewer for Probable Maximum Precipitation Study (2009) funded by Arizona Department of Water Resources.
- Prepare monthly statewide temperature and precipitation updates and calculation of watershed SPI for drought monitoring for the Governor's Drought Task Force.
- Web-publish monthly newsletter summary of Arizona climate, and contribute monthly temperature and precipitation summaries to the Arizona-New Mexico – CLIMAS publication "Southwest Climate Outlook".
- Archive data from the PRISMS network for Phoenix, Flood Control District of Maricopa County, and the Phoenix first-order weather station, and the AZMet network for Arizona.
- Started CoCoRaHS precipitation monitoring in Arizona, to operate in parallel with the Rainlog network run by the University of Arizona.

Arkansas Office of the State Climatologist

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Michael J. Borengasser, State Climatologist

The Arkansas Office of the State Climatologist has been able to respond to a number of requests for climate data and general inquiries related to the climate of Arkansas. Since locating at the Arkansas Natural Resources Commission (ANRC) in 2008, the office has relied on a website, www.climate.ar.gov, and word-of-mouth for most of its outreach to the public. There is still a lack of awareness among potential users of services the office can provide.

In April 2009, the State Climate Office initiated CoCoRaHS. Currently, the registration stands at 190 stations. After an initial rapid growth, stations continue to be added at a slower rate. Contacts are being made to expand participation through the State Extension Service and related programs.

The year 2009 may well be the wettest year on record for the State of Arkansas. Many locations experienced 125% to 175% of normal rainfall, or 15 to 30 inches above normal. More than a dozen COOP sites had over 80 inches of rain; three had in excess of 90 inches. Fifteen (15) COOP stations recorded new annual totals. Statewide, May and October were the wettest on record; September ranked #2 and July #3. Despite the heavy rainfall on Christmas Eve, December only ranked #22.

The NWS COOP station at Leola, Grant County, established a State record for precipitation in a year. The 100.05 inches exceed the old record of 98.55 inches at Newhope, Pike County, in 1957.

The ANRC is also the State Coordinating Agency for the National Flood Insurance Program (NFIP). The State Climatologist is also the State Coordinator for the NFIP. In 2009, there were two Federal Disaster Declarations involving flash flooding. During the Christmas Eve event, several stations recorded rainfall exceeding the 100-year or 1% chance frequency.

The State Climate Office was represented at the WERA 1012 Meeting in Estes Park, Colorado, in May; the AASC Annual Meeting in Grand Rapids, Michigan, in July; and the U.S. Drought Monitor Forum in Austin, Texas, in October.

The Southern Regional Climate Center in Baton Rouge has been very helpful in providing data and assistance in using CLIMOD.

Office of the California State Climatologist (OSC) and CalClim (California Climate Data Archive)

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Michael Anderson, State Climatologist

The California Office of the State Climatologist (OSC) is housed in the California Department of Water Resources (DWR) Division of Flood Management. Interacting with other divisions within DWR which makes up the state climate office (SCO) and the California Climate Data Archive (CalClim) at the Western Regional Climate Center (WRCC), the OSC provides a growing range of climate services for California.

Another year filled with activity and adventure for the California, the OSC, and CalClim. Work continued on many fronts over the past year. NOAA is working to produce an update to its rainfall frequency product for California which should be complete sometime in late 2010 or early 2011. California's Bulletin 195, a compilation of depth duration frequency curves, continues to be updated with the help of retired State Climatologist Jim Goodridge. Both of these products will be used in an effort to produce hydrologic information for floodplain mapping and other hydrologic and hydraulic studies associated with California's FloodSAFE (http://www.water.ca.gov/floodsafe/) program.

Collaboration with NOAA and Scripps Institute of Oceanography continues on the development of an extreme precipitation monitoring network that will include GPS-Met stations to monitor atmospheric water vapor, soil moisture sensors, and vertically-pointing radar to detect freezing level in the atmosphere. The project, born out of NOAA's Hydrometeorological Testbed work in the American River watershed, is a five-year effort to lay out the initial components to a statewide monitoring network to improve precipitation forecasts and increase lead time for flood mitigation actions. Two snow-level-radar installations have been completed: one at Shasta Dam and one at Colfax in the American River watershed. These installations are shown in Figure 1. Two more are scheduled for this year including one in the Merced River watershed and one in the Kings River watershed. On the soil moisture monitoring front, a soil moisture workshop is being organized to bring together the different agencies and research personnel who are monitoring soil moisture in California. The workshop will review the methods and equipment used, indentify locations of activities, and explore opportunities to leverage efforts to obtain a statewide network. Another development this past year for this collaboration is the expansion of the effort to include four partial atmospheric river

observatories along the coast of California. This effort will expand the investment in the network from $7.5 million to $10.5 million.

Figure 1. Snow level radar installations at Lake Shasta (left) and Colfax (right).

California is now in year two of CoCoRaHS. Over 650 volunteers have signed up with NWS Weather Forecast Offices taking the lead as regional coordinators with help from some DWR personnel. Observers are located in 51 of California's 58 counties. Approximately 9000 reports are submitted per month from California's CoCoRaHS volunteers.

Drought response activities continued with a third dry year in the books. The OSC participated in the DWR drought team providing data and material for decision support and outreach activities. Interactions with the U.S. Drought Monitor continued with increased coordination between the OSC and the NWS California-Nevada River Forecast Center, the Sacramento Weather Forecast Office and the WRCC. New graphical products were developed by the California-Nevada River Forecast Center and are available at: http://www.cnrfc.noaa.gov/climate.php. These products look at California's Sacramento Basin 8-Station Index, its San Joaquin 5-Station Index, and storage at a selected number of California's reservoirs. The current state of these indices and reservoirs are related to Drought Monitor classes based on the frequency of the observed state. Significant improvement in California's water conditions occurred this past year with the exception of California's State Water Project. The Feather River watershed, which is the headwaters for the project, did not benefit from the winter storms as much as the nearby headwaters to Shasta Reservoir. As a result, drought activities will likely continue.

Data serving for California climate data improved this past year with the help of a collaborative project between DWR and Western Region Climate Center. The effort looks to identify quality control routines to run through data coming in from the California Data Exchange Center and develop tools to help analyze the data. Histogram and wind rose graphics are some examples of these new tools. The tools are housed in the California Climate Data Archive. Data serving continues via the web, phone and email.

Travel and presentations were prominent again this past year. Presentations and/or session moderating duties included meetings for the California Water and Environment Modeling Forum, California Cooperative Snow Surveys Annual Meeting, a keynote speech at the CalGIS conference, two keynote talks at Department of Commerce workshops held in California on climate, water, and energy, three talks at the NOAA Climate Prediction and Assessment Science Workshop, and a talk for the California Water Law and Policy Conference. Out-of-state travel was limited this past year due to budget problems and will continue to be a challenge in the coming year.

California, with help from the Nevada State Climate Office, will host the 2010 annual meeting of the American Association of State Climatologists. The meeting will be held in South Lake Tahoe from July 12-15. Planning and organizing this event has been a major focus of the OSC this past year.

The annual WERA-102 Committee meeting, a meeting of western State Climatologists, the Western Region Climate Center, and federal resource agency partners was hosted by the OSC and the Monterey Weather Forecast Office this year. Discussion focused on the development of the next five-year authorization for the committee. Work for that authorization was completed in early May.

The State Climatologist has also been involved in the Department's climate change matrix team and FloodSafe's Central Valley Hydrology Study and Central Valley Flood Protection Plan. The matrix team meets quarterly to discuss all things climate change related to the Department. The Central Valley Hydrology Study is developing new design hydrology data to help the Department's floodplain mapping and flood project studies activities. This effort will include a climate change component in which the State Climatologist will be taking a lead role. The Central Valley Flood Protection Plan (CVFPP) is a 5-year plan that lays out the flood protection project activities that need to be carried out for the State. This past year the CVFPP convened a climate change working group to advise what climate change activities should be included in the CVFPP. Membership in this committee included the State Climatologist, Kelly Redmond from Western Region Climate Center, Robin Webb from NOAA's Earth System Research Laboratory, Stu Townsley from the Corps of Engineers, and David Raff from the Bureau of Reclamation, among others. A second technical committee has come out of this effort that will look at quantitative methods of incorporating climate change into the CVFPP that will coordinate with the efforts of the Central Valley Hydrology Study.

Coordination potential of the OSC was improved this past year with the signing of a 5-year agreement between the Department of Water Resources and the University of California Office of the President. This agreement allows the OSC to engage the research community of the University of California for climate services via a task order process. Six task orders are currently in the approval process for a range of studies.

Looking ahead to the coming year, the California OSC plans to continue coordination of activities with the CalClim Group and the WRCC, and continue development of the website and its capabilities to improve data serving. The State Climatologist will also

continue efforts to engage climate researchers active in the State and continue collaborative efforts with NOAA personnel and others.

Colorado Climate Center (CCC)

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Introduction and background

The Colorado Climate Center (CCC) was established by the State in 1974, through the Colorado State University Agricultural Experiment Station, to provide information and expertise on Colorado's complex climate. Through its threefold program of Climate Monitoring (data acquisition, analysis, and archiving), Climate Services and Climate Research, the Center responds to many climate-related questions and challenges. The Center monitors climatic conditions on both broad, regional scales and very local scales. By documenting climate variations in time and space, the relationships between climate, water supplies, other natural resources, agriculture and societal responses can be better understood and applied to support appropriate planning and decision making.

Priorities of the Colorado Climate Center in 2009

1) Conduct and coordinate climate monitoring and research specific to practical needs and applications. In 2009, the CCC began work with the National Integrated Drought Information System's (NIDIS) Upper Colorado River Basin Pilot Project. This effort included surveying stakeholders on their data and information needs and triggers related to drought planning and early warning. The CCC continues to maintain the historic Fort Collins weather station and completed 121 years of uninterrupted continuous climate monitoring in 2009.

2) Assess the observed trends and variations in key climatic elements such as temperature, precipitation, snow accumulation and evapotranspiration and provide this information to the citizens of Colorado to help address concerns over climate change and public response. This work resulted in the launching of a new Colorado Climate Trends website: http://climatetrends.colostate.edu/.

3) Support and coordinate the Colorado Agricultural Meteorological Network (COAGMET; http://climate.colostate.edu/~coagmet/), expand the network where appropriate, and promote the use of these data in decision making. With shrinking budgets, hard decisions were initiated in 2009 to start a gradual downsizing of CoAgMet and to build broader user bases and constituencies to support the CoAgMet effort.

4) Engage the citizens of Colorado in backyard climate monitoring through the Community Collaborative Rain, Hail and Snow network (CoCoRaHS; http://www.cocorahs.org) and related activities.

5) Broadly disseminate climatic information, expertise and applications, and assist others in applied climate research.

Publications

Dupigny-Giroux, L., Mock, C. 2009. Historical Climate Variability and Impacts in North America; XIV, ISBN: 978-90-481-2827-3; Dec 16; Springer.

Recent publications are available from the CCC's web site at: http://ccc.atmos.colostate.edu.

Budget issues and limitations

The Colorado Climate Center continues to be actively involved in a full range of climate monitoring, research and service, but the practical reality is that state and local budgets have been extremely stressed and local support has dwindled during the recent economic recession. Federal contracts and grants such as NIDIS and CoCoRaHS have buoyed the CCC during this time period helping offset some of the budget cuts experienced through the state and university. Budget issues are on ongoing challenge occupying a great deal of time.

ARSCO Qualifications

The Colorado Climate Center is designated by the AASC as the official state climate office for Colorado. The following sections describe ways in which CCC addressed each of the ARSCO qualifications in 2009:

Communication Capabilities

Communication and outreach remain high priorities for the Colorado Climate Center. The CCC website and links are a critical part but not the only communications capability. Through a partnership with the Colorado State University Public Relations Department, CCC has direct access to print, broadcast, and e-media in Colorado. Many interviews and press releases are conducted or issued each year. The CCC benefits from good relations and strong communications with NOAA's National Weather Service, National Climatic Data Center, and also other state and federal agencies that are providers and/or users of climate information. The Colorado Climate Center works closely with the Colorado Water Institute (CWI) and publishes climate updates through the CWI newsletter throughout the year. A semiformal association with the Western Water Assessment at the University of Colorado (one of several NOAA Regional Integrated Science Assessments – RISAs – across the country) leverages additional communications capabilities. CCC participates in the Colorado Water Availability Task Force and State Flood Review Task Force providing year-round updates on water supplies and flood potential.

The Colorado Climate Center became actively involved in 2008 in the production of TV and streaming video broadcasts of climate and water information. Working with

the Poudre School District educational TV studio and utilizing the talent of local high school students, the "Water Report" has become a monthly cable TV show to help students and others in the community help track climatic conditions in northern Colorado and the impact on water supplies (http://www.psdschools.org/services/channel10/wtwy.aspx).

Information Services

The Colorado Climate Center staff routinely responds to requests for climatic data and expertise. The number of individualized phone and e-mail requests is significant, but continues to dwindle. Most people now rely on the web for nearly all climate information requests and services. The CCC website (http://ccc.atmos.colostate.edu) serves tens of thousands of users and provides access to both real-time data, historic data, products, narrative climate descriptions and publications. Unique examples include water year precipitation summaries and drought index information. CCC also features access to the CoAgMet (Colorado Agricultural Meteorological) automated weather network with near real time and historic data gathered specifically for agricultural applications. CoAgMet is the primary source in Colorado for computed estimates of reference, crop and turf evapotranspiration using classic Kimberly Penman ET computation methodologies and the Standardized ASCE Penman-Monteith method.

By the end of 2009, the Community Collaborative Rain, Hail and Snow network (CoCoRaHS), which was initiated in 1998 by the CCC, expanded to all 50 states. Precipitation data from CoCoRaHS – rain, hail and snow information – is publically available and used daily by many individuals and organizations, and is used routinely for research applications as well. Special data export features were developed in 2009 to provide easy access to large volumes of nationwide precipitation As CoCoRaHS has expanded and matured in recent years, the CCC now integrates much of the precipitation data from Colorado and surrounding states into routine climate products and services. Beginning in 2009 and completed in 2010, CoCoRaHS has added a "Drought Impacts Reports" capability. CoCoRaHS participants anywhere in the country can share their observations of how drought is affecting them locally to help populate a national database of drought impacts.

Research

Current and ongoing research at the Colorado Climate Center is focused in four areas:

1) Detection and interpretation of trends in climate time series including temperature, precipitation and evaporation. Working with scientists with the Western Water Assessment RISA, we are developing best practices for displaying and describing observed climate time series for public use and interpretation.

2) Drought monitoring and drought early warning. We began active participation with the National Integrated Drought Information System (NIDIS) in their initial pilot project focused on the Upper Colorado River Basin.

3) Precipitation characteristics and statistical properties. Using nation-wide CoCoRaHS precipitation data sets, we are exploring seasonal and geographic differences in frequency distributions of daily precipitation amounts. In-depth hail

climatologies for Colorado are being developed, also based on CoCoRaHS data. Extreme precipitation frequencies and magnitudes are also being explored via CoCoRaHS.

4) High elevation evapotranspiration research began in 2009. A small number of CoAgMet weather stations were installed in mountain meadows of the North Platte River in conjunction with the Division Engineer's efforts to maintain a seasonal lysimeter. We are in data-gathering mode now, but we will eventually compare observations with model estimates to work towards improved methodologies for ET computations in mountain valleys.

Outreach

The Colorado Climate Center maintains an outreach focus. We participate, to the extent possible with our limited staff and budget, in as many outreach efforts as we can ranging from children's water festivals, school programs, hosting field trips to the CSU Weather Station and giving guest lectures at several Colorado universities. In the past year, the CCC was involved in the Colorado Water Congress, the Colorado Foundation for Water Education, the National Western Stock Show, the Colorado Farm Show, the State of the River meetings, the WWA "Climate Road Show", the South Platte Forum, the Arkansas Basin Water Forum, and many other smaller venues. As stated earlier, we work with our University Public Relations Office to disseminate research and monitoring products and stories of interest. We are currently on the planning committee for Colorado YOW!2012 – a special year-long celebration of water being planned for 2012.

The single largest outreach effort continues to be CoCoRaHS. Approximately 15,000 participants from all 50 states are actively engaged in data helping measure and report precipitation from across the country. CoCoRaHS has been very effective at not only reaching the general public but also building partnerships with other State Climate Offices, National Weather Service forecast offices and regional headquarters, and other local, state and federal organizations who benefit from detailed and timely precipitation information. An online survey of CoCoRaHS volunteers was conducted during the fall of 2009 and over 7,000 volunteers responded.

Nolan Doesken served as President of the American Association of State Climatologists during all of 2009. This provided other professional outreach opportunities including visits to NWS headquarters and Capitol Hill during the past year.

Connecticut State Climate Center (CSCC)

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Xiusheng (Harrison) Yang, State Climatologist

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1. Past and current activities

During the academic year of 2009-2010, Connecticut State Climate Center (CSCC) has been increasingly becoming a valuable asset of the university community and the general public of the State of Connecticut. With support provided by the University of Connecticut (UConn) Graduate School and the College of Agriculture and Natural Resources, CSCC has provided numerous services to support research, education and outreach activities at University. Over one hundred services were also provided to state and local government agencies, schools, and the general public in the State. Provided below are the highlights of the accomplishments:

1.1 Support

A full graduate assistantship was provided by the UConn Graduate School and the College of Agriculture and Natural Resources. A PhD student was employed to operate the climate center on a daily basis. The duty of the GA includes maintenance of the website, receiving and replying to inquiries, obtaining and processing climate data, providing technical service to end-users, and conducting climate-related research and analysis.

1.2 Research

a. CSCC has acquired, processed, and provided NCDC quality-assured climatic data for 5 (2 new in 2010) research projects in the fields of climate change, natural resources modeling, environmental engineering, and plant science. The service was especially essential for one research project on long-term climate change.
b. CSCC has completed a study to characterize the climate and climate change in the State of Connecticut over the past century. The study has provided useful information for the policy makers and the research community. The results are to be used to update the CSCC website, and especially the book entitled "Climate in Connecticut", which was published in late 1960's.
c. CSCC has participated with faculty groups in writing 3 large multi-disciplinary research and education proposals. CSCC has also been working with the UConn Atmospheric Group to successfully make the university become a member of UCAR (University Corporation for Atmospheric Research).

1.3 Teaching

a. Several courses are developed and taught at the University of Connecticut using the climatic data provided by CSCC. In particular, NRE 3145 *Meteorology* has been using live images of weather in teaching large scale storms (mid-latitude cycles and hurricanes). An online version of the course has been taught in summer which has attracted many non-traditional off-campus students. A new course, NRE 3146 *Climatology*, has been developed and taught for the first time focusing on spatial variation and temporal change of global and regional climates. The course also provided a detailed introduction to the current issues of global climate change.
b. CSCC is working with other faculty members to develop more structured educational and training programs at the University of Connecticut. A proposal was submitted to NASA global climate change program for establishing an integrated training program, in which CSCC is an important contributor at various levels of education, from K12 through Ph.D. students.

1.4 Outreach

a. An online data distribution system was established and used for the public to access climatic data for the State of Connecticut. The system is hosted by the University of Connecticut CANR server (http://www.canr.uconn.edu/nrme/cscc), providing processed climatic data for 17 stations across the State. Many residents, government agencies, schools, and businesses in the State have used the system in the past year for various purposes.
b. An effort is being made to update the website to include more stations (from 17 to 39) and cover longer periods (from 1971-1999 to 1900-2008). More climate variables and statistics will also be provided.
c. In addition to the website, the CSCC also delivers climate information via the joint web page with Connecticut IWR (http://www.ctiwr.uconn.edu), feature articles in various local media (New London *The Day*, for example), traditional ways through our cooperative extension system, posters and demonstrations at university and college organized events (such as *Cornucopia* and the Connecticut Conference on Natural Resources), and peer-reviewed publications.
c. CSCC has delivered over one hundred services to university research community, governmental agencies and general public by providing processed and certified climatic data sets in various formats through email, telephone, fax, and mail.
d. As the Director of CSCC, Dr. Yang has provided many impact analyses to various media (newspapers, magazines, and radio talks), local governments and schools, and state government agencies on climate change, El Niño, drought, and abnormal wintry weather. In particular, he has been a member on the Agricultural Working Group, Adaptation Subcommittee of the Governor's Steering Committee on Climate Change. He also has been invited by out-of-state users to provide specific microclimate assessment.

2. Future planning

CSCC is planning to work on the following projects in the next year:

a. Completion upgrading the CSCC website. This will make CSCC the most authentic source of climatic data in the state.
b. Integrate our website into national and regional systems.
c. Draft the new edition of the source book "The Climate of Connecticut".
d. Apply for NCDC fellowship and send a graduate student to the national climatic data center for training. Such training is anticipated to greatly improve the effectiveness of services provided by CSCC.
e. Develop teaching modules of climate analysis for classroom and online instruction. Such modules will enable students to study the fundamental theories of meteorology and climatology using information from current weather and climate events.
f. Actively participate in the AASC organized activities of research, education, and outreach, and take full advantages of the climate initiatives of the federal, state, and local governments.
g. Publish an annual or semi-annual newsletter for the center.
h. Establish an advisory board for CSCC to increase the visibility of the center.

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Kevin R. Brinson, Assistant State Climatologist

The Office of the Delaware State Climatologist is located in Newark, Delaware at the University of Delaware and is co-operated and co-located with the Delaware Environmental Observing System (DEOS). In July of 2009, both DEOS and the Office of the State Climatologist moved to the newly-formed College of Earth, Ocean, and Environment and joined a new University-wide environmental institute. Both the Office and the State Climatologist continue to provide climate support services to the State of Delaware, albeit without state or federal funding.

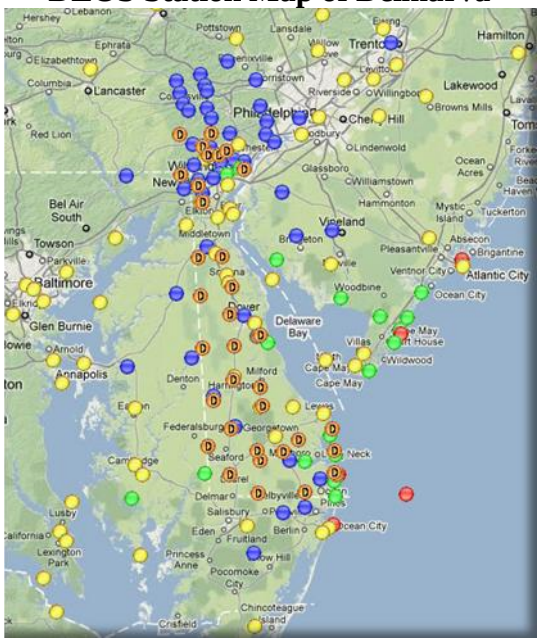
The Office of the Delaware State Climatologist is an AASC Recognized State Climate Office (ARSCO) and partners with the National Climatic Data Center, the Northeast Regional Climate Center, and the National Weather Service in Mt. Holly, NJ to provide data and climate services to the citizens of the State of Delaware. As with most State Climate Offices, we provide climate data and expertise to the public and private sector as well as conduct newspaper, radio, and television interviews, give public lectures, and provide legal expertise and court testimony. The Delaware State Climatologist's Office also serves in the Technical Assistance Center of the Delaware Emergency Management Agency during critical weather events. Delaware State Senate Bill 72, adding the State Climatologist as a statutory member of the Water Supply Coordinating Council (WSCC), was signed into law on July 6, 2009. The Office currently has two main projects:

The Delaware Environmental Observing System (DEOS)
Our main funding effort has been the maintenance of a real-time system dedicated to monitoring environmental conditions across the Delmarva Peninsula. The Delaware Environmental Observing System (DEOS; http://www.deos.udel.edu) is designed as a tool for decision makers involved with emergency management, natural resource monitoring, transportation, and other activities throughout the State of Delaware. DEOS also provides both State agencies and the citizens of Delaware with immediate information as to environmental conditions in and around the State. Being that it is supported by the Office of the Delaware State Climatologist, DEOS also provides a climate archive of the five-minute data to support the developing needs of high-resolution requests for environmental data.

Our network has now grown to a total of forty stations located in the three counties of Delaware, Chester County in Pennsylvania (in cooperation with Chester County

Emergency Management), and Cecil County in Maryland. Data are collected and disseminated from our website from approximately 200 additional observing platforms. With new projects focusing on coastal flood monitoring and enhancing agricultural weather information, we expect that several more stations – including the development of a portable DEOS system – will be available in the coming years.

DEOS Station Map of Delmarva



The DEOS GeoBrowser displays the spatial distribution of stations (by type) on the Delmarva Peninsula. The orange symbols with a D in the center are stations maintained by DEOS. The complete list of symbol types is listed at http://www.deos.udel.edu/geobrowser.html.

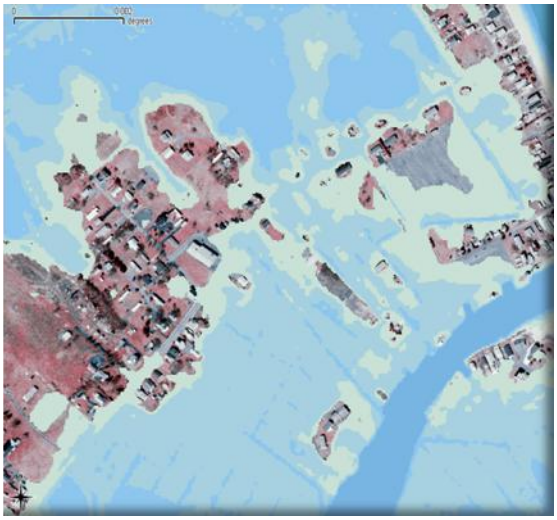
DEOS consists of three main components: (1) the DEOS Environmental Monitoring and Observing Network (DEMON), a network of thirty-one new meteorological observation sites coupled with existing weather and other environmental observation sites in and around Delmarva; (2) the DEOS Integrated Visualization and Analysis System (DIVAS), a GIS-based integration of surface weather observations with National Weather Service WSR-88D radar estimates of precipitation, thereby providing estimates of meteorological and environmental variables over a high spatial resolution grid; and (3) a number of DEOS Analysis Systems (DAS), designed to provide decision support in a variety of environmentally-sensitive areas. One such system will provide transportation and emergency management officials with real-time assessments of coastal and stream flood risk potentials.

To make appropriate decisions that depend upon the environmental conditions, decision makers must have environmental data with the highest spatial and temporal resolution possible. Data needs include weather information, observations of streamflow, bay and ocean conditions, and water and air quality. DEOS integrates existing observations from federal, state, and local sources and augments these existing observations with approximately twenty additional observing sites (primarily weather stations, but installed sensors also have included water temperature, wave period, and water quality for the Delaware Bay) around Delaware, Maryland, and Pennsylvania. These observations are connected to a central data collection facility through existing telecommunications capabilities. DEOS currently provides timely data dissemination to State agencies, the National Weather Service, and the public and also is in the process of developing reliable data quality control and quality assurance procedures.

The Delaware Coastal Flood Monitoring Project

Being a peninsula, isolated by the Delaware Bay, the Delaware River, and the Chesapeake Bay, the Delmarva Peninsula is very much affected by coastal storms and processes. Much of the damage during tropical and extra-tropical weather systems is

associated with severe coastal flooding. The Delaware coastline is extremely vulnerable to such events, examples being the great March, 1962 storm and the recent coastal flooding incident of May 12, 2008. A GAP Analysis of pertinent coastal data needs and a comprehensive survey of inland inundation levels during previous coastal flooding events have been completed as part of a cooperative effort between the University of Delaware and several Delaware State Agencies. The goal is to better monitor conditions along the Delaware coastline and to provide advance warning of impending coastal flooding events.

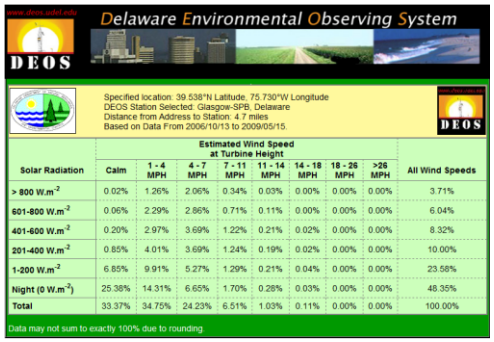


An example flood inundation map produced by John Callahan (Delaware Geological Survey) for Bowers Beach at 6 feet above Mean High High Water.

This project included an exhaustive inventory of real-time and archived data suitable for coastal flood monitoring and research. The inventory includes meteorological, tidal, stream flow and buoy data sources, along with ancillary sources of coastal information (e.g., modeling, research publications, and non-digital records). The inventory has lead to a series of recommendations as to the data needed to reach an "optimum" coastal monitoring network, and the spatial placement and temporal resolution of additional sensors that may need to be deployed to reach the optimum configuration. Thus, the GAP Analysis defines the present state of coastal data collection efforts across the state, suggests an "optimum" data collection network for coastal flood monitoring and research, identifies "gaps" in the present network of stations and recommends data that need to be added to the current network configuration. An inventory of available high water marks from previous coastal flooding events has been created to aid in understanding the relationships between water levels at tidal monitoring points and inland locations. All available high water records have been identified, their history confirmed and the inundation level recorded. Much of this data has been transcribed from handwritten forms to digital media. The verification of the handwritten material is an ongoing component of this project. The inundation data will be used in conjunction with observed tide heights at tidal monitoring points to better understand the inland inundation associated with various tidal levels along the coast.

The Delaware Green Energy Spatial Calculator

DEOS has developed the Delaware Green Energy Spatial Calculator. It allows the user to determine the frequency and intensity of



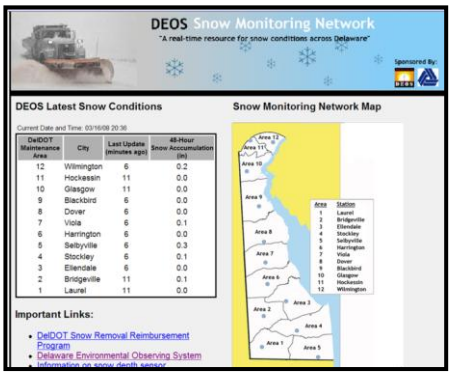
Solar Radiation	Estimated Wind Speed at Turbine Height								All Wind Speeds
	Calm	1 - 4 MPH	4 - 7 MPH	7 - 11 MPH	11 - 14 MPH	14 - 18 MPH	18 - 26 MPH	>26 MPH	
> 800 W.m^{-2}	0.02%	1.26%	2.06%	0.34%	0.03%	0.00%	0.00%	0.00%	3.71%
601-800 W.m^{-2}	0.06%	2.29%	2.86%	0.71%	0.11%	0.00%	0.00%	0.00%	6.04%
401-600 W.m^{-2}	0.20%	2.97%	3.69%	1.22%	0.21%	0.02%	0.00%	0.00%	8.32%
201-400 W.m^{-2}	0.85%	4.01%	3.69%	1.24%	0.19%	0.02%	0.00%	0.00%	10.00%
1-200 W.m^{-2}	6.85%	9.91%	5.27%	1.29%	0.21%	0.04%	0.00%	0.00%	23.58%
Night (0 W.m^{-2})	25.38%	14.31%	6.65%	1.70%	0.28%	0.03%	0.00%	0.00%	48.35%
Total	33.37%	34.75%	24.23%	6.51%	1.03%	0.11%	0.00%	0.00%	100.00%

Data may not sum to exactly 100% due to rounding.

An example of a tabular output for solar radiation and wind speed produced by the Delaware Green Energy Spatial Calculator for Glasgow, DE.

wind speed and/or solar radiation from the nearest DEOS weather station to their proposed location (interpolation is unnecessary owing to the relatively dense DEOS network). For users who specify both wind speed and solar radiation, a contingency table is displayed to show what percentage of the time they can expect to receive significant effects from solar power, wind power, both, and neither. Row and column sums provide the marginal probabilities. Data are updated monthly and stored on the computer so each table is not regenerated each time a request is made (see http://www.deos.udel.edu/dgep).

The DEOS Snow Monitoring Network



DEOS supports the Delaware Department of Transportation (DelDOT) Snow Removal Reimbursement Program with snow depth measurements in each of the 12 transportation districts statewide. These data are used to provide input to reimburse housing developments for snow removal costs. Sonic ranging depth sensors are installed at the 12 selected locations during the winter months (October through April). The 48-hour accumulation of snow is updated every ten minutes on the DEOS snow depth monitoring website, http://www.deos.udel.edu/odd-divas/snow_current.php?network=DEOS&units=english.

The measurement technique has two distinct characteristics which separate the DEOS snow depth data from the National Weather Service snowfall totals. The first is that a 2' x 2' x 4" asphalt pad is constructed beneath each sensor. DelDOT is interested in how much snow accumulates on a black top surface during an entire event. The asphalt pad is more representative of the thermal properties of a paved road than a well-insulated surface (like a snow board). The second difference is that the snow is never cleared from the pad during the snow event, which allows for the natural compaction of snow with time.

The Delaware Community Collaborative Rain, Hail, and Snow (CoCoRaHS) Network

The State of Delaware transitioned from the DEOS Environmental Monitors Program (DEMs) into CoCoRaHS on September 1, 2009. DEMs was a statewide spotter network DEMs system which the State Climate Office used to identify those people that were truly interested in taking long-term climate measurements and make them official cooperative observers by providing them with more accurate equipment.

In summary, the Office of the Delaware State Climatologist is growing. In the past several years, we have obtained support for three undergraduate and three graduate students working on specific projects with DEOS and State Climate personnel. We also have obtained permanent support for two technicians and a programmer to continue the development of DEOS.

Florida Climate Center

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David Zierden, State Climatologist
James J. O'Brien, Emeritus State Climatologist
Melissa Griffin, Assistant State Climatologist
Preston Leftwich, Climate Research Assistant

About the Florida Climate Center

The Florida Climate Center is housed at the Center for Ocean-Atmospheric Prediction Studies (COAPS) in the Fuqua Research Complex at Tallahassee's Innovation Park. Though physically located off-campus, COAPS and the Florida Climate Center are part of the Department of Meteorology at the Florida State University (FSU). The Florida Climate Center is a public service center sponsored by the Institute of Science and Public Affairs. The office space, facilities, and equipment are provided by COAPS, but the Climate Center receives ongoing state financial support that covers the salaries of 1.5 full-time employees. The Florida Climate Center staff currently consists of David F. Zierden, State Climatologist; Melissa Griffin, Assistant State Climatologist; Preston Leftwich, a part-time research associate and instructor of an introductory undergraduate meteorology course at FSU; and Marcus Williams, a graduate student assistant. Dr. Mort Winsberg, author of *Florida's Weather* and professor emeritus of geography at FSU, collaborates with the Florida Climate Center staff on relevant projects; and Dr. James. J. O'Brien, former State Climatologist and Professor Emeritus, remains actively involved and provides welcome leadership to the Florida Climate Center.

The Florida Climate Center is an American Association of State Climatologists (AASC) Recognized State Climate Office (ARSCO) and works in partnership with the National Climatic Data Center (NCDC), Southeast Regional Climate Center, and National Weather Service to provide data and climate services to the citizens of the State of Florida. We have a standing memorandum of understanding with NCDC and letters of support from the National Weather Service Forecast Offices.

Florida Climate Center's Approach to Climate Services

One of the primary missions of the office is to provide routine climate data and services. In addition to the inquiries that come straight to the office, they are also referred to us from NCDC, the regional climate centers, and the National Weather Service Forecast Offices. The Florida Climate Center receives dozens of phone calls, emails and faxes each week requesting everything from answers to simple climate and weather questions to detailed data requests and analyses. We have developed a unique philosophy on climate services that allows us to best serve the needs of our "customers". The keys to our philosophy are as follows:

- Maintain and provide access to historical data archives
- Listen to and respond to the needs of our customers
- Look beyond traditional weather variables; use derived quantities and other products
- Charge for services, where applicable
- Certifying data, legal services
- Provide education/outreach on weather and climate issues across the state

Research and Involvement with the Southeast Climate Consortium

The Florida Climate Center is a leading authority on climate variability in Florida, particularly as related to El Niño Southern Oscillation (ENSO). The Florida Climate Center has long been an active partner with the Southeast Climate Consortium, one of the Regional Integrated Science and Assessment (RISA) teams funded by NOAA's Office of Global Programs. Through this involvement, we conduct research into downscaled and localized climate forecasts and their application to the sectors of agriculture, forestry, and water resources. Recent expansion of the consortium now includes the State Climate Offices of Georgia, Alabama and North Carolina, as well as agriculturists, hydrologists, and social scientists from the University of Florida, University of Miami, University of Georgia, University of Alabama Huntsville, Auburn University, North Carolina State University and Clemson University. The Southeast Climate Consortium now receives additional funding through USDA and USDA Risk Management Agency.

The primary mechanism for disseminating climate forecast information for the Southeast Climate Consortium is *AgroClimate*, a web-based decision support system for climate and agriculture in the Southeast U.S. The Climate Center has been a key participant in the development of *AgroClimate* (www.agroclimate.org), a web-based decision support system facilitating the effective use of climate forecast information in agriculture and forestry in the Southeast U.S. *AgroClimate* displays information on ENSO climate variability based on historical weather data from over 300 cooperative observer stations in the Southeast. In addition, *AgroClimate* provides probabilistic information on how climate variability affects yields of crops such as peanuts, tomatoes, and potatoes. *ArogClimate* also provides background information on ENSO and climate as well as management options of crops and forests during the various ENSO phases.

Community Outreach and Education

In October 2007 Florida became the 23rd state to join the Community Collaborative Rain Hail and Snow (CoCoRaHS) program and now boasts over 500 active observers across the State of Florida. Melissa Griffin, Florida's Assistant State Climatologist, is the State Coordinator for CoCoRaHS in Florida and provided the momentum to initiate the program in this state. As a non-profit organization, CoCoRaHS stresses training and education and welcomes volunteers from all walks of life to take part in monitoring precipitation. Florida CoCoRaHS has recently received a grant from Florida 4-H to support K-12 participation.

In addition to the CoCoRaHS activities, members of the climate office staff have taken part in numerous outreach events across portions of the state, including weather and climate classrooms at elementary and middle schools, university open houses, and summer camps.

The State Climatologist has also become active in education and community outreach on the subject of climate change in the State of Florida. David Zierden is now an adjunct member of the University of Florida Extension Service's climate variability and change focus group, a grassroots group of extension agents and faculty that are initiating programs on coping with climate change in agriculture, community planning, and sustainable living. Through this focus group, David Zierden has presented material on the science of climate change and its impacts on Florida in the last year at the UF Extension virtual symposium and a climate change in-service training program. We have videotaped the presentation and made it available via webcast. The Florida Climate Center is also teamed with other scientist at COAPS and educators at University of South Florida in a NASA proposal on climate change education for public school teachers.

State and Regional Climate Issues

The Florida Climate Center had teamed up with the University of Florida and plays an important and active role in the formation and development of the Florida Climate Institute (http://www.floridaclimateinstitute.org). Through this partnership, top biological, social and agricultural scientists work with climatologists in order to bring together the best science expertise in the state to address the complex issues associated with climate change and societal response. In addition to providing expert knowledge and understand of the climate of Florida, the center has been tasked with providing high-quality datasets for a variety of climate scenarios for the institute.

The Florida Climate Center is actively involved in the National Integrated Drought Information System (NIDIS) pilot project in the Southeast U.S. The NIDIS pilot project is concentrating on drought issues in the Alabama, Coosa, and Tallapoosa (ACT) and Apalachicola/Chattahoochee/Flint (ACF) river basins and hosted an initial stakeholder workshop last April in Peachtree City. David Zierden has also recently presented information on climate variability and its impacts on natural resources at the Tampa Bay Water Resource Summit and at a meeting of the Tampa Bay Regional Planning Council. The state climatologist routinely provides input to the weekly U.S. Drought Monitor.

Monitoring and Impact Assessment

The Florida Climate Center has begun to produce monthly state climate reports with an emphasis on impacts to agriculture and water resources under the AASC State Climate Exchange Program. These climate summaries detail the recent weather and climate in each state and put it into historical context. The state climate summaries are released on the third working day of each month and contain the following information:

- A list of average temperature and precipitation across the state, including departures from normal, historical ranks, and a more local breakdown if

necessary. The same breakdown may be given for longer time periods (3 months, 6 months, etc) if pertinent.

- A summary of extreme weather, severe events, and storm reports over the past month.
- An overview of how recent climatic conditions are affecting ongoing or developing drought, if applicable.
- With input from Extension specialists, a summary of how the past month's weather and climate affected agricultural production and practices for key commodities.
- A review of how the past month's temperature and precipitation patterns followed the seasonal climate forecasts or known ENSO patterns.
- Any appropriate maps, graphs, or tables of climate information needed to support the above elements.
- Supplemental information or observations from non-standard sources such as state mesonets.

These monthly climate reports or summaries are used to supplement the monthly reports from the Southeast Regional Climate Center (SERCC) and NCDC and in conjunction with periodic climate outlooks produced by the Southeast Climate Consortium and disseminated through AgroClimate.org.

Finally, the State Climatologist and staff are always available to the media for facts and opinions on current climate issues. We have a working relationship with such newspapers as the *USA today, Tampa Tribune, St. Petersburg Times, Tallahassee Democrat, Gainesville Sun, News-Press, Florida Today* to name a few, and television outlets such as the *Florida News Channel.* The State Climatologist and staff comment on such issues as global climate change, drought, El Niño, hurricanes, and damaging freezes.

Georgia State Climatology Office

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David Stooksbury, State Climatologist
Pam Knox, Assistant State Climatologist
Pierre Gerard-Marchant, postdoctoral scientist

The Georgia State Climatology Office is located in Athens, GA, on the campus of The University of Georgia in the Biological and Agricultural Engineering Department. The office houses two full-time climatologists: Dr. David Stooksbury, the State Climatologist and Associate Professor, and Pam Knox, the Assistant State Climatologist. We also had a postdoctoral scientist, Dr. Pierre Gerard-Marchant, working on hydrologic projects during 2009.

The Georgia State Climatology Office continues to be involved in a variety of research and public outreach activities. We maintain a web site (http://climate.engr.uga.edu) and actively interact with users from around the state. These contacts include university scientists, educators, lawyers, construction and insurance companies, government agencies, reporters, and private citizens. Many of these data requests come by way of email, but we also receive phone calls, walk-ins and the occasional letter.

The State Climatology Office has been heavily involved this year with the Southeast Climate Consortium on a variety of research projects. We have participated with other states in training activities for Extension agents on the use of the AgClimate.org website, a web site which relates climate statistics for the Southeastern US to El Niño phase and crop management issues. We are now developing a similar site for water managers (called sewaterclimate.org). This site will provide assistance in planning for drought and wet conditions using ENSO phase information and Climate Prediction Center projections of current and upcoming precipitation amounts. Interviews with a variety of water managers and stakeholders have helped us continue to hone the content of the site and our understanding of how water managers use climate information. We also contribute to the National Drought Monitor and write a monthly climate summary for use by the Southeast Regional Climate Center and our web visitors.

In addition to research activities, we provide guidance to a number of state agencies on weather and climate conditions and severe weather, including the State Drought Monitoring Committee (which Dr. Stooksbury co-chairs with the Director of the Georgia Environmental Protection Division) and the Georgia Emergency Management Agency (GEMA). The State Climatologist regularly monitors water conditions across the state

and issues drought statements and other special climate statements when conditions warrant it.

Dr. Stooksbury is on the National Integrated Drought Information System (NIDIS) implementation team. The office is working with NIDIS on a pilot project identifying early warnings for drought on the Appalachicola-Chattahoochee-Flint River basin and has co-hosted several planning meetings. Dr. Stooksbury is the coordinator for the upper basin subcommittee and Pam Knox is the leader of the database group.

In May of 2008 Georgia joined the CoCoRaHS network, founded in Colorado by Nolan Doesken and collaborators. Pam Knox assisted in setting up the network and continues as a regional coordinator for Regions 1 and 3 in Georgia. As of April 14, 2010, there were almost 500 active stations in the network. On a typical day we expect close to 200 observations to come in from observers all over the state.

Hawaii State Climate Office (HSCO)

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Pao-Shin Chu, State Climatologist
Ying Ruan, Graduate Research Assistant
Sean Newsome, Student Assistant

The Hawaii State Climate Office (HSCO) has been dedicated to completing several projects and handling a variety of requests.

One of the projects that the HSCO has been involved with is providing data for updating *Rainfall Atlas of Hawaii*. The project has been funded by the US Army Corps of Engineers and is led by a faculty in the UH Department of Geography. The latest *Rainfall Atlas of Hawaii* was made back in 1986. Twenty-five years have passed and there have been a lot of changes in station distribution and data quality since then. We are in the process of updating both the listing of stations with data quality information and monthly rainfall data.

A proposal submitted to the NCDC/CDMP last October regarding digitization of the historical, daily rainfall data kept in HSCO was successful. A lot of historical records that are kept in HSCO are in paper forms and unavailable to NCDC. The completion of this data set would extend the data length and station coverage at NCDC. This project is intended for multi-yr.

With funding from NOAA through the UH/JIMAR, a new pilot project began this year to provide climate change information for coffee growers in Kona on the Island of Hawaii. Available rainfall and temperature records from the Kona area have been collected, and the trends in different stations located at different elevations have been estimated. The relationship between local rainfall amounts and ENSO cycle are analyzed. This project will be finished by September 2010.

We also routinely provided the monthly reports for Hawaii's climate and impacts, starting from November 2008 to September 2009. This is a SCEP award from NOAA/NCDC and was aimed at improving the communication between the WRCC and the HSCO. The monthly reports not only have been put on the website of HSCO, but also the AASC website. Moreover, the WRCC will include part of our report in their regional monthly assessment to the NCDC, and this in turn will bring the WRCC closer to the needs of NCDC.

The most outstanding feature during the past year is diversity—both in terms of the people who made requests and the kinds of data they requested. Requesters represented a range of different fields in both the public and private sectors. Local government wants information about extreme rainfall, IRS employees need climate information regarding the temperature and precipitation distribution in Hawaii, a private company required rain gage data for a watershed, a pilot asked for wind data, etc. We also received a request from the Honolulu Board of Water Supply for evapotranspiration data in Oahu for a conservation program.

The HSCO is also keen on doing research concerning Hawaii climate; for example, the *Journal of Climate* has accepted one paper about changes in extreme rainfall events in Hawaii (Chu and Chen, 2010, Changes in precipitation extremes in the Hawaiian Islands in a warming climate).

Idaho State Climate Services (ISCS)

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Russell J. Qualls, State Climatologist
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Climatic information is essential to every citizen of Idaho. To help people obtain the climatic and water data and information necessary to planning and everyday work, the State Climatologist Program strives to acquire, archive, process and disseminate, in the most cost-effective manner possible, climate and weather information that is or could be of value to policy and decision makers in the state and to provide climatic services that are important to the people of Idaho.

The functions of the State Climatologist and State Climate Services are to:

- act as liaison between Idaho weather information users and the National Climatic Data Center
- maintain a data bank of climatological and hydrological data and information
- supply data in a form useful to users
- perform requested climate analyses or refer requests to other appropriate persons, agencies or consulting firms
- maintain contact with users of climatic and hydrological data in order to ascertain their needs for data and analyses
- maintain a bibliography of publications pertinent to Idaho and Pacific Northwest climate

In May, 1978, an agreement was concluded among the National Climatic Data Center, the National Weather Service and the University of Idaho to provide climate services which had been provided by a former National Weather Service program. ISCS became the AASC Recognized State Climate Office (ARSCO) for the State of Idaho in 2001.

Idaho State Climate Services is housed in the Department of Biological and Agricultural Engineering and is directed by the Idaho State Climatologist. It is supported by the Idaho Agricultural Experiment Station and the Idaho Cooperative Extension System in cooperation with the Idaho Water Resources Research Institute.

ARSCO Qualifications: ISCS is designated by the AASC as the official state climate office for Idaho. The following describes the ways in which ISCS addresses each of the ARSCO qualifications:

Communication Capabilities:

- ISCS maintains a website and internet, email, telephone, and fax communication links.

Information Services:

- Idaho joined CoCoRaHS in January 2009; the Idaho SC serves as the statewide coordinator of the precipitation network, which now has 134 observers.
- Maintain an online archive of the complete period of record for all Idaho Cooperative Observer data sets in cooperation with the University of Idaho Library, which may be downloaded by user-selected station (http://inside.uidaho.edu/asp/liststations.asp).
- Responded to numerous e-mail requests for climate data/information/services.
- Addressed telephone requests for information, services and research.
- Interviewed by local, state and national newspapers, radio stations, and other media outlets.
- Maintain three automated weather stations, a Cooperative Observer Station with over 110 years of data, a CoCoRaHS non-recording precipitation gage, and a recording precipitation gage, and partially fund a SNOTEL site.
- ISCS provides numerous reports including Intensity-Duration-Frequency spreadsheets for many cities in Idaho.
- Established three Idaho Transportation Department Road Weather Information System Weather Stations.

Research:

- Use remote sensing to simulate snowmelt runoff from the Upper Snake River.
- Examine the effect of climate change scenarios on snowpack and runoff volumes and timing for the eastern Snake River Plain, the principal water supply for southern Idaho.
- Evaluate the impact of current water rights on distribution of irrigation water under changing supplies associated with various climate change scenarios.
- Evaluate the impact of climate change scenarios to evapotranspiration on irrigation water demand and the resulting economic impact on agricultural revenues.
- Analyzing historical temperature trends at climate stations across Idaho.
- Developing algorithms and models to assimilate remotely sensed data for use in spatially distributed land surface–atmosphere exchange models.
- Maintain a 130 foot tall eddy covariance forest research tower to study water and carbon exchange in complex mountainous, forested topography.
- Conducting studies for the Idaho Transportation Department on the interaction of inclement weather and road slope and curvature on the frequency of accident occurrences.

Outreach:

- Presentations to Idaho State Legislative committees on climate and climate change issues in the state.
- Climate products made available through ISCS website, and the printed volume, *Climates of Idaho* (Abramovich, R., M. Molnau, and K. Craine, University of Idaho, College of Agricultural and Life Sciences).
- Participate in discussion and meetings regarding formation of National Climate Services.
- Climate Presentations to local elementary schools.
- Interviewed by print, radio and television media contacts.
- Serve as a climate expert on Idaho Public Television talk shows.
- Work with Boy Scouts of America as a merit badge counselor for Environmental Science and Weather.

Monitoring and Impact Assessment:

- ISCS archives Cooperative Observer Network data and makes it available to the public through http://inside.uidaho.edu/asp/liststations.asp.
- ISCS helps monitor current and historical precipitation through the CoCoRaHS network and QA/QC analyses of the Idaho network.
- ISCS is conducting studies of the impact of climate scenarios on state climate, water supply, agricultural water demand, and agricultural revenue for the Snake River Plain of southern Idaho. These are related to historical observations from the Cooperative Observer Network, SNOTEL (http://www.wcc.nrcs.usda.gov/snow/), and an agricultural meteorology network (AgriMet; http://www.usbr.gov/pn/agrimet/).

Illinois State Climatologist Office

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http://www.sws.uiuc.edu/atmos/statecli/

Jim Angel, State Climatologist

The Illinois State Climatologist Office (SCO) is located at the Illinois State Water Survey (ISWS) in Champaign, Illinois on the campus of the University of Illinois. Since 1973, the ISWS has supplied the salary for the state climatologist, as well as computer and communication support and office space. The office also operates the NWS coop site for Champaign-Urbana.

ARSCO Qualifications

The AASC has designated the Illinois SCO as the state climate office for Illinois. The following describes the ways in which the office addresses each of the ARSCO qualifications:

Communication Capabilities

The Illinois SCO has phone, fax, and email services with high-speed Internet service for the rapid transfer of data. The state climatologist maintains a web site and blog devoted to climate data and information on a wide variety of climate topics.

Information Services

The Illinois SCO is actively engaged in providing information services within Illinois. In the past year, 88 contacts were made with the media. In addition, regular monthly press releases are widely used throughout the state. In the past year, 19 public talks were given around the state to a wide range of audiences. Approximately 500 phone calls and emails for specific climate information were received. Many such requests are now fulfilled by the web site. In the first quarter of 2010, the state climatologist web site received 308,000 hits with 23,000 unique visitors and 3,800 repeat users. A change in the server prevented a comparison with data for 2009.

Research

The Illinois SCO maintains an active research program, with applied research focused on Illinois and the Midwest. A journal article looking at future Great Lakes water level scenarios from GCM simulations used in the 2007 IPCC report is in the *Journal of Great Lakes Research* (in press). The Illinois SC is currently in Year 3 of a grant from NOAA using the CDMP Forts daily climate observation data set to analyze 19th

century extreme climate events. The Illinois SC is in Year 2 of a grant from NOAA Climate Program Office (CPO) Sector Applications Research Program (SARP) through the National Drought Mitigation Center to develop a "Drought Ready Community" for Decatur, Illinois. In the past year funding has been received from the AASC for a comparison of CRN and nearby COOP sites in Illinois. A journal article on those results is in preparation. Additional funding from the AASC led to the development of new CRN products. Advance prototypes of those products are available on the Midwestern Regional Climate Center web site (http://mrcc.isws.illinois.edu/).

Outreach

The Illinois SCO engages in a number of outreach activities. In the last year, the Illinois SC has written contributions to the monthly ISWS Water and Climate Summary. He has provided data and guidance to agencies in Illinois, including the Illinois Drought Response Task Force, the Illinois Department of Transportation, the Illinois Attorney General's office, and the Illinois Emergency Management Agency. He has worked closely with University of Illinois Extension on a number of issues that included: a) training of CoCoRaHS weather observers, b) teaching a section on climate to Master Naturalists in Champaign and Madison Counties, c) speaking at University of Illinois Extension Seminars around the state, d) speaking to other groups that are either part of or hosted by Extension such as marketing clubs, and e) occasional guest (April and October) on the Illinois Gardener program on WILL-TV. He was a guest lecturer for both an environmental science and landscape architecture class on the campus of the University of Illinois.

The Illinois SC has worked closely with the National Weather Service on a variety of issues that included: a) training of CoCoRaHS weather observers, b) supporting the cooperative weather observer network through contributions to newsletters, letters of appreciation, attending award ceremonies, etc., and c) coordinating climate services needs in Illinois amongst the five NWS offices that serve Illinois.

The Illinois SC is a member of the American Meteorological Society, Illinois State Academy of Science, and the American Association of State Climatologists.

Monitoring and Impact Assessment

The Illinois SCO regularly monitors the climate conditions within the state. The noteworthy events of 2009 were the wet spring that hampered planting, the coldest July on record for the state, and a cold, wet fall that hampered crop maturation and harvest operations. A report on the 2009 growing season is being prepared. Input on drought and their impacts are provided to the U.S. Drought Monitor.

Indiana State Climate Office (IClimate)

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Dev Niyogi, State Climatologist
Ken Scheeringa, Associate State Climatologist

The Indiana State Climate Office (*IClimate*) was established in 1956 in the Agronomy Department of Purdue University where it continues today. In addition to permanent staff the office provides work opportunities to graduate and undergraduate students in research projects and customer service interactions.

ARSCO Qualifications

IClimate is an American Association of State Climatologists (AASC) Recognized State Climate Office (ARSCO). This office fulfills the ARSCO requirements in the following ways:

Communications Capabilities

IClimate has full access to Internet, email, telephone, and fax capabilities. We maintain a website with daily and hourly Indiana observations from multiple climate networks. The Office also routinely hosts workshops, meetings, and talks to community groups, educators, and policy makers and publishes reports or journal articles.

Information Services

A priority of *IClimate* is to collect and archive historical and current climate data for Indiana and to make these publicly available on the *IClimate* web site (www.iclimate.org). Databases are maintained for observation networks including NWS cooperative stations, ASOS stations, and a statewide automated network of Purdue agricultural weather stations. These databases were transferred to an SQL server in 2009 which has improved speed and reliability through web access. Clients can query these databases or email data questions to us via web forms. We also assist clients to interpret these data as needed to solve their climate related problems.

Research

Iclimate is involved in several research projects primarily supported through NSF, NASA, and other federal agencies. One project is related to the assessment of the role of land use and land cover including urbanization on the regional hydro-climatology. A second is on the development of a regional drought information portal and an environmental cyber-infrastructure prototype for heterogeneous data access and

processing. Other projects involving the role of land use change on the surface temperature datasets and rainfall trends across continental or eastern US are underway. Projects are also underway related to the design framework of land use planning as a tool for climate change adaptation in greener cities with particular focus on Indianapolis, Indiana. Details regarding these projects and resulting publications can be found at http://landsurface.org.

Outreach

A range of media interviews, outreach meetings, and press releases continued through the office, particularly during times of significant weather events and as new seasonal outlooks were released.

Targeted presentations were made to a wide range of clientele ranging from new detectives at a Crime Scene Investigator course ("Weather Resources for Forensics") to talks on climate change and agriculture's future, the role of agriculture in mitigating climate change in the Midwest, drought vulnerability and mapping, climate change education, etc.

IClimate continued as state co-manager of CoCoRaHS Indiana. *IClimate,* NWS staff, and local coordinators again conducted CoCoRaHS training sessions for new observers in 2009 with a free rain gauge as a training incentive. At the end of our fourth year in 2009 more than 1250 volunteers had joined CoCoRaHS Indiana. We write occasional CoCoRaHS state newsletters as a tool to keep volunteers informed and involved.

Monitoring and Impact assessment

In 2009 *IClimate* joined an assessment group known as the Purdue Flood Team. The purpose of the group is to build strategies to assist communities in the mitigation, prevention, preparation, response, and recovery from flood disasters in Indiana in conjunction with county based Community Organizations Active in Disaster (COADs). This year the Purdue Flood Team joined Silver Jackets, a multi-agency collaboration in several states under the US Dept of Homeland Security, focused on flood mitigation efforts. In 2009 the Purdue Flood Team worked with a US Congressman from northern Indiana in an educational effort among citizens who suffer repeated flood disasters in their district.

Iclimate has provided data analysis of drought indices and trigger criteria to the Indiana Department of Natural Resources (DNR) to facilitate the 2009 water shortage plan for Indiana.

At the request of the Policy Director of the Indiana Governor's Office, *IClimate* provided monthly updates on weather events and impacts during winter as the state evaluated its policies regarding its state energy assistance program.

IClimate completed its 2009 AASC grant with the goal to enhance our monthly state climate summaries, particularly to include impact reports. Though the grant has

expired, *IClimate* continues to write weekly and monthly weather summaries which are posted monthly online at our web site: http://www.iclimate.org/summary.asp.

Collaboration with our NWS and RCC partners continues. The local NWS offices sought *IClimate* input when release of an April freeze warning was deliberated after an early warm spring had significantly advanced fruit crops. *IClimate* is a regular participant in the NWS Central Region bimonthly Climate Services webinars and Data Stewardship webinars. *IClimate* routinely accesses climate data from the MRCC MACS system and participates in the new MRCC regional conference calls to state climate offices.

Work continues in monitoring reference evapotranspiration (RefET) throughout Indiana under a two-year grant provided by Purdue Ag Research Programs (ARP). RefET measurements are now integrated into the Purdue automated weather station network with hourly web database updates. Maps of daily total RefET are in process to be posted online as a new product at our web site: http://www.iclimate.org/ET/images/ET.asp. The results of RefET measurements collected in 2009 and 2010 will be compared to RefET models available in the University of Idaho RefET software along with other analyses as part of an ARP sponsored climatology of RefET in Indiana.

At client request weekly and monthly Indiana total precipitation GIS maps based on CoCoRaHS observations are being added to our web site: http://www.iclimate.org/precip/images/precip.asp. *Iclimate* provides weekly rainfall, heat unit, and growing degree day GIS maps to the Purdue Entomology Department for publication in their *Pest and Crop Newsletter*: http://extension.entm.purdue.edu/pestcrop/2010/index.html. A technique to automate the production of GIS maps for our precipitation and RefET products will be investigated in 2010.

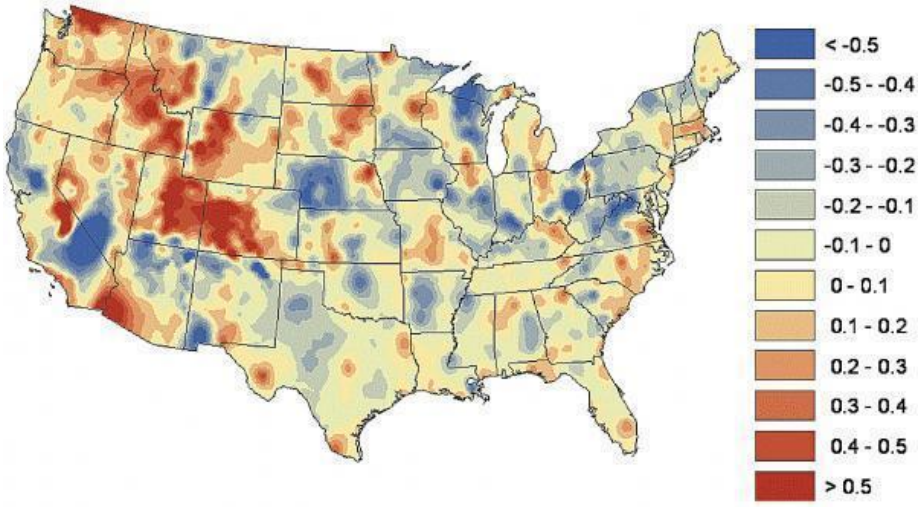
IClimate participates in environmental quality monitoring. In 2009 Ken Scheeringa received recognition for 20 years as observer at the IN41 station of the National Atmospheric Deposition Program (NADP), which monitors precipitation chemistry at over 200 locations nationwide.

IClimate supports other Purdue staff active in the EPA National Air Emission Monitoring Study by providing a data feed as an independent source of quality assurance data for their field measurements nationwide.

During the growing season *IClimate* participates in the biweekly Purdue Crop Weather Roundtable. The discussion topic is the impact of current and forecast weather on diseases, weeds, insects, farm economics, and other concerns on growing field crops. On campus meeting participants are Purdue crop specialists. Extension educators in Indiana counties join the meeting remotely using Adobe Connect.

Education

Through an NSF grant, *IClimate* is working with a network of teachers in developing and delivering a curriculum on climate science with a focus on the Midwest US. The website (http://iclimate.org/ccc) is being used by teachers to access climate change curriculum modules that can be integrated into middle school activities. The office is also developing an exhibit on climate change education for the Indiana State Fair where more than 500,000 visitors are expected on Purdue Day. A comic book targeted for younger audiences is in review.



Map showing observation minus reanalysis (OMR) trends in the continental United States from 1979-2003. The trends are associated with land use and land-use changes. Units are in degrees Celsius per decade. (Fall S., D. Niyogi, R. A. Pielke Sr., A. Gluhovsky, E. Kalnay and G. Rochon, 2009: Impacts of land use land cover on temperature trends over the continental United States: assessment using the North American Regional Reanalysis, International Journal of Climatology, DOI: 10.1002/joc.1996.)

Page out of the "life size" comic book being developed on climate change education.

Iowa State Climatologist Office

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Harry J. Hillaker, State Climatologist

The State Climatologist Office (Iowa SC) is a bureau of the Iowa Dept. of Agriculture & Land Stewardship. The State Climatologist is appointed by the Iowa Secretary of Agriculture (an elected state official). The Iowa SC office was founded in Iowa City at the University of Iowa on October 1, 1875 and was initially known as the Iowa Weather Service. In 1890 the Iowa Weather Service operations were moved to Des Moines and came under the supervision of the Iowa Weather & Crop Service. The Iowa SC was co-located with the National Weather Service from 1890 until 2003 and has worked very closely with that agency since its inception. Finally, the Iowa SC was made a division of the newly created Iowa Department of Agriculture in 1923.

Information Services

The Iowa SC office maintains archives of NWS co-op and first order station data back to the beginning of records. This would include the regular NCDC reports such as *Storm Data*, *Iowa Climatological Data* and *Local Climatological Data*, as well as the original observations. Access to a multitude of federal and state weather and climate data archives are also maintained. With 134 years of continuous operation, the Iowa SC Office has an unusually large archive of original federal and state books, reports and manuscripts from the 19th and early 20th century.

Research

The Iowa SC office primarily is involved with the acquisition, processing, dissemination and archiving of weather and climate data. However, research activities are performed as funding permits and have been conducted in cooperation with agencies such as the National Climatic Data Center (NWS co-op network metadata), the Midwestern Regional Climate Center (pre-1948 data keying project), the National Science Foundation (crop-hail climatology), U. S. Army Corps of Engineers (evaporation, snow, short-duration precipitation studies) and the Iowa Dept. of Natural Resources (development of more timely temperature data resources).

In the past year the Iowa SC office has been working with the Midwestern Regional Climate Center (MRCC) to document the quality control methods utilized in creating a serially complete set of daily Iowa temperature, precipitation, snowfall and snow depth data dating to January 1991. These records have been converted by MRCC into the common TD-3200 format for use by other interested researchers. It is hoped that this

data set will be useful in evaluating the effectiveness of data QC techniques used by other agencies, as well as in documenting any trends in data completeness and accuracy over the 18 year period of record. Further, the data set should be of great utility in applications requiring complete time-series of data (i.e., no missing or cumulative data). This report was published in the *Journal of Service Climatology*.

Work also has continued in developing a monthly data base of historical Iowa precipitation records with about 19,600 station-years compiled. Preliminary work in developing statewide averages of various weather statistics beyond average monthly temperature, precipitation and snowfall was also begun. These new averages include the number of days per year reaching or exceeding maximum temperatures of 90º or 100ºF and minimum temperatures at or below 0ºF, dates of last spring and first fall freeze, as well as extreme annual maximum and minimum temperature and maximum daily precipitation amount.

Outreach

The office maintains very open communication with the news media with a total of 326 news media contacts this past fiscal year. This, combined with preparation of Public Information Statements issued in cooperation with the National Weather Service, and weekly and monthly crop-weather summaries prepared for the USDA provides very wide dissemination of climate products and information. A total of 2,351 inquiries were answered during the past year. Most inquiries were received from government agencies (31%), the news media (14%), attorneys (11%), education (5%) and insurance (5%). Virtually every major branch of State government utilizes the Iowa SC Office data on a regular basis.

The office also prepares regular monthly climate reports, the *Preliminary Iowa Monthly Weather Summary* and the *Iowa Climate Review*. The Preliminary Monthly Weather Summary is issued within the first few work days of each month and provides a brief summary of Iowa's weather conditions for the previous month. This report is available on-line and is also sent free of charge via regular mail. The Iowa Climate Review is a monthly report containing daily data for all official Iowa weather stations and is available by subscription. The Climate Review report is not currently on-line; however, the raw data are provided to Iowa State University's Iowa Environmental Mesonet web page and made available at that site. As part of the AASC/NCDC exchange program work began in providing monthly weather summaries to the Midwestern Regional Climate Center (MRCC), via the AASC web page, beginning with the November 2008 summary. Occasional special storm event summaries have also been prepared for the MRCC as part of this grant. This reporting has continued beyond the end of the grant funding in September 2009.

The Iowa State Climate Office works closely with the National Weather Service in monitoring the co-op and ASOS data networks so as to improve the quantity, quality and timeliness of Iowa climate observations. The State Climatologist has served on several NWS regional and national committees involved with climate and data issues and is currently active on the National Data Stewardship Committee. Finally, the Iowa SC

attended the AASC annual meeting in Grand Rapids, MI in July 2009 and has served as the AASC Secretary-Treasurer since January 2009.

Monitoring and Impact Assessments

The Iowa State Climate Office is a member of the Governor's Drought Task Force and Flood Task Force. The office provides regular updates of monthly temperature and precipitation data to the USDA Farm Service Agency for their use in evaluating county-by-county eligibility for disaster relief programs. The office assists the Iowa Homeland Security and Emergency Management Division in their operations and occasionally provides guidance for county and regional emergency response offices. The office also provides near real-time rain event maps for the Iowa DOT for their use in evaluating where roadways may be in need of detailed examination for possible flood damage. The past calendar year was a much quieter one than 2008, with the lowest number of tornadoes since 1997. Precipitation was very heavy for the third consecutive year, ranking 11th highest among 137 years of records. However, flooding was much less extensive than in 2008. A record cool July in 2009 highlighted the third coolest summer of record. Cool weather greatly delayed crop development and harvest; nevertheless crop production was excellent with a record high state average corn yield. The year closed with two major blizzards in December which contributed heavily to the second snowiest calendar month among 122 years of snowfall records.

Kentucky Climate Center (KCC)

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Stuart A. Foster, State Climatologist and Director
Rezaul Mahmood, Associate Director

The Kentucky Climate Center (KCC) observed its 32nd year of operation in 2010. As a member of Western Kentucky University's Applied Research and Technology Program (ARTP), the KCC received funding to support both undergraduate and graduate students and provide opportunities for them to participate in a variety of research and service activities, including presentations at statewide, regional, and national meetings. The KCC currently supports students from programs in geography, meteorology, and mathematics.

The KCC is recognized by the AASC as the State Climate Office for Kentucky in the National Climate Services Partnership. Therein, the KCC had developed strong relationships with the five National Weather Service forecast offices that serve portions of Kentucky, which include Jackson, KY, Louisville, KY, Paducah, KY, Wilmington, OH, and Charleston, WV. The KCC also enjoys supportive relationships with the Midwestern Regional Climate Center and the National Climatic Data Center.

In addition to housing the Office of the State Climatologist, the Kentucky Climate Center is home to the Kentucky Mesonet and the Climate Research Laboratory. The Kentucky Mesonet is a statewide network of automated weather and climate stations that is recognized as the official source of climatological observations for the Commonwealth of Kentucky. The Climate Research Laboratory houses several Linux workstations running WRF, WRF-Chem, MM5, and RAMS and supports atmospheric and atmospheric chemistry modeling focusing on impacts of land use and land cover change.

Information Services

The KCC provides climate data and information through a variety of channels. These include communication via telephone, fax, and e-mail. Our primary source of service delivery is via our website, which includes a variety of narratives, tables, maps, and graphs summarizing Kentucky's historical climate. The website emphasizes interactive graphics to help users find the data and information they need. The Kentucky Climate Center produces monthly climate summaries for Kentucky. These reports are submitted to the Midwestern Regional Climate Center and disseminated through the AASC website, as well as the KCC website. In addition, the KCC maintains the Kentucky Mesonet

website (http://www.kymesonet.org/). The Kentucky Mesonet, a partnership with the National Weather Service, was recognized in 2010 by Kentucky's Commonwealth Office of Technology as winner of the Best of Kentucky Technology Award for Best Application Serving Public Agencies.

Research

Faculty and students associated with the Kentucky Climate Center are involved in a variety of applied research projects. A current focus is on the analysis of data from the Kentucky Mesonet, including mountain/valley temperature differences and temperature bias due to station exposure and instrumentation. Modeling research continues to assess impacts of land-use/land-cover change and soil moisture on planetary boundary layer, precipitation, and air quality dispersion. Papers on these topics were published in Atmospheric Environment, Applied Engineering in Agriculture, and Journal of Geophysical Research. The KCC also contributed to a monograph addressing the bias in daily mean temperature when calculated using different formulas for NCDC's Climate Database Modernization Program.

Faculty, staff, and students affiliated with the Kentucky Climate Center presented research papers at the Annual Meetings of the American Meteorological Society, the Association of American Geographers, the Kentucky Academy of Sciences, and the Southeast Division Association of American Geographers.

Outreach

The KCC provides outreach via the media, including interviews through the television, radio, and newspaper media addressing significant weather events, climate change, and the Kentucky Mesonet.

The state climatologist plays an active role on the Drought Mitigation and Response Advisory Council organized through the Kentucky Division of Water within the Kentucky Cabinet for Energy and Environment.

The KCC was a contributing sponsor of the Regional Climate Change Forum (http://www.kstc.com/conferences/rccf/index.cfm) organized and hosted by the Kentucky Science and Technology Corporation. The state climatologist delivered a featured presentation highlighting Kentucky's climate, natural hazards, and documented climate variability and change in Kentucky.

The Kentucky Division of Emergency Management and the Kentucky Climate Center hosted the 2010 Kentucky Weather Conference in January. This event was targeted at emergency managers and other first responders and was the first in what is anticipated to become an annual event.

The KCC was an invited presenter at the Kentucky Association of Mitigation Managers 2010 annual meeting. The presentation highlighted the Kentucky Mesonet and its value for hazard mitigation and response.

Monitoring and Impact Assessments

Development of the Kentucky Mesonet continued. Forty-nine automated environmental monitoring stations have been installed throughout the state as of May 2010, including 25 new stations over the previous year. Mesonet staff continues to enhance relationships with NWS forecast offices serving Kentucky. Data from the Kentucky Mesonet are freely available to the public at http://www.kymesonet.org/.

Louisiana Office of State Climatology (LOSC)

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Mission

The mission of the Louisiana Office of State Climatology (LOSC) and the LA State Climatologist is to serve as the State focal point for activities pertaining to the climate of Louisiana. Responsibilities include:

- to collect, archive, and make available climate data for the state of Louisiana
- to provide climate education and information to the citizens of the region through various outreach programs including the media
- to maintain an active research program pertaining to the climate of Louisiana and the region

To achieve these goals, the LOSC cooperates with LSU, the National Weather Service (NWS), the Southern Regional Headquarter of the NWS, the Southern Regional Climate Center (SRCC), and the National Climatic Data Center (NCDC). LSU provides the infrastructure for the LOSC, and the National Weather Service Offices maintain the quality of weather observations in the region, with climate data exchanged between the LOSC, NWS, SRCC, and the NCDC.

ARSCO Qualifications

LOSC is designated by the AASC as the official state climate office for Louisiana.

Communication Capabilities

LOSC has full access to internet, email, multiple phone lines, facsimile machines, and regular mail. We maintain a website with updates of daily, weekly, and monthly summaries for the State.

Information Services

The LOSC collects and archives high quality climate data for Louisiana and then make these data available to the public, often with some interpretation or forensic application. Users include researchers, attorneys, construction companies, federal and state planning agencies, private consultants, power companies, insurance companies, teachers and students, among others. The number of requests continues to decline,

though hundreds are still handled annually. We also collaborate with the Louisiana Office of USDA's National Agricultural Statistics Service, where data are shared.

Research

The LOSC maintains an active research agenda involving the State and region, and sometimes beyond. Over the past year, this research primarily focused on hurricanes and applied climatology. We also work with the University of Oklahoma to operate a NOAA-Regional Integrated Sciences and Assessment called SCIPP – the Southern Climate Impacts Planning Program. Recent publications include:

Keim, B.D., and R.A. Muller. 2009. *Hurricanes of the Gulf of Mexico*. Louisiana State University Press: Baton Rouge, Louisiana, 232 pp.

Hamilton, L.C., and B.D. Keim. 2009. Regional Variation in Perceptions about Climate Change. *International Journal of Climatology* 29(15):2348-2352. DOI 10.1002/joc.1930.

Allard, J., B.D. Keim, J.E. Chassereau, D. Sathiaraj, 2009. Spuriously Induced Precipitation Trends in the Southeast United States. *Theoretical and Applied Climatology* DOI 10.1007/s00704-008-0021-9.

Outreach

The LOSC conducts frequent interviews with radio, newspaper, and magazine media. Several hundred media contacts were logged in 2009. We cooperate and coordinate efforts closely with the NWS Offices in the region. We also remain primed and ready to work with Louisiana Office of Emergency Preparedness when needed.

Monitoring and Impact Assessments

The LOSC has taken on the responsibility of producing a weekly summary of the State's weather and climate in the form of the *Louisiana Weekly Climate Review* available on the LOSC website (www.losc.lsu.edu). This report is also e-mailed to over 100 recipients across Louisiana, including most television weather-casters in the State, concerned State Office Officials, as well as the National Weather Service Offices that serve Louisiana. The Office also provides a weekly summary of Louisiana Climate Data to the National Agricultural Statistics Service (NASS) that is published weekly in the *Louisiana Crop Weather Summary.* In addition to these weekly products, the LOSC also produces monthly summaries of the State's Climate data, which is also available on the LOSC website. The office also produces event-based summaries for significant weather events that impact Louisiana. The LOSC is also active on the ad hoc committee of the *U.S. Drought Monitor*.

Office of the Maine State Climatologist

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George L. Jacobson, State Climatologist

The year's activities included many routine informational services, establishment of an informative web site, and follow-up throughout the State of Maine to a major climate report prepared in 2009 at the request of Governor Baldacci.

The report, ***Maine's Climate Future: An Initial Assessment***, was formally delivered to Governor Baldacci in early 2009. At that presentation, the Maine State Climatologist briefed the Governor and his entire Cabinet, and the Governor encouraged all state agencies to work with the research teams to incorporate climate-related planning in future policy.

The report is available in pdf form at the new ***Maine Climate News*** website: http://www.extension.umaine.edu/maineclimatenews/

Jacobson, G.L., I.J. Fernandez, P.A. Mayewski, and C.V. Schmitt (eds). 2009. Maine's Climate Future: An initial assessment. Orono, ME: University of Maine.

Legislation directing the **Maine Department of Environmental Protection** (DEP) to undertake stakeholder-driven adaptation planning was passed by the Maine Legislature in April 2009. That process was begun with the a major meeting on 1 May 2009, at which the Maine State Climatologist provided a background briefing about the science of climate change in a Maine context. Subsequent stakeholder-participatory discussions took place during the remainder of 2009, and led to a report that was completed early February 2010. This report, ***People and Nature; Adapting to Climate Change: Charting Maine's Course***, is a good example of how the public and private sectors in the state can collaborate in meaningful planning for future change. The Maine Legislature unanimously endorsed the report and instructed the DEP to continue the process of planning and evaluation for climate adaptation.

A second follow-up to the 2009 ***Maine Climate Future*** report was undertaken in the field of public health. **Dr. Dora Ann Mills**, **Director of the Maine Center for Disease Prevention**, has ordered an analysis of the implications of climate change as a new priority for her office. As one initiative, they held a one-day conference on 7 April 2010 to explore themes around ***Climate Change and Human Health***, with the Maine State Climatologist as one of the featured speakers. That conference then led to other meetings, proposal writing, and various activities designed to make additional progress in that area. Health professionals in Maine have been particularly interested in the possible

consequences of climate change on the vectors that spread **Lyme Disease** and **Eastern Equine Encephalitis**.

The Maine State Climatologist has continued to make public presentations (several dozen) throughout the state; he has been the invited speaker at scientific conferences, and has met frequently with the media. All of these interactions are part of an active initiative to provide climate-related information and perspective to Maine citizens, policy makers, educators, and decision makers throughout the state.

We are pleased to note that a new web site is now providing easy access for the public. The site ***(Maine Climate News)*** is operated cooperatively by the Maine State Climatologist, University of Maine Sea Grant (NOAA), and University of Maine Cooperative Extension; the two National Weather Service offices from Maine (Caribou and Gray) are also linked there. The site includes information about recent weather patterns, reports on climate-related research activities by University of Maine faculty and students, links to relevant reports, and a means for Maine citizens to request information and to have questions answered. One especially pleasing feature of the site is "***Ask the Climatologist***" – a means for the public to enquire about matters that interest them. A group of senior graduate students in the **Climate Change Institute** has kindly agreed to respond to most of the queries, giving them practice in dealing with a broad range of issues and communicating with the public. The most interesting questions and responses are posted (and archived) on the ***Maine Climate News*** site for broad distribution.

After a very wet summer of 2009, the weather in the autumn turned cool. October was unusually cold throughout the Northeast, just as it was in the lower 48 states and most of Western Europe. For Maine, October was the sixth coldest in the past 115 years, and winter-heating season seemed to have begun in earnest earlier than usual. (This was, of course, a good example of how local and regional weather patterns can lead to mistaken impressions of the larger picture; in fact, from a global perspective October was actually the sixth warmest for that month since 1880.)

After the cold October weather, the rest of autumn and the subsequent winter were strikingly warm. November was the fourth warmest since records have been kept; December was also warmer than normal. January temperatures were more than 7.3^{o}F warmer than expected (tenth warmest since 1985), and February was 8.7^{o}F warmer than expected (second warmest since 1895). The pattern continued through March and April. With little snow after February in most of the state, the "spring" season seemed to appear early by two-to-four weeks (especially in the southern two-thirds of the state). As the Northeast Regional Climate Center reports, the GDD (growing degree days) for Maine were at least one to two weeks (and even more along the coast) ahead of normal for the period from 15 March to 23 May 2010.

The relatively mild conditions of the 2009-2010 winter and spring were among the warmest of the period of instrumental records. But they were not so unusual in the context of El Niño years. Comparisons of this past season to the previous nine El Niño configurations for the period November through March show that the pattern of warmth

along 45^{o} N latitude is rather typical. This pattern led, of course, to disappointingly warm, wet weather during the 2010 Winter Olympics in Vancouver, BC. But inhabitants of Maine and the northern tier of the United States probably minded less when golf and even fishing seasons were moved ahead by several weeks or more this spring.

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Konstantin Vinnikov, Acting State Climatologist
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The State of Maryland Climatologist Office is Maryland's hub for all climate-related information. We provide climate data to Maryland state businesses, agencies, students, researchers, and citizens of Maryland. We maintain links with many cooperative meteorological stations in the state, the National Climatic Data Center (NCDC), National Weather Service Forecast Offices, National Atmospheric and Oceanic Administration (NOAA), and many other private sources of climate and weather information.

Summary of Activities in 2009

The State of Maryland Climatologist Office received approximately 160 data requests in 2009. The majority of data requests are sent via e-mail to climate@atmos.umd.edu. We also receive several requests via telephone and mail. The State Climatologist Office is responsible for answering these requests in a timely manner. The type of data request that we most often receive is for archived temperature and precipitation data. Most of this data are obtained from NCDC and are then forwarded on in a useful form to the user. We also have data requests from several law firms asking for weather information that occurred on a specific day. Students and research scientists also request data on a regular basis. Their requests can vary from climatological information to hydrological information to investigating the upcoming seasonal weather outlook. Some governmental agencies that contact us for climate data include the Frontier Group for Environment Maryland, Geo-Technology Associates, Inc., Baltimore County Department of Public Works, United States Naval Academy, etc. Overall, most data requests are processed using NCDC data, with National Weather Service (Sterling, VA office) data as the runner-up. All of the data we send out is official data, unless otherwise stated.

The State of Maryland Climatologist Office is also active with Maryland COOP stations. We receive and archive monthly e-mails and letters from approximately 30 observing stations in Maryland, in which they send a summary of the daily weather for each month. These sites are located across the State of Maryland and are managed by private citizens.

The Assistant to State Climatologists Lisa Wojdan has redesigned the official web site of the Office (http://www.atmos.umd.edu/~climate). It is still in process of developing.

We have begun to collect the longest, more than 95 years, of daily climatic records for MD and vicinity that can be used for analysis of trends in climate variability and heat

wave statistics. Figure 1 provides schematic map of such stations with such a long records which data is available now. We continue work on quality control and homogenization of these time series. They will be made available through our web site.

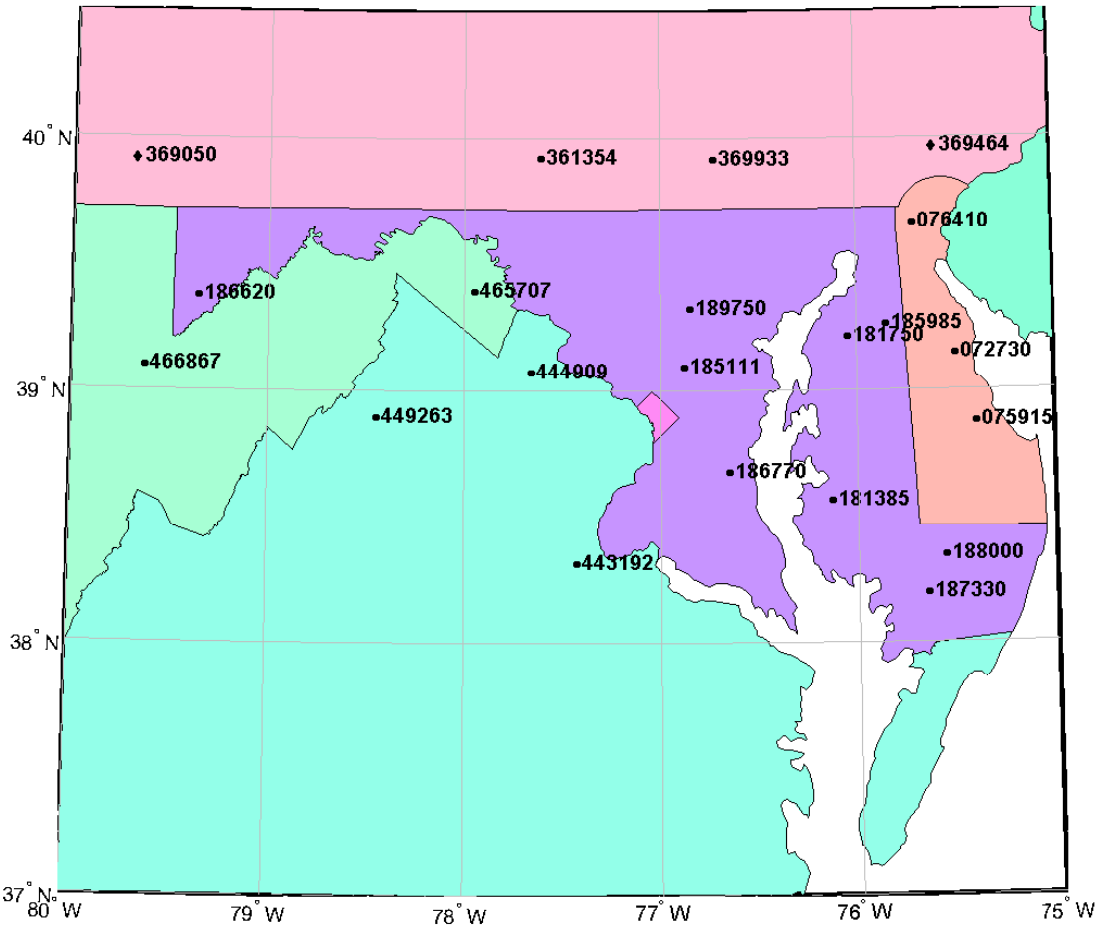

Figure 1. Map of stations in Maryland and vicinity with available climatic records longer than 95 years. NCDC/NOAA stations ID numbers are used here instead of stations' names.

Michigan State Climatological Resources Program (MRCP)

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Jeff Andresen, State Climatologist

The Michigan Climatological Resources Program (MRCP), home of the Office of the Michigan State Climatologist within MSU's Dept. of Geography, is the archival and service center for climatological data and related information for Michigan. Leadership of MCRP is the responsibility of the State Climatologist, who supervises operational and research activities under the direction of the Chair of the Geography Department. Operational and research support in the program are provided by Peter Kurtz and Aaron Pollyea, while technical and clerical support is provided by Cathy Sernick.

ARSCO Qualifications

The MRCP is an American Association of State Climatologists (AASC) Recognized State Climate Office (ARSCO) and fulfills a number of qualifications as outlined below. Major objectives of the MCRP are consistent with the AASC-defined role of a state partner in provision of climate services, including: 1) Collection of observations for the purpose of climate monitoring, summarization and dissemination of weather and climate information to the user community; 2) Demonstration of the utility of climate information in the decision making process and assessment of climate impacts; 3) Development of an active research program addressing climate-related issues in the state and region; and 4) Development of an educational element of the program which allows and encourages students to participate in climatological research, gain operational job experience on internships, and provide training in applied use of climatological information.

Communication Capabilities

The majority of public requests for climate data and information are placed via telephone and email exchanges. While a fraction of requests are still filled through conventional mail service, a growing proportion of responses are through email. MCRP also provides information through dedicated web sites (see below). Climate data are collected operationally in the program via internet (Unidata's Internet Data Distribution system) and dedicated satellite receiver connections, and via internet and telephone through the program's Enviro-Weather information access system.

Information Services

The total number of public requests for climate-related data and information in 2009 was just under 1000, most of which were received via phone or email. The majority of these requests were from law firms, the insurance industry, and other researchers. The number of formal billable user requests filled in FY 2009 was 135. The numbers of formal user requests and amount of request income have decreased significantly during the past 10 years, which mirrors trends observed at other climatological service organizations in the US. These decreases are most widely thought to be attributed to the growing access and availability of weather and climate data on the internet. This is also consistent with the numbers of users on the associated Climate Information (climate.geo.msu.edu), MAWN (www.agweather.geo.msu.edu/mawn) and Enviro-weather (www.enviro-weather.msu.edu) web sites, which have collectively grown from less than 25 per day in 1997 to more than 4300 per day in 2009.

Outreach Activities

The MCRP in conjunction with MSUE (through the SC's formal appointment) also maintains an active outreach program through traditional venues, providing climate-related information in formats ranging from public speaking engagements to regular columns in the popular press. During 2009, the MCRP staff provided 10 interviews to print, radio, and television media and 12 talks or seminars to the public. The SC and some MCRP staff also write weather- and climate-related columns on a daily (MSUE Crop Advisory Team, see www.ipm.msu.edu/aboutcat.htm) and bimonthly (Michigan Farm Bureau) basis. During 2009, 92 columns were written. The MCRP also actively supports a number of local and state government functions. During 2009, the SC served as a member of the State of Michigan's Climate Action Council. The Climate Action Council was tasked (by Governor Jennifer Granholm) with developing an inventory and statewide strategy for reduction of greenhouse gases as a part of future legislation related to climate change mitigation.

Research

MCRP maintains an active research program addressing climate-related issues in the state and region. Current projects involve agricultural water use research within the state (including operational irrigation scheduling), investigation of past and projected future climate changes in the region, and the impacts of weather and climate on regional agriculture. We also continued work on the Enviro-Weather project, the primary objective of which is the development and implementation of www-based techniques and tools that address weather- and climate-related processes in agricultural and natural resource management in Michigan. During 2009, staff at MCRP authored or co-authored 5 refereed journal articles, 2 book chapters, and 35 non-refereed articles and technical reports. MCRP was awarded 2 new external grants during 2009, had 3 grants in force from previous years, and 6 new grant proposals were submitted for review.

Minnesota State Climatology Office (MN_SCO)

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Jim Zandlo, State Climatologist

The Minnesota State Climatology Office (MN_SCO) exists to manage, analyze, and disseminate climate information in service to the citizens of Minnesota. The MN_SCO is funded by the State of Minnesota Department of Natural Resources - Division of Waters, and housed at the University of Minnesota - Department of Soil, Water, and Climate. This partnership was formed in 1973.

The MN_SCO assists its customers in their investigations of the climate's impact on various components of the natural environment, and on socioeconomic activities. The MN_SCO uses its climate monitoring resources to quantify weather conditions and to place these conditions within historical and geographical context. The MN_SCO also provides quantitative summaries of historical climate conditions, allowing users to make informed decisions about future activities.

In order to provide its services, the MN_SCO requires an extensive historical climate data set. The climate database managed by the MN_SCO consists of over 100 million data points. The database features data collected by Minnesota's high spatial density precipitation monitoring program, formed in the early 1970's. This "network of networks" utilizes the efforts of water-oriented state and local agencies to assemble precipitation data from approximately 1500 observers each year. Additionally, the National Weather Service (formerly the U.S. Weather Bureau) has maintained a large scale, volunteer-based climate monitoring network in Minnesota since 1890. Other, smaller-scale climate monitoring efforts extend the historical record earlier into the 19th century. The MN_SCO also archives multi-element hourly weather data gathered at Minnesota's airports.

The MN_SCO provides customers with free access to a comprehensive electronic climate database. The MN_SCO also serves its customers by offering a variety of value-added analyses of climate data in the form of narratives, maps, graphs, and tables. Customers access MN_SCO products and services via a Web site, e-mail, telephone, and office visits.

The customers of the MN_SCO are many and varied. Customers can be grouped in the following categories:

- Minnesota Department of Natural Resources (sponsoring agency)

- State, Federal, and Local Governmental Agencies
- Private Sector Professionals
- Academic Community
- General Public

ARSCO Qualifications

The MN_SCO is designated by the AASC as the official state climate office for Minnesota. The following describes the ways in which the MN_SCO addresses each of the ARSCO qualifications:

Communication Capabilities

- full-featured Web site
- fully staffed information line
- near-immediate response to e-mail inquiries

Information Services

- Web site – the MN_SCO Web site hosts approximately 3000 users per day. The Web site offers free access to nearly all of Minnesota's digitized climate data, as well as a number of value-added products such as narratives, maps, and tabular summaries.
- The Web site offers on-line daily data entry and data maintenance capability to volunteer precipitation observers. These near real-time data are automatically transferred to the National Weather Service North Central River Forecast Center.
- Phone and e-mail – the MN_SCO answers dozens of phone calls and e-mails per week from customers with climate questions.

Research

- In 2009, the MN_SCO continued a project that compares hourly precipitation data (TD-3240) with daily precipitation data (TD-3200 and Minnesota's high spatial density precipitation monitoring program) in an effort to 1) refine or create time-of-observation metadata and 2) provide a quantitative evaluation of observer behavior. A primary use of the project concerns the preparation of data sets for NOAA's Hydrometeorological Design Studies Center work on the NOAA Atlas 14 - Midwest Volume.
- The State Climatologist is a principle member of two advisory committees tasked to provide guidance concerning climate change adaptation research and outreach.

Outreach

- Staff are commonly requested to attend multi-agency, multi-displinary meetings where a climatological perspective is required.
- Staff give frequent interviews to electronic and print media.

Monitoring and Impact Assessments

- In late-2009, Minnesota became the 50th and final *CoCoRaHS* state, working with the National Weather Service and the Colorado Climate Center to blend Minnesota's existing precipitation monitoring program with the national initiative.

- Web site offers a variety of routinely prepared summaries of weekly and monthly temperature, degree day, precipitation, and snow depth data.
- Web site offers a chronological journal of significant weather events, providing a description of the event, impacts, and historical context.
- The MN_SCO utilizes a list server to deliver a monthly electronic newsletter summarizing climate conditions observed during the previous month and the resulting impact on water resources (approximately 500 subscribers).
- The MN_SCO is in frequent communication with authors of the U.S. Drought Monitor.

Office of the Mississippi State Climatologist

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Charles Wax, State Climatologist
Michael Brown, Assistant State Climatologist

Dr. Charles L. Wax was appointed Mississippi State Climatologist upon nomination by Governor William Winter and the execution of a Memorandum of Agreement between NCDC, NWS Southern Region, and Mississippi State University dated April 21, 1983. The MOA was signed by University President James McComas and the SC Office was vested in the Department of Geosciences at Mississippi State University, where the office remains today. The SC is not funded beyond one-quarter time release from teaching in the department. The SC is involved in teaching, research, and service through the university, and has been granted ARSCO status. A new Memorandum of Agreement between NCDC and Mississippi State University dated October 17, 2008 recognizes the Mississippi State Climate Office as the ARSCO State Climate Office for the State of Mississippi with Dr. Charles L. Wax as State Climatologist. The 2008 MOA was signed by Dr. Vance Watson, University President, and Dr. Tom Karl, NCDC Director. Dr. Wax is presently the longest-serving SC in the AASC.

Service activities of the SC this past year include the routine handling of daily requests for data or information, and provision of data analyses for more complex requests. The same sort of climate data consumers are found in Mississippi as elsewhere—lawyers, engineers, professors, researchers of all types, businessmen, housewives, farmers, teachers, students with science fair projects, and every other imaginable user. Much time is spent providing weather summaries to other government agencies upon request, but no routine publication of this sort is attempted. An estimated 50 email requests are handled daily in the SC office.

Outreach activities this past year have continued to be heavily focused on the perceptions and possible effects of climate change. The SC office continues to be overwhelmed with requests for information and for presentations about potentially changing weather characteristics to groups throughout the state and region. The SC has been cast in the unwelcome role of "expert" on climate change! The Mississippi public is also manifesting a heightened awareness of the effects of weather and climate on all types of activities, especially severe weather, due most likely to increased media coverage of weather and climate.

Research activities this past year included modeling the physical and cultural impacts on groundwater resources from the shallow alluvial aquifer of the Mississippi Delta region;

climatic influences on duck migration patterns in the Mississippi Flyway; distribution of tornadoes, thunderstorms, and lightning strikes in Mississippi**;** and climate's impact on the distribution of West Nile Virus in Mississippi. An article on climatically controlled disposal of large hog farm wastewater in Mississippi was published in the new AASC Journal of Service Climatology!

This past year the SC was designated lead author and developer of a disaster mitigation plan for Mississippi State University. The work was funded by FEMA and resulted in a document detailing vulnerabilities of the university to everything from earthquakes, tornadoes, hurricanes, ice storms, lightning, and wildfires to all man-made hazards such as terrorism and crime.

The following specific outreach activities and public educational presentations on weather and climate were conducted this year:

- Served as co-state coordinator for the CoCoRaHS network. Over 200 observers are enlisted across the state at present, and the State Climate Office has used a little over $2000 of grant money to buy rain gauges to distribute to the observers. Mississippi came in second in the nation-wide "March Madness" observer enlistment contest this year.
- Served as a member of Mississippi Mesonet Steering Committee attempting to establish a mesonet in the state
- Presented a guest lecture to the Broadcast Meteorology Program Summer Workshop at Mississippi State University
- Presented a guest lecture on climate change to a Wildlife and Fisheries undergraduate seminar class at Mississippi State University
- Presented a seminar on climate change to University of Mississippi Chemical Engineering Department graduate students and faculty in Oxford, MS
- Conducted a field trip on "Climate on the Prairie" for the Extension Service Ecology and Conservation Camp on the Black Prairie field study site in eastern Mississippi
- Presented a lecture on "Weather and Climate of the Mississippi Delta" in support of the Maroon Edition's study of John Grisham's book "The Painted House"
- Conducted two Forestry shortcourse presentations on "Weather and Stability for Controlled Burning" for the Mississippi Forestry Commission, at Starkville in April and at Hattiesburg in October
- "Climate Change." Guest lecture presented to the Environmental Science class at Jackson Preparatory School, Jackson, MS
- "Severe Weather." Guest lecture presented to 450 6-7-8th graders at Jackson Preparatory School, Jackson, MS as a part of Science Month activities
- "Climate and Climate Change." Presented to Starkville Senior Center, Starkville, MS
- Conducted a radio interview on global warming for the American Family Radio "Nothing But Truth" show

Invited Conference presentations:
2009. Wax, C.L., J. Pote and T. Merrell. "Climatological and Cultural Influences on the potential for conservation of groundwater in the Mississippi Delta Shallow Alluvial Aquifer by substituting surface water for irrigation." Mississippi Water Resources Conference, Tunica, MS.

2009. Wax, C.L. "Changing Climate Trends and Cycles." Alabama Vegetative Management Association, Tuscaloosa, AL.

2009. Wax, C.L. "Climate Change and Agriculture." Mississippi Agricultural Information Council, Orange Beach, AL.

Grants funded:
Mississippi Institutions of Higher Learning Board. Development and Implementation of a Multi-Hazard Mitigation Plan for Mississippi State University." $84,611.

Mississippi Water Resources Research Institute: "A Climate-driven model to serve as a predictive tool for management of groundwater use from the Mississippi Delta Shallow Alluvial Aquifer." $106,616.

Grant proposals submitted:
USDA National Institute for Food and Agriculture, Agriculture and Food Research Initiative Competitive Grants Program: "Climate Change Mitigation and Adaptation in Agriculture". $210,000. (Co-PI)

USGS: "Integrated GIS-Neural Network Decision Support System to Estimate Groundwater Levels in the Mississippi Delta Alluvial Aquifer." $190,000. (Co-PI)

Publications:
2009. Wax, C.L., J. Pote and T. Merrell. "Climatological and Cultural Influences on the potential for conservation of groundwater in the Mississippi Delta Shallow Alluvial Aquifer by substituting surface water for irrigation." In Proceedings, Mississippi Water Resources Conference. Mississippi Water Resources Research Institute. http://www.wrri.msstate.edu/pdf/2009_wrri_proceedings.pdf.

2009. Schummer, M., R. Kaminski, C. Wax, and M. Brown. "Predicting Duck Migration with a Weather-Severity Index." Delta Wildlife, 17(4): 34-35.

2010. Wang, G., R. Minnis, J. Belant, and C. Wax. "Dry Weather Induces Outbreaks of Human West Nile Virus Infections." BMC Infectious Diseases, 10:38. http://www.biomedcentral.com/1471-2334/10/38.

In Press. _____. "Mississippi's Climate." The Mississippi Enclylopedia, Ed. Charles R. Wilson. University Press of Mississippi, Oxford,MS.

In Press. Brown, M.E. and C. L. Wax. "Disaster Resistant University Hazard Mitigation Plan, Mississippi State University." FEMA Document--Mississippi State University.

Missouri Climate Center (MCC)

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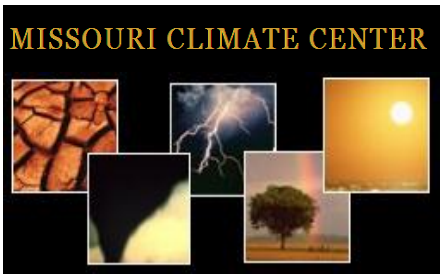

Patrick Guinan, State Climatologist
Charly Clendenning, Undergraduate Assistant
Jane Niemeyer, Undergraduate Assistant
Jeffery Hall, Undergraduate Assistant

The Missouri Climate Center (MCC) is designated by the AASC as the official state climate office for Missouri. As State Climatologist for Missouri and Director of the Missouri Climate Center, the SC serves as a resource for weather and climate information. The State Climatologist collects and maintains an extensive historical climate database of Missouri weather records for monitoring and dissemination to the citizens of the state and beyond. This includes performing and assisting in the primary functions of the center whose mission is to advance the use of climate information for the economic and environmental benefit of Missouri and the public safety of its citizens through climate monitoring, research, education, and extension and information services. In 2009 alone, we fulfilled hundreds of climate data requests and gave educational presentations in dozens of venues around Missouri. The following information provides information over the past year of how the Missouri Climate Center addressed each of its ARSCO qualifications.

Communication Capabilities

- The MCC web site provides easy access to weather and climate information including links to specialized web sites for real-time and historical weather in Missouri. In 2009, the Missouri Climate Center began posting weather and climate stories pertinent to current events or responsive to requests for specific climate information, such as a spring and autumn freeze maps for the state. The web site has been a widely used "go to" resource for weather and climate information, especially in regard to Missouri climate. New products and extensive advertisement of the web site has enhanced visibility and increased the value of this important resource for climate information.
- An agricultural weather forecast is developed by the undergraduate assistants every morning and e-mailed to all the county extension offices in Missouri;
- Over 4000 lines of data arrays are collected daily from a network of 29 automated weather stations. The daily and hourly arrays are posted on a server for free access.
- The Meteorological Assimilation Data Ingest System (MADIS) incorporates 5-minute weather conditions from 17 real-time weather stations in Missouri associated with the Commercial Agriculture Automated Weather Station network.

- Continued development and recruitment for an e-mail delivery agricultural weather product called Horizon Point. Horizon Point is a custom weather analysis system for farmers and provides an opportunity to have specific weather reports sent directly to their e-mail address. Currently over 600 Missouri agricultural producers and agents are enrolled.

Information Services

- Submitted numerous press releases and updates to the Extension news service related to weather, climate and the environment;
- Serve as an information source for the media including national, state, and local mediums;
- Fulfilled hundreds of requests for climate information and provided climatological expertise to numerous individuals, groups and agencies;
- Submit weather and soil information published in a national bulletin **Weekly Weather and Crop Bulletin** (http://www.usda.gov/oce/weather/pubs/Weekly/Wwcb/);
- Run the black cutworm forecasting program over the internet for public utility (http://agebb.missouri.edu/weather/reports/weabcws.asp);
- Run the rice model program to predict rice growth stages (http://agebb.missouri.edu/weather/reports/ricedds.asp);
- Provide weather data from the automated network to be used in a risk assessment tool for wheat scab prediction (http://www.wheatscab.psu.edu/);
- Provide a weekly climate summary table for the **Integrated Pest and Crop Management** Newsletter (http://ppp.missouri.edu/newsletters/ipcmindex.htm);
- Provide a 2-inch and 6-inch soil temperature table for the Agricultural Electronic Bulletin Board (AgEBB) (http://agebb.missouri.edu/weather/reports/soilTemp2.asp; http://agebb.missouri.edu/weather/reports/soysoil6.asp);
- Campus weather station linked to main MU web site (http://www.missouri.edu/);
- Campus weather station and forecast linked to College of Agriculture web site (http://cafnr.missouri.edu/);
- The real-time stations are providing 5-minute weather conditions to the Meteorological Assimilation Data Ingest System (MADIS);
- Participate in a weekly radio show on KMZU, Carrollton, MO, featuring Ag Weather.

Research

- Providing real-time weather status to 17 weather stations in the Commercial Agriculture Automated Weather Station Network for Integrated Pest Management;
- Provide climate data for graduate students and faculty research projects;
- Co-authored a journal article titled “The interannual variability of Midwestern temperatures and precipitation as related to the ENSO and PDO”. Birk, K., A.R. Lupo, P.E. Guinan, and C.E. Barbieri. Atomsfera. 2010.

Outreach: Education, Awareness, and Contact Activities

- Instructor for People, Plants, and Environment. Reid Smeda and Mary Ann Gowdy, Instructors. University of Missouri, Columbia. Topic: Climate Change and More;
- Instructor for Allen Thompson's Ag Systems Management class. Topic: Automated Weather Application for Agriculture;
- Weather presentation to numerous field days across the state;
- Agricultural weather presentation associated with MU's Winter Crop Conferences in Lamar, St. Joseph, Wentzville and Wellington, MO;
- Ag Weather session at MU's Annual Crop Management Conference;
- Gave several "Historical Climate Trends", "Climate Change" and "Weather Resource" talks across the state including In-Service Extension Educational programs, Master Gardener and Master Naturalists meetings;
- Weather updates for MU Extension Quarterly Ag-Marketing Teleconferences;
- Weather updates weekly for MU's IPM Agronomy and Horticulture Teleconferences (April-August);
- State Co-Coordinator of the Community Collaborative Rain, Hail and Snow Network (CoCoRaHS) in Missouri;
- Member of the Missouri Drought Assessment Committee;
- Member of the Plant Protection Programs steering committee;
- Member of the North Central 1018 Regional Climate Committee: Food, Feed, Fuel and Fiber: Security Under a Changing Climate;
- Member of the WERA 1012 Regional Coordinating Committee: Managing and Utilizing Precipitation Observations from Volunteer Networks;
- Information resource for the following media outlets: Missouri Net, Brownfield Network, Cooperative Video Group, and numerous local television, radio, and newspaper outlets across the state;
- In late May and June 2009, the SC served as a mentor for an Algerian student who was a Norman E. Borlaug Fellow. The student works as an Irrigation and Rural Development Specialist in the Laboratory of Bioclimatology at the Algerian Institute for Research in Agronomy. One of the student's fellowship objectives while in Missouri was to receive training on agro-climatic and agrometeorological monitoring tools and applications.

Nebraska Climate Office

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Al Dutcher, Nebraska State Climatologist

During the period 1/01/09-12/31/09, the Nebraska SCO handled 679 data requests for climate information by users, of which 258 have been media interviews and/or forecasts. A total of $3216 was generated in 2009 from data requests, with an additional $2500 from the American Association of State Climatologist for a monthly submission of a preliminary climate update to the HPRCC for their monthly report submission to the National Climatic Data Center.

The Nebraska SC gave 18 talks from 1/1-10/31/09 to 1188 people covering a diverse range of topics including the climate of Nebraska, irrigation issues, spring flooding, spring planting delays, fall wheat planting establishment, freeze risk, below normal growing season weather, and probable harvest activity delays. The number of talks this year was significantly lower than past years due to the abundance of moisture and lowered drought concerns. For the first time since 1999, Nebraska was free of any drought classification.

The Nebraska SCO continued its certification as an American Association of State Climatologists Recognized State Climate Office (ARSCO) by submitting an annual operations report that is posted on the AASC web-site. The SC also attended the national meetings in Grand Rapids, Michigan and gave a report of office activities. During September, the SC worked with the executive committee to petition members of the Senate to include AASC funding for "Climate Services" within Senator Boxer's and Kerry's Climate bill.

The Nebraska SCO performed a monthly analysis of 220 cooperative weather observer forms with an emphasis on identifying outlier observation reports. Typical errors include incorrect observations in wrong entry columns, shifting of observations to prior days, incorrect maximum and/or minimum temperatures in relation to at observation temperatures, invalid summation of precipitation variables, and failure to record at observation temperatures. After manual inspection of data, observations were manually entered into digital archives for analysis by summary programs. Summary programs on temperature and precipitation variables were ran to identify outlier stations. Identified errors were relayed to local National Weather Service offices so their personnel could contact and re-train weather observers.

The Nebraska SCO web-site will be going live sometime in mid-2010. A request to go live in 2009 was put on hold when it was learned that the web-site files were built in the

wrong CIT server location and had to be rebuilt. The SC personally built over 2000 statistical files and re-built almost 1000 preliminary climate graphic files for the web-site. Approximately 500 of the 3000 total files still need to be properly linked before the site will become live. Forecast information, contacts, and related climate information still need to be built and the SC anticipates a fully functioning web-site sometime in 2010 which will also include the transfer of a large percentage of the data from the old Nebraska Climate office web-site. The SC is also taking advanced classes for working on the UNL Liferay system and these classes meet every two weeks for a 2-hour training session.

The SCO worked with the UNL CropWatch editor to develop products aimed at tracking GDD development, soil temperatures, phenological tracking, and irrigation scheduling. The CropWatch web-site is the go-to location for UNL agronomic information. During June 2009, over 40,000 unique visitors accessed the CropWatch home page, which does not include direct links to specific locations within the web-site. In addition, the SC provided nine article submissions to CropWatch covering diverse topics including reservoir status and projections, spring flooding coverage, crop maturity projects, harvest weather forecasts, and seasonal outlooks.

In addition to providing support to CropWatch, the SC provided weekly U.S. weather forecasts to the World Wide Ag Network and Market Journal, as well as a two-week weather outlook for Heartland Express's Farm and Ranch Magazine. Heartland Express reaches over 50,000 households each printing cycle, while Market Journal reaches over 20,000 households (2008 Nielson rating). In August, the SC worked with KRVN radio out of Lexington, to provide a weekly file of random weather thoughts to be included in their weather blog.

The Nebraska SCO provided the Nebraska Agricultural Statistics Service (NASS) daily updates through tabular and graphical files of precipitation trends for defined periods, soil temperature summaries, growing degree day accumulations, and temperature extremes. This information is critical for the department to track crop development, planting delays, and unusual weather events. Monthly summaries are used by NASS as inputs into their yield forecast models. In addition, the SC provided a year-in-review summary of temperatures and precipitation trends that was included in their annual wheat yield estimate publication.

The SC worked with CIT to produce four radio programs in 2009 addressing the weather outlook for each of the seasons, as well the subject of spring planting. Each 4 minute, 15 second radio taping would summarize current climate conditions and focus on relevant issues facing Nebraska such as reservoir status, snow pack, flooding potential, crop maturity delays, freeze risk, and potential harvest delays. CIT releases these radio spots to all media outlets servicing the state of Nebraska for follow-up interviews if media entities so desire.

The SC served as the chair of the Water Availability and Outlook Committee (WAOC) of the governors Climate Assessment and Response Committee. Worked with other WAOC

members to summarize climate assessments for the state and present those findings to CARC during the spring meeting. Outlook scenarios of climate trends were presented to the committee so that appropriate recommendations could be made to the governor in terms of drought aid, water policy, and mitigation strategies. WAOC findings were put in the report form that can be accessed through the CARC web-site. The SC also served as the IANR representative on CARC.

The SCO participated in the university Crops Teleconference phone bridge. The phone bride meets monthly from September through March, then weekly from April through August. Provided the conference call participants updates on soil moisture, crop status, climatic risks to crops during the upcoming forecast period, unusual climate trends, expected precipitation and/or severe temperature events, and additional crop concerns from other regions of the country when necessary.

The SCO provided the U.S. Drought Monitor group recommendations for drought classification with the boundaries of Nebraska. The SCO also conducted analysis of precipitation trends, soil moisture, crop water use, streamflow summaries, and reservoir levels to effectively portray drought levels. Upgrades/Downgrades were forwarded to the DM authors based upon these analyses.

The SC worked with Ge Lin, and others at the Nebraska Medical Center in Omaha to submit a grant to the Center for Disease Control in April. The SC also worked with Nebraska Energy Office personnel to put together information for their first annual Energy Conference held in downtown Lincoln at the end of September. The SC agreed to teach the Thursday morning 10-11 am recitation section for NRES 103. An average of 6 hours a week was spent on preparing class material, as well as grading weekly report submissions.

The SC participated in 5 of the SNR Faculty meetings held so far in 2009. All but one of the missed Faculty meetings was due to conflicts from talks or previously scheduled meetings. Attended ACS monthly meetings when held and participated in the 5-year SNR review and listening sessions.

Nevada State Climate Office (NVSCO)

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Jeffrey Underwood, State Climatologist & Assistant Professor
Jeffrey Thompson, Assistant State Climatologist

The Nevada State Climate Office (NVSCO) was established under Nevada Revised Statute 396.595 with the mission of maintaining descriptions of information on the climate in the state including atmospheric conditions and levels of precipitation.

The NVSCO has doubled in size in the past year. Jeff Thompson joined the office in 2009 as Assistant Nevada State Climatologist, the first full-time faculty position committed to daily office operations. Dr. Jeffrey Underwood continues to expand his role as Nevada State Climatologist, directing an expanding body of projects and research. Two Jeffs are better than one, and with this additional person running day-to-day office operations, the NVSCO now has the ability to launch a number of new projects.

Data Collection and Reporting

The NVSCO continues its state mandated responsibility of providing a quarterly state climate summary. These reports have expanded in scope and content, with improved coverage of eastern and southern Nevada. The office has added new cooperative observers, and reconnected with past observers, to grow the body of data available in these summaries. A grant is also pending that would considerably grow the office and expand the NVSCO statewide data network. The network of precipitation storage gauges under NVSCO operation has also been repaired, recharged, and expanded, with past data reorganized and available for statistical use.

Outreach

The NVSCO is connecting with the citizens of the Silver State in a number of new and exciting media and outreach efforts. The office currently writes a monthly article on weather and climate for seven newspapers around the state. The NVSCO website (http://www.climate.unr.edu) has been completely overhauled, and now utilizes video, twitter, and flickr, allowing the public new ways to learn about and interact with the office. A video project for the website, with possible local television applications, is also under development. The Reno-Tahoe Winter Olympic Coalition is also working with the NVSCO on the meteorology and environmental sections of their 2022 Winter Olympic Games bid effort.

Research
Several projects are underway, including the investigation of upper tropospheric rivers in the development of heavy flooding in the Sierra, thunderstorm climatology in relation to the Las Vegas Valley, the relationship of downslope flows and lightning, and lake-effect snowfall on Lake Tahoe.

AARSCO
The NVSCO is co-hosting the 2010 annual meeting at Lake Tahoe with the Office of the California State Climatologist.

New Hampshire State Climate Office (NHSCO)

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Mary Stampone, State Climatologist

The New Hampshire State Climate Office (NHSCO) resides within the Department of Geography at the University of New Hampshire – Durham, a land-, sea-, and space-grant institution. In concert with the mission of the University of New Hampshire, the goal of the NHSCO is to:

- provide New Hampshire citizens and other constituents with climate information at the local, county, and state levels.
- conduct research on climate-related issues relevant to the state of New Hampshire and its residents.
- be a resource in climate science for educational and outreach purposes.

In keeping with this mission, the NHSCO has focused on providing the public with quality and timely information on weather and climate though research, outreach activities, production of online materials, regular media interviews and dissemination of data and analyses to the user community.

ARSCO Qualifications

The following activities address the NHSCO's qualifications as an ARSCO.

Communication Capabilities

The NHSCO regularly provides information on weather and climate to a wide variety of users including state agencies, local businesses, law enforcement, concerned citizens, K-12 and university faculty and students. Data and analyses are disseminated via the internet, email, telephone, regular mail and in person through interviews and presentations. The NHSCO has continued to maintain a website that allows users, with various interests and skill levels, direct access to climate data from a variety of data repositories. Community access to climate and weather data information will be improved by the launch of a new, more up-to-date website, which will include additional links to climate and weather services, data and educational material.

Information Services

The NHSCO has responded to over one hundred data requests from New Hampshire citizens, businesses, schools, and organizations and maintained a regular presence in

local print, radio and television media. Given the above-average precipitation received statewide over the past few years, public interest in precipitation data and analysis of storm events has grown considerably. The NHSCO has begun a series of seasonal state weather and climate summary reports that will available to the public through the new NHSCO website. These documents provide temperature and precipitation statistics and graphics as well as a summary of recent weather patterns and events. In addition to climate data and analysis, public interest in climate outlooks has also increased and the NHSCO is regularly asked to provide monthly and seasonal weather outlooks to citizens and the media.

The NHSCO provides information to UNH Media Relations for press releases on current and recent weather events. This year's news continued to focus primarily on precipitation and severe weather events, including the anniversaries of the 2008 tornado (NHPR – *The Exchange*, 7/29/2009) and ice storm (*UNH press release*, 12/9/2009). Excessive summer 2009 rainfall (New England Cable Network, 6/30/2009 and NHPR – *The Exchange*, 7/10/2010) and the March 2010 storms (*UNH press release*, 4/1/2010) were of particular interest to NH residents. Precipitation was also the topic of NHSCO research presented at the 2010 Applied Climatology Conference of the AMS (*UNH press release* – 1/25/2010), which was covered by local media including a live interview on WMUR Channel 9 (ABC affiliate). The February announcement confirming the fall of the Mount Washington "World Wind Speed Record" made national headlines and comments from the NHSCO were included in over 300 national media stories and featured in the *New York Times* – Week in Review (1/26/2010). The NHSCO also serves as a resource of UNH journalism students and student reporters, providing information on a wide variety of scientific topics from warm March temperatures to volcanic eruptions.

Research

Work on organizing state analogue and digital data sources continued and preliminary results on total annual precipitation patterns for long-term state climate records were presented at the 2010 Applied Climatology Conference of the AMS. Ongoing research will address long-term seasonal patterns in total precipitation and snow, extreme precipitation events and links between precipitation and atmospheric circulation patterns. As in 2010, results of research conducted by NHSCO staff will be presented at professional conferences and publication in peer-reviewed journals will be pursued. Plans for collaboration with the NWS Forecast Office in Gray, Maine, as well as UNH faculty and students, are underway.

Outreach

Given the importance of community engagement and the public demand for quality, scientific information on climate science issues, the NHSCO has made a strong commitment to community outreach. The NHSCO is very involved a variety of outreach programs and activities. The state climatologist is a co-coordinator for NH CoCoRaHS and has committed to an advisory role in Picture Post. This year, the state climatologist participated in the New Market Elementary School Mentors program, was an invited speaker at the Liberty Mutual "Take your kids to work" event,

demonstrated weather instrumentation and data collection to elementary school children and attended community climate change discussion groups.

Monitoring and impact assessment

The NHSCO worked closely with the NWS Forecast Offices in Gray, ME and Taunton, MA as well as the Mount Washington Observatory, Plymouth State University faculty, and UNH/NOAA National Ocean Service research faculty to coordinate and launch the NH CoCoRaHS network. Since the official kick off at the Mount Washington Discovery Center on July 1, 2009, the network has added almost 200 volunteer observers statewide. Additionally, the NHSCO continues to be the point of contact for the two NOAA Climate Reference Network (CRN) stations located in southern New Hampshire. Above average precipitation and power outages have increased the amount of station maintenance required this year. The NHSCO will also take over Durham NWS COOP station observations, which had been conducted by UNH Maintenance and Facilities personnel.

Office of the New Jersey State Climatologist (ONJSC)

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Founded in 1979, the Office of the New Jersey State Climatologist (ONJSC) resides within the Rutgers University Center for Environmental Prediction. Our mission is to monitor and understand the diverse weather and climate conditions experienced across the Garden State on various temporal and spatial scales. Included are efforts to inform and educate, thus making the 8.7 million residents of this most densely-populated state weather and climate aware.

The ONJSC operates the New Jersey Weather and Climate Network, or NJWxNet. This unique network of over 150 weather stations (http://climate.rutgers.edu/njwxnet) serves as a one-stop Internet resource for New Jersey weather and climate data. The NJWxNet is a network of networks, including, among others, NJ Dept. Transportation RWIS, NWS ASOS, South Jersey Resource Conservation and Development Council RISE, NOAA IFLOWS, USGS stations and two networks operated by the ONJSC. Stations operated by ONJSC include 15 NJ Mesonet sites, monitoring a rich suite of atmospheric and surface variables, and 25 NJ SafetyNet stations, monitoring a subset of important variables primarily at public safety agencies. Hourly observations are collected and displayed in real time as colorful maps and tables on the NJWxNet web site. This past year marked further upgrades of our various servers. Mesonet upgrades continued and renewed support was received from the NJDEP, US Forest Service and NJ Office of Emergency Management.

New Jersey's second year in the Community Collaborative Rain, Hail and Snow Network saw upwards of 150 observers each day submitting vital observations. We introduced additional color-filled state and regional maps of snowfall, snow cover and snow water equivalent to go along with our precipitation maps (http://climate.rutgers.edu/stateclim/?section=menu&%20target=CoCoRaHS). In

addition to the NJWxNet and NJ CoCoRaHS, the ONJSC maintains a comprehensive archive of historical data, metadata and climatologies from National Weather Service primary and cooperative stations. This is supplemented with data submitted by ONJSC volunteer observers. This information is manually processed and displayed in event, weekly and monthly maps and tables.

Research endeavors within the ONJSC range from student projects on topics such as regional heat islands and snow climatologies to collaborative efforts with Rutgers colleagues and state and federal agencies. Examples of ONJSC outreach activities include participation in the Liberty Science Center teacher training program, the creation of online weather training materials for NJ public safety officials, and a wealth of interviews and presentations. The record snows and flooding of this past February and March resulted in over 100 media interviews.

The ONJSC continued partnering with the NJ Institute of Technology, through support from the NJ Department of Transportation, to develop a roadway decision support system. We have also been working with agriculture extension colleagues to develop indices for blueberries and apples. We partnered with Columbia University colleagues to install a CO2 sensor at our Liberty State Park Mesonet station and are developing a lawn watering program with the South Jersey Resource Conservation and Development Council.

The ONJSC continued our monthly reports of NJ weather and climate highlights, including societal impacts. Reports are shared with the Northeast Regional Climate Center, posted on the AASC national website and on the ONJSC website, and published in the "Weather Shelter" newsletter of the North Jersey Weather Observers.

ARSCO Qualifications: The ONJSC is an American Association of State Climatologists (AASC) Recognized State Climate Office (ARSCO). As such, the office fulfills a number of qualifications outlined below.

Communication capabilities

- Ingest, process, archive and disseminate historic and real time climate data.
- Maintain numerous web sites related to the ONJSC mission (http://climate.rutgers.edu/stateclim).

Information Services

- More than 500 specific requests for data and products each year.
- More than 500 unique visits to ONJSC web sites each day.
- Weekly and monthly climate summaries in map and tubular form.

Research

- Collaborate with Rutgers colleagues, as well as state and federal agencies on projects associated with issues such as forest fire management, pest management, agriculture, transportation, water resources, public safety, homeland security.

- Student research on topics such as urban heat islands, state snow cover variability, and ocean influences on state weather and climate.

Outreach

- Up to several hundred media interviews each year.
- Presentations to schools, civic organizations, Liberty Science Center, etc.
- Conference presentations to the NJ Clean Water Council, the 4-H Climate Change Workshop, the NJ Homeland Security Research Symposium, the NJ Agribusiness Association, the NJ Weather and Environmental Hazards Symposium, the NJ After School Conference, and many others.
- The NJ State Climatologist is a member of the National Academy of Sciences Climate Research Committee, the NOAA Climate Working Group, the NWS StormReady Community Program advisory board, and the Liberty Science Center Education and Teaching Advisory Committee.

Monitoring and impact assessment

- Operation of the NJWxNet (http://climate.rutgers.edu/njwxnet).
- State operation of NJ CoCoRaHS.
- Web site updates for significant winter events.
- The NJ State Climatologist is a member of the NJ Drought advisory committee.
- Statewide climate variability and change is being assessed through the NJ Climate Report Card project (http://climate.rutgers.edu/stateclim_v1/climreportcard/climate_report_card.html).

New Mexico Climate Center (NMCC)

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David DuBois, State Climatologist (for T. Sammis, former SC)
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General Information

The New Mexico Climate Center (NMCC) resides within the Department of Plant and Environmental Sciences of the Agricultural Experiment Station at New Mexico State University (NMSU) in Las Cruces, New Mexico. The climate center is comprised of one faculty position, a part-time staff position, and a graduate student assistant. By law, the duties of the NMCC are to (1) assess the effect of climate on the natural environment, agricultural production, land and natural resources and human health, (2) coordinate climate impact studies and programs, (3) consult and coordinate with the federal and state agencies government in climate related activities, and (4) disseminate climate data, information, advice and assessments to state and local agencies and the general public.

Information Services

The NMCC collects, archives, and disseminates climate data from official U.S. government and private observing stations throughout New Mexico. Additionally, the NMCC maintained a network of 16 automated weather stations throughout the state that are used primarily for agricultural purposes. In all, daily data from approximately 136 sites is collected, processed, and distributed via the NMCC website (http://weather.nmsu.edu/). In 2009, the NMCC website had again an estimated over one million page hits for climate information and data. Many other requests were also answered by phone and email. In addition, the New Mexico Climate Center provided a variety of web based tools for decision support in the areas of agriculture, hydrology, construction, health and economic development. Drought information was posted by not only the New Mexico climate center which looked at climate-based drought but by the New Mexico Drought Task Force which posted information on all aspects of drought. CoCoRaHS expansion was funded by the Rio Grande project and the state coordinator is continuing to interact with new people that move to New Mexico to get them to participate in the program.

Research

Research activities in 2009 consisted primarily of applied research in which climatic information was used for studies involving particulate matter emissions from croplands, crop improvement, and irrigation/water management. NMCC continued collaboration with University of Connecticut in agricultural air quality research studies and modeling.

NMCC staff members worked collaboratively with the NMSU Water Task Force, other university researchers, and local stakeholders on the Rio Grande Basin Initiative, a Texas A & M University and NMSU effort aimed at improving water conservation through research and education of irrigation efficiency.

A project on irrigation management of Pecans continued to be funded and the state climatology office supplied data for calculating reference evapotranspiration and developed the methodology to automate the calculation of Et using satellite imagery. The state climatology program hosted the new computing resource including scripts that automate the downloading and processing of satellite data. Dr. Sammis continued to provide undergraduate students with real world experience in agricultural meteorology with the student gaining information on climate data acquisition and management.

Research results were published as a book chapter on water use studies on Phreatophyte Control in Arid Environments (Wang and Sammis 2009), analysis of the Surface Energy Balance Algorithm for Land model (Wang et al., 2009), an article on pecan orchard pruning residue (Kallestad et al., 2009) and a case study documenting chile production in an extension setting (Sammis et al., 2009). Studies on measuring and simulating local dust dispersion from field agriculture operations using meteorological and LIDAR instrumentation were also published (Wang et al., 2009).

Outreach

A collaborative work for the New Mexico Energy and Minerals Department continued this year for operation of a meteor burst communication system and weather station in a remote site. This data is to be used for calculation of Et on a watershed manipulate to increase water yield. Dr. Sammis published one climate center new letter in 2009 with stories relating to global warming and water harvesting in New Mexico.

Goals

Plans for 2010 include the continued development of our web resources including implementing a mapping protocol for displaying the entire climate data that is collect by the center. The NMCC will continue to work with the Climate Assessment of the Southwest (CLIMAS) program at the University of Arizona to continue developing and evaluating web resources, to maintain and build stakeholder relationships, and to improve drought monitoring and impact reporting capabilities. A wiki that documents station information metadata, data acquisition system and the data processing methodology has been implemented. A search for a new state climatologist was successful and the new state climatologist was hired in November, 2009. Dr. Dave DuBois will start his duties in February 2010 after moving from Las Vegas, NV.

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The State Climate Office of North Carolina is a public service center for climate-environment interactions at NC State University. It serves the State of North Carolina as the American Association of State Climatologists Recognized State Climate Office (ARSCO) for North Carolina. Its public service mission includes extension, research, and educational components.

Extension efforts were focused on delivery of services through direct interaction and communication with clients, partnerships with state agencies, and collaboration with extension specialists and scientists at NC State University. Significant extension activities in 2009-2010 included deployment of one new ECONet station, several CRONOS updates, initiation of new projects with agricultural scientists, and continued collaboration with the Southeast Climate Consortium.

Research efforts in the past year focused on the study of North Carolina's climate and its interaction with the environment. Specific activities include atmospheric dispersion modeling validation, evaluation of model performance for several agro-meteorological applications and development of a recreation and tourism climatology.

Educational outreach activities in the State Climate Office are designed so that climate scientists interact with K-12, community college teachers and students, and with other community organizations on different aspects of NC climate and environment. Specific activities include the NC Science Olympiad, Stormfest, hosting Centennial Campus Middle School students, and numerous community and school group presentations.

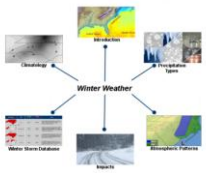
Highlights of Climate Services

Requests for Services: 8% decrease in time spent directly responding to requests for services from clients. Clients request services via email, phone, and through the Climate Office website. There was a 30% increase in web activity and a 22% increase in web requests to our online CRONOS database.

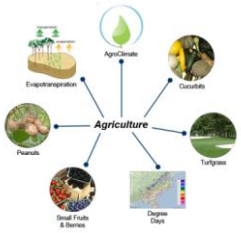
Monthly climate summaries: Climate summary reports are prepared each month to highlight climate patterns and impacts to agriculture and water resources in NC. These are distributed via a monthly online newsletter, reports to NOAA through the Southeast Regional Climate Center (SERCC), and reports to the American Association of State Climatologists (AASC). The SCO uses the newsletters to also inform users about new products and services. The AASC provided $2500 in 2009 to support this activity. While direct support for this activity is no longer available from AASC, the SCO continues to provide these monthly climate reports and newsletters to enable improved communication with its stakeholders.

Tropical Cyclone Climatology: A series of pages on tropical cyclones was added to the SCO website in 8 parts, including historical statistics and an overview of storm development and impacts. The feature tool included in these pages is an interactive database of all tropical cyclones where users can search by year, name, storm intensity, and proximity to any location of interest.

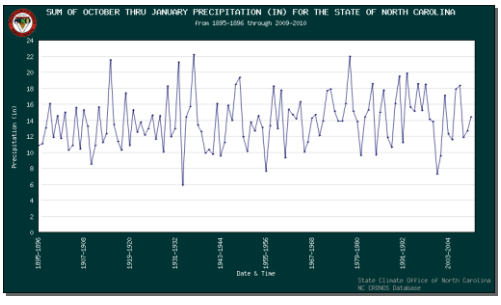
Winter Weather Climatology: A series of web pages on winter weather storms and their impacts was developed. The highlight of the new winter weather section is a searchable database of the official "Storm Reports" for all winter weather events, many of which were previously not available in electronic form. Users can search all types of winter weather events and view the associated climate data stored in CRONOS.



Agriculture Tools: A new resource for all SCO agriculture tools was created to highlight projects with partners in CALS such as peanut disease advisories and the Cucurbiut Downy Mildew forecasts. Several CRONOS-based tools are highlighted, including:



- *Growing Degree Day Maps:* users can define GDD base and period of interest to map accumulated GDD across the southeast.
- *Blueberry & Blackberry Heat/Chill unit models*: tools previously developed for testing with Bill Cline and Gina Fernandez are now operational.
- *Reference Evapotranspiration Tools*: monitoring and climatology tool that includes map and time series analysis of accumulated RefEt across the southeast.



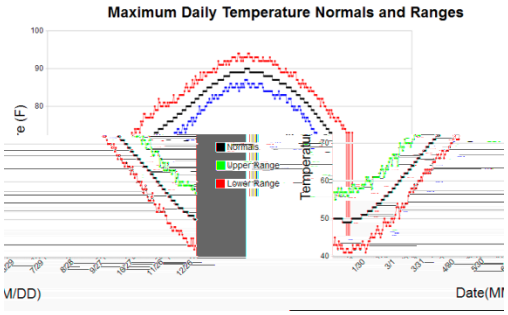
Climate Division Data: Data by region since 1895, including temperature, precipitation, and a variety of drought indices, can be compiled

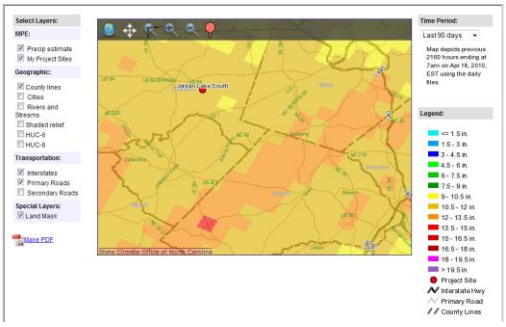
and graphed. This tool has been especially helpful with monthly climate summaries.

Ask a Meteorologist database: an interactive and easy-to-use way to view questions about weather and climate. The database was assembled from questions that meteorologists at the State Climate Office have answered in the past. The purpose of the database is to give users with a weather- or climate-related question a chance to find their question or similar questions, and to do so without searching through pages of unrelated questions and answers.

Climate Change in NC: renovated, expanded overview of climate change in NC focused on observations.

Normals Range: Based on an SCO-authored manuscript from 2006, daily climate normals as published by NOAA are not very meaningful since they do not account for typical daily variability. To address, SCO has implemented daily normals "range" that conveys the typical temperature variability that one might expect for any location in NC. SCO plans to target NWS and media to encourage a daily normals range be reported instead of just the NOAA published normal for any given day.





Precipitation Monitoring and Alerts for DOT Stormwater Management: SCO has a contract with DOT to provide precipitation monitoring and heavy rainfall alerts to support testing and evaluation of highway and construction stormwater controls. DOT continued financial support of this tool in 2009-2010 and funded several enhancements. Products derived from this tool are now used by DENR Water Resources. DOT is looking to develop a long-term support strategy for these tools that would allow multiple state agencies to fund and use the multi-sensor precipitation estimates.

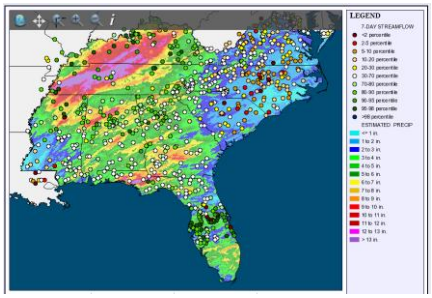
Peanut Disease Advisories: Working with Dr. Barbara Shew (NCSU Plant Pathology), SCO provided daily guidance for fungicide spraying to peanut growers in NC from June-October 2000. These advisories take advantage of research into the relationships between climate and the development of two peanut fungal diseases. In 2010, SCO will begin its 6th year of collaborating with Dr. Shew to provide these advisories.

Strawberry Frost Guidance: Working with Dr. Barclay Poling (NCSU Horticulture Science), SCO is working to develop a weather-based decision support system for strawberry growers to evaluate their risk to frost and freeze events. A website is being developed that will help predict the type of frost likely to occur at a given location. We

are currently building crop stage and farm management capabilities into the website to help growers figure out how this frost risk translates to their specific farm. Dr. Poling has identified a small set of growers who would like to begin testing the website in late 2010.

Climate Information for Thrips Risk Assessment: In collaboration with Drs. George Kennedy and Hannah Burrack (NCSU Entomology), SCO is working to develop an online, automated advisory system that evaluates the risk of thrips in tobacco. Work began in summer 2009 and a beta website will be tested by select growers in summer 2010.

Tobacco Blue Mold and TSWV Support: In collaboration with Dr. Asimina Mila (NCSU Plant Pathology), SCO is providing IT support for the tobacco blue mold reporting and forecast website. SCO is providing climate data/expertise and automating equations for estimating the pre-season risk for tomato spotted wilt virus (TSWV) in tobacco. Work began in April 2010 and will conclude by July 2010.



Water and Climate Data for Tennessee Valley Water Partnership: Based on work to support DENR Water Resources, SCO is working with partners in seven states that form the Tennessee Valley Water Partnership to expand the NC water resources database and monitoring tools to Kentucky, Virginia, Tennessee, Mississippi, Georgia, and Alabama. Called the Water Atlas of The Eastern Region (WATER), a test version is now online for review. Ongoing funding to support this service is expected after the initial development phase.

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Mission Statement: The mission of the North Dakota State Climate Office (NDSCO) is to advance the use of climate information for the economic and environmental benefit of North Dakota and the public safety of its citizens, through climate monitoring, research, education, and extension and information services.

ARSCO Qualifications

NDSCO has been recognition by the AASC as the official state climate office for North Dakota since March 2007. NDSCO also enjoys the support from local National Weather Service Forecast office in Fargo-Grand Forks, High Plains Regional Climate Center and holds a Memorandum of Agreement between NCDC and the State Representative. In addition, the following describes the ways in which NDSCO addresses each of the ARSCO qualifications:

Observation Capabilities

The State Climate Office operates a state of the art Automated Environmental Weather Monitoring Network called The North Dakota Agricultural Weather Network (NDAWN) which consists of 72 stations distributed across North Dakota, the Red River Valley, and border regions of surrounding states.

Stations provide hourly averages or totals for all variables and hourly maximum wind speed plus daily summaries consisting of maximum and minimum air temperature, maximum wind speed, times of occurrence, and various totals or averages for all other variables in English or metric units. Measured and calculated variables and more complete descriptions of each may be found in the site description and archived data areas.

Data are retrieved via telephone modem shortly after midnight each day. A computer program identifies missing or erroneous values which are replaced by estimates calculated from data at surrounding stations. Following this initial quality control (QC) data are loaded into the NDAWN data base and made available to the general public via the NDAWN web site free of charge. Every Monday thru Friday morning, except holidays, data from all stations are visually compared in order to identify suspicious or erroneous data that the computer program cannot detect. In addition, weekly and

monthly average data are similarly compared to identify possible calibration or other problems.

Communication Capabilities

The North Dakota State Climate Office oversees the operation of the NDAWN Center. The access information to NDAWN Center and the services are listed below:

- North Dakota Agricultural Weather (NDAWN): http://ndawn.ndsu.nodak.edu/
- NDAWN Weather Data
  - Tables and Maps (Hourly, Daily, Weekly, Monthly, Annually, Normals, Departure from Normals); http://ndawn.ndsu.nodak.edu/hourly-table-form.html.
- NDAWN Agricultural Applications
  - Barley, Canola, Corn, Potato, Sugar beet, Sunflower, Wheat, Small Grains, Crop Water Use, Insect Development, Degree day for the energy use (http://ndawn.ndsu.nodak.edu/applications.html).
- Answers e-mails requesting climate information or asking climate related questions frequently.
- Regularly answers to telephone requests.
- Frequent media contacts.

Publications

Badh, A., F. A. Akyüz, G. Vocke, B. Mullins, 2009: Impact of Climate Change on the Growing Seasons in Select Cities of North Dakota, United States of America. International Journal of Climate Change: Impacts and Responses. V.1, Number 1, 105-117.

DeSutter, T., D. Franzen, F. Casey, D. Hopkins, B. Saini-Eidukat, A. Akyüz, and V. Jyoti. 2009. Distribution of total mercury in North Dakota soils. *In* Annual meeting abstracts [CD-ROM]. ASA, CSSA, and SSSA, Madison, WI.

Badh, A. F. A. Akyüz, G. Vocke, B. Mullins. 2009: Fluctuations in the Length of Growing Season in North Dakota. North Dakota EPSCOR State Conference. Fargo, ND. September 24, 2009.

Badh, A., A. Akyuz, G. Vocke, B. Mullins, 2009: Plant selection based on the climatic Trend in the state of North Dakota, United States. International Annual Meetings of the American Society of Agronomy, Crop Science Society of America, and Soil Science Society of America. November 1-5, 2009. Pittsburg, PA.

Badh, A., A. Akyuz, G. Vocke, B. Mullins, 2009:Variations in the last day of spring frost, first day of fall frost and growing season length in North Dakota. Proceedings of the North Dakota Academy of Science. Vol 63, pp 39, 2009.

Badh, A. F. A. Akyüz, G. Vocke, B. Mullins. 2009: Fluctuations in the Length of Growing Season in North Dakota. 2009 International Conference on Climate Change.Pune, India. January 2009.

Akyuz, F. A., 2009: North Dakota Agricultural Weather Network and its Agricultural Applications. 31st Annual National Sunflower Association Research Forum. Fargo, ND. Electronic publication: http://www.sunflowernsa.com/uploads/Akyuz_NDAWN_09.pdf.

Invited Presentations

1. Climate Change. North Dakota on the Road to Copenhagen. NDSU, Fargo, ND. December 1, 2009
2. High Density Precipitation Observing Network in ND and its Benefits to Irrigation Scheduler of the NDAWN Application. Irrigation Workshop. Bismarck, ND. December 10, 2009.
3. NDAWN Applications: Irrigation Scheduler. Irrigation Workshop. Grand Forks, ND. December 15, 2009.
4. Climate Change Science, its Basics and local Implications on ND's Agriculture and Renewable Energy Sources (Session I). ND Farmer's Union State Conference. Fargo, ND. November 20, 2009.
5. Climate Change Science, its Basics and local Implications on ND's Agriculture and Renewable Energy Sources (Session II). ND Farmer's Union State Conference. Fargo, ND. November 20, 2009.
6. Meteorological Observations at Elementary Schools and their Potential Involvement in High Density Precipitation Observing Network. Kennedy Elementary School. Fargo, ND. November 25, 2009.
7. Climate Change Basics: Definition, Causes and Implications. NRM 150 Guest Lecture. NDSU, Fargo, ND. November 30, 2009.
8. North Dakota Agricultural Weather Network Sugarbeet Applications in ND's Sugarbeet Production and its Applicability to Turkish Sugarbeet Production. (2^{nd} meeting) NDSU, Fargo, ND. October 19, 2009.
9. Conspiracy Behind Greenwashing: Separating Facts From Fiction About Sustainability. Panel Discussion on Climate Change. NDSU, Fargo, ND. October 20, 2009.
10. Meteorological Measurements in Hydrological Application. Guest Lecturer. Hydrology 477/677. NDSU, Fargo, ND. September 1, 2009.
11. North Dakota Agricultural Weather Network Application in Sugarbeet Production. Turkish Sugarbeet Delegation vs. NDSU Interaction Meeting. NDSU, Fargo ND. September 18, 2009.
12. Tornado Information and Safety. Hands-on Demonstration of Tornado Formation. 2^{nd} Annual Emergency Preparedness Expo. NDSU, Fargo, ND. September 24, 2009.
13. Climate Change Energy and National Security Roundtable. Fargo, ND. September 25, 2009.
14. High Density Precipitation Network Establishment in ND. Green-bag Lunch Presentation. NDSU, Fargo, ND. September 30, 2009.
15. North Dakota Agricultural Weather Network Application in Gardening. Master Gardner Workshop. NDSU, Fargo, ND and Live Feed across the State. August 28, 2009.
16. Impact of Climate and Soil on Crop Selection. NC1018 Multistate Research Fund Annual Meeting. Grand Rapids, MI. July 6-7, 2009.
17. Synopsis of the Great Flood of 2009 in the Red River Valley of the North. American Association of State Climatologists Annual Meeting. Grand Rapids, MI. July 7-10, 2009.

18. Climate Change and its Agricultural Implications in the Northern Plains. Biomass'09: Power, Fuels and Chemical Workshop. Grand Forks, ND. July 14-15, 2009.
19. Community Collaborative Rain, Hail and Snow Network benefits in ND's Weather Monitoring. Summer Camp for Tribal College Students, Faculty and High School Teachers. Nurturing American Tribal Undergraduate Research and Education (NATURE) Program. NDSU, Fargo, ND. June 1, 2009.
20. How do Tornados form? Science, Technology, Education and Mathematics (STEM) for kids Summer Enrichment Program. NDSU, Fargo, ND. June 23, 2009.
21. What is Coriolis force and what its Implications on Earth's Climate? Science, Technology, Education and Mathematics (STEM) for kids Summer Enrichment Program. NDSU, Fargo, ND. June 23, 2009.
22. Tornado Formation and Safety: Helmet use in shelters. First Grade Elementary. Kennedy Elementary School. Fargo, ND. May 4, 2009.
23. North Dakota Agricultural Weather Network. Managing and Utilizing Precipitation Observations from Volunteer Networks (WERA10212) Annual Meeting. Estes Park, Colorado. May 19-22, 2009.
24. Variations in the last day of spring frost, first day of fall frost and growing season length in North Dakota. North Dakota Academy of Science Conference. Fargo, ND. Apr 30, 2009.
25. Climate Change: Signs, Science and Solutions from Global to Local Perspectives. National Teach-In, NDSU, Fargo, ND. Feb 2, 2009.
26. Severe Weather Safety. K-4 Science Fair. Kennedy Elementary School, Faro, ND. Feb 9, 2009
27. North Dakota Agricultural Weather Network Applications in North Dakota. Northern Soybean Expo Forum. Fargo, ND. Feb 10, 2009.
28. North Dakota Agricultural Weather Network Impact on North Dakota's Agricultural Commodities. Best of the Best in Wheat Research Workshop. Bismarck, ND. Feb 13, 2009.
29. Corn Application of the North Dakota Agricultural Weather Network. Corn Seminar. Oakes, ND. Feb 19, 2009
30. Agricultural Application of the North Dakota Agricultural Weather Network (NDAWN). 31st National Sunflower Association Research Forum. Ramada Plaza Convention Center. Fargo, ND. January 13-14, 2009.

List of radio and TV presentations and spots made

1. Climate Change. North Dakota on the Road to Copenhagen. Press Conference. NDSU, Fargo, ND. December 1, 2009
2. Precipitation Pattern Comparison with 2008-2009. How close are we to another Flood of 2009? Forum Newspaper. Fargo, ND. November 9, 2009.
3. Corn Maturity Assessment across the State: How bad is it? Minot Daily News, Minot, ND. October 15, 2009.
4. Already one of the Wettest Octobers in History: Will 2009 repeat? KVLY Valley News TV. Fargo, ND. October 22, 2009.
5. One of the warmest Septembers followed by one of the coldest Octobers. Is this a part of Climate Change? What is the flood probability in next spring? WDAY News TV. Fargo, ND. October 22, 2009.

6. Minot Thunderstorm Event of September 7 and its impact on Local Agriculture: Minot Daily News. Minot, ND. September 8, 2009.
7. High Density Precipitation Network Usage in ND. Grand Forks Herald. Grand Forks, ND. September 9, 2009.
8. Corn Growth Stage in Fargo and Jamestown and Comparison with Last Year and 2004. Jamestown Sun. Jamestown, ND. September 16, 2009.
9. Community Collaborative Rain Hail and Snow Network in ND. Grand Forks Herald. August 6, 2009.
10. Corn Growth Stage based on NDAWN Corn Growing Degree Units and First Day of the Killing Frost Days in ND. KFYR and KBMR Radios. Bismarck, ND (Taped Earlier). August 28, 2009.
11. Community Collaborative Rain Hail and Snow Network in ND. How does the network help ND Farmers? KFYR and KBMR Radios. Bismarck, ND (Taped Earlier). August 28, 2009.
12. Current ENSO Conditions. What does it mean for ND? KVLY Valley-News TV, Fargo, ND. July 17, 2009.
13. Frost Dates and Probabilities under the Current Conditions. Forum Newspaper. Fargo, ND. July 22, 2009.
14. Drought Conditions across the Region: Is it normal? Associate Press. July 27, 2009.
15. Why is western ND more susceptible to Drought? How do we prepare? Associate Press. July 28, 2009.
16. Climate Change Legislation, Environmental Stewardship vs. Global Warming, CO2 vs. Global Warming and Growing Season Length this year compared to 2004 in ND. KQLX Radio (Live). July 28, 2009
17. May Climate Assessment. KVLY Valley-News TV. Fargo, ND. June 3, 2009.
18. Global Climate Change Impacts in the United States. What did the Interagency find? KFGO 790 AM Radio. Live. Fargo, ND. June 18, 2009.
19. Community Collaborative Rain Hail and Snow Network in ND. Assisting NWS in Flood Warnings. Prairie Public Radio. Fargo, ND. June 25, 2009.
20. Climate Change and Flood Risk. KVLY Valley-News Fargo, ND. June 26, 2009.
21. Teaching our kids about Tornado Safety. WDAY TV. Fargo, ND. May 4, 2004.
22. Community Collaborative Rain Hail and Snow Network usage in ND. WDAY Radio (Live). May 8, 2009.
23. Use of Helmets in Tornado Initiative. Prairie Public Radio. May 12, 2009.
24. Climate Change impact of RRV Floods. Forum Newspaper. Fargo, ND. May 20, 2009.
25. Flood Update. Minneapolis Star Tribune. Apr 1, 2009.
26. Flood Impact on ND's Agriculture. Farm and Ranch Guide. Apr 3, 2009.
27. Flood of 2009. Are we out of the woods? Forum. Apr 6, 2009.
28. Flood Impact. Valley-News, KVLY TV. Fargo, ND. Apr 9, 2009.
29. Flood Warning for the Entire State: How Rare is it? KNOX Radio AM 1310. Grand Forks, ND (Taped). Apr 14, 2009.
30. Spring Flooding in Devils Lake and RRV/ Drought Conditions in Western ND. Farm and Ranch Guide Magazine.
31. Flood Conditions in the RRV. 890AM KQLX Farm Talk Show (Live). Mar 23, 2009.
32. Flood Update. Bloomberg News, Chicago. Mar 25, 2009.
33. Flood Conditions in the RRV. Minneapolis Star Tribune. Mar 25, 2009.

34. Flood of 2009. CBS News (Phone). Mar 25, 2009.
35. Flood Update. Minneapolis Star Tribune. Mar 25, 2009.
36. Prelude to Flood of 2009. Prairie Public Radio (Live). Mar 25, 2009.
37. Flood Update. Minneapolis Star Tribune. Mar 26, 2009.
38. Cold Air Impact on the Flood: Is it desirable? CBC News (on-Camera). Mar 27, 2009.
39. Flood Update. Minneapolis Star Tribune. Mar 31, 2009.
40. Spring and Summer 2009 Forecast and NDAWN Status: Agweek Magazine. Feb 10, 2009.
41. Upcoming Seasonal Forecast. Grand Forks Herald. Feb 11, 2009
42. What are the implications of Sundogs, Halos, and Sun-Pillars? Valley News Live. KVLY TV. Fargo, ND. Feb 18, 2009.
43. Moisture Conditions across the State: Forum Newspaper. Jan 5, 2009.
44. Record-breaking December snowfall in Fargo and Grand Forks. Should we worry about a spring flood? Prairie Public Radio with Daniel Webster. Jan 9, 2009.
45. Flood potential in RRV: Spectrum. Jan 14, 2009.
46. December Climate Synopsis: Harvey Herald Press. Jan 15, 2009.
47. Drought History in ND: Associate Press. Jan 16, 2009.

Oklahoma Climatological Survey (OCS)

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Renee McPherson, Interim State Climatologist
Gary McManus, Associate State Climatologist
Mark Shafer, Climatologist & Director of the Southern Climate Impacts Planning Program

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Note: As we ended our third decade as the state's climate agency, we said goodbye to our long-time director, Dr. Ken Crawford. Crawford served as State Climatologist and OCS Director from 1989 through the end of 2009. Under his leadership, we partnered with Oklahoma State University to build the Oklahoma Mesonet and we developed nationally recognized education programs, software tools, and decision support systems.

Discussions of climate variability and change became more prominent in 2009, both nationwide and within Oklahoma. In particular, agencies, organizations, and communities are trying to determine how climate change will impact their finances and decision processes. To help address some of the questions, OCS hosted the following meetings in concert with our Southern Climate Impacts Planning Program (SCIPP): Climate Prediction Applications Science workshop (85 participants) on March 24-27, the Fourth Annual Climate and Loss Mitigation Conference (90 participants) on April 9, and the Climate Adaptation Planning Kick-off Meeting (64 participants) on December 10. In addition, with our SCIPP partners at Louisiana State University, we led a series of four "world café" break-out sessions at the 2009 U.S. Fish and Wildlife Service (Region 2) and U.S. Geological Survey climate change workshop (Austin, TX; August 10-12), and we convened the first annual SCIPP stakeholder services meeting (Norman; June 19). We distributed a survey on hazard planning and climate change to 1,900 people in SCIPP's six-state region.

OCS also participated in the American Association of State Climatologists conference, Annual Meeting of the American Meteorological Society (AMS), the AMS Summer Community Meeting, Governor's Water Conference, Apple Worldwide Developers' Conference, OWRRI Water Research Symposium, Inter-Tribal Emergency Management Summit, May 3 Tornado Outbreak 10th Anniversary Event, Oklahoma Wind Commerce 2009, Norman Chamber of Commerce Weather Committee, SMAP Algorithms & Cal/Val Workshop, Leadership Oklahoma, Oklahoma Ag Expo, OU Risk Center Community Advisory Board Meeting, 6th Drought Monitor Forum, Communicating Science Conference, Artificial Recharge Task Force meetings, and National Science Foundation Facilities Assessment Editorial Board Meeting.

OCS presented for the Governor's Water Conference (*Water Planning at the Oklahoma Climatological Survey*), the AMS Summer Community Meeting (*The Human Dimension*), the NOAA Climate Board (*Managing Drought in a Multi-Hazard Context*), Fourth Hazard and Loss Mitigation Conference (*Finding Weather and Climate Information*), Research Experiences for Undergraduates (*Knowledge and Action: The Role of Social Sciences*), and Norman Chamber of Commerce (*The Opportunities of Climate Change*). Our scientists taught graduate and undergraduate courses in the OU School of Meteorology, including the Honors section of Introduction to Meteorology, Severe and Unusual Weather, and Applied Climatology and Meteorology.

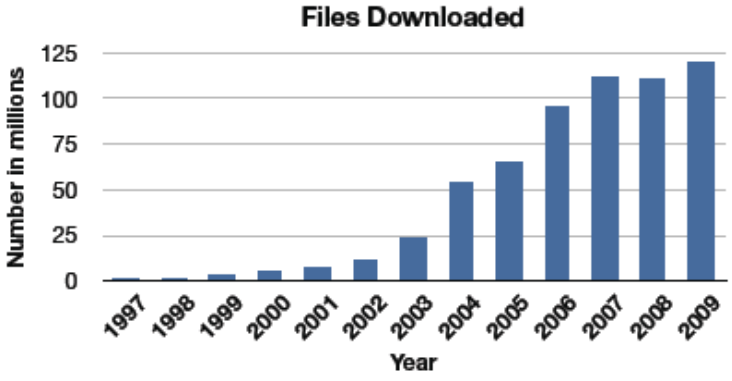
Crawford served as Councilor for the American Meteorological Society and served on the Executive Committee of the American Association of State Climatologists. McPherson served as Chair of the Metadata Working Group of the AMS Ad Hoc Committee for a Nationwide Network of Networks and as a member of the AMS ITS/Surface Transportation Subcommittee. Basara served as member of the National Science Foundation Facilities Assessment Editorial Board and Advisory Board for the Atmospheric Radar Research Center. Fiebrich served as member of the National Ecological Observing Network Design Review Panel, AMS Committee on Measurements, and AMS Nationwide Network of Networks Architecture Working Group. Melvin served on the ACT National Assessment of Educational Progress Achievement Level Setting Pilot Committee for 12th Grade Science and the Oklahoma Conservation Commission's Oklahoma Environmental Education Coordinating Committee. Giuliano served on the National Severe Weather Workshop 2010 committee.

Internationally, OCS received funding from the Province of Québec, Canada, to continue development of software tools for Mesonet-Québec; from the Republic of Croatia to conduct a feasibility study for modernization of their national meteorological and hydrological services; and from the Republic of Korea (South Korea) to assess their surface weather observing systems.

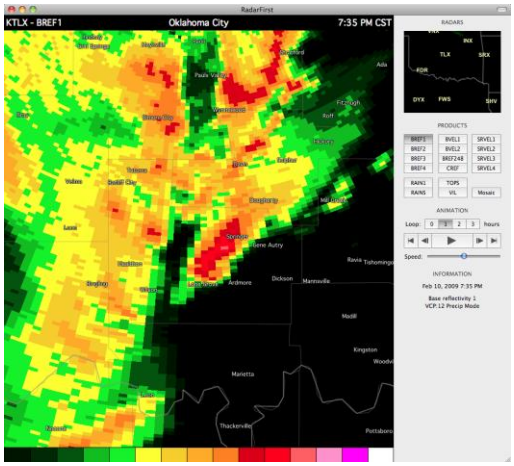
At the end of 2009, OCS employed 31 professional staff, 6 graduate students, and 8 undergraduates. We administered 28 financial accounts with a fiscal year (July 1, 2008 to June 30, 2009) budget totaling $3.8 million.

Information Services

OCS served 120 million files of data and products to our customers in 2009. On our web servers alone, we served 12.2 Terabytes of information from 1.5 billion hits to our web pages. We also fulfilled 229 detailed information requests from phone or email, which generated $47,523 in revenue – a 212% increase from 2008.



During 2009, products that were upgraded included the spinach white rust advisor, peanut leaf spot advisor, and pecan scab advisor. We also implemented a new drift risk advisor, a tool to help agriculture chemical applicators determine potential spray times using weather forecasts. We developed, deployed, and operated a new web site for the Southern Climate Impacts Planning Program. OCS developed and began testing WeatherMapper 1.0, a general-purpose map generation tool to replace our existing map generation programs. In the process, we created WeatherMapper configurations for over 100 operational maps. We also released version 1.0 of RadarFirst for OK-First participants. RadarFirst provides a scaled-down version of basic radar imagery and overlays and is expected to fill a niche for rapid real-time information.



We created and maintained Facebook fan pages for the Oklahoma Mesonet and Oklahoma City Micronet (OKCNET) as well as Twitter feeds for the OCS/Mesonet Ticker and OKCNET. These information methods were added to our RSS feeds of news items through our web pages and our state page at www.stateclimate.org.

Research

Funded by the Oklahoma Water Resources Board, OCS began a project to inform the Oklahoma Comprehensive Water Plan. The ongoing study examines 15 years of Oklahoma Mesonet data to quantify the seasonal and interannual variability of evapotranspiration across Oklahoma. We also sought to identify how the linkages between the land surface and the atmosphere affect water resources. Initial results confirmed critical links between evapotranspiration, precipitation, and soil moisture.

In 2009, research studies ranged the impacts of the remnants of Tropical Storm Erin (2007) to updates on national and regional assessment programs to drought policy. Examples of research activities include the following (OCS authors underlined):

Arndt, D. A., J. B. Basara, R. A. McPherson, B. G. Illston, G. D. McManus, and D. B. Demko, 2009: The overland reintensification of Tropical Storm Erin (2007). *Bull. Amer. Meteor. Soc.*, **90**, 1079–1093.

Campbell, H., 2009: Drought policy in Oklahoma and Missouri. Poster, *Seventh Annual Climate Prediction Applications Science (CPAS) Workshop*, Norman, OK, March 24-27, 2009.

Fiebrich, C.A., 2009: History of surface weather observations in the United States. *Earth-Science Reviews*, **93**, 77-84.

Jenkins-Smith, H., C. Silva, K. H. Goebbert, K. E. Klockow, M. Yuan, M. Nowlin, and G. DeLozier 2009: Experiencing the weather: Public perceptions of changes in local weather patterns. Extended abstract, *4th Symposium on Policy and Socio-Economic Research*, AMS, Phoenix, AZ, January 12-15, 2009.

Pinker, R.T., D. Sun, M.P. Hung, C. Li, and J.B. Basara, 2009: Evaluation of Satellite Estimates of Land Surface Temperature from GOES over the United States. *J. Appl. Meteor. Climatol*., **48**, 167–180.

Shafer, M. A., 2009: Update on activities of the National Integrated Drought Information System (NIDIS). Abstract, *Seventh Annual Climate Prediction Applications Science Workshop*, Norman, OK, March 24-27, 2009.

Shafer, M. A., 2009: Southern Climate Impacts Planning Program (SCIPP). Abstract, *6th U.S. Drought Monitor Forum*, Austin, TX, October 8, 2009.

Shafer, M. A., T. E. James, and N. Giuliano, 2009: Enhancing climate literacy. Extended abstract, *18th Symposium on Education*, American Meteorological Society, Phoenix, AZ, January 12-15, 2009.

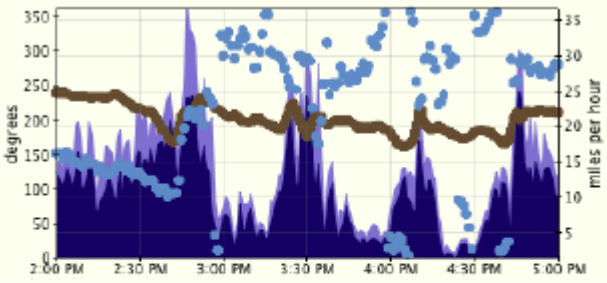
Monitoring & Impact Assessments

Statewide, 2009 was Oklahoma's 37th coolest and 31st wettest (since record-keeping began in 1895), a result of a cool and wet second half of the year. A combination of the negative phase of the Arctic Oscillation (average index of -3.4 in December) and a strong El Niño (Oceanic Niño Index of +1.5 for October – December period) were linked to a cold and wet winter for Oklahoma, including a significant ice and snow storm just before Christmas Day. The storm stranded travelers on the interstates and at Will Rogers World Airport, which closed all runways for 14 hours. Although only 35,000 customers lost electricity during the event, utility infrastructure damage estimates approached $2 million and the event was rated a "Level 3" (on a scale of 1 to 5) on the Sperry-Piltz Ice Accumulation index.

An historic Christmastime blizzard dominated the weather stories during December, an otherwise dry and cold month. The snow was heaviest in central and northeastern Oklahoma, along and to either side of the I-44 corridor. Photo courtesy of Christine Riley.

OCS helped to certify our new state record 24-hour snowfall total: 26.0 inches at both Freedom and Woodward on March 27-28. We measured a 500-year rainfall event at the Burneyville Mesonet site on April 29, 2009, with 12.89 inches of rain in 24 hours and 11.73 inches in 12 hours. Four major disasters or emergencies were declared in Oklahoma during 2009 (via the Federal Emergency Management Agency), tying our state for third in the nation.

OCS provided frequent assessments of and context regarding a range of disastrous weather events that affected Oklahoma during 2009, including the December blizzard/ice storm and February tornado outbreak. We also participated in state hazard mitigation and artificial recharge meetings.



One-minute observations of wind speed (dark blue), wind gusts (purple), wind direction (aqua dots), and station pressure (brown line) as four supercell thunderstorms pass close to the Oklahoma City Mesonet site near Quail Springs Mall (KNW101) on 10 February 2009.

In 2009, OCS also logged 229 specific information requests, including a review of the U.S. Bureau of Reclamation's "Literature Synthesis on Climate Change Implications for Reclamation's Water Resources" (Tech. Memo. 86-68210-091). We initiated a SCIPP pilot project with Austin Energy to develop a community climate action plan.

OCS operates and maintains weather and climate stations in partnership with the Oklahoma Mesonet, the Agriculture Research Service, and the City of Oklahoma City. During 2009, we dedicated our calibration laboratory to the Oklahoma Mesonet's first manager: Dr. Fred Brock. Now aptly named the Fred V. Brock Standards Laboratory, it is the site of a new LabView Pyranometer Calibration setup that uses a touch screen, interfaces with the sensor database, and generates a calibration certificate using MATLAB.

At 9:48 AM on May 27, 2009, the Oklahoma Mesonet measured its *four billionth* air and soil observation. The event was celebrated by Mesonet staff from both the University of Oklahoma and Oklahoma State University, highlighting the partnership that we have enjoyed since before observation #1.

In 2009, we completed 2,361 laboratory calibrations of sensors, including 354 calibrations for relative humidity, 499 for air temperature, 279 for wind speed, and 424 for soil temperature. To maintain our remote sites and sensors in the field, we conducted 540 site visits to 120 Oklahoma Mesonet stations, 56 visits to 20 Little Washita Micronet stations, 75 visits to 15 Fort Cobb Micronet stations, and 13 visits to 36 Oklahoma City Micronet stations. We found and repaired 327 sensor or communications problems in these three networks. Groundwater well sensors were installed at our Shawnee, Chickasha, and Spencer sites for the Oklahoma Water Resources Board.

Outreach

OCS hosted 23 K-12 programs, providing education to 1,298 students and 296 teachers and adults, and conducted 17 OK-First workshops, thereby educating 214 public safety officials. OCS or the Oklahoma Mesonet was referenced in 61 *The Oklahoman* newspaper articles during 2009. We participated in 43 SUNUP broadcasts.

We updated many of our materials for workshops (e.g., lessons learned from the February 10, 2009 Lone Grove tornado event) and established a new participant database to help us keep track of our users and their certification status. To aid our law enforcement participants, we obtained CLEET (Council on Law Enforcement Education and Training) certification for our OK-First courses.

Through the OU Speaker Service, we provided the following talks across Oklahoma: *Dust Bowl: Lessons Learned... and Lost* (6 talks, G. McManus); *Climate Change* (4 talks, McManus); *Basics of Meteorology* (Giuliano); *The Reality of Storm Chasing* (Giuliano); *Severe Weather Safety* (2 talks, Giuliano); *Disaster Preparedness* (Melvin); *Cloudy with a Chance of Meatballs* (2 talks, Melvin); *Meteorology Careers* (Melvin); *Weather Safety Preparedness* (Melvin); *The Weather and Climate of Oklahoma* (Arndt); and *10 Weather Events That Impacted History* (Arndt).

Oregon Climate Service (OCS)

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Philip Mote, State Climatologist
Kathie Dello, Faculty Research Assistant
Darrin Sharp, Faculty Research Assistant
Katy Stienmetz, Undergraduate Assistant

Personnel

In 2009, Oregon Climate Services (OCS) became a part of the Oregon Climate Change Research Institute (OCCRI) at Oregon State University. Dr. Philip Mote began as Director of OCCRI in March of 2009. In August, Kathie Dello and Darrin Sharp joined the team as Faculty Research Assistants. Kathie handles the climate inquiries and Darrin manages the OCS website and server. Katy Stienmetz came on board as an undergraduate assistant in early 2010 to archive cooperative data and help to restore the OCS website.

Website

The server that hosted the popular OCS webpage (http://www.ocs.oregonstate.edu) suffered a fatal crash in May 2009, rendering the website useless until mid-summer. OCS staff revived the website to a workable state in the fall after configuring a new server. In the interim, staff responded to an increased number of phone calls and e-mails, many inquiring about the status of the website. The feedback from these calls led to the hiring of an undergraduate assistant to aid in the development of a brand new OCS website. She is mapping the tangled web of pages and inventorying the data, reports, narratives, tools, and other material currently on the web page. We are moving ahead with building a replacement website and the anticipated release date is summer 2010.

Cooperative data archive

Oregon has a robust network of cooperative observers. About 120 observers, all but 10 of whom are NWS cooperative observers, send their climate information directly to OCS. Most of these records are received by mail, though some observers have started to fax or e-mail their monthly reports. These observations are archived and provided as requested. The office typically receives and responds to 15-20 requests for climate information per week. Much time and effort has been devoted to dealing with a backlog of cooperative data from the beginning of 2009, when the office was in transition.

Routine activities

OCS produces a monthly newsletter highlighting the past month's significant weather events, station records, and interesting Oregon-specific climate information. This publication is available to interested users electronically, and supplants the monthly weather summary of tabulated co-op data. The office participates in outreach activities, such as KOHD Stormfest in Bend, OR. Staff typically respond to 1-2 media inquiries per month. These requests are mostly for print or radio. Additionally, OCS produces reports about past weather events under contract for the private sector.

Pennsylvania State Climate Office

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Tel: 814-863-1842
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psc@mail.meteo.psu.edu
http://climate.psu.edu/

Paul Knight, State Climatologist

The Pennsylvania State Climate Office database continues to incorporate observations from more than a half dozen separate networks within the Commonwealth. Approximately 800 hourly reporting stations (primarily from the Citizen Weather Observation Program) are now being ingested into the office's relational database. When combined with hourly reports from the FAA and Pennsylvania's DEP, there are nearly 1000 observations of temperature, dew-point and wind each hour in the PA region. The State Climate Office has added new tools to the web interface.

The vision for a Pennsylvania Mesonet remains a priority for the State Climate Office, though funding sources remain sparse. The CoCoRaHS network continues to expand across Pennsylvania under the auspices of the state climate office and with the name FROST. By the end of the year, over 200 volunteer observers had enrolled and typically, 125 faithfully report each day.

Information Technology Capabilities

- About forty web data requests were logged each month (besides those by phone and US mail)
- Primary users are commercial, educational and government organizations
- The entire North American Regional Reanalysis data set (approximately 4.5 terabytes) has been augmented routinely so that the complete data set is through 12/31/09 and this now constitutes a 30 year data base.

Communication Capabilities

- The web server was separated from the database host to increase the capacity of numerous web inquiries simultaneously. Development of new products has mainly focused on grant-related items, such as those connected with a data inventory for the National Park Service and Wheat Scab model predictions.

Information Services

- The Interactive Data Archive has been expanded to include data queries for specific dates and strings of dates. A collaborative effort with the Northeast Regional Climate Center continues to bring evapo-transpiration data to users and is part of a water budget project.

User Base Growth

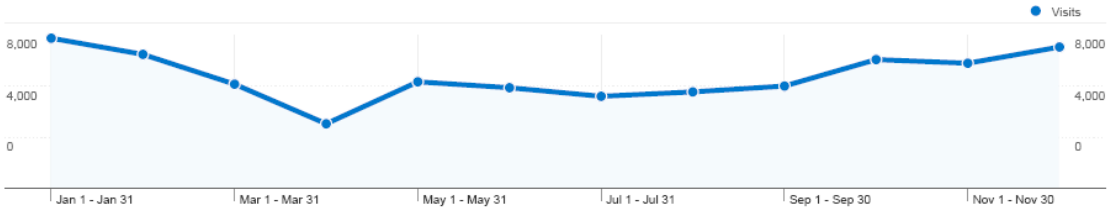
- The number of sites accessed has leveled off during the past year. The following charts show the 2009 user volume and city probes:

climate.met.psu.edu

Traffic Sources Overview

Jan 1, 2009 - Dec 31, 2009

Comparing to: Site



All traffic sources sent a total of 70,336 visits

20.06% Direct Traffic


59.43% Referring Sites


20.51% Search Engines

- **Referring Sites** 41,799.00 (59.43%)
- **Search Engines** 14,424.00 (20.51%)
- **Direct Traffic** 14,108.00 (20.06%)
- **Other** 5 (0.01%)

Top Traffic Sources

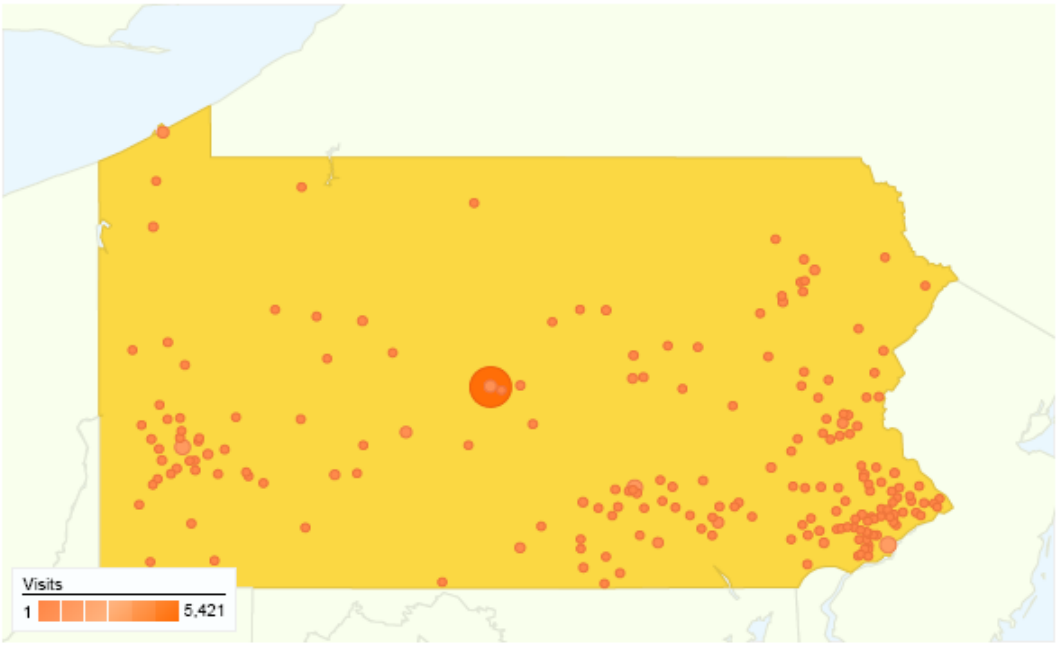
Sources	Visits	% visits
images.google.com (referral)	16,540	23.52%
(direct) ((none))	14,108	20.06%
google (organic)	11,407	16.22%
google.com (referral)	4,023	5.72%
climate.psu.edu (referral)	2,665	3.79%

Keywords	Visits	% visits
rainbow	342	2.37%
weather	167	1.16%
pa weather cams	143	0.99%
wllp1	122	0.85%
penndot cameras	116	0.80%

climate.met.psu.edu

State Detail:
Pennsylvania

Jan 1, 2009 - Dec 31, 2009
Comparing to: Site



This state sent 23,573 visits via 591 cities

Site Usage

Visits	Pages/Visit	Avg. Time on Site	% New Visits	Bounce Rate
23,573 % of Site Total: 33.51%	4.23 Site Avg: 2.65 (59.88%)	00:02:59 Site Avg: 00:01:32 (94.42%)	63.32% Site Avg: 83.33% (-24.01%)	55.13% Site Avg: 62.25% (-11.44%)

City	Visits	Pages/Visit	Avg. Time on Site	% New Visits	Bounce Rate
State College	5,421	4.57	00:04:06	41.32%	53.00%
Philadelphia	1,312	3.79	00:02:50	77.59%	54.57%
Pittsburgh	1,156	4.39	00:02:47	75.17%	57.87%
Harrisburg	1,119	5.03	00:03:32	53.71%	45.84%
University Park	615	2.53	00:01:24	29.92%	58.05%
Erie	542	2.75	00:02:10	64.58%	68.63%
Altoona	503	5.20	00:03:08	60.04%	49.50%
Lancaster	467	5.07	00:03:18	71.31%	50.11%
Allentown	385	4.77	00:03:14	72.21%	54.81%

1

Google Analytics

Data Quality Control/Assurance

- The PA Climate office takes advantage of the sophisticated DQ control routines provided by MADIS on CWOP. Other data is manually QA with student support. A trend comparison of surface temperature and dew point (comparing FAA sites and NARR grid point data) has shown the quality of both data sets for long-term trends.

Climate Office Projects

- In collaboration with the National Park Service, a climate data inventory project is now in its fifth year. Annual and seasonal summaries have been designed which will have applicability to Pennsylvania climate stations (and DCNR) that are not part of this project. The interface for the National Park Service data inventory and retrieval has been upgraded to the current state climate interface.

Special Projects

- Collaboration with experts in the College of Agricultural Sciences continues with the refinement of environmental data monitoring systems for a Wheat Scab project and development of phenology models for Organic Growers of Cucurbits and the implementation of an Apple Disease forecast systems. A project with Pennsylvania DOT and the top forecasters from the forecasting practicum course continued to provide an early alert for hazardous winter weather for surface transportation in Pennsylvania. Collaboration continues between ZedX, Inc. and the state climate office in providing forecast charts and commentary for the Soy Bean Rust project with USDA.

SCEP

- The Pennsylvania State Climate Office contributed monthly state weather summaries including its societal impacts to the Northeast Regional Climate Center during all of 2009 as per Task 2.1 of the 2009-2010 NCDC-SCEP agreement. In addition, the state climate office in collaboration with the department tv studio staff and facilities, designed and produced 4 video vignettes highlighting the climate products from NCDC, RCC's and State Climate Offices.

South Carolina Office of Climatology (SCO)

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Hope Mizzell, State Climatologist
Wes Tyler, Assistant State Climatologist for Service
Mark Malsick, Severe Weather Program Liaison

Created in 1986, the Office of State Climatology (SCO), as mandated by the South Carolina General Assembly (Section 49-25-10 et seq., Code of Laws of South Carolina, 1976), represents the State in all climate and meteorology matters. The SCO resides within the South Carolina Department of Natural Resources (SCDNR). The SCO serves as liaison between the National Weather Service and State agencies, such as the Governor's Office, SCDNR, SC Department of Public Safety, and the SC Emergency Management Division. The SCO assists other State and Federal agencies in data acquisition and interpretation before, during, and after periods of severe weather.

The SCO provides a unique service to the state by archiving and distributing climate and meteorological data, reports, and research that date back to the early 1700s. The SCO also serves as an expert witness in civil and criminal litigation involving weather and climate, averaging 12-24 cases per year. The SCO administers the *South Carolina Drought Response Act*, which requires the office to formulate, coordinate, and execute a comprehensive drought response program for the State of South Carolina.

ARSCO Qualifications The following describes the ways in which the SCO addressed each of the ARSCO qualifications during 2009:

Communication Capabilities

- The office expanded the SCO website (http://www.dnr.sc.gov/climate/sco).
- The office operates an email notification system focused on severe weather notification and tropical advisories. The address list increased from 458 subscribers in 2008 to 736 in 2009. The subscribers are from Federal, State and county agencies, municipalities, and school districts.
- The office maintained the on-line Regional Drought Monitor Application. The application was developed through a partnership with Carolinas Integrated Sciences and Assessments (CISA) and Duke Energy (https://www.dnr.sc.gov/drought/).

Information Services

- During 2009, the SCO averaged 60 monthly phone and email requests for climate data and 30,000 information retrievals from the SCO web site. During significant weather events these numbers double with 60,000 web information retrievals and 120 email and monthly phone requests.
- Staff assisted SC Department of Natural Resources Law Enforcement and SC Highway Patrol with 62 accident investigations.
- Media inquiries averaged 20 per month.
- The office issued weekly and annual summaries of the State's weather and climate in the *South Carolina Weekly Weather and Climate Report* and the *South Carolina Year in Review,* both of which are available on the SCO website. The SCO also provided a weekly summary of South Carolina Weather and Climate Data to the National Agricultural Statistics Service (NASS) that is published weekly in the South Carolina *Crop Weather Summary.*
- The office issued a weekly weather forecast summary for the SC Soybean Rust Newsletter. The newsletter is distributed electronically by Clemson to over 300 subscribers including county agents, soybean growers, seed/chemical & fertilizer industry personnel, and consultants.
- The Drought Response Program requires regular correspondence with 48 Drought Response Committee Members, four major power companies, and over 2,000 water utilities. Correspondence includes drought projections, official declarations, and suggested response. During 2009, the SC Drought Response Committee was convened six times to review the drought conditions and issue declarations. Bi-weekly drought updates were distributed by email to committee members and list serve subscribers. Staff utilized an online application to monitor water conservation actions implemented by SC water systems (http://www.dnr.sc.gov/climate/sco/Drought/drought_water_restriction.php).
- The office worked with hydroelectric dam operators and other resource agencies to enhance drought mitigation efforts as a part of the implementation of their Federal Energy Regulatory Commission's (FERC) hydro-power dam license. Staff served as a member on the Catawba-Wateree and Yadkin Pee Dee Drought Management Advisory Committees participating in monthly meetings or conference calls. Staff also served on a special subcommittee focused on revising the Catawba-Wateree Low Inflow Protocol systems (http://www.dnr.sc.gov/climate/sco/Drought/drought_water_restriction.php).
- The office routinely provided drought and climate information to the SC Attorney General's Office related to South Carolina's lawsuit over water in the Catawba Wateree Basin.

Research

- During 2009, the Severe Weather Liaison updated South Carolina's Tornado climatology (http://www.dnr.sc.gov/climate/sco/ClimateData/SC_Tornado_Climo.pdf) and the Hurricanes and Tropical Storms Affecting South Carolina 2000-2009 (http://www.dnr.sc.gov/climate/sco/Tropics/2000s.php).

- The office is a cooperating institution in the Carolinas Integrated Sciences and Assessments (CISA) project focused on integrating climate science and water management in North and South Carolina.
- The office assisted the State Paper with a series of articles for the 20th anniversary of Hurricane Hugo.

Outreach

- During 2009, the SCO provided approximately 54 annual presentations to various governmental, private sector, and civic organizations.
- Staff attended state and national conferences such as the Southeast Regional Climate Center's Technical Advisory Committee's Annual Meeting, American Association of State Climatologists Annual Meeting, Carolinas National Integrated Drought Information System Pilot Project meeting, South Carolina's Hurricane /Emergency Management Workshop.
- The office hosted site visits from Dekalb University (Australia) representatives and staff from the Kentucky State Climate Office.
- The State Climatologist provided a monthly weather and climate segment on the South Carolina Educational Television show "Making It Grow."
- The Assistant State Climatologist serves as commissioned law enforcement officer to assist SCDNR during weather emergencies.
- The State Climatologist was selected to take an 18-month Certified Public Managers (CPM) Course. The CPM is a nationally recognized professional development program for supervisors and managers in government.

Monitoring and Impact Assessment

- SC CoCoRaHS network grew to 350 active observers.
- Staff installed automated weather stations at two middle schools that were implementing a new "Natural Resources in Schools" program.
- Staff worked closely with the National Weather Service to monitor the COOP and ASOS data networks to maintain the quality of SC climate observations.
- As a member of the State's Emergency Operations Team, SCO staff participated in quarterly hurricane task force meetings, annual exercise, and training. SCO staff were activated to the SC Emergency Operations Center during the April Horry County Wildfire. Staff issued 7 weather outlooks, 9 fire weather outlooks, 19 severe thunderstorm/tornado advisories, 21 tropical cyclone advisories, 34 weekly tropical updates, and 6 cold weather advisories. The fire weather outlooks were customized for the SC Forestry Commission.

South Dakota Office of Climate and Weather (SDOCW)

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Dennis Todey, State/Extension Climatologist
Chirag Shukla, Climate Data Specialist

The South Dakota Office of Climate and Weather is part of the Cooperative Extension Service at South Dakota State University. Consequently the mission of the state climate office of providing data and information to the people of the state overlaps the mission of the extension service in providing science-based information to the people of the state. As part of the SD CES, the state climate office has connections in every county of the state to communicate with people of the state providing for a direct set of users as well as contacts to transfer information back to the on state impacts and needs. The South Dakota Office of Weather and Climate (SDOCW) was granted ARSCO status in 2005.

Personnel

Dr. Dennis Todey continues as state climatologist and director of the climate office. During 2009 he completed a 6 month assignment as Acting Director of the High Plains Regional Climate Center (August 2008 – January 2009) during an extended health absence of Dr. Ken Hubbard. Since March of 2009, he is back at SDSU full time. At the 2009 American Association of State Climatologists' annual meeting Dr. Todey was elected president-elect of the AASC.

The state climate office lost its assistant after Christmas. Chirag Shukla accepted an offer in private industry. Refilling of positions is on-going. We wish him well in his future ventures. Ms. Joanne Anderson continues as a graduate assistant.

The state climate office added compilation of wind resources data via the South Dakota Wind Resource Assessment Network (WRAN) to its portfolio of work. This network is a set of anemometers located on tall towers collecting wind data for wind energy studies and developing a wind climatology at turbine heights. Activities with this include collecting and archiving data and completing wind reports. This activity is currently funded by the US Department of Energy Sun Grant.

Reporting

The state climate office continues to supply data and create reports through a contract with South Dakota Agricultural Statistics Service. This data is used for official reports weekly during the growing season and monthly during the off-season.

During the year the SCO completed monthly climate reports as funded through a SCEP funded climate reporting project. These reports were compiled and posted on the SD state climate site, the AASC site and forwarded to HPRCC for use in their monthly report.

The state climate office manages and archives data from a 40 station automated weather station network across the state. Activities on the network during the year included general maintenance and trouble-shooting communications. No expansion of the network occurred. Searching out additional funding to support the network's ongoing needs continued. Data from this network is used for/by:

- National Weather Service for forecasting and verifying severe weather
- Local crop and weed sprayers for decision-making of spraying
- Farmers and others in ag business tracking soil temperatures

Extreme Events Reporting

A moderately wet, but quite cool summer limited drought conditions leading to little activity on drought reporting. Cool and wet conditions in the spring delayed planting requiring reporting to media and extension personnel. An excessively wet fall and numerous winter storms (including potentially the largest state-wide snowfall recorded) led to several press releases and media interaction about these events. The SCO also compiled data for SD Emergency Management to report on various events for disaster declarations.

Dr. Todey was added to state hazard mitigation team through SD Emergency Management. The goal is to add more climate expertise especially in re-writing the state emergency management plan. Editing and revising the plan is being done through private contractors with input from various state agencies. The new plan will be completed in 2010.

Outreach

The state climate web site has maintained its central access point for various data in the state including federal and non-federal data. The site serves the general public, other researchers and a variety of clientele across the state.

The web site and individual responses continue to supply data for various users in the state and outside the state. Over 100 individual data request and several legal data requests have been supplied by the SCO during the last year.

Dr. Todey continues to be a source for climate information locally, regionally and nationally. Planting conditions, outlooks and reports on records continue to be a popular media need.

Dr. Todey and the SCO continue various outreach efforts. The most frequent requests are talks on outlooks, climate trends and climate change impacts. He has done over 30 talks within the state and region. Schools are another source of outreach talking about general

climate issues, climate change or forecasting. Master gardener training is done through SD Cooperative Extension.

Office of the Texas State Climatologist

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John W. Nielsen-Gammon, Texas State Climatologist
Brent McRoberts, Research Associate
Marissa Pazos, Undergraduate Assistant

Physical Location and Funding

The Office of the State Climatologist (OSC) is housed in the Department of Atmospheric Sciences, Texas A&M University. Direct University support for this fiscal year included 50% salary of a research associate (Brent McRoberts) from the Department of Atmospheric Sciences. The College of Geosciences contributed $5,000. Remaining operating expenses were paid by the State Climatologist through returned indirect costs and salary savings. Office space is provided free of charge by the University. In addition to the State Climatologist and the Research Associate, an undergraduate student (Marissa Pazos) provides assistance with phone inquiries and data requests. Steven Quiring, a faculty member in the Geography Department, also assisted with OSC activities. Cost recovery is available for large data requests. External funding is provided for sponsored research projects.

Communication and Information Services

In 2009, about 200 electronic climate requests were received and responded to. Annually, the Office receives approximately 100-150 phone calls and sends dozens of facsimiles and mailings. For the Texas Almanac, the Office provides and verifies a significant amount of climatological data for the publication. On the Office website, (http://atmo.tamu.edu/osc), monthly climate summaries for the state and the Bryan/College Station area are posted. The Texas Monthly summary includes a crop report, precipitation and temperature deviations from normal for the major cities in Texas, and a summary of the previous month's weather. Over the past year, the Office has developed an online library of climate resources that includes OSC publications, publications from the State of Texas, and links to other climatic resources.

Research

The Office of the State Climatologist is continuing work on a project directed toward producing a homogeneous climate division precipitation data set. The basis of this project was the use of an interpolation technique to estimate missing monthly precipitation observations from surrounding stations, thereby eliminating biases associated with

changes in network configuration. The resulting climate division information will be much more suited to long-term variability and climate change studies.

In another project, the Office has been producing high-resolution, precipitation products that encapsulate the state of drought and/or wetness in Texas. This includes analyses of percent of normal precipitation, the Standardized Precipitation Index (SPI), and the SPI Blend, all available at http://atmo.tamu.edu/osc/drought. The SPI Blend is a product created by the Office that modifies the SPI by giving a higher influence to more recent precipitation. These products utilize the Advanced Hydrologic Prediction System (AHPS) daily, 4 km precipitation analyses available at http://water.weather.gov. The products are produced on a weekly basis and are utilized for drought severity assessments in the US Drought Monitor.

The Office completed an investigation into the local-scale and large-scale controls on summertime precipitation in Texas with three research papers that have or will appear in journals in 2010. Our study found that precipitation on monthly time scales during the summer in Texas is primarily controlled by variations in convective inhibition (CIN) and is almost unaffected by CAPE. Other research projects have involved historical weather events, wintertime weather variability, and expert review of development of updated storm surge probability maps for Texas.

Outreach

The Office's primary means of outreach is through data access and publications available on the OSC web site. In addition, the OSC responds regularly to media requests and requests for guest lectures. During the past year, the greatest interest among the public has been with regard to topics related to drought and climate change. During 2008, the Texas State Climatologist gave invited lectures to the following groups and venues: the Fort Worth local chapter of the American Meteorological Society, the Southern Region Headquarters of the National Weather Service, the San Antonio Parks and Recreation Department, the Decatur Texas AgriLife Rancher's Gathering, the San Antonio A&M Club, the Shell Center for Sustainability, the Southern Gas Association, the Texas Commission on Environmental Quality, and the Alamo Chapter of the Sierra Club.

A newer form of outreach is the blog Atmo.Sphere, hosted by the Houston Chronicle (http://www.chron.com/commons/readerblogs/atmosphere). The blog focuses on climate change, with some discussion of current weather events as well. The blog is written by the State Climatologist and by Barry Lefer, a faculty member at the University of Houston.

Monitoring and Impact Assessments

The State Climatologist is an appointed member of the Texas Drought Preparedness Council, a statewide interagency committee created by the Texas Legislature in 1998 to monitor drought conditions and coordinate drought mitigation activities. The Council meets monthly in Austin. The State Climatologist is also an active participant in the United States Drought Monitor mailing list.

The Office produced a report on the severity of the 2008-2009 Texas Drought, comparing the drought to other historical droughts on a variety of time scales, and concluding that, for nine counties in south-central and southern Texas, the drought was probably the most severe summertime drought in the period of record.

Since December 2008, with SCEP funding from NOAA, the Office has produced a monthly climate impacts report that documents the print media coverage of weather and climate effects on the general public and is posted on both the OSC and AASC websites. Because of the diversity of climate impacts in Texas, reports include more than a hundred impact reports. Reports are gathered from newspapers and other sources throughout the state with links to the original source material. The reports are posted on our own web site at http://atmo.tamu.edu/osc/socimpacts as well as on http://www.stateclimate.org.

Utah Climate Center (UCC)

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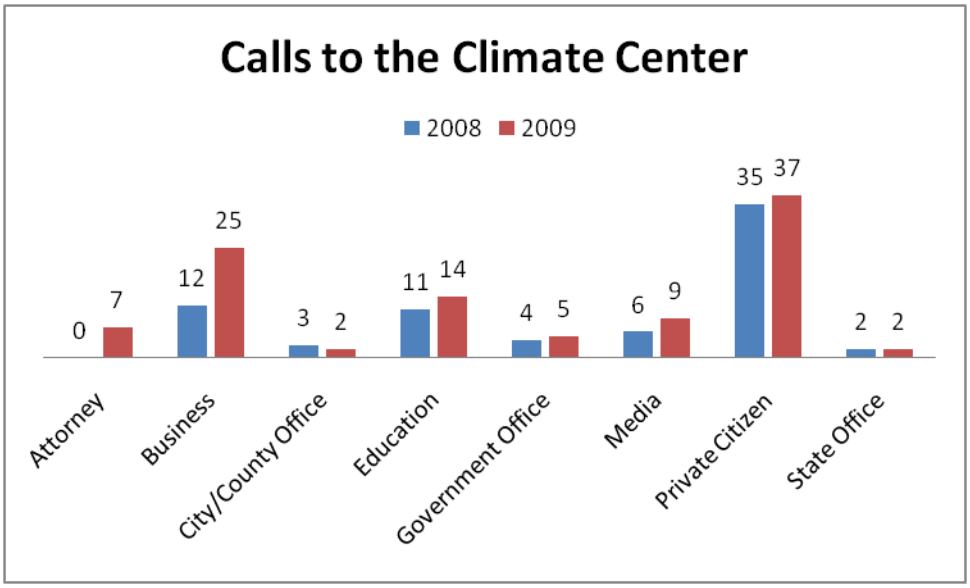
http://climate.usurf.usu.edu/

Robert Gillies, State Climatologist
Esmaiel Malek, Associate Director
Shih-Yu Wang, Postdoc Research Associate
Alan Moller, Meteorologist
Marty Booth, Meteorologist
Jonathan Carlisle, Research Technician

The climate center continued service for the State of Utah during 2009.

Dr Gillies represented the Utah Climate Center (UCC) at the American Association of State Climatologists (AASC) and at Western Extension and Research Administrative (WERA) committees WERA 102 & WERA 1012.

The number of telephone data requests increased over last year and are shown below. Calls have originated from a variety of sources with general inquiries from private citizens being the most dominant source. The following figure represents the distribution of phone calls to the Climate Center over 2008 and 2009. (Note: a few months of call log data is missing for spring of 2008.)



This phone call report is restricted to types of calls in which a climate/data/service related request or question was made to the Climate Center. It does not, for example, include "in

house" calls like the admin office asking about a particular meeting or financial document.

As was mentioned in last year's report the website continues to be the major source that clients are simply retrieving their data / information from the web server as was intended at the outset. As was the case for 2008 the climate data download continues as the most visited / used page – see attached Google analytics attachment.

As per last year, the statistics of use is monitored by Google analytics. The statistics are dramatic with an overall increase in visits of 23% and page views of 43%. Other % changes are more striking with, for example, data download showing an increase of 83%. Feedback to the climate center as to the level of service the webpage offers – representative e-mails can be supplied upon request.

The statistics as to utility of the website again underlie the importance of the IT infrastructure that is now in place in the UCC.

In 2008 Dr. S-Y Simon Wang was hired as a post-doc to research the climate of Utah and the Intermountain west. The research activity is highlighted here as a noteworthy effort on the part of the UCC this year.

a. Long-term climate variability

Using various climate datasets derived from surface stations, state-of-the-art assimilation systems, satellite observations, and tree ring records, we identified a unique "cycle" in the hydrology of the central Intermountain Region. This hydrologic cycle repeats once about every 12 years and closely modulates the Great Salt Lake elevation. Using sophisticated diagnostic tools, we were able to physically link this hydrologic cycle to the sea surface temperature (SST) variations in the tropical Pacific Ocean, as well as the atmospheric process in between. Moreover, the discovery of this physical process suggests a plausible climate prediction scheme for Utah: by monitoring the variation of the Pacific SST, it is feasible to predict precipitation in Utah with a 2-3 year lead time and the Great Salt Lake elevation with a 4-6 year lead time.
This work has led to three papers in peer-review journals (*Geophysical Research Letters, Journal of Climate, and Climate Dynamics*) and three conference presentations. Moreover, given the significance of the work, it was invited and posted on the National Weather Service website, and has attracted media attention. A follow-up study focusing on a longer drought cycle with a frequency of about 40-50 years is being conducted.

b. Dynamical downscaling of Utah climate

The term "dynamical downscaling" defines the process of deriving regional climate information based on large-scale conditions through the use of regional climate models (RCMs). Flexible resolutions and full physics offered by RCMs allow for climate impact assessments to be made at any necessary scales. We have analyzed six of such RCMs participating in the North American Regional Climate Change Assessment Program (NARCCAP) and reported their characteristics in a paper published in *Geophysical Research Letters*. This is also the first paper of the NARCCAP. Based on those findings,

we are currently conducting experiments using one of the RCMs to overcome the reported biases and, ultimately, obtain reliable high-resolution climate simulations for Utah. Such model simulations will provide climate impact assessments for water management and environmental control in Utah and its vicinity.

c. Climate change impact study

It is known that the warming climate of the Western U.S. causes snowpack to melt early and produces more rain than snow in spring. Using snowfall observations derived from the National Weather Service Cooperative Stations, satellite observations, and the NARCCAP RCMs, we investigated the change in precipitation regime during winter. The results indicate a rapid decline in the ratio between snowfall and rainfall in deep winter, contrary to the common perception that the decline in snowfall is most pronounced in spring. The analysis of future climate projected by the NARCCAP RCMs indicates a continued decline in winter snowfall accompanied by slowly increasing rainfall in Utah.

d. Synoptic analysis

Winter inversion leading to harmful air quality has been plaguing Utah. Prolonged episodes of strong inversion are particularly dangerous and difficult to predict. We analyzed historical inversion events for the past 30 years and found that prolong inversion episodes tend to occur in conjunction with a periodic atmospheric variation mode, namely the intraseasonal oscillation which is connected to the tropics. This finding suggests that current numerical weather prediction models are (and will be) incapable of predicting a full episode of prolonged inversion; however, ongoing research of climate prediction by way of tracing the intraseasonal oscillation may be an alternative approach to forecast prolong inversion episodes and the associated air quality. A research paper reporting these results has been accepted for publication in *Weather and Forecasting*.

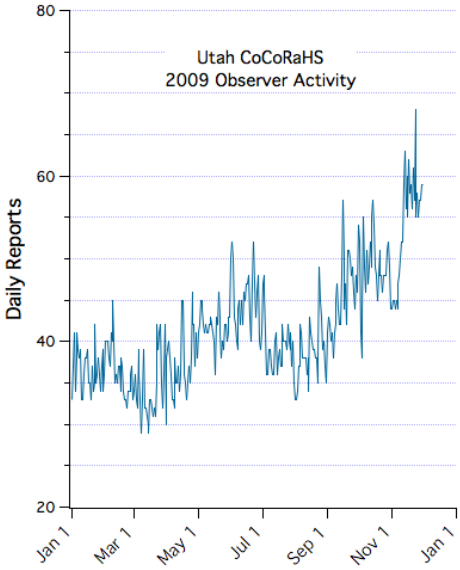
Dr Gillies presented (all **invited**) at various venues on the subject of climate and climate change:

- **Robert R. Gillies**. 2009. Climate Change and its Impact on Utah's Future Water Supply. Sixth Annul "AND JUSTICE FOR ALL" Continuing Legal Education Seminar. Water Sustainability in an Uncertain Future. February 5, 2009; Utah Law and Justice Center, Salt Lake City, Utah.
- **Robert R. Gillies**. 2009. Climate Change, Water Supplies, and Utah. A Symposium – Climate Change and Utah's Water Supply (hosted by National Weather Service Forecast Office etc). February 24, 2009, Salt Lake City Library, Utah.
- **Robert R. Gillies**. 2009. The Climate Puzzle of Global Warming: It is not just about Chilies! Fifth Southwest Rare Plant Conference – Changing Landscapes in the Southwest. March 16-20, 2009, Salt Lake City, Utah.
- **Robert R. Gillies**. 2009. Science of Climate Change. Utah's Changing Climate – Utah Energy Forum. April 6, 2009, State Office Building, Salt Lake City, Utah.

- **Robert R. Gillies**. 2009. Local modeling of climate and meteorological studies as applied to Utah/projected climate scenarios for Utah in worst and medium case scenarios – A private discussion with Congressman Jim Matheson. April 24, 2009, Salt Lake City, Utah.
- **Robert R. Gillies**. 2009. Climate Change and Water Supply in the Western U.S.: Baseline and Emerging Regulatory Issues. 55th Annual Rocky Mountain Mineral Law Institute. July 23-25, 2009, San Francisco.
- **Robert R. Gillies**. 2009. Northern Utah Climate Modeling. Bear River Symposium. September 10, 2009, Garden City, Utah.
- **Robert R. Gillies**. 2009. Science of Climate Change. Senior University, Utah State University. September 30, 2009, Logan, Utah.
- **Robert R. Gillies**. 2009. Future Climate and Weather Patterns in the West (Utah). Utah Department of Natural Resources (Division of Wildlife Resources – Aquatic Section). November 9-10, 2009. Salt Lake City, Utah.
- **Robert R. Gillies**. 2009. Cottonwood Canyon Foundation (Tour with Ranger Training). Holiday Library, Salt Lake City, Utah.

CoCoRaHS

CoCoRaHS is a unique, non-profit, community-based network of volunteers of all ages and backgrounds working together to measure and map precipitation (rain, hail and snow). By using low-cost measurement tools, stressing training and education, and utilizing an interactive website, our aim is to provide the highest quality data for natural resource, education and research applications. CoCoRaHS currently operates in many states across the country. The network originated with the Colorado Climate Center at Colorado State University in 1998 thanks in part to the Fort Collins 1997 flood. In the years since, CoCoRaHS has expanded rapidly with over 12,000+ observers in thirty-nine states. Utah joined CoCoRaHS in July, 2008.

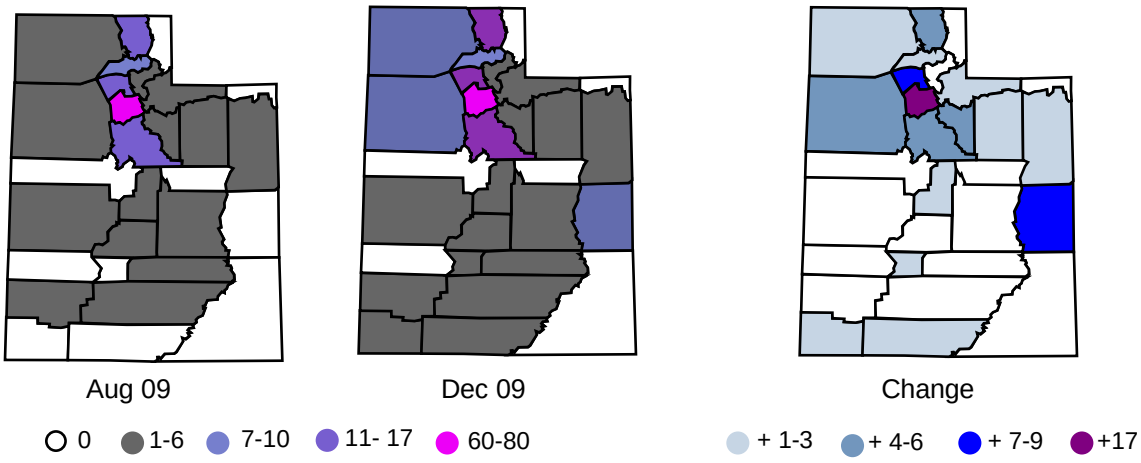


CoCoRAHS efforts have involved expanding the observer network in Utah, not only in numbers, but also coverage:

1. *With respect to numbers* — we've thus far increased our total registered observers by 47%, from 147 to 214. However, the real number of merit, the number of daily observations, is still in flux. It's still early, as our most intense recruitment efforts were in mid-Autumn and observers are still setting themselves up. Still, daily observations for the 2nd half of Nov. and 1st week of Dec. are up 35% over the same period last year.

2. *With respect to coverage* — we've increased participating counties from 19 to 23 (new counties are Grand, Kane, Piute and Washington). More than total numbers, coverage remains our most important task and the we'll be focusing on more directed recruitment in the coming months.

2009 CoCoRaHS Observer Coverage



A summary of Dr. Rob Davies's CoCoRaHS activities since August as follows:

- *Introductory slide show* — Developed new introductory presentation, focusing on motivation for the program. In particular, I've shifted the emphasis from sudden, heavy downpour and flood warning, to longer term water issues. Focusing on three major factors of concern — (i) increasing population, both in Utah and the southwest; (ii) historical records suggesting recent history (the past century) is well outside the norm of the past millennium; and (iii) the uncertainty of how climate change will impact Utah precipitation in the 21st century — I've related the importance of CoCoRaHS data to two major areas: efforts by hydrologists to project water supplies; and efforts by climate modelers to improve and validate regional-scale precipitation models through hindcasting. I should make clear that the value of data to flood warning is certainly still valid in Utah, though I felt potential Utah observers would be more strongly motivated by the longer-term water issues.
- *Extension efforts* — Traveled to three Utah regional staff meetings in September and gave the updated Utah Water Ranger presentation to the state's extension agents. Principal benefit to date has been the involvement of Mike Johnson from Grand County. Mike advertised locally in Grand County for volunteers and was able to recruit 14 people to an evening meeting in Moab, which I drove down to conduct. This effort has so far produced 8 actively reporting observers in Grand County, where we previously had none. In the coming months I'll be using this experience to model additional Extension efforts in under-represented counties. To this end, Mike is going to put together a short write-up / presentation for other extension agents.

- *Media efforts* — Press release and media flurry near the end of October. We had coverage in most Utah news outlets, including all of the state's major newspapers (and many of the smaller ones); Salt Lake City television stations; and Utah Public Radio (who also produced a feature story on the Utah Water Ranger program). This media blitz is the effort that gleaned most of our new observers.
- *Instructional videos* — Began producing training videos for rain and snow measurement. Specifically, we've filmed the snow measurement video; editing is in progress.
- *Website updates* — Implemented some cosmetic and content updates to the Utah Water Rangers website.

Publications and Internet Resources

Article (refereed journal)

- Wang, S.-Y., R. R. Gillies, J. Jin, and L. E. Hipps, 2009: **Recent rainfall cycle in the Intermountain Region as a quadrature amplitude modulation from the Pacific Decadal Oscillation**, Geophysical Research Letters, Vol:36, L02705, doi:10.1029/2008GL036329.
- Wang, S.-Y., R. R. Gillies, E. S. Takle, and W. J. Gutowski Jr., 2009: **Evaluation of precipitation in the Intermountain Region simulated by the NARCCAP regional climate models**, Geophysical Research Letters, Vol: 36, L11704, doi:10.1029/2009GL037930.
- Wang, S.-Y., R. R. Gillies, L. E. Hipps, and J. Jin, 2010: **A transition-phase teleconnection of the Pacific quasi-decadal oscillation**, Climate Dynamics, doi: 10.1007/s00382-009-0722-5 (in press)
- Wang, S.-Y., R. R. Gillies, J. Jin, and L. E. Hipps, 2010: **Coherence between the Great Salt Lake Level and the Pacific quasi-decadal oscillation**, Journal of Climate, doi: 10.1175/2009JCLI2979.1 (in press)
- Wang, S.-Y., L. E. Hipps, R. R. Gillies, X. Jiang, and A. L. Moller, 2010: **Circumglobal teleconnection and early summer rainfall in the US Intermountain West**, Theoretical and Applied Climatology, doi: 10.1007/s00704-010-0260-4 (in press)
- Gillies, R. R., S.-Y. Wang, and M. R. Booth, 2010: **Atmospheric scale interactions on wintertime Intermountain West inversions**. Weather and. Forecasting (accepted; http://cliserv.jql.usu.edu/paper/14306.pdf)

Article (other)

- Gillies, R. R., and S.-Y. Wang, 2009: **The Pacific QDO as a natural predictor for the Great Salt Lake elevation**. Climate Prediction Science and Technique Digest, NOAA National Weather Service, December 2009, pg 15-19.

- Rangeland Resources of Utah (**Section 5 – *Climate of Utah***) Robert R. Gillies and R. Douglas Ramsey — Utah Public Lands Policy Coordination Office 2009

Article, misc. magazine/newspaper/newsletter

- Judy Fahys, **Scientists find patterns in Utah's wet-dry cycles**, Salt Lake Tribune (http://www.sltrib.com/ci_13681950?IADID=Search-www.sltrib.com-www.sltrib.com)
- Judy Fahys, Wasatch foul air linked to Arctic, Salt Lake Tribune (http://www.sltrib.com/ci_14345046?IADID=Search-www.sltrib.com-www.sltrib.com)
- Kim Burgess, **Inversions linked to Arctic trend: USU researcher says weather pattern most pronounced since '50s**, Logan Herald Journal (http://hjnews.townnews.com/articles/2010/02/14/news/news02-02-14-10.txt)
- National Environmental Education Foundation, **Climate Fact: Intermountain Precipitation and the PDO**, http://www.earthgauge.net/2009/climate-fact-intermountain-precipitation-and-the-pdo

Poster Presentation

- **Estimated changes in the winter precipitation regime over Utah** (August 24, 2009), Melbourne, Australia, 6th International Scientific Conference on the Global Energy and Water Cycle
- **Linked Micromap Plots for Evaluating Trends in Multi-Pollutant Deposition** (October 06, 2009), Saratoga Springs, NY, NADP 2009 Annual Meeting and Scientific Symposium

Scholarly Paper Presentation (other)

- **Evaluation of precipitation in the Intermountain Region simulated by the NARCCAP regional climate models** (August 24, 2009), Melbourne, Australia, 6th International Scientific Conference on the Global Energy and Water Cycle
- **Evaluation of precipitation in the Intermountain Region simulated by the NARCCAP regional climate models** (March 03, 2009), Logan, Utah, Spring Runoff Conference
- **Recent rainfall cycle in the Intermountain Region as a quadrature amplitude modulation from the Pacific decadal oscillation** (March 03, 2009), Logan, Utah, Spring Runoff Conference

Scholarly Paper Presentation (Invited, Selected, Reviewed)

- **The Pacific QDO as a natural predictor for the Great Salt Lake elevation.** (November 23, 2009), Silver Springs, MD, Conference
- **The mysterious coherence between the Great Salt Lake and the Pacific quasi-decadal oscillation.** (October 26, 2009), , Monterey, CA, NOAA's 34th Climate Diagnostics and Prediction Workshop
- **Coherence between the Great Salt Lake and the Pacific quasi-decadal oscillation.** (October 09, 2009), Boulder, CO, 64th Annual Meeting of the Rocky Mountain Hydrologic Research Center, Boulder

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Website

- Posted monthly – are the Utah Climate Updates newletters.
- Special news items – e.g., July 2009 - Utah Monthly Climate Update – Why was June of 2009 so unusually wet?
- Continual update of data resources – COOP, AWOS & GSOD
- The Climate Reference Network (CRN) real-time data / network interface was completed. The CRN was established through a small grant from the American Association of State Climatologists (AASC) State Climatologists Exchange Program (SCEP).

Educational Efforts

Apart from CoCoRaHS, the center has been actively involved in educational presentations for elementary, middle and high school students. Other organizations, such as scouts, have requested weather presentations. These involve giving weather presentations and conducting weather experiments at various elementary schools. Marty Booth or Alan Moller, and at times both of them together would conduct these presentations. This year included presentations at the following schools:

- Cache High, Class visited the Climate center on two separate occasions, January 13 and February 11, 2009, Climate/weather presentation given at the center
- River Heights Elementary, weather presentation for Ms. Brown's 4th grade class on February 12, 2009
- Ellis Elementary, Weather presentation for Ms. Booth's 2nd grade class on February 19, 2009
- On March 3, 2009 a group of students from Snow College will visit the climate center for a tour
- Ellis Elementary, Weather experiments for Ms. Booth's 2nd grade class, March 6, 2009
- Cedar Hills Middle School, Display and Discuss "Tools of Meteorology" at the school's Tool Fair, March 18, 2009

- Ellis Elementary, Weather presentation for three 2nd grade classes, March 19, 2009
- Woods Cross Elementary, Weather presentation for three 2nd grade classes, March 25, 2009
- Canyon Elementary, Weather presentations for a rotating set of groups which included all students at the school, May 27, 2009
- Thomas Edison Elementary – North Campus, Weather presentation for two 2nd grade classes, November 6, 2009

Other Projects and New Initiatives

I. Fruit Growers Meteorological Monitoring Network (FGNet) and associated WEB based Integrated Pest Management (IPM) Tools

Work continued on a project between the Climate Center and Utah Extension to develop WEB based pest and disease management tools for Utah's fruit growers (http://climate.usurf.usu.edu/pest.php). This project is managed by Marion Murray, Extension IPM Project Leader, with technical support from James Frisby, Plants, Soils, and Climate Department and Climate Center data managers/programmers Tony Kirkham and Marty Israelsen. Guidance and oversight is provided by faculty members Diane Alston, Utah Extension IPM Coordinator, Brent Black, Extension Fruit Crop Specialist, and Robert Gillies, Utah State Climate Center Director. Utah TRAPs (Timing Resource and Alert for Pests) use degree day models and insect phenology to forecast insect densities for pest forecasting, while the disease severity tool uses near real time air temperatures and precipitation amounts to predict fire blight severity. Observations are collected from 11 fruit orchards in northern Utah. A standard meteorological station is located within each orchard, recording air and soil temperature, relative humidity, wind speed and direction, solar radiation, soil water potential, soil moisture and precipitation (Photo 1.). Evapotranspiration (ET), soil water deficiency, apple scab potential, apple fruit size estimate, and chill units are calculated onsite. Data is remotely harvested every hour, quality controlled then ingested into the Climate Center database for pest model use and public download. Jobie Carlisle's role in this project is to manage data collection, data quality, and liaison between the IPM team and the programmers to assure data flow and facilitate web-tool development. This last year the stations received a major retrofit, which significantly improved data quality and availability. Enhancements to the infrastructure included new telecommunication equipment (digital cell modems, antenna, cabling, lightning protection, etc.), new and rebuilt/recalibrated sensors, and new enclosures, and new dataloggers. Two new stations will be added to the network before the start of the growing season next year.

We are working to expand the area of coverage for Utah TRAPs with the incorporation of MesoWest Network data. This new dataset will allow us to add a statewide map based ET/water deficiency tool and provide fine scale climatological information for commercial agriculture and home garden applications. Much of the groundwork for MesoWest integration and the ET tools took place this past year. In the coming year, the pest and disease tools will incorporate additional insects and diseases.

Photo 1. Typical FGNet station

II. Meteorological Station at Bear Lake Observatory, Garden City, Utah

The Climate Center has reestablished a meteorological monitoring station at USU's Physics Department's Bear Lake Observatory (BLO) in Garden City this summer. The station has a sensor suite similar to a standard FGNet station and will be part of the FGNet network with data available through the 'plant management tools' link on the Climate Center's website. New sensors were purchased in part with financial support from the Physics Department and Utah State Extension. Telecommunications to the logger was recently established, thus public access to this data will be available before the year's end.

III. Peter Sinks Temperature Monitoring Project

Twenty five miles NE of Logan at 2500m elevation lies Peter Sinks (41.913136°N, 111.514149°W), a limestone sink basin where nocturnal cold air pooling is accentuated due to its unique geographical and climatological setting. On February 1, 1985, at Peter Sinks, Utah Climate Center student researchers Zane Stevens and Tim Wright recorded the second lowest temperature in the contiguous US: an astounding -56ºC! Armed with a seasonal permit from the Forest Service the Climate Center, with cooperation from Campbell Scientific installed this past March a temperature monitoring station in the Sinks with hopes to record a new low temperature record.

Access to the Peter Sinks is logistically challenging especially in winter when snow depths can approach 8 feet. On March 28, Tim Wright, Kyle Campbell (Campbell Scientific), Marty Booth, Alan Molar (Climate Center) and Jobie Carlisle trudged to a sink at the north end of Peter Sinks where the 1985 record temperature was recorded. After shoveling roughly 6 feet into to snowpack to reach ground, they secured the station's tripod base on the rim of a sink hole…or so had thought (photo 2). On a data retrieval hike to the site in the spring, we were disheartened to discover that the station electronics enclosure was completely submerged in melt-water as we had located the station in the bottom of the sink hole (photo 3). The high ionic concentration of the water damaged the electronics beyond repair. This embarrassing loss of gear as well as data reinforced the need for telecommunications to the site. Campbell Scientific maintains a meteorological station atop Logan Peak 18 miles to the south, transmitting data via 900 MHz spread spectrum radio frequency. We unsuccessfully tried to link the Peter Sinks station to this RF network but were impeded by topography. It was evident that a repeater tower and radio would be required to establish communication to the Sinks station. Working with Joshua Campbell at Campbell Scientific, we procured the necessary equipment to reequip the temperature monitoring station and establish a repeater on the north rim of Peter Sinks. During the fall months the sinks station was moved from the bottom to the edge of the sink hole and a repeater station was deployed on the north rim of Peter Sinks (photos 4 & 5).

Temperature and wind data from the sinks station and rim repeater is output every 15 minutes and downloaded hourly. The latest plots and data are temporarily posted at http://twdef.usu.edu/Peter_Sinks/Sinks.html (see Figure 1 for an example data plot showing a 40 degree temperature between the rim and sink, only a 400 foot difference in elevation). Peter Sinks data will be hosted from the Climate Center website once the new map interface for the Climate Center website has passed beta testing.

Photo 2. Peter Sinks March 28, 2009

Photo 3. Sinks station May 2009

Photo 5. Peter Sinks October 2009

Photo 4. Peter Sinks repeater November 2009

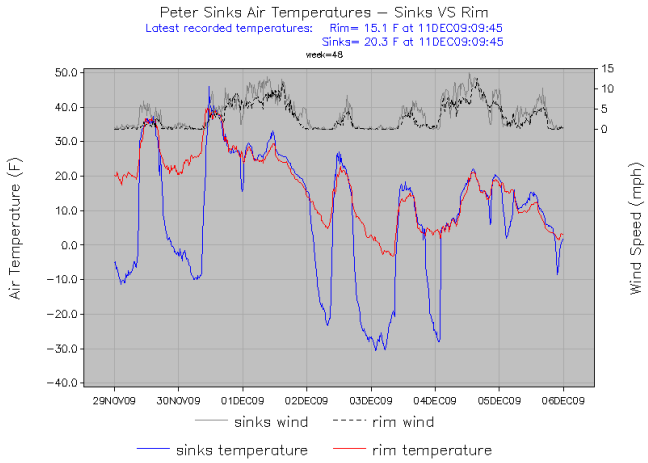

Figure 1. Sample data plot

Vermont State Climate Office (VTSCO)

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Lesley-Ann L. Dupigny-Giroux, State Climatologist

The Vermont State Climate Office (VTSCO) received its ARSCO recognition in June 2005. The office is housed within the Department of Geography at the University of Vermont (UVM) & State Agricultural College, a land-grant institution that emphasizes outreach as one of its core missions. The VTSCO is located in a laboratory setting donated by the Geography department. Climate Database Modernization Program (CDMP)-funded equipment, archival publications and documents are housed there, with adequate facilities for the undergraduate and graduate assistants.

The core mission of the VTSCO is to provide climate research and services to Vermonters and other constituents (university researchers, policy makers, state agencies, legal firms or school children) in a timely and efficient manner. This is facilitated via a dedicated website and e-mail address.

Over the course of the AY 2009-2010, two undergraduate and one graduate student were affiliated with the VTSCO. The Ph.D. student from the Plant and Soil Science department was funded by a research assistantship from the Graduate College of the University of Vermont, funding that will end with this academic year. He worked on the use of high-resolution aerial photography and satellite imagery to quantify wetland dynamics across the state. The undergraduate Geography student assisted with the background research on muck fire dynamics. The second undergraduate worked on the redesign of the VTSCO website.

ARSCO Qualifications: The VTSCO is the AASC-designated state climate office for Vermont. The following activities address each of the Office's ARSCO qualifications.

Communications capabilities

- continued enhancement of the VTSCO website (http://www.uvm.edu/~ldupigny/sc) with access to both hydrometeorological and geospatial data; ongoing CDMP historical data collection; mitigation awareness resources; data access and; a streamlining of the most commonly requested NCDC datasets.
- provide free data, expert opinions and recommendations via the telephone, facsimile, electronic mail and regular mail.

Information services

- seasonal contributions on aspects of Vermont's weather and climate for the Rutland Herald newspaper.
- provided four interviews on hurricanes, historical storms, climate change issues and Service-learning to the Vermont Quarterly, UVM Today, Plattsburgh Radio.
- handled over 22 non-CDMP related email, mail and telephone requests.

Research

- "Exploring the Challenges of Climate Science Literacy: Lessons from Students, Teachers and Lifelong Learners," *GeoCompass*, 2(26): 1-15. Invited paper.
- "Backward seasons, droughts and other bioclimatic indicators of variability," in Historical climate variability and impacts in North America, Lesley-Ann Dupigny-Giroux and Cary Mock (Editors), Springer Publishers.
- Prevatt, D.O., Dupigny-Giroux, L. and Masters, F.J. (2010) "Engineering Perspectives on Reducing Hurricane Damage to Housing in CARICOM Caribbean Islands" *Natural Hazards Review*, in press.
- Prevatt, D.O., Dupigny-Giroux, L.-A. and Masters, F.J. "Twenty-five years of Caribbean hurricane disaster mitigation,: in Wind Storm and Storm Surge Mitigation, Nasim Uddin (Editor), American Society of Civil Engineers, pp. 13.1-13.9.
- Section leader for Weather, Climate and Climate Change in Vermont. Vermont Monitoring Cooperative 20-year activity report.
- CDMP-related data collection of weather and climate data in personal diaries from the 1700s to early 1900s in the Library Research Annex of the UVM's Bailey/Howe Library. These were imaged and forwarded to the CDMP for uploading to WSSRD. Databases of the contacts, findings and progress of visits around the state were updated.

Outreach

- 10 presentations on historical climate in Vermont and New Hampshire in the 1700s-1800s; Vermont's perspective in terms of climate change; forest hazards.
- liaise with the Vermont Emergency Management on drought, flooding and hazard issues.
- hosted a campus-wide visit by Dr. Kerry A. Emanual (MIT) on the nature of hurricanes.

University of Virginia Climatology Office

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Philip J. Stenger, Director

The University of Virginia Climatology Office is a Research and Public Service Center in the Department of Environmental Sciences. The office is also an integral member of the Southeast Regional Climate Center and the director sits on the center's Technical Advisory Committee.

The office provides information and conducts research on the atmospheric environment and the impact of weather and climate on economic and ecologic systems to government, education, industry, the media and individuals. Its on-line, "Climate Advisories" feature climate research and/or educational material, and its web site offers an extensive array of climatic information and guidance to a broad spectrum of climatic data services.

ARSCO Qualifications: The AASC has designated the Climatology Office at the University of Virginia as the state climate office for Virginia. The following describes the ways in which the office addresses each of the ARSCO qualifications:

Communication Capabilities

The University of Virginia Climatology Office has phone, fax, email and videoconferencing capabilities with high-speed Internet service for the rapid transfer of data. The office maintains a web site devoted to a variety of its educational, informational, data provision and outreach goals.

Information Services

The University of Virginia Climatology Office serves as the official repository and provider of climatic records within Virginia. It handles thousands of requests for information annually, and provides general guidance on climate issues of all spatial and temporal scales. Its web-based information services are accessed tens of thousands of times a year, with an estimated total download of information in the hundreds of thousands of pages. These inquiries come from individuals, industry, the media and dozens of governmental and educational entities, worldwide. In addition, the office's monthly video "Climate Advisory," a brief discussion of relevant topics regarding the climate of Virginia, is televised statewide on Public Television, public access channels and agricultural information networks.

Research

During 2009 the office was an integral participant in the ShenAir Institute Research Program, which was designed to expand understanding of the atmospheric environment of the Shenandoah Valley region of Virginia. Under this program, the office was involved with the following projects:

- Air Quality Climatology for the Shenandoah Valley
- Asthma Alert System for Shenandoah Valley
- Demographic Relationship to Respiratory Health in the Shenandoah Valley

In addition, continued major research efforts of the office included:

- Examination of the relationships between U.S. climatic regimes and exacerbation of respiratory distress — in collaboration with the U.Va. Health Sciences Center. This work has been expanded to include studies being conducted on patients in Central America.
- Drought and drought impact monitoring.

Outreach

- Provides data and expertise to dozens of state, federal and local government entities, and educational institutions each year.
- The office distributes information via hundreds of contacts with the print, radio and television media.
- The office serves as a lead scientific contributor to the Virginia Drought Monitoring Task Force, with periodic drought reports and analyses.
- Video Climate Advisories regarding aspects of Virginia climate are produced monthly for television and web-based distribution.
- The office has been increasing emphasis on its web site as a vehicle for making information available to potential users. This has succeeded in reaching larger numbers of individuals and organizations in a more cost-effective fashion. The estimated amount of information accessed has increased substantially from the previous year.
- Presentation of education and training lectures for the Virginia Master Naturalist Program.
- Informational presentations before local government and advisory groups regarding climate-related topics of community concern.
- Involvement with school-related groups regarding climate topics.
- Work with graduate and undergraduate students at the University of Virginia and other institutions on degree research and class-related projects.

Monitoring and Impact Assessment

- Work on the foundations for development of a system for short-range forecasts of human health related atmospheric information.
- Provision of data and impact assessment for and service as a member of the Virginia Drought Monitoring Task Force.
- Participation as a member of the Virginia Hazard Mitigation Steering Committee, including development of climatic hazards analyses. The final version the Virginia Hazard Mitigation Plan was submitted to FEMA in 2009.
- Participation in a joint proposal with the Mid-Atlantic Climate Service Consortium

for the Regional Integrated Science and Assessment Program of NOAA.

Papers Published in 2009

Sleeman, J.M., J.E. Howell, W.M. Knox, P.J. Stenger. Incidence Of Hemorrhagic Disease In Virginia Associated With Winter And Summer Climatic Conditions, *EcoHealth.*

Papers Accepted For Publication in 2009

Davis, R.E., C.P. Normile, L.J. Sitka, D.M. Hondula, D.B. Knight, S.D. Gawtry, P.J. Stenger. A Comparison of Trajectory and Air Mass Approaches to Examine Ozone Variability, *Atmospheric Environment*.

Hondula D.M., L. Sitka, R.E. Davis, D.B. Knight, S.D. Gawtry, M.L. Deaton, T.R. Lee, C.P. Normile, and P.J. Stenger, A Back-Trajectory and Air Mass Climatology for the Northern Shenandoah Valley, USA, *International Journal of Climatology.*

Office of Washington State Climatologist (OWSC)

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Philip Mote, State Climatologist (until July 2009)
Nicholas Bond, State Climatologist (starting April 2010)
Gary Grove, Associate State Climatologist
Karin Bumbaco, Assistant State Climatologist
Robert Norheim, Assistant State Climatologist
Guillaume Mauger, Researcher
Eliza Keeley, Student Assistant
Nathaniel Mote, Student Assistant

It has been a year of transition for OWSC. Philip Mote, State Climatologist, left to become the Director of the Oregon Climate Change Research Institute and OR State Climatologist in July. Funding issues prevented an immediate replacement, and Karin Bumbaco took primary responsibility for the office during the transition. As of April 2010, however, Nick Bond joined the office as the State Climatologist – welcome, Nick! Nick is a senior research scientist with the Joint Institute for the Study of Atmosphere and Ocean (JISAO) at the University of Washington (UW), with which he has been affiliated since 1990. He is also an affiliate associate professor with the Department of Atmospheric Science at UW. His research is on a variety of topics with a recent focus on the effects of climate on the marine ecosystems of the North Pacific. He has a special interest in the weather and climate of the Pacific Northwest, and looks forward to his involvement with OWSC.

Two of our student assistants, Eliza – who was mainly responsible for managing WA CoCoRaHS, and Nat – who developed web tools, have moved on as students tend to do. Guillaume Mauger was hired on part-time to help with the Optimal Network Design project (described below) and to assist a summer NOAA Hollings Scholar, Karen McKinnon, on extreme precipitation research. Guillaume now has a post-doc appointment with the University of Washington's Climate Impacts Group.

Website
The OWSC website has been maintained throughout the past 12 months. A few notable updates include the addition of the 2009-2010 season to our Mountain Snow Depth plotting tool (http://climate.washington.edu/snowdepth/), including a new record confirmed by NCDC on our Fun Climate Facts page (http://www.climate.washington.edu/facts.html), updating monthly totals on our Precipitation Ranking utility (http://www.climate.washington.edu/precipranking/), and adding new WA Agriculture Weather Network (AWN) sites to our Climate Inventory

Map (http://www.climate.washington.edu/maps/). New features on the website include weather and climate event summaries (http://www.climate.washington.edu/events/) on the dry spell during the 2009 summer, the July 2009 heat wave, and record warmth in January 2010. Water year precipitation has also been monitored on our website near a dam southeast of Seattle (Howard Hanson Dam) due to below normal capacity resulting from damage from the January 2009 heavy rain event (http://www.climate.washington.edu/events/2009howardhanson/). Fortunately, there has not been an issue with flooding this winter.

Research: Optimal Network Design

More progress has been made on the Network Design project that was first described in last year's annual report. To recap, OWSC, in collaboration with Greg Hakim (UW Atmospheric Sciences), Guillaume Mauger (now with UW Climate Impacts Group), and Phil Mote (OR Climate Change Research Institute), have succeeded in testing an approach that selects an optimal distribution of observing stations in the Pacific Northwest. The approach, ensemble sensitivity, takes into account practical constraints while selecting the point that explains the most variance in a given climate field. We are currently working on publishing the details of the method, along with preliminary results of the pilot study done in the Pacific Northwest.

The approach has many different applications, but the ultimate goal of our study is to provide quality recommendations for the United States Historical Climate Network modernization (USHCN-M). We, in coordination with a few other western State Climatologists, had written a letter to the National Climatic Data Center (NCDC) regarding their plans for siting stations for the USHCN-M. We recently heard back from Tom Karl (Director, NCDC) regarding our approach, and are beginning discussions with David Easterling and his team to share ideas. We encourage other State Climatologists to do this as well.

Outreach/Support: Newsletters, Inquiries, CoCoRaHS, Pacific Science Center

A variety of outreach and support activities took place during the last twelve months. Over 100 data inquiries and requests were filled during just the 2009 calendar year. Many of these were from state and local agencies. For example, we provided climate data to multiple people at the WA State Department of Ecology (ECY) and the Department of Natural Resources (DNR). To highlight a few others: we provided data and extra analysis to a DNR group that was studying landslides that resulted from the January 2009 heavy rain and flooding event, provided climate data for a WA Department of Health group that were conducting West Nile Virus studies, and provided precipitation data for local emergency management coordinators that were concerned with the threat of flooding from the Howard Hanson Dam's reduced capacity.

Other activities include the continued distribution of a monthly newsletter on WA climate by the 3rd weekday of each month. WA State CoCoRaHS (Community Collaborative Rain Hail and Snow Network) is also continuing to be partly managed by OWSC. Six local county coordinators were recruited by OWSC in the last 12 months, and currently 705 volunteers are signed up in WA.

In addition, Assistant State Climatologist, Karin Bumbaco, and Guillaume Mauger partnered with Seattle's Pacific Science Center to develop climate concepts and their research into hands-on demonstrations for the science center visitors. One of the activities demonstrates Karin and Guillaume's involvement with the Network Design project, and gets Pacific Science Center (PSC) attendees to think about the best place in WA to put rain gauges. The visitors have a chance to place rain gauges (represented as test tubes) on a map of WA while they discuss potential strategies for designing a network. They then choose a winter or summer Plexiglas overlay that has holes drilled in sizes that match the amount of precipitation received. Finally, the science center attendees can "make it rain" over the state with a watering can to test their network. Another activity that Karin designed uses black beans to represent year-to-year precipitation totals that ultimately explain the difference between weather and climate. Karin has facilitated her hands-on activities several times at the PSC, and has also become a PSC Science Communication Fellow. She is looking forward to future involvement with PSC.

West Virginia State Climate Office (WVSCO)

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Kevin Law, State Climatologist

The West Virginia State Climate Office (WVSCO) continued its goal to provide weather and climate information to public and private entities in order to further climate education. This includes improving weather- and climate-related mitigation practices and decision-making activities that affect the economic and environmental quality of the state. The WVSCO has taken an active role on the West Virginia Hazard Mitigation Council. Serving as a consultant, the WVSCO helped create new objectives and mitigation strategies and projects in response to vulnerable areas identified in a risk assessment analysis. The WVSCO also helped provide climate data and information research institutions, private firms, media outlets, as well as other agencies and the general public.

It has officially been one year since the CoCoRaHS network was established in the state and the volunteers have increased to 106 members. The WVSCO has also taken part with many educational outreach projects in the community. Two weather balloon launches were conducted with the help of meteorology students from Marshall University and engineering students from WVU Tech. Launches were conducted at Barboursville Middle School and Marshall University to allow students of all ages to see what is exactly involved. It was a great learning experience for all of the students as they could see how the temperature and humidity varied throughout the atmosphere. A small video camera was placed inside along with a GPS tracking device to retrieve the balloon.

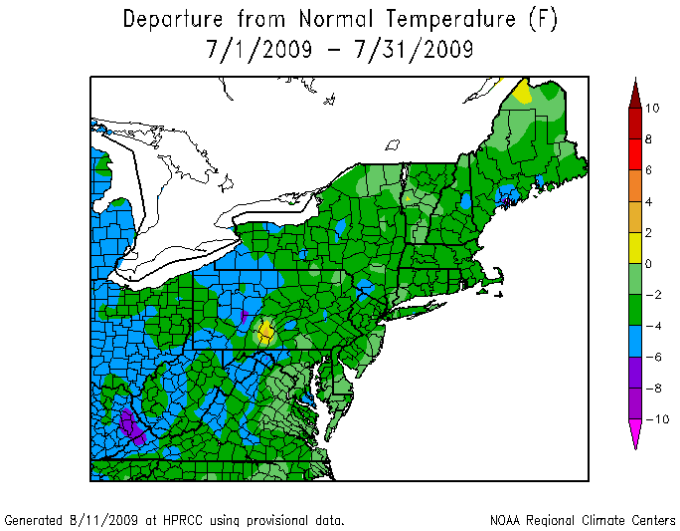
Prior to launch

Prior to launch

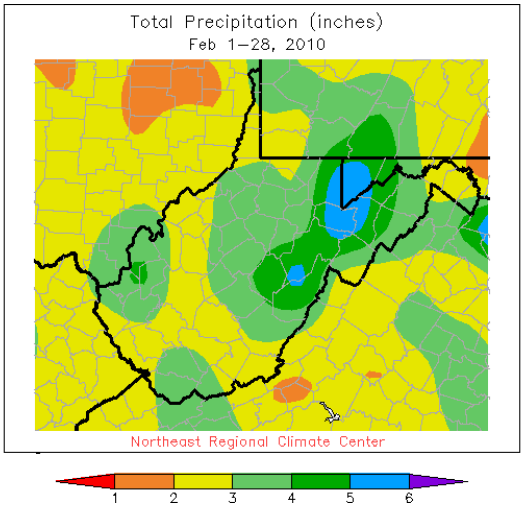
Balloon landing in tree

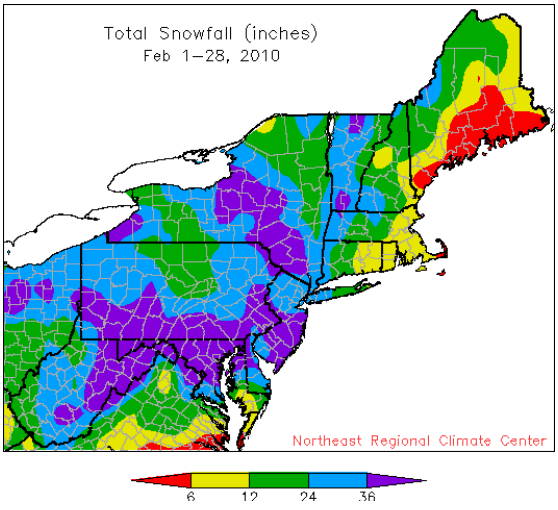
Weather in Review

The average 2009 temperatures across the state were slightly lower than normal overall, particularly during the summer. In fact, the average temperatures in July were the coldest on record as a persistent trough was in place over the Ohio Valley. Although the temperatures were much cooler than normal during the summer, precipitation totals were near normal for much of the year. However, this changed as El Niño became more pronounced and brought above normal precipitation and below normal temperatures for the winter.



The winter of 2009-10 will not soon be forgotten as it was one of the snowiest on record. A heavy snowstorm occurred on December 18-19 that brought 1-2 ft to much of the state. Intermittent snow occurred throughout January but the bulk of the snow fell during the month of February. Three major snowstorms occurred during the month as all-time monthly snowfall records were destroyed. Beckley, Charleston, and Elkins broke monthly records. For the entire state, the previous February record was 88" in 1964, however, there were several locations reporting over 100". In response, the West Virginia Climate Extremes Committee was formed and is still deliberating over which total to officially accept. Regardless, a new February snowfall total will be set; it is just a matter of which location will be the new state record. Several cities such as Beckley broke their seasonal snowfall records. The all-time state seasonal snowfall was 301.4" in 1959-60, and this past season was slightly lower as unofficial totals ranged between 250-290".





Wisconsin State Climatology Office

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John Young, State Climatologist
Ed Hopkins, Assistant State Climatologist
Lyle Anderson, Office Manager and Data Services

The Wisconsin State Climatology Office (SCO) is affiliated with the Department of Atmospheric and Oceanic Sciences at the University of Wisconsin-Madison and is a partner with the Midwestern Regional Climate Center.

Our mission includes:

- Acquisition, archiving, and distribution of past weather observations from nearly 200 weather stations throughout the state.
- Summarization and dissemination of the information to users and for SCO climate monitoring of variability and trends.
- Production of "value-added" analyses of climate information for use in studies of climate impacts, decision making, and advice to the government on droughts, extreme temperature and precipitation events, probabilities of occurrence, & climate change.
- Conduct collaborations on applied climate research on climate variability, trends, extremes, and impacts.
- Stewardship of an extensive collection of original manuscript records for Wisconsin weather stations, some dating back to the 19th century.

Information Services

Website

The SCO maintains its website **(**http://www.aos.wisc.edu/~sco) that provides an expanding variety of graphical climate information, data, and links for citizens, scientists and clients in the government and private sector. Approximately 810 visits per day were made to this website during 2009. Recent progress on the site includes:

- New development of a **Wisconsin Climate Impacts** section, featuring climate variables relevant to extreme events and impacts, with applications from water to agriculture to energy. We continue to be involved with WICCI (Wisconsin Initiative on Climate Change Impacts) through its Outreach Committee and applied climatology collaborations.

- New development of an **Educator's Data Portal**. Under the Climate Education and Outreach page, select "For Teachers" for our first-ever links to selected data files for Wisconsin and climate divisions within the U.S.
- New **Climate Change** page, with links to Wisconsin, the Midwest, U.S, and global information (e.g., IPCC).
- **Climate History**: Graphics that demonstrate observed climate variability by year and locations through the state are routinely updated. Extensive records for seven cities illustrate interannual and interdecadal fluctuations and recent climate trends.

Data Services

The SCO staff provides advice on web links to climate data and maps from regional and national centers. In addition, they also answer questions and fill data requests made by telephone, fax, email and office visits. The public, media, private sector (e.g., legal, insurance), and governmental agencies made approximately 875 data requests per year. Most requests made by the public are answered without charge. A minimal service charge plus costs is assessed for special data requests that require significant time or scientific effort.

Outreach

The SCO continues to make its presence more widely known to University colleagues and residents of Wisconsin. In addition to interviews with electronic and print media in the state, the staff gives lectures at service groups, universities and business conferences.

- **University of Wisconsin**- John Young continues to be liaison with the Department of Atmospheric & Oceanic Sciences and climate-related research faculty in other departments. Ed (Dr. Data) Hopkins continues assisting faculty and student researchers from six departments and consulting on data issues with the Center for Climate Research.
- **Climate Change**- Young was an invited speaker, discussant, and breakout session leader at several public Symposia on global climate change.
- **WICCI**- The SCO continues to be a collaborator within the developing Wisconsin Initiative on Climate Change Impacts, a multidisciplinary program involving university and government scientists. This collaboration is likely to lead to an expanded SCO mission in Wisconsin climate change science applications in the future.
- **National Weather Service**- SCO regularly interacts with three NWS offices.

Research

Ed Hopkins continues analyzing weather extremes reported at individual stations throughout the state and is a member of the State Climate Extremes Committee. He coauthored a chapter on early weather observations in the Old Northwest that appeared in a book on the early climate variability in North America and an article late 20th century climate change across Wisconsin in *Physical Geography*. Young is developing plans to expand the probabilistic content of our data analyses, which will provide a clearer starting point for analysis of climate extremes and their trend.

Particular attention is being paid to the recurrence probabilities for heavy multi-day rains. The SCO continues to collaborate in a climate research project with the Center for Climatic Research and the Nelson Institute for Environmental Studies at the University of Wisconsin-Madison involving regional climate change.

Projects at the End of 2009

- Create a more formal relation of the SCO with the University.
- Formally define all staff positions and develop funding for them.
- Establish ARSCO status.
- Partner with local, state and federal government agencies on matters relating to climate services and long-term climate change.
- Continue expansion of website information, smoothed graphics, & probabilities.
- Expand collaborative research with campus and state in WICCI.
- Continue contacts with media and issue timely press releases.
- Develop small applied research projects & collaborations with AOS researchers.

Wyoming State Climate Office

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Tony Bergantino	Assistant State Climatologist
Chris Nicholson	Outreach and Technology Coordinator
Barbara Muller	Librarian and Archivist
Jodi Preston	Office Administrator and Data Manager
Scott Laursen	Data Services/Research Associate
Michelle Ogden	Data Services/Research Associate

The **Wyoming Water Resources Data System** (WRDS; http://www.wrds.uwyo.edu/) and its **State Climate Office** branch (SCO; http://www.wrds.uwyo.edu/wrds/wsc/wsc.html) are the single largest providers of water- and climate-related data in the state. Housed within the Department of Civil and Architectural Engineering at the University of Wyoming, WRDS and the SCO are funded primarily through contracts with the Wyoming Water Development Commission.

The WRDS-SCO staff provide a variety of services, ranging from the development of enhanced drought-monitoring products to the online dissemination of water and climate data. WRDS and the SCO also support a wide range of groups by assisting in the development of the State Water Plan and helping to coordinate climate- and hydrologic-monitoring efforts throughout Wyoming.

Activities Related to the ARSCO Mission

Information Services

Data and information services at the Wyoming SCO are provided primarily via the World Wide Web. The links below provide a sampling of related products:

- http://www.wrds.uwyo.edu/
- http://library.wrds.uwyo.edu/
- http://www.wrds.uwyo.edu/sco/data/data.html

In addition to internet services, we also responded to 171 direct requests (i.e. via phone, mail, or other personal contact) for climate data and climate-related information, which is a nearly 15% increase over 2008. We also continued to work with several state and federal agencies to (1) improve infrastructure related to climate monitoring and (2) improve methods for online access to climate data. Towards these ends we collaborated with the NRCS, NOAA-NWS, Wyoming Dept. of Agriculture and Wyoming State Engineers Office on new instrumentation, upgrades to existing

climate/water monitoring sites, and improved data access. Highlights of this work include final installations or upgrades at 25 soil-moisture monitoring sites, and final installation of six new NRCS SNOTEL sites. New work initiated in 2009 includes development of 3-4 new stream gage and precipitation monitoring stations that will serve as early-warning systems for flood prone municipalities. We also worked with NOAA-NWS to deploy automated climate stations in three locations around Yellowstone National Park and the headwaters of the Green River in western Wyoming.

Outreach

While dry conditions eased somewhat in 2008-09, drought and water supplies continued to be a major concern in Wyoming. Climate change also continues to be a topic of tremendous interest. In turn, we focused much of our effort on high-impact events designed to educate the public and members of state government about drought and climate science. Out of some 30 invited presentations, key examples include:

- Gray, S.T. **Snow Monitoring and Climate Predictions: Critical Data Needs for the Western US.** *Interstate Council on Water Policy, Annual Meeting, Jackson, Wyoming. September 2009.*

- Gray, S.T. **Climate Change and a New Era for Wyoming Water?** *Wyoming Association of Rural Water Users, Annual Meeting, Laramie, Wyoming. September 2009.*

- Gray, S.T. **Climate Change, the Death of Stationarity and a New Era for Western Water.** *University of Colorado Law School's Martz Conference on Natural Resources Law and Policy, Boulder, Colorado. June 2009.*

- Gray, S.T. **Climate Change in the Green River Basin: New Challenges for Natural Resource Management.** *Wyoming Landscape Conservation Initiative, Multi-Agency Science Workshop, Laramie, Wyoming. May 2009.*

- Gray, S.T. **Climate Change Impacts and Natural Resource in the Western United States.** *Keynote Address to the Colorado-Wyoming Division of the American Fisheries Society, Loveland, Colorado. February 2009.*

In addition, the Wyoming SCO co-organized a workshop on drought, climate variability and climate change with Wyoming Game and Fish and the Wildlife Conservation Society. In total, we conducted over 40 print, radio and television interviews with media outlets from throughout the state and surrounding region.

Developing Improved Communications Capabilities

One of our primary focus areas in 2009 was creation of a report on the potential impacts of climate variability and change for Wyoming's water resources. Published in December, this report summarizes current scientific knowledge related drought and climate change and incorporates input from a wide variety of researchers and

stakeholder groups. The report was carefully written to reach a wide audience, but it also includes information aimed specifically at water managers and decision makers. Initial reaction to the report has been overwhelmingly positive, and we hope that this publication will spur further discussion on how to best manage Wyoming's water resources in the face of climate variability and change. The full report can be accessed at: http://www.uwyo.edu/enrsupport/projects/UofW-Water_Climate_final_comp.pdf.

Research

In 2009 the Wyoming SCO was directly involved in a variety of research projects, including work related to:

- Climate variability and hydrologic impacts in high-mountain areas
- Long-term history of Wyoming and western U.S. climate
- Ecosystem impacts of drought

Examples of papers published or accepted for publication in 2009 include:

- Aziz, O.A., G.A. Tootle, S.T. Gray and T.C. Piechota. 2010. Identification of Pacific Ocean sea surface temperature influences on Colorado River Basin snowpack. *Water Resources Research*, In press.

- Barnett, F.A., S.T. Gray and G.A. Tootle. 2010. Upper Green River Basin (USA) streamflow reconstructions. *Journal of Hydrologic Engineering*, In press.

- Gray, S.T. and G.J. McCabe. 2010. Combined water balance and tree-ring approaches to understanding the potential hydrologic effects of climate change in the Central Rocky Mountain Region. *Water Resources Research*, In press.

- Jackson, S.T., J.L. Betancourt, R.K. Booth and S.T. Gray. 2009. Ecology and the ratchet of events: Climate variability, niche dimensions, and species distributions. *Proceedings of the National Academy of Sciences*, doi:10.1073/pnas.0901644106.

- Jackson, S.T., S.T. Gray and B. Shuman. 2009. Paleoecology and resource management in a dynamic landscape: Case studies from the Rocky Mountain headwaters. *The Paleontological Society Papers*, 15:61-80.

- Kelleners, T., V.B. Paige, S.T. Gray. 2009. Measurement of the dielectric properties of Wyoming soils using electromagnetic sensors. *Soil Science Society of America Journal*, 73:1626-1637, doi:10.2136/sssaj2008.0361.

- Watson, T.A., F.A. Barnett, S.T. Gray and G.A. Tootle. 2009. Reconstructed stream flows for the headwaters of the Wind River, Wyoming, USA. *Journal of the American Water Resources Association*, 45:224-236.

AASC 2009 Annual Meeting
Business Meeting Minutes
July 9-10, 2009, Grand Rapids, MI

Thursday, July 9, 2009 business meeting session

Business meeting called to order by President Doesken at 3:30 p.m.

Doesken reports that the AASC Executive Committee met by conference call 20 times in the past year. Special thanks were extended to Marjorie McGuirk for providing conference call minutes and the use of the NCDC phone bridge. Also thanks to outgoing board members Paul Knight and Hope Mizzell for their excellent service. The 2008 business meeting minutes were approved by electronic vote last fall and are posted on the AASC web site.

Treasurer Hillaker presented the AASC Treasurer's report. The report included the final budget for 2008; projected budget for 2009 and a highly speculative proposed budget for 2010. The primary point of the report is that the AASC budget has grown tremendously over the past year from $30,748.44 in 2008 to a projected $126,460.00 in 2009. Most of the increase resulted from a much larger State Climatologist Exchange Program (SCEP) grant from NCDC. A total of 39 grants have been awarded among 27 states. The bulk of the SCEP funds have been earmarked for three research areas: Monthly State Climate Impacts; CRN & HCN-M data summaries and applications; and an SC climate economics survey to supplement the NOAA Economics web page.

Hillaker pointed out that an error appears in the AASC budget hand-out in that service charges were already accounted for in the net income and should not have been listed in the expenses section. Thus a slightly larger budget surplus is projected than listed for 2009 and 2010. It was moved, seconded and approved for the acceptance of the Treasurer's report.

McGuirk reports that there is no way of knowing what the SCEP budget could be for FY2010 since no budget has been approved at this point. However, it would not be unrealistic to assume a potential budget of up to $250K. Any SCEP funds likely will be for research to solve specific problems and to help state programs with critical funding needs. Efforts will be made to develop relationships between the AASC members and other organizations, such as NSF, USDA, etc. Climate Extension, Education Outreach & Research are likely areas of emphasis for the coming year, with New Jersey and Pennsylvania to be the first states in this effort. Marjorie also notes that funding would be sought for SCs who wish to participate in the NOAA Climate Speakers Bureau.

Nolan notes that it is important for SCs to stay on task and not just sit back and wait for federal funding opportunities to come to them. We need to be active in initiating research and service projects.

Paul Knight, on behalf of the AASC Nominating Committee (Crawford, Brown, Angel) presented Dennis Todey of South Dakota as the nominee for AASC President-Elect. The membership approved the committee's recommendation and Todey accepted the appointment. Todey will be taking Knight's place on the AASC Executive Committee.

Mike Anderson reports that the 2010 AASC annual meeting likely will take place at S. Lake Tahoe, CA on July 12-14. The most likely venue will be the Embassy Suites. An informal e-mail survey of AASC members found that either June or July were acceptable meeting times, and that projected higher meeting costs should not preclude a meeting in California. Mike chose July among the two suggested months owing to preference for having the meeting in the next fiscal year.

A brief discussion was held for possible 2011 meeting locations. Doesken notes that our informal practice of rotating meeting locations would point toward returning to the eastern U.S. in 2011. Stooksbury suggested that it will have been nine years since Asheville last hosted the meeting (2011 vs. 2002) and this would be a logical choice for the AASC. Boyles volunteered to help if North Carolina were to be the host state. Zierden offered Florida as the host state. He indicated that a coastal location, such as Destin or Clearwater would be the most likely location. No decision was made concerning the 2011 meeting site (presentations to be made at next year's meeting?). A few suggested a return to Bar Harbor, Maine.

The afternoon session of the business meeting was concluded with a reminder from Doesken about the mission of the various standing committees formed at the 2008 meeting. These committees are:

Meetings: Akyuz, Mote, Dupigny-Giroux, Andresen, Reges.
Strategic Plan: Redmond, Shafer, Nielsen-Gammon, Angel, Anderson, Arndt, Stooksbury.
Finance: Mizzell, Hillaker, Christy.
Policy & Procedures: Crawford, Zandlo, Guinan, D. Robinson, Foster, Young.
Partners: Boyles, Todey, DeGaetano, Curtis, D. Robinson, Archer.
Membership: Boyles, Keim, Arndt, Dutcher, Knight.
Journal: Stooksbury & JSC editors.

There was an open invitation for more members for these committees.

A training and education committee was suggested. Stooksbury noted that we need guidelines for what a climatology graduate should be expected to know. The AASC would be the logical organization to develop education standards. Nielsen-Gammon is currently the chair of the AMS education committee that sets standards for meteorologists. Doesken appoints Dupigny-Giroux, Akyuz, Hubbard, Nielsen-Gammon, Timofeyeva and Stooksbury to this new committee. Marina notes that the NWS does have specific requirements for some of their climate-related positions.

In other business, Redmond noted that he would like to see an AASC membership list. Such a list may need to be password-protected on the AASC web page.

Finally, Lou Vasquez of ERC Broadband in Asheville was introduced as the new AASC webmaster. Lou reports several items for potential inclusion on the web page:

1) Post conference papers.
2) Post the State Climatologist annual summary document.
3) Add an 'AASC Partners' pull-down menu (such as exists for SCs and RCCs).
4) Assume supervision of the AASC list-serve, if such a move was wanted.
5) RSS feed to allow incoming, as well as out-going messages.
6) JSC announcements as new articles are posted.
7) Add a data products list/forum.

It was noted that any 'national' news item on the AASC web page was first be approved by the Executive Committee.

Friday, July 10, 2009 business meeting session.

Doesken called the meeting to order at 8:04 a.m.

Nominating committee needs to come up with a nominee for a new AASC Secretary-Treasurer to take office for the two years beginning January 1, 2011.

Nominations for new associate members were presented and approved. This year nominations were accepted via e-mail ahead of the meeting with a nomination form to be completed. However, this procedure was not fully utilized. The new associate members are: Jason Allard (Valdosta State U.), Joel Cline (NWS HQ), Gregory Goodrich (Western Kentucky U.), Michelle Hawkins (NWS HQ), Jenna Meyers (NWS HQ), Tye Parzybok (Metstat, Inc.), Kevin Schrab (NWS HQ), Mark Simpson (U. Tennessee- Martin), Marina Timofeyeva (NWS HQ), Tom Townsend (NWS CR), Natalie Umphlett (HPRCC), Lou Vasquez (ERC Broadband), Jim Zdrojewski (NWS HQ), Becky Smith (MRCC), Leslie Ensor (MRCC), Erin Saffell (Arizona), Karin Bumbaco (Washington SCO), Nancy Westcott (MRCC), Mike Timlin (MRCC).

Dutcher remind us that he needs the e-mails for the new associate members so that they can be added to the list-serve.

Stooksbury suggests a 'fellows' committee be formed for the AASC to draw up standards for an AASC Fellow designation. Doesken favors placing this effort into the existing membership committee. Crawford notes that the AMS limits the Fellows designation to only 0.2% of the membership.

Doesken introduces Crawford's draft 'Standards for a Surface-Based National Mesonet'. How do we move forward with this draft? Crawford reports that he drafted the document unilaterally and that it needs input. Nolan notes that we are not in a position to vote on the document at this point, but what should be our next step? Christy asks how the proposed standards would compare with those existing for CRN? Palecki will provide a copy of the CRN standards (which are the same as those for the HCN-M).

Curtis offered to provide a copy of the USDA standards. Boyles suggests going back to the committee for review and bring it back to the AASC within six months. Hilberg suggests a specific comment period open to everyone. Zierden asks if we want an 'external' review? Doesken notes that if we (AASC) don't have the necessary expertise to review this, then who does? Our federal partners will have an opportunity to review the document anyway. Crawford has sought some comments from those in the NWS. Redmond notes that we do not need to rush, but need to keep moving the document along. D. Robinson notes that the sooner we have this completed the better the chances are of the document having a positive impact. Doesken would like the comments limited to only a few weeks. Nigoyi notes that the draft is strong and does not need a lot of work, so let's move it along quickly. Christy asks why the emphasis on 'near real-time' in the proposed archives standards? Crawford notes that we can have both a 'weather' and a 'climate' network, thus get both bases covered and appeal to a broader constituency. We

can't really afford both; plus NOAA doesn't care about surface climate data. Crawford would prefer to have NCDC as the archive and the more frequent the data the better. Christy notes that data volume for a surface-based network pales in comparison to most remote-sensing networks; thus high frequency of observations should not be an archive problem. McGuirk notes that NCDC likely will not comment on the draft since they already have their own set of observing standards in the CRN. Perhaps we should consider regional data centers for non-Federal networks and investigate getting an AASC seat on OFCM and DMC (Data Management Committee) committees. Crawford notes that George Frederick says that AMS national mesonet committee left AASC out, but that this was not an intentional oversight and would like to bring us in. Hubbard noted that we already have the CRN HCN-M standards. Do we need another set? Crawford reports that we are consistent with the federal standards but do not want to scare off local/state networks that think they could never meet these standards. We would like all networks to aspire to Tier 1 standards but realistically there is a place for Tier 2 and 3.

Nielsen-Gammon suggests the following time-line which was adopted:

1) August 1. Deadline for initial comments.
2) October 1. Second draft released.
3) November 1. Deadline for comments on second draft.
4) December 1. Final draft released.
5) December 15. Deadline for approval of final draft.

Doesken then initiated a discussion on the potential creation of an Executive Director position for the AASC. Traditionally NCDC has partially met this need for the AASC over the years. However, with our 501c3 status we need more. We need better follow-up on matters of interest to the AASC. This would require a strong commitment on the part of the AASC. Perhaps something like a one-half time position with around $50K for annual salary and operating expenses would be ideal. However, this is probably not realistic with our present financial resources. An ARSCO fee of $1K per year per state would nearly meet such a need. Much larger fees/dues are levied for some national organizations (State Engineers, etc.), but these positions traditionally have more stable funding/State Code directives. Probably would be difficult to do with SC's. An informal count of 'raised hands' suggests that many SC's would at least explore the possibility implementing much higher state-office dues.

Mote notes that the role of AASC President has grown and asked how much time does this require? Doesken estimates he spends about 20 hours per week on AASC business and Hillaker about one-sixth time with Secretary-Treasurer duties. It was emphasized that much more time could be spent on AASC business if time allowed. Angel notes that an Executive Director has the advantage of bringing continuity and 'corporate memory' to the AASC. Doesken notes that we currently do not have the numbers to generate really big dollars. Some organizations use corporate sponsors, others have large sources of grant funding (such as from the EPA). Perhaps we will have the grant money to do this. Crawford notes that the NRC report on mesonets suggests a 501c3 as a 'neutral broker' for a national mesonet. McGuirk notes that it is acceptable for the AASC to

charge administrative costs for administering grants from NCDC; however, such costs must never be used for lobbying. Niyogi suggests that we come up with a collective AASC project(s) and bring it up to NSF, NOAA, etc. Anderson notes that we have lots of ideas but that we must have a specific plan to move forward and direct our efforts. It takes time to develop such a plan but it is worth it in the long-run. McGuirk notes that there are opportunities in seeking donations as a 501c3. Robbins asks do we need a lobbyist, fundraiser, etc… someone who looks for opportunities? After much discussion it was agreed that an Executive Director position was a good idea and should be pursued.

Boyles notes that we need more communication from the AASC Executive Committee and that the minutes from EC meetings must be published. Doesken agrees with this suggestion.

Stooksbury made a motion to split the AASC Secretary-Treasurer position into separate Secretary and Treasurer positions. This was seconded by Nielsen-Gammon. Boyles suggests that we could use a Finance Committee to assist the Treasurer. Archer suggests a volunteer(s) to help in the interim since the split in positions will require some sort of constitutional change. The proposal to split the position was unanimously approved.

Crawford wants to see a formal thank you extended to outgoing Executive Committee members Knight and Mizzell.

Doesken reports that Climate Change writing committee was waiting for the Policy & Procedures committee to outline the procedure for developing a new AASC climate change statement. This was not followed up after last year's meeting. Mote has outlined a possible procedure which needs to be reviewed.

The business meeting was adjourned at 9:20 a.m.

34th Annual Meeting
July 7-10, 2009

AASC
AMERICAN ASSOCIATION OF STATE CLIMATOLOGISTS

1. Adnan Akyuz, ND
2. Ken Hubbard, HPRCC
3. Harry Hillaker, IA
4. Nancy Selover, AZ
5. Jim Angel, IL
6. David Stooksbury, GA
7. George Jacobson, ME
8. David Zierden, FL
9. Dennis Todey, SD
10. John Neilsen-Gammon, TX
11. John Christy, AL
12. Peter Robinson, SRCC
13. Jeff Andersen, MI
14. Dev Niyogi, IN
15. Steve Hilberg, MRCC
16. Mike Anderson, CA
17. Robert Gillies, UT
18. Kevin Robbins, SRCC
19. Lesley-Ann Dupigny-Giroux, VT
20. Charlie Wax, MS
21. Ed Hopkins, WI
22. Hope Mizzell, SC
23. Kelly Redmond, WRCC
24. Steve Gray, WY
25. Al Dutcher, NE
26. Phil Mote, WA & OR
27. Paul Knight, PA
28. Ryan Boyles, NC
29. Mike Borengasser, AR
30. Jeff Rogers, OH
31. Kevin Law, WV
32. Ken Crawford, OK
33. Mark Wysocki, NY
34. Keith Eggleston, NRCC
35. Stu Foster, KY
36. Dave Robinson, NJ
37. Nolan Doesken, CO