THE STATE CLIMATOLOGIST
2013/14 Annual Summary
Volume 32, Issue 1

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

Assembled by Olivia Kellner, Indiana State Climate Office, Purdue University. Spring 2014.
# Table of Contents

PRESIDENT’S LETTER ........................................................................................................... 4
ABOUT THE AMERICAN ASSOCIATION OF STATE CLIMATOLOGISTS ......................... 5
2012 SUMMARY OF THE UNITED STATES CLIMATE .................................................. 6
Seasonal Analysis .................................................................................................................. 9
Alaska Annual Summary ....................................................................................................... 16
Very Warm/Cold and Wet/Dry Percentages ....................................................................... 18
Climate Extremes Index ...................................................................................................... 21
Drought ............................................................................................................................... 23
Wildfires ............................................................................................................................. 37
Hurricanes & Tropical Storms ............................................................................................. 43
National Snow & Ice ........................................................................................................... 49
Tornadoes ............................................................................................................................ 58
NATURAL RESOURCES CONSERVATION SERVICE (NRCS) ............................................ 65
HIGH PLAINS REGIONAL CLIMATE CENTER (HPRCC) .................................................. 68
ALABAMA OFFICE OF THE STATE CLIMATOLOGIST (AOSC) ....................................... 72
ALASKA STATE CLIMATE CENTER (ASCC) ...................................................................... 75
ALASKA CLIMATE RESEARCH CENTER (ACRC) .............................................................. 78
OFFICE OF THE ARIZONA STATE CLIMATOLOGIST (ASCO) ........................................... 81
OFFICE OF THE CALIFORNIA STATE CLIMATOLOGIST .................................................. 84
COLORADO CLIMATE CENTER (CCC) .............................................................................. 87
OFFICE OF THE DELAWARE STATE CLIMATOLOGIST (ODSC) ......................................... 91
GEORGIA OFFICE OF THE STATE CLIMATOLOGIST ....................................................... 94
HAWAII STATE CLIMATE OFFICE (HSCO) ................................................................... 95
IDAHO STATE CLIMATE SERVICES (ISCS) .................................................................... 97
ILLINOIS STATE CLIMATOLOGIST OFFICE .................................................................. 100
INDIANA STATE CLIMATE OFFICE (ICLIMATE) ............................................................ 102
IOWA STATE CLIMATOLOGIST OFFICE ......................................................................... 105
KANSAS STATE CLIMATE OFFICE .................................................................................. 108
KENTUCKY CLIMATE CENTER (KCC) ............................................................................ 110
MICHIGAN STATE CLIMATOLOGICAL RESOURCES PROGRAM (MCRP) .................... 113
MINNESOTA STATE CLIMATOLOGY OFFICE (MN_SCO) ................................................... 115
MISSOURI CLIMATE CENTER (MCC) ............................................................................ 117
NEVADA STATE CLIMATE OFFICE (NSCO) .................................................................. 120
NEW HAMPSHIRE STATE CLIMATE OFFICE (NHSCO) .................................................. 123
OFFICE OF THE NEW JERSEY STATE CLIMATOLOGIST (ONJSC) ................................. 126
NEW MEXICO CLIMATE CENTER (NMCC) ................................................................. 129
STATE CLIMATE OFFICE OF NORTH CAROLINA ......................................................... 132
NORTH DAKOTA STATE CLIMATE OFFICE (NDSO) ..................................................... 136
OKLAHOMA CLIMATOLOGICAL SURVEY (OCS) ............................................................ 139
OREGON CLIMATE SERVICE (OCS) ............................................................................... 143
PENNSYLVANIA STATE CLIMATE OFFICE ................................................................. 146
SOUTH CAROLINA OFFICE OF CLIMATOLOGY ............................................................ 149
SOUTH DAKOTA OFFICE OF CLIMATE AND WEATHER (SDOCW) .............................. 152
OFFICE OF THE TEXAS STATE CLIMATOLOGIST ......................................................... 157
UTAH CLIMATE CENTER (UCC) ........................................................................................................... 159
VERMONT STATE CLIMATE OFFICE (VTSCO) .................................................................................. 164
UNIVERSITY OF VIRGINIA CLIMATOLOGY OFFICE ...................................................................... 166
OFFICE OF WASHINGTON STATE CLIMATOLOGIST (OWSC) ........................................................... 169
WEST VIRGINIA STATE CLIMATE OFFICE (WVSCO) ..................................................................... 172
WISCONSIN STATE CLIMATOLOGY OFFICE ..................................................................................... 174
WYOMING STATE CLIMATE OFFICE .................................................................................................. 177
AASC CURRENT STATE CLIMATOLOGISTS/OFFICE DIRECTORS .............................................. 180
Dear Fellow Climatologists, Partners, and Friends of the AASC,

The complex links between climate and society have received increasing attention over recent years, and concerns about future climate continue to be in the public discussion. Within that context, it is my distinct pleasure to share the 2014 edition of The State Climatologist, a summary of accomplishments of the AASC over the past year. This publication brings attention to the activities of state climate offices, regional climate centers, and our federal partners over the past year. The contributors are a dedicated group of professionals with a common goal of promoting the public good by serving as a source of reliable data and information to advance knowledge and aid decision making in matters related to climate from the local to the national scale. Please review the contents of this document highlighting the activities of our members.

This has been a transitional year for the AASC. With strong support, our voting members approved a proposal to restructure the AASC by expanding our traditional membership structure, consisting of full and associate individual memberships, to include institutional memberships at two levels: Institutional Leaders and Institutional Associates. These membership options provide a means to increase membership revenue necessary for the AASC to hire an executive director and establish a national office. I thank those institutions that have already stepped forward and committed to support the AASC. Building on their support, the AASC will then be positioned to enhance the level of service that it offers to all of its members. But there is still much work to do in the coming year as we seek to implement the new structure and pursue opportunities in the rapidly expanding arena of climate services.

As I complete my term as president, I thank and give credit to members of the executive board who have provided expert advice and played key roles in the day to day operations of the AASC. I also express my sincere appreciation to those members who agreed to serve on committees in support of the interests of the association. Further, thanks to all who were willing to publicly express their opinions and provide feedback, both positive and negative, as the executive board formalized and then presented proposals to our membership for vote. Finally, I would like to thank everyone for the opportunity to be of service to this outstanding organization. It has truly been an honor to work on your behalf as president over the past two years. As I pass the reigns of leadership, I am excited about what the future holds for the AASC and its members.

Sincerely,

President of the American Association of State Climatologists
State Climatologist for Kentucky
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 48 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 employment of the state climatologist, representatives of federal climate agencies, retired state climatologists, or others interested in climate services. 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.
The following National Overview information for 2013 is reproduced from NCDC:
Supplemental 2013 Temperature and Precipitation Information

- Year-to-date temperature evolution for select U.S. cities
- Year-to-date precipitation evolution for the contiguous U.S.
- 2013 U.S. Drought Improvement
- 2013 Alaska Extremes
- Select U.S. stations with extreme year

In 2013, the contiguous United States (CONUS) average temperature of 52.4°F was 0.3°F above the 20th century average, and tied with 1980 as the 37th warmest year in the 119-year period of record. The 2013 annual temperature marked the coolest year for the nation since 2009. The 2013 CONUS average temperature was 2.9°F cooler than the 2012 average temperature, which was the warmest year on record for the nation. Since 1895, when national temperature records began, the CONUS has observed a long-term temperature increase of about 0.13°F per decade. Precipitation averaged across the CONUS in 2013 was 31.17 inches, 2.03 inches above the 20th century average. This marked the 21st wettest year on record for the nation and the wettest since 2009. Compared to 2012, which was the 18th driest year on record, the CONUS was 4.50 inches wetter in 2013. Over the 119-year period of record, precipitation across the CONUS increased at an average rate of 0.17 inch per decade.

On a statewide and seasonal level, 2013 was a year of precipitation extremes, with temperature extremes being more muted than the previous year. Above-average temperatures during 2013 were observed in parts of the West, Northeast, and in Florida. No state had annual temperatures that ranked among the ten warmest. California tied its 12th warmest year with a statewide average temperature of 60.3°F, 1.4°F above average. Below-average annual temperatures were observed from the Northern Plains, through the Central Plains and Midwest, and into the Southeast. No state had annual temperatures that ranked among the ten coolest. Despite no state
having a record warm or cool year, numerous locations across California and Florida had their warmest year on record, while numerous locations across the Plains and Mid-South had their coolest year on record. A map of those stations is available here. Based on NOAA’s Residential Energy Demand Temperature Index (REDTI), the contiguous U.S. temperature-related energy demand during 2013 was 7 percent above average and ranked as the 49th lowest in the 1895-2013 period of record. On a local level during 2013, approximately 26,100 daily warm temperature records were tied or broken (10,100 warm daily maximum records and 16,000 warm daily minimum records); while approximately 28,800 daily cool temperature records were tied or broken (16,900 cool daily maximum records and 11,900 cool daily minimum records).

Overall, much of the CONUS was wetter than average for the year, particularly east of the Rockies. The largest precipitation departures from average were observed in the Northern Plains, the Upper Midwest, and the Southeast. In total 10 states had annual precipitation totals that ranked among the ten wettest years on record. Michigan had its wettest year on record with 40.12 inches of precipitation, 8.9 inches above average. This bested the previous record wet year of 1985 by 0.64 inch. North Dakota also had its wettest year on record with 24.54 inches of precipitation, 7.18 inches above average. This bested the previous record wet year of 2010 by 0.29 inch. In contrast, portions of the West were dry. California had its driest calendar year on record with 7.38 inches of precipitation, 15.13 inches below average. This was 2.42 inches below the previous record dry year of 1898. By the end of 2013, 27.6 percent of California was in Severe Drought. To the north, Oregon had its fourth driest year, while Idaho had its 12th driest. Numerous locations across the Southeast, Midwest, Northern Plains, and Rockies experienced their wettest year on record, while locations in California, Idaho, and Washington had their driest. A map of those stations is available here. In term of drought, according to the U.S. Drought Monitor, conditions improved across much of the southeastern and central U.S. during 2013, but deteriorated in the Far West and Northeast. At the end of 2013, about 31.0 percent of the contiguous U.S. was experiencing drought, down from 61.1 percent at the beginning of the year.

Seasonal highlights in 2013 included:

- The CONUS had its 20th warmest winter on record, with much of the eastern U.S. having above-average temperatures. Florida had its tenth warmest winter on record. Below-average temperatures were observed in parts of the West. The CONUS winter precipitation was above average with wetter-than-average conditions along the Gulf Coast and the western Great Lakes, where seven states had a top ten wet winter season. The winter snow cover extent for the CONUS was 15th largest on record.
- Spring temperatures were cool for the CONUS with a temperature 0.5°F below average. This marked the first season since the winter of 2010/11 with below average CONUS temperatures and this was the coldest spring since 1996. Below-average temperatures were widespread in the central and southeastern U.S., where 14 states had spring temperatures ranking among the ten coolest on record. The West and New England were warmer than average. California had its seventh warmest spring on record. Spring precipitation was near-average nationally, with above-average precipitation in the Upper Midwest and below-average precipitation in much of the West. Iowa had its wettest spring on record, in addition to five additional nearby states having a top 10 wet spring. Below-average spring
precipitation was observed in the West and Mid-Atlantic. California and New Mexico had a top 10 dry spring.

- The summer CONUS temperature was above average and tied with 1937 as the 15th warmest summer on record. Above-average temperatures were present in the West and Northeast where nine states had one of the 10 warmest summers on record. Below-average temperatures were observed in the Midwest and Southeast. The summer of 2013 was the eighth wettest on record for the CONUS and the wettest since 2004. Record and near-record wet conditions were observed in the East and Southwest. New York, South Carolina, Georgia, and Florida each had their wettest summer on record.

- The CONUS was slightly warmer than average during autumn, with much of the nation having near-average temperatures. The autumn precipitation total was above average. Near-record wet conditions were observed across the High Plains and Northern Plains, where five states were top 10 wet. California had its 10th driest autumn on record.

This annual report places the temperature and precipitation averages into historical perspective, while summarizing the notable events that occurred in 2013. More detailed analysis on individual months can be found through the Climate Monitoring home page.

Seasonal Analysis

Winter

Winter 2012/2013 Statewide Temperature Rank Map
The winter season of 2012/13 was warmer than average for the contiguous U.S. with a temperature of 34.2°F, 1.9°F above the 20th century average, and the 20th warmest winter on record. Much of the winter warmth came early in the season. The December average temperature was 3.4°F above average and tied with 1994 as the 10th warmest December on record. The January and February average temperatures were both near the 20th century average. During the December 2012–February 2013 period, above-average temperatures were widespread east of the Rockies. Florida had its tenth warmest winter with a seasonal temperature 3.4°F above average.

Part of the West had near-average winter temperatures, while the Southwest and Oregon had a cooler-than-average winter season.

The 3-month average CONUS precipitation of 7.05 inches was 0.58 inch above average and the 26th wettest winter season on record. Above-average winter precipitation was widespread east of the Rockies, with the largest departures from average occurring across the Southeast and Great Lakes. Louisiana, Mississippi, Alabama, Georgia, Wisconsin, Illinois, and Michigan each had a top ten wet winter season. Below-average precipitation was present across the northwestern quadrant of the country and the West Coast. December was particularly wet across the country, with the CONUS average precipitation 0.50 inch above average marking the 20th wettest December. January and February both had near-average precipitation, masking both regional wet and dry extremes during the two months. Georgia had its wettest February on record, receiving more than twice the average monthly precipitation. This began a very wet year for the state that drastically improved the drought conditions that had plagued the state since 2010. Over the course of the season, the above-average precipitation shrank the national drought footprint from 62.4 percent at the beginning of December 2012 to 61.1 percent at the beginning of January and to 54. percent at the end of February. Most of the drought improvement occurred in the Southeast. In terms of snow cover, numerous winter storms impacted the CONUS during the three-month period. The satellite-derived snow cover extent for December 2012-February 2013 was approximately 1.3 million square miles, which was 127,000 square miles above the 1981-2010 average. This marked the 15th largest seasonal snow cover extent in the 1966-present period of record. Despite the above-average precipitation in the Great Lakes region, all of the Great
Lakes had below-average water levels in January 2013 and Lakes Huron and Michigan (hydrologically the same lake) reached a new record low level in the 1918-present period of record, according to the Army Corps of Engineers.

Spring

![Spring 2013 Statewide Temperature Rank Map](image1)

![Spring 2013 Statewide Precipitation Rank Map](image2)

The national spring temperature of 50.4°F was 0.5°F below the 20th century average. This was the coolest spring for the nation since 1996 and in stark contrast to the spring of 2012, just one year earlier, when the U.S. experienced its record warmest spring. The spring of 2013 was 5.6°F cooler than the spring of 2012. The March temperature was 0.9°F below than average, April was 1.4°F cooler than average, and the May temperature was 0.8°F above average. The starkest contrast between 2012 and 2013 was in March, when the year-over-year difference in monthly temperature was 9.7°F. On a statewide level, below-average temperature stretched from the
Upper Midwest, through the Mississippi River Valley, and into the Southeast where 14 states had seasonal temperatures ranking among the 10 coolest. Above-average temperatures were present in parts of New England and the West. California had its seventh warmest spring with a temperature of 60.5°F, 3.9°F above average.

The national spring precipitation total was 0.21 inch above average at 7.92 inches, which ranked near the median value for the season. Nationally, March was drier than average and ranked as the fifth driest such month on record, April was wetter than average and the 19th wettest such month, and May was the 17th wettest on record. The national precipitation average masked both wet and dry extremes that occurred regionally during the season. The Great Lakes and Upper Midwest had a very wet spring. Six states from Michigan to North Dakota had a top 10 wet spring. Iowa was record wet with 196 percent of average precipitation for the period March-May. The Mid-Atlantic and southwestern quadrant of the country were drier than average during spring. California had its eighth driest spring with a seasonal precipitation total 41 percent of average. New Mexico had its second driest spring with a seasonal precipitation total 28 percent of average.

The wet conditions in the central U.S. resulted in several rivers in Illinois, Iowa, and Michigan reaching record high levels, with widespread flooding observed. The Mississippi River at St. Louis also reached flood stage after dropping to near-record low levels at the beginning of the year. Drought conditions during spring drastically improved in the Southeast and Midwest, remained the nearly the same across parts of the High Plains, and deteriorated in the Southern Rockies and Far West. At the beginning of the spring, the CONUS drought footprint covered 54.2 percent of the Lower-48, but contracted to 44.3 percent of the CONUS by the end of spring. Snow cover extent was above average and ranked as the eighth largest on record for the spring season. After a warmer than average winter with many locations receiving below-average snowfall, several winter storms resulted in numerous cities receiving more snowfall during the March-May period than during the December-February period. A list of those cities can be found here. Despite the national snow cover extent being above average, many locations across the Sierra Nevada Mountains, Great Basin, and Southern Rockies had snow pack totals less than 50 percent of normal as of April 1st. Snowpack this time of year is important due to the water it provides to communities during the spring and summer melt season.
The CONUS average temperature during summer (June-August) was 72.6°F, 1.2°F above average, and tied with 1937 as the 15th warmest summer on record. This was on the heels of the summers of 2011 and 2012, both of which were among the three warmest summer seasons on record. Cooler-than-average temperatures were present during summer from the Midwest and into the Southeast. Above-average temperatures dominated West of the Rockies, with above-average temperatures also present in the Northeast. In the West, eight states had summer temperatures that ranked among the ten warmest on record. In the Northeast, Massachusetts had its ninth warmest summer on record. June was the 15th warmest such month on record for the CONUS with a temperature 2.0°F above average; the July temperature was 0.7°F above average, the 30th warmest July, and the CONUS had its 28th warmest August with a temperature 1.0°F above average. In Alaska, the statewide average temperature for the June-August period was
2.7°F above the 1971-2000 average and the second warmest summer in the 1918-2013 record. The state had its third warmest June, fifth warmest July, and 11th warmest August.

The CONUS precipitation total during summer was 9.53 inches, 1.28 inches above average, and the eighth wettest summer on record. This was the wettest summer since 2004. Most locations in the East had much-above-average precipitation during the June-August period. Twenty states, from Maine to Florida, had three-month precipitation totals that were among the top 10 wettest. New York, South Carolina, Georgia, and Florida each had their wettest summer on record. In fact, this was the second summer in a row that Florida broke its June-August precipitation record. Specific locations that had their wettest summer on record can be found here. Above-average precipitation was also observed in the Southwest and parts of the Plains. Arizona had its ninth wettest summer on record, partially due increased monsoonal precipitation during the season. Below-average precipitation was observed across the western Gulf States, parts of the Midwest and Northern Rockies and Plains. The June precipitation total ranked as the 13th wettest such month on record. Tropical Storm Andrea, the only tropical cyclone to make landfall in the U.S. during 2013, made landfall along Florida's Gulf Coast on June 6th, bringing heavy rain to parts of the Southeast. The July precipitation total ranked as the fifth wettest on record, while the August CONUS precipitation total was near average. In terms of the drought footprint, 44.3 percent of the Lower-48 was experiencing drought at the beginning of the summer, and 50.1 percent at the end of the summer. Drought conditions redeveloped across parts of the Upper Mississippi River Valley and Midwest. Drought improved in parts of the Southern Plains and Rockies and intensified in the West. The drought conditions in the West were also associated with several large wildfires, including the Rim Fire in California which burned over 255,000 acres, the third largest fire in California history; the Black Forest Fire, which destroyed over 500 homes near Colorado Springs, Colorado, the most destructive wildfire in Colorado history; and the erratic Yarnell Hill Fire, near Prescott, Arizona, that was responsible for 19 firefighter fatalities.

Fall

Fall 2013 Statewide Temperature Rank Map
The September–November CONUS temperature of 54.1°F was 0.5°F above average and ranked near the long-term median value for the season. Most of the CONUS had near-average temperatures during the three-month season. Below-average temperatures were observed across parts of the Northeast, Mid-Atlantic, and Southeast. Above-average temperatures were observed in Florida and parts of the Rockies. September was the seventh warmest such month on record for the CONUS, with a monthly temperature 2.4°F above average, while the October temperature was below average, and the November temperature near average. Alaska had its tenth warmest autumn with a seasonal temperature 4.0°F above the 1971-2000 average. The seasonal warmth was mostly driven by a record warm October in the state, when the monthly temperature was 8.8°F above average and 1.1°F warmer than the previous record warm October. Locally, the Fairbanks average October temperature of 36.1°F was 11.9°F above normal.

The autumn CONUS precipitation total was 0.52 inch above average at 7.23 inches, and the 34th wettest autumn on record. Below-average precipitation was observed in the Southeast and parts of the Mid-Mississippi River Valley. California continued its trend of below average precipitation during 2013 with its tenth driest autumn season. Above-average precipitation was observed in parts of the Midwest, Gulf Coast, Rockies, Northern Plains, and Great Basin. Five states from Colorado to North Dakota had one of their ten wettest autumns on record. Much of the heavy precipitation fell during the month of September in Colorado. Between September 9th–16th, a cut-off low pressure system situated over the Great Basin pumped deep tropical moisture into the Colorado Front Range, resulting in record-breaking precipitation. Streams and rivers approached and exceeded record levels with widespread flooding reported. Colorado had its wettest September on record with 312 percent of average precipitation. Oregon and Washington also had a record wet September, which is part of the dry season there. However, below-average precipitation in those two states during October and November, led to a seasonal precipitation total that was near average. The CONUS drought footprint shrank drastically during the autumn. At the beginning of the season, 50.0 percent of the CONUS was experiencing drought, by the end of the season, the drought footprint shrank to 30.1 percent of the CONUS, the smallest extent in nearly two years. Drought improved across the High Plains, Southern Plains, and parts
of the Rockies. Drought intensified in the Far West, with 98 percent of California in drought at the end of the season. Alaska had its third wettest autumn season with a precipitation total 42.7 percent above the 1971-2010 average. This marked the wettest autumn for the state since 1993 when the seasonal precipitation total was 52.0 percent above average.

Alaska Annual Summary

Jan-Dec 2013 Alaska Temperature Time Series

Jan-Dec 2013 Alaska Precipitation Time Series
Alaska temperatures in 2013 were above the 1971-2000 average. The annual temperature for the state was 1.8°F above average and marked the 10th warmest year in the 95-year period of record for the state. This was the warmest year since 2005 for Alaska, when the temperature was 2.3°F above the 1971-2000 average. The warmest year on record for the state was 1926, when the temperature was 3.8°F above average. Alaska had its 27th warmest winter season, with a temperature 2.0°F above average. Alaska was cooler than average during the spring with a temperature 3.2°F below average, the 18th coolest such season on record. During the spring season, Alaska had its seventh coolest April on record. Temperatures quickly rose during the summer season, which was the second warmest summer on record for Alaska with a temperature 2.6°F above average. The warmest summer on record in Alaska occurred in 2004 when the seasonal temperature was 4.2°F above average. The summer of 2013 consisted of the third warmest June, the fifth warmest July, and 11th warmest August. Autumn ranked as the 10th warmest in Alaska, with a temperature 4.0°F above average. The state experienced its warmest October on record with a temperature 8.8°F above average. This bested the previous record warm October of 1925 by more than 1.0°F. The December temperature was 2.0°F above average — the 28th warmest such month on record.

The Alaska precipitation total during 2013 was 25.1 percent above the 1971-2000 average and ranked as the third wettest year in the 95-year period of record for the state. Only 1929 and 1963 were wetter. Alaska had its 17th wettest winter season, with a precipitation total 33.0 percent above average. Spring ranked as the 31st wettest season for the state with precipitation total 17.0 percent above average. Summer precipitation was slightly above average and ranked as the 48th wettest such season on record. Precipitation peaked during autumn, which was the third wettest such season on record. The seasonal precipitation total was 42.7 percent above average, and consisted of the 18th wettest September, 3rd wettest October, and 13th wettest November. December precipitation ranked as the fifth highest on record for the month at 51.0 percent above average.
Very Warm/Cold and Wet/Dry Percentages

U.S. Percentage Areas Very Warm/Very Cold

United States Percentage Area

U.S. Percentage Areas Very Wet/Very Dry

United States Percentage Area
One way to assess the magnitude of warm/cold and wet/dry episodes is to compute the percent area of the contiguous United States that was "very warm/very cold" and that which was "very wet/very dry". The figures above depict these values for each month in the past 30 years. These percentages are computed based on the climate division data set. Those climate divisions having a monthly average temperature/precipitation in the top ten percent (> 90th percentile) of their historical distribution are considered "very warm/very wet" and those in the bottom ten percent (< 10th percentile) are "very cold/very dry". The “very warm” categories translate to the “much above average” while the “very cold” categories translate to the “much below average” in terms of the NCDC ranking methods. This is similar for the “very wet” and “very dry” categories and the NCDC ranking methods of precipitation totals.

The table below shows the percent area of the nation "very warm" and "very cold" for each month of 2013 as well as the annual averaged values.

<table>
<thead>
<tr>
<th>Month</th>
<th>Percent area of CONUS &quot;very warm&quot;</th>
<th>Percent area of CONUS &quot;very cold&quot;</th>
</tr>
</thead>
<tbody>
<tr>
<td>January</td>
<td>1.89</td>
<td>6.66</td>
</tr>
<tr>
<td>February</td>
<td>0.44</td>
<td>0.00</td>
</tr>
<tr>
<td>March</td>
<td>12.98</td>
<td>13.37</td>
</tr>
<tr>
<td>April</td>
<td>3.50</td>
<td>24.30</td>
</tr>
<tr>
<td>May</td>
<td>2.53</td>
<td>3.31</td>
</tr>
<tr>
<td>June</td>
<td>21.92</td>
<td>0.00</td>
</tr>
<tr>
<td>July</td>
<td>24.09</td>
<td>8.39</td>
</tr>
<tr>
<td>August</td>
<td>11.64</td>
<td>3.29</td>
</tr>
</tbody>
</table>
The table below shows the percent area of the nation "very wet" and "very dry" for each month of 2013 as well as the annual averaged values.

<table>
<thead>
<tr>
<th>Month</th>
<th>Percent area of CONUS &quot;very wet&quot;</th>
<th>Percent area of CONUS &quot;very dry&quot;</th>
</tr>
</thead>
<tbody>
<tr>
<td>January</td>
<td>9.95</td>
<td>9.96</td>
</tr>
<tr>
<td>February</td>
<td>11.69</td>
<td>14.81</td>
</tr>
<tr>
<td>March</td>
<td>0.74</td>
<td>18.18</td>
</tr>
<tr>
<td>April</td>
<td>12.00</td>
<td>7.64</td>
</tr>
<tr>
<td>May</td>
<td>15.60</td>
<td>8.66</td>
</tr>
<tr>
<td>June</td>
<td>15.29</td>
<td>16.09</td>
</tr>
<tr>
<td>July</td>
<td>25.85</td>
<td>8.34</td>
</tr>
<tr>
<td>August</td>
<td>10.59</td>
<td>10.54</td>
</tr>
<tr>
<td>September</td>
<td>28.62</td>
<td>2.22</td>
</tr>
<tr>
<td>October</td>
<td>14.79</td>
<td>7.76</td>
</tr>
<tr>
<td>November</td>
<td>3.56</td>
<td>3.51</td>
</tr>
<tr>
<td>December</td>
<td>13.18</td>
<td>13.12</td>
</tr>
<tr>
<td>2013</td>
<td>13.49</td>
<td>10.07</td>
</tr>
</tbody>
</table>
The annual USCEI was 18 percent, which is slightly below the long-term average extent of extremes. This was the first time since 2009 the annual USCEI value was below average. The principal contributor to this value was the large footprint of dry Palmer Drought Severity Index (PDSI) extremes, covering approximately twice the average area. The Southeast had approximately 41 percent of the region impacted by extremes in 2013. The above average extremes were primarily due to above average extent of cold maximum temperatures, wet PDSI, proportion of 1-day precipitation and days with precipitation.
In the spring (Mar-May), the USCEI indicated that approximately 28 percent of the CONUS was impacted by extremes. Regions which experienced an above average extent in extremes include the West, the Northern Rockies and Plains, and the Upper Midwest. In the West, warm temperatures, dry PDSI and extremes in the proportion of 1-day precipitation were the most significant factors to the elevated extent of extremes across the region. Cold temperatures, dry PDSI, and extremes in 1-day precipitation were above average across the Northern Plains and Rockies. Extremes across the Upper Midwest were seen primarily in the cold temperature and 1-day precipitation indicators.

During the summer (Jun-Aug), extremes in the USCEI covered about 24 percent of the CONUS. The Northwest, West, Southwest and Southeast Regions had extremes which were above average. An above average extent of warm temperatures and extremes in 1-day precipitation dominated the Northwest. Warm temperatures also impacted the West as well as an above average footprint of dry PDSI. A lack of substantial precipitation during 2013 led California to its driest year on record. In the Southwest, extremes in warm temperatures and dry PDSI prevailed. Conversely, the above average extent of extremes experienced across the Southeast were the result of cold maximum temperatures, warm minimum temperatures, wet PDSI and a large number of days experiencing precipitation.

In contrast to the two previous seasons, fall (Sep-Nov) had below average extremes across the CONUS with an extent of only 11 percent. Extremes in temperatures were nearly absent across the Lower 48 states. Below to near average extremes occurred in all regions except the Northern Rockies and Plains, where warm minimum temperatures, wet PDSI, 1-day precipitation extremes, and the number of days with precipitation were above average.
Drought - Annual 2013

The data presented in this drought report are preliminary. Ranks, anomalies, and percent areas may change as more complete data are received and processed.

National Drought Overview

A key feature of 2013 was the significant recovery from the major 2012 drought in some areas, while drought persisted in others. On a month-by-month basis, 2013 was characterized by large areas of dry weather which were more than counterbalanced by large areas of wet weather. Six months (January, February, March, June, August, and December) had ten percent or more of the country experiencing very dry precipitation anomalies (at the tenth percentile of the historical record or drier), while ten (all except March and November) had ten percent or more of the country experiencing very wet anomalies (monthly precipitation totals at the 90th percentile of the historical record or wetter). Two months (July and September) had more than a fourth (25 percent) of the country very wet. When averaged together, the wet and dry anomalies resulted in the fifth driest March, nationally, in the 1895-2013 record, but all other months ranked near the middle of the historical record (near normal) or on the wet side. While some months were unusually warm during 2013, the heat was not as pervasive, nationally, as in 2012. Five months (March, June, July, August, and September) had ten percent or more of the contiguous U.S. (CONUS) very warm (monthly temperatures at the 90th percentile of the historical record or warmer), compared to eleven last year, but 2013 had four months (March, April, October, and December) with more than ten percent of the country very cold (monthly temperatures at the tenth percentile of the historical record or colder). Consequently, water demand (as measured by evapotranspiration) was not as great, nationally and in many regions, as it was in 2012. On a national scale, the Palmer Z Index (which integrates monthly water supply and demand) was dominated by dry (negative) values throughout 2012, whereas wet (positive) values prevailed in
2013. In fact, the national Z Index was almost continuously dry from June 2011 through March 2013, and wet from April through December 2013.

<table>
<thead>
<tr>
<th>2013 Palmer Z Index maps:</th>
</tr>
</thead>
<tbody>
<tr>
<td>January,</td>
</tr>
<tr>
<td>February,</td>
</tr>
<tr>
<td>March,</td>
</tr>
<tr>
<td>April,</td>
</tr>
<tr>
<td>May,</td>
</tr>
<tr>
<td>June,</td>
</tr>
<tr>
<td>July,</td>
</tr>
<tr>
<td>August,</td>
</tr>
<tr>
<td>September,</td>
</tr>
<tr>
<td>October,</td>
</tr>
<tr>
<td>November,</td>
</tr>
<tr>
<td>December,</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>2013 U.S. Drought Monitor maps:</th>
</tr>
</thead>
<tbody>
<tr>
<td>January,</td>
</tr>
<tr>
<td>February,</td>
</tr>
<tr>
<td>March,</td>
</tr>
<tr>
<td>April,</td>
</tr>
<tr>
<td>May,</td>
</tr>
<tr>
<td>June,</td>
</tr>
<tr>
<td>July,</td>
</tr>
<tr>
<td>August,</td>
</tr>
<tr>
<td>September,</td>
</tr>
<tr>
<td>October,</td>
</tr>
<tr>
<td>November,</td>
</tr>
<tr>
<td>December.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>2013 Palmer Drought Severity Index maps:</th>
</tr>
</thead>
<tbody>
<tr>
<td>January,</td>
</tr>
<tr>
<td>February,</td>
</tr>
<tr>
<td>March,</td>
</tr>
<tr>
<td>April,</td>
</tr>
<tr>
<td>May,</td>
</tr>
<tr>
<td>June,</td>
</tr>
<tr>
<td>July,</td>
</tr>
<tr>
<td>August,</td>
</tr>
<tr>
<td>September,</td>
</tr>
<tr>
<td>October,</td>
</tr>
<tr>
<td>November,</td>
</tr>
<tr>
<td>December.</td>
</tr>
</tbody>
</table>

An important feature of the weather conditions in 2013 was the variability of precipitation from month to month. Some regions experienced extremely dry conditions during part of the year and extremely wet conditions during other months. Some examples include: the Pacific Northwest (September vs. October-December), the Midwest (focused on Iowa) (April-June vs. July-September), the Southeast (June-August vs. September-October), and the Southwest (March-June vs. July-September). An exception was California, which was persistently drier than normal for most of the year (especially during its wet season). Dry weather affected parts of the West during every month except September, when monsoon showers and frontal rains moistened many areas. Dryness lingered in parts of the Plains during the first three months of the year and during the summer months, and also during the spring months in parts of the Southern Plains. Parts of the East Coast were drier than normal in January, March, April, September, and October, but wet weather dominated during February and especially the summer months and December, countering development of widespread drought. After a wet spring (April-June), the Midwest dried out during the summer (July-September), bringing memories of the 2012 drought but not as severe.

The year started out with 61.1 percent of the CONUS in moderate to exceptional drought (based on the U.S. Drought Monitor [USDM]) manifested in two drought epicenters — a large area of moderate to exceptional drought stretching from the West, across the Great Plains, and into the Midwest, with the worst drought areas in the Plains States, and another area from the Southeast to Mid-Atlantic States. Moderate to extreme drought continued across parts of Hawaii and a spot of moderate drought was in Alaska. As the year progressed, drought contracted in the West, Northern and Central Plains, Midwest, and Hawaii, and disappeared entirely from the East, with the moderate to exceptional drought area down to 43.8 percent of the CONUS by the end of June. As spring ended and summer began, drought was expanding in the West, especially in the Southwest. Drought returned to the Midwest and expanded in Alaska as the summer wore on, while continuing to contract in the Plains and shrinking in the Southwest, with 50.7 percent of
the CONUS affected by drought at mid-September. During the fall and early winter, drought returned to the Coastal Northeast and expanded in the West, while shrinking in the Midwest, Northern and Central Rockies, and Alaska. By year's end, the drought area had fallen to 31.0 percent of the CONUS. The change in drought area from the beginning of the year to the end of the year can be seen here.

![Contiguous U.S. Percent Area](chart.png)

The percent area* of the contiguous U.S. experiencing moderate to extreme drought (based on the Palmer Drought Index) started the year at about 54.2 percent, shrank to 44.0 percent by the end of February, grew to 48.7 percent by the end of March, shrank to a low of 13.4 percent by the end of October, then expanded again to end the year at about 18.5 percent. The Palmer Drought Index data go back 114 years.

![U.S. Percent Area Wet or Dry](chart2.png)
*This drought statistic is based on the Palmer Drought Index, a widely used measure of drought. The Palmer Drought Index uses numerical values derived from weather and climate data to classify moisture conditions throughout the contiguous United States and includes drought categories on a scale from mild to moderate, severe and extreme.

---

**Regional Drought Overview**

**U.S. Drought Monitor**

January 1, 2013

USDM map depicting drought at the beginning of 2013
USDM map depicting drought at the end of 2013

West:

Percent Area of Western US in Moderate to Exceptional Drought since 2000 (based on USDM).
The West began the 2012-2013 hydrologic year (water year, October 2012-September 2013) on a wet note, with October-December 2012 wetter than normal in the western and northern areas while the Four Corners states were drier than normal. December 2012 was a wet month for much of the West, but then the weather turned dry in 2013. January-June 2013 was especially dry for California, Nevada, Arizona, and New Mexico, while the focus of dryness for January-August 2013 was California to Idaho. The 2012-2013 hydrologic year ended with a patchwork pattern of drier- and wetter-than-normal areas. October-December 2013 turned dry for the Northwest, with the 2013 calendar year (January-December 2013) having a pattern of severe dryness from California to Idaho. The 2013 calendar year began with 69.3 percent of the West in moderate to exceptional drought (according to weekly USDM statistics). The percent area shrank to 62.8 percent by mid-March, expanded to 77.7 percent in August, then contracted during the fall, ending the year at 51.4 percent. A similar variation in the percent area over time is seen in monthly statistics based on the Palmer Drought Index. The year began with 54.9 percent of the West in moderate to extreme drought, with the area expanding to 77.0 percent by the end of June, shrinking to 26.8 percent by the end of October, and ending the year at 40.4 percent.
The wet season for California is roughly November to March, which is when most of the precipitation falls in the state. A calendar year typically begins with the last half of one wet season and ends with the first half of the next wet season. California began 2013 with a drier-than-normal wet season and ended it with a drier-than-normal wet season, which gave the state the driest calendar year in the 1895-2013 record.
The Southwest region (the Four Corners states of Arizona, New Mexico, Colorado, and Utah) had a dry start to 2013, then experienced a wetter-than-average summer monsoon season, and ended the year with precipitation anomalies that varied month-to-month. March-June 2013 ranked as the fifth driest March-June in the region's 1895-2013 record and was the third such consecutive season with below-normal precipitation. Severe drought had afflicted the region for several years. After the second driest March-May on record, all of New Mexico was classified in moderate to exceptional drought by the end of spring according to the USDM. Rains from the summer monsoon and upper-level systems brought relief and gave the Southwest region the wettest July-September on record, with drought in New Mexico and surrounding states quickly retreating.
Northwest region precipitation normal and departure, January 2012-December 2013

Northwest region precipitation, October-December, 1895-2013

As in California, 2013 began with a drier-than-normal wet season and ended with a drier-than-normal wet season in the Pacific Northwest. The region had the fourth driest January-March and third driest October-December, giving the year a rank of seventh driest. Similar monthly anomalies occurred in Oregon and Washington. Oregon began the year with the second driest January-March and ended the year with the third driest October-December, for an annual rank of fourth driest year on record. Washington started a little wetter, with the 17th driest January-March but ended with the second driest October-December, for an annual rank of 20th driest year.
Great Plains and Midwest:

**Percent area of the High Plains in moderate to exceptional drought, 2000-2013, based on the USDM.**

In 2012, the entire Great Plains region was afflicted by drought with a large part of the Midwest sharing the misery. During 2013, significant recovery occurred in the Central to Northern Plains (from Kansas and Colorado to North Dakota, the High Plains region). The January 1, 2013 USDM had 93.0 percent of the High Plains in moderate to exceptional drought. This percentage steadily fell throughout the year as cold fronts, low pressure systems, and convective thunderstorms dropped precipitation, reaching 19.3 percent by early December. Recovery also occurred in the Southern Plains, although not as remarkable as in the Northern Plains, with extreme to exceptional drought lingering over the western parts of Texas and Oklahoma.

**Percent area of the Midwest in moderate to exceptional drought, 2000-2013, based on the USDM.**
The Midwest began 2013 with 54.9 percent of the region in moderate to exceptional drought, according to the USDM. Widespread, persistent, heavy precipitation during the spring and early summer nearly eliminated drought by the end of June. Iowa had the wettest April, May, March-May, April-June, and March-June; Michigan had the wettest April-May and April-June; and Wisconsin had the wettest April-June. This gave the East North Central region (Upper Midwest region) the wettest April-May and April-June, region-wide. But then the rains stopped in July with dryness continuing into the fall, driving the regional drought area percentage back up to 32.0 percent by mid-September. Iowa had the second driest July-August and July-September on record, as well as the third driest July-October, seventh driest July-November, and sixth driest July-December. In fact, July-September was drier in 2013 (second driest) than in 2012 (fourth driest) for Iowa, and 2013 marked the third consecutive drier-than-normal July-September.
Southeast to Northeast:

The Southeast began 2013 with 45.7 percent of the region in moderate to exceptional drought. Beneficial rains in February, April, and May drove the drought area percentage into single digits, with a very wet summer driving it to zero. Dry conditions returned in the fall, with the Southeast region having the tenth driest September-October in the 119-year record. A small area of drought crept back into the Southeast region, as well as the Northeast region, by November.

Hawaii and other Pacific Islands:

The year began with 63.3 percent of Hawaii in moderate to exceptional drought, according to USDMS statistics. Beneficial rains steadily shrank the drought to 33.1 percent by the end of July,
but dryness beginning in late summer expanded it to 67.7 percent by the middle of November. November-December rains shrank the drought area to 49.6 percent by the end of the year.

January-December 2013 Precipitation (Percent of Normal)

2013 Annual percent of normal precipitation for U.S. Affiliated Pacific Islands

Annual (Jan-Dec) 2013 Precipitation Rank

2013 Annual precipitation ranks for U.S. Affiliated Pacific Islands

January-December 2013 was drier than normal for many of the U.S.-Affiliated Pacific Islands, especially those in the Republic of the Marshall Islands. Kwajalein had the second driest year in the 1953-2013 record and Majuro ranked fourth driest in the 1954-2013 record. In the Federated States of Micronesia, Pohnpei ranked second driest in the 1953-2013 record and Chuuk had the seventh driest year in the 1991-2013 record. In the Republic of Palau, Koror ranked sixth driest in the 1953-2013 record, while in the Mariana Islands, Saipan had the eighth driest year in the 1989-2013 record.
Drought became severe in the Marshall Islands during spring. The Republic of the Marshall Islands Cabinet and the Chief Secretary on April 16 declared a state of emergency for the Northern Marshall Islands as reservoirs became depleted and rain catchment dried up, well water became too salty for human consumption, and agriculture was damaged or destroyed. On May 6, the state of emergency was elevated to a state of disaster. Dry conditions continued in August, with Pohnpei recording the driest August in the 1953-2013 record, and in October when Kwajalein had the driest October, driest August-October, and second driest January-October in the 1953-2013 record.
Wildfires - Annual 2013

Please note: Material provided in this report is chosen subjectively and included at the discretion of the National Climatic Data Center (NCDC). The ability to report on a given event is limited by the amount of information available to NCDC at the time of publication. Data included in this report are preliminary unless otherwise stated. Links to supporting information are valid at the time of publication, but they are not maintained or changed after publication.

Number of fires & acres burned in January 2000-2013
Overview

January is not considered to be part of the U.S. wildfire season, with fire activity typically being slow during the month. January 2013 experienced below-average activity in terms of the number of fires and acres burned, with 964 fires charring 8,573 acres. During the 14-year period of record, only the January 2007 values were lower when 387 fires burned 4,597 acres. Isolated large wildfires sparked across the country within the states of Montana, Oklahoma, and Florida. Meanwhile, fire management officials leveraged conditions for conducting winter season prescribed burns in northern areas of California and Arizona as well as across the Gulf Coast and Southeast.

<table>
<thead>
<tr>
<th>January</th>
<th>Totals</th>
<th>Rank (out of 14 years)</th>
<th>Record</th>
<th>2000-2010 Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acres Burned</td>
<td>8,573</td>
<td>13th Most</td>
<td>330,447</td>
<td>53,742</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2nd Least</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of Fires</td>
<td>964</td>
<td>13th Most</td>
<td>3,507</td>
<td>1,784</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2nd Least</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Acres Burned per Fire</td>
<td>8.9</td>
<td>11th Most</td>
<td>94.2</td>
<td>23.5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4th Least</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1-Month Wildfire Statistics*

*Data Source: The National Interagency Fire Center (NIFC)
Discussion

In January, winter storms deposited snowfalls across the nation's northern tier and significant rain fell over parts of the South, Southeast, lower Midwest, and Mid-Atlantic states. Dryness expanded in south Florida during early January, which increased the state's wildfire risk. By month's end the Florida Panhandle's drought worsened from moderate to severe, while the Peninsula's dryness increased. Elsewhere, drought conditions improved in the Great Basin, much of Texas, and Virginia during the month. Extreme to exceptional drought remained anchored over the central Great Plains.

Significant Events

Please note, this is a list of select fires that occurred during January. More comprehensive fire information can be found through Inciweb.

Florida
The Florida Forest Service reported 3,905 acres burned by wildfires in the state from January 1st–31st. A wildfire in east central Florida swept through over 900 acres of marshland in the St. John's Wildlife National Refuge after sparking on January 12th. Smoke from the Flora Vista fire caused the overnight closure of State Road 407 in Brevard County. The flames moved to the northwest and stayed away from homes and structures.

On NOAA’s Hazard Mapping System (HMS) map product, the red dots correspond to hot spots and the grey area represent smoke plumes from possible fire locations (including prescribed fires) detected over North America by satellite observations. After igniting on January 23rd, the Black Creek wildfire scorched 127 acres of the Apalachicola National Forest in Florida. In the adjacent Tate's Hell State Forest, smoke from a fire drifted over the eastern Gulf of Mexico on January 24th, while the Bucksiding Road wildfire, which sparked on January 28th, consumed 400 acres by month’s end. The Buck #1 wildfire also burned nearly 1,200 forest acres to the south of Sumatra, Florida, during January.

**Monthly Wildfire Conditions**
Wildfire information and environmental conditions are provided by the National Interagency Fire Center (NIFC) and the U.S. Forest Service (USFS) Wildland Fire Assessment System (WFAS).
During the first two weeks of January, the 10-hour fuel moisture gradually lessened below four percent in parts of the extreme Southwest. Likewise, at the 100-hour and 1000-hour intervals the Southwest's fuel moistures decreased to values between 6 to 10 percent. Below-normal snowpack kept the fine fuels of the Upper and Mid-Mississippi Valley drier than normal, while wetter-than-normal conditions in the Ohio Valley kept soils very moist. Fuel moistures in excess of 15 percent dominated at all intervals (10-hour, 100-hour, and 1000-hour) with the exception of eastern Florida, where the Keetch-Byram Drought Index (KBDI) value exceeded 600 units.
Over 2,750 acres burned in a wildfire in southeastern Montana where dryness and above-average temperatures persisted. Grasslands in the central High Plains were drier than average as the snowpack along the Colorado Front Range into southeast Wyoming was about 75 percent of average. At mid-month, the 10-hour fuel moisture decreased to below eight percent across New Mexico, Texas, and Oklahoma, as well as parts of the central Plains and lower Mississippi Valley. The 100-hour fuel moisture in Nebraska and the western parts of Kansas, Oklahoma, and Texas dropped under 10 percent.

Later in the month, new fires sparked in eastern Oklahoma, Alabama, and Florida. The Buck Trot wildfire burned over 2,100 acres in Oklahoma near Stilwell from January 23rd until January 27th when the area received a light rainfall. Meanwhile, three smaller fires in Oklahoma each burned 200 acres or less. Elsewhere, in the Gulf Coast of southwestern Alabama, the Industrial Road wildfire singed 119 acres near Citronelle on January 25th. KBDI values exceeded 600 units in parts of the Great Basin, South Dakota, Nebraska, extreme southern Texas, and much of the Florida Peninsula.
Hurricanes & Tropical Storms - Annual 2013

Atlantic Basin, 2013 Season Summary:

North Atlantic ACE Index
1950-2013

2013 Atlantic Tropical Cyclone ACE 1950-2013

North Atlantic Basin
Number of Tropical Storms and Hurricanes
1950-2013

North Atlantic Tropical Cyclone Count 1950-2013
The 2013 North Atlantic hurricane season had 13 named storms, two hurricanes, and no major hurricanes. The number of tropical storms was slightly above the 1981-2010 average of 12.1, the number of hurricanes was below the average of 6.4, and the lack of major hurricanes was also below the average of 2.7. In terms of total named storms, this was the slowest season since 2009. The last time only two hurricanes were observed was in 1982 and the last season with no major hurricanes was 1994. The two hurricanes that formed during the season, Humberto and Ingrid, were both short lived. Humberto reached hurricane strength on September 11th, tying the latest date for the first hurricane of the season. The average date for the first hurricane is August 4th. No hurricanes made landfall in the U.S. during 2013. Tropical Storm Andrea made landfall along the Gulf Coast of Florida in June, and was the only tropical storm to directly impact the contiguous U.S. during the season. Hurricane Ingrid made landfall in Mexico in September, causing major flooding; more information is available below.

The Accumulated Cyclone Energy (ACE) index of tropical cyclone activity also indicated a below-average season in the North Atlantic. The ACE index is used to calculate the intensity of the hurricane season and is a function of the wind speed and duration of each tropical cyclone. The 2013 Atlantic hurricane season had an approximate ACE of $33 \times 10^4$ (knots$^2$) which was well below the 1981-2010 average value of $104 \times 10^4$ (knots$^2$). This is the lowest ACE for a hurricane season since 1983 and the 14th lowest in the 1851-present period of record. Despite the above-average number of named storms, the low number and short-lived nature of the hurricanes and the lack of major hurricanes depressed the ACE value for 2013 in the North Atlantic.

Individual tropical cyclone summaries are available through NOAA's National Hurricane Center.
East Pacific Basin, 2013 Season Summary:

![East Pacific Tropical Cyclone ACE Index Graph](image1)

![Eastern Pacific Basin Tropical Storms and Hurricanes Count Graph](image2)
The 2013 East Pacific hurricane season had 18 named storms, seven hurricanes, one of which was a major hurricane. The 1981-2010 average number of named storms in the East Pacific is 16.5, with 8.9 hurricanes, and 4.3 major hurricanes. The ACE index for the season was 66 \((x10^4 \text{ knots}^2)\), which is below the 1981-2010 average of 132 \((x10^4 \text{ knots}^2)\). The below-average number of major hurricanes in the basin kept the ACE low for 2013. Several of the storms, including two hurricanes, made landfall in Mexico. Hurricane Manuel caused the most damage across the country, with widespread flooding and mudslides.

Hurricane Manuel formed off the west coast of Mexico on September 13th. The storm made landfall in the state of Guerrero on the 15th as a strong tropical storm with winds of 70 mph. Manuel brought up to a foot of rainfall to the coastal mountains, with 7.41 inches observed in Acapulco. The heavy rainfall flooded the Acapulco Airport, stranding thousands of tourists. Manuel moved back over the ocean, skirting the Mexican coast and made a second landfall farther north as a category one hurricane, with sustained winds of 75 mph. The slow moving nature of the storm dropped several inches of rain along the mainland coast and southern portions of the Baja California Peninsula. While Manuel was impacting Mexico's West Coast, Hurricane Ingrid made landfall along Mexico's Atlantic Coast. The one-two punch of Manuel and Ingrid marked the first time since 1958 that two tropical cyclones impacted both the Atlantic and Pacific Coast of Mexico within 24 hours. The precursor low of Hurricane Ingrid formed in the Bay of Campeche on September 12th and reached hurricane strength on the 14th, reaching peak intensity on the 15th with sustained winds of 85 mph. Due to the wind shear associated with nearby Manuel, Ingrid weakened to a strong tropical storm with winds of 65 mph before making landfall near La Pesca, Mexico on the 16th. The largest impact from Ingrid was the heavy rainfall that fell across northern Mexico, causing significant flooding and numerous landslides. The flooding and landslides from both Manuel and Ingrid displaced tens of thousands of residents, damaged over 20,000 homes, left approximately 191 people dead (169 from Manuel, 23 from Ingrid), and caused over $5.0 billion (U.S. dollars) in damage.
Individual tropical cyclone summaries are available through [NOAA's National Hurricane Center](https://www.nhc.noaa.gov/).

**Other Tropical Cyclone Basin Significant Events**

**Tropical Storm Flossie**

Tropical Storm Flossie developed from a broad area of low pressure southwest of Acapulco, Mexico on July 25\textsuperscript{th}. The storm traversed a large portion of the eastern and central Pacific Ocean over the course of five days. The storm's intensity peaked with winds of 70 mph on the 27\textsuperscript{th} over open water. The storm weakened as it approached the Hawaiian Islands, and dropped to tropical depression status off the northern coast of Maui on the 30\textsuperscript{th}. Tropical Storm warnings were issued for most of the state, with the expectation of Flossie being the first tropical storm to hit the state since Hurricane Iniki in 1992. This was also the first time tropical storm warnings had been issued for Hawaii since 2007. The storm weakened drastically as it approached Hawaii due to strong wind shear. Rainfall totals generally ranged from 1 to 3 inches in many locations in the state, and contributed to an already wet month. Gusty winds, approaching 50 mph, and lightning strikes caused most of the impacts, with downed trees and more than 10,000 homes losing power.

*Tropical Storm Flossie Track. Source: National Weather Service*
Typhoon Haiyan

Typhoon Haiyan (known as Yolanda in the Philippines) was a large and powerful tropical cyclone that caused significant damage across Southeast Asia in November. The Philippines bore the brunt of the devastation, with the estimated number of fatalities at the end of 2013 at over 6,000 people. This is potentially the deadliest or second deadliest tropical cyclone in Philippines history. Tropical Storm Thelma was responsible for killing between 5,000 and 8,000 people in the country in 1991. After moving through the Philippines, Haiyan impacted southern China and Vietnam, causing additional damage and taking at least 20 additional lives. According to the United Nations, a total of 11 million people were directly impacted by the storm with the total impacts still being evaluated.

The precursor low pressure system formed on November 3rd to the east-southeast of the Federated States of Micronesia. The storm reached typhoon strength on November 5th and by the 6th had intensified into a super typhoon. On November 7th, at about 5 hours before landfall in the Philippines, Haiyan's intensity peaked with 1-minute sustained winds of 195 mph and a central minimum pressure of 895mb. The wind speed at landfall of 195 mph is the strongest tropical cyclone winds to impact land, surpassing Hurricane Camille, which hit the U.S. state of Mississippi in 1969 and had winds of 190 mph. It should be noted that Haiyan's peak intensity was estimated using satellites by the Joint Typhoon Warning Center (JTWC). The highest wind speeds directly measured within a tropical cyclone on record was 190 mph in Typhoon Tip, Hurricane Camille, and Hurricane Allen. The central minimum pressure ranked as the 20th lowest in the JTWC's dataset for the West Pacific Basin, well above the record set in Typhoon Tip at 870 mb. The lowest pressure measured in an Atlantic Hurricane was in Wilma in 2005 with a pressure of 882 mb.
The 2012/13 winter season (December 2012-February 2013) was warmer and wetter than average for the contiguous United States. December was warm (10th warmest) and wet (20th wettest) for the Lower-48, while January and February were both near average in terms of temperature and precipitation. Regionally, warmer-than-average temperatures during the three-month period were observed east of the Rockies, while the West had near- and below-average temperatures. In terms of precipitation, most locations east of the Rockies were also wetter than average, with the wettest locations being the Great Lakes and Southeast. The West Coast and Northern Rockies had below-average precipitation during the winter season. Several major
winter storms did impact the central and eastern U.S. during the cold season of 2012/13 bringing with them significant snowfall, mostly during February and March, with two unusual late-season storms in April and May. However, snowfall and winter snowpack were below-average across the high elevations of California, the Great Basin, and the Southern Rockies. The low snowfall totals across California were a precursor to both the driest year on record in the state and the development of drought conditions during 2013.

![Contiguous U.S. Winter Snow Cover Extent Anomalies](image)

According to data from the Rutgers Global Snow Lab, the winter snow cover extent was above average, while the spring snow cover extent was much above average. The satellite-derived snow cover extent for December 2012—February 2013 was approximately 1.3 million square miles, which was 127,000 square miles above the 1981-2010 average. This marked the 15th largest seasonal snow cover extent in the 1966-present period of record. Despite a below-average May snow cover extent for the Lower-48, the above-average snow cover in March and April was enough for the spring (March-May) snow cover extent to be 130,090 square miles above the 1981-2010 average of 355,500 square miles and the eighth largest spring snow cover extent on record. The above-average spring snowfall in many locations exceeded the amount of snow that was observed during the preceding winter season. A select list of those locations is available here.
Winter and spring mountain snowpack provide a crucial water source across much of the western United States. The total annual water budget for agriculture and human use in the mountainous West is highly dependent on the amount of snow melt that will occur in spring and is proportional to the amount of snow on the ground. The annual snowpack typically reaches its maximum value at the end of March. According to data from the USDA, on April 1st, above-normal snowpack was observed across the Cascades of Oregon and Washington; near-normal snowpack was present for much of the Northern Rockies of Idaho and Montana; below and much below normal snowpack was observed for central and eastern Oregon, the Sierra Nevada Mountains, much of the Great Basin and in the Central and Southern Rockies. Locations in California, Nevada, Arizona, and New Mexico had snowpack totals less than 25 percent of normal. In Alaska, much of the state had near-normal snowpack with the exception of northwestern and southwestern areas of the state. Snowpack totals greater than 130 percent of normal were reported along the Alaskan panhandle. By May 1st, the snowpack totals across the Sierra Nevada Mountains and the Southern Rockies were less than 25 percent of normal.
Select Significant Events

A Nor'easter hit the East Coast on February 7th-10th dropping heavy snowfall from New Jersey to Maine. The storm was rated a Category 3 on a scale from 1 to 5 on NOAA's Northeast Snowfall Impact Scale (NESIS), which takes into account snowfall in populated areas to understand societal impact. A Category 3 denotes a "major" winter storm for the region. This was the most significant snow storm to hit the region since February 2010. The footprint of heavy snow was relatively small when compared to other Nor'easters, but the heavy snowfall in the densely populated New York City and Boston metro areas led to a high NESIS value. Hamden, Connecticut had the highest reported snowfall total with 40.0 inches. The 21.8 inches at Boston's Logan Airport was the sixth largest single storm total on record for the city. In Portland, Maine, 31.9 inches of snow fell, and according to the National Weather Service, was the largest storm total for the city. Other impacts from the storm included strong winds and storm surge. Wind gusts in excess of 80 mph led to blizzard conditions for many locations. The storm caused significant storm surge along the Massachusetts coast, but since the storm hit at low tide coastal flooding was only a minor issue.
The first of back-to-back major winter storms impacted the Central Plains, parts of the Ohio Valley, and Upper Midwest states on February 20th-23rd. The storm was the result of a powerful low pressure system that emerged from the Southern Rockies, dropping heavy snow from New Mexico to Michigan. The heaviest snowfall was centered on Kansas, with a large portion of the state receiving over a foot of snow. Wichita, Kansas received 14.2 inches of snow, marking the second largest single-storm snowfall total for the city, behind a 1962 storm when 15.0 inches of snow was observed. Russell, Kansas received 22.0 inches of snow from the event. In the South Climate Region, the storm ranked as a Category 4 on the Regional Snowfall Impact (RSI) scale, a regional variant of the NESIS. This marked the 10th most significant winter storm on record for the region. Despite numerous negative impacts, the precipitation was a welcome sight for many as it provided some drought relief in the region.

The second of the two major winter storms to hit the central U.S. occurred on February 25th-28th. Heavy snowfall was once again reported from New Mexico to Michigan, but the heaviest snowfall totals were displaced farther south compared to the previous storm. The northern Texas panhandle and western Oklahoma bore the brunt of the heavy snow and wind. Wichita, Kansas, received an additional 6.8 inches of snow, contributing to a monthly total of 21.2 inches of snow for the city — the most on record for any month. The previous snowiest month was February 1913 when 20.5 inches of snow was observed. Blizzard conditions were reported in the Texas Panhandle and western Oklahoma for several hours, with visibilities reduced to less than 50 feet. Numerous roads, including interstate highways 40 and 27, were closed for several hours as crews were not able to keep roads clear due to the rapid rate of snowfall. Amarillo, Texas, received 19.0 inches of snow with winds of 75 miles per hour. Numerous snow records were broken or nearly broken for Amarillo — this was the third largest snow event for the city, the second largest calendar day snowfall of any date, and the largest single day snowfall during the month of
February. The strong winds and heavy snow resulted in snow drifts exceeding 10 feet in height. This storm also provided some drought relief to the areas where snow was observed.

A late-season snow storm moved from the Northern Plains to the Mid-Atlantic on March 4th-9th bringing snowfall from the Dakotas to East Coast. The storm originated as a fast-moving low pressure system from Canada, often referred to as a 'clipper'. The storm intensified into a Nor'easter as it moved off the East Coast. Locations in the Central Appalachians of the Virginias, as well as parts of New England, received over 20 inches of snowfall from the storm. Locations in seventeen states received at least 6 inches of snow. The storm also caused coastal flooding and erosion from Delaware to Maine as it moved along the coast. The large size of the storm, combined with strong winds, caused water to pile up along coastal regions resulting in high water levels. Several structures along the waterfront were lost in Massachusetts. The storm was rated a Category 2 ("Significant") storm on the Northeast Snowfall Impact Scale (NESIS).
A very active storm pattern, from the Central Rockies through the Northern Plains and into the Midwest, in combination with colder-than-average conditions, resulted in record snowfall totals during April. The two largest storms hit on April 9th-12th and April 13th-15th. The first storm system dropped heavy snowfall from Colorado to South Dakota. Rapid City, South Dakota received 22.4 inches of snow — the second most for any April storm in that city — and the 15 inches that fell on the 9th was the third highest single-day snowfall on record for the city. Areas just west of Denver, Colorado received nearly 2 feet of snow, and hundreds of flights were cancelled at Denver International Airport. The second storm, on the 13th-15th, hit the Northern Plains. In Bismarck, North Dakota 17.3 inches of snow fell on the 14th, breaking the record for most snowfall on any calendar day. All 350 miles of Interstate 94 passing through North Dakota were closed, as well as a large portion of the same highway in Minnesota.

Select April snow records

- **Duluth, Minnesota**: April snow total of 50.8 inches marked snowiest month of any month on record.
- **Rapid City, South Dakota**: April snow total of 43.1 inches marked snowiest month of any month on record.
- **Pierre, South Dakota**: April snow total of 20.8 inches, most on record for April.
- **Twin Cities, Minnesota**: April snow total of 17.9 inches marked 3rd snowiest April on record.
- **Fargo, North Dakota**: April snowfall total of 16.7 inches was the most monthly snowfall this winter season and 4th snowiest April on record.
- **Bismarck, North Dakota**:  
  - April 14th snowfall (17.3 inches) record snowfall for any date.
  - April 2013 monthly snowfall of 21.8 inches marked snowiest April on record.
A strong storm brought late-season snowfall on May 1st-3rd from the Rockies, through the Central Plains, and into the Mississippi River Valley. Locations as far south as Arkansas received measurable snowfall. Ahead of the storm system, temperatures surged into the mid and upper 80s in the Upper Midwest. Behind the system, cold Arctic air filtered into the central United States, allowing precipitation to fall mostly as snow. The cold, Arctic air broke temperature records for this late in the spring season. Denver, Colorado dipped to 19°F on May 2nd, tying the record coldest temperature observed during the month of May. The highest snowfall totals occurred across the Rockies and the Upper Midwest, where snowfall exceeded 20 inches in parts of Colorado and Wyoming as well as northern Wisconsin. Many locations in the storm's track broke daily, 2-day, and monthly snowfall totals during the event.

**Select snowfall records from the May 1st – 3rd, based on preliminary data from the National Weather Service:**

- **Eau Claire, WI:** 2-day snowfall of 9.3 inches on May 2nd – 3rd. This broke the 2-day snowfall record for May and exceeded the monthly average snowfall for the city.
- **Decatur, AR:** Storm total of 5.0 inches of snow. First snow ever observed in Arkansas during month of May and latest snowfall on record for the state.
- **St. Cloud, MN:** 2-day snowfall of 3.3 inches on May 2nd – 3rd was a record 2-day May snowfall.
- **Omaha, NE:** 2-day snowfall of 3.1 inches on May 1st–2nd was a record 2-day May snowfall and record monthly snowfall total.
- **Lincoln, NE:** 2-day snowfall of 2.7 inches on May 1st–2nd was the second largest May snow event.
- **Osage, IA:** Storm total snowfall of 13.0 inches. Highest May snowfall total for Iowa and first May snow storm to produce more than one foot of snow in the state.
- **Des Moines, IA**: Storm total snowfall of 6.9 inches was the largest May snowfall and a monthly record snowfall.
- **Kansas City, MO**: Trace of snow on May 3rd was the latest date of observed snowfall in the city.
- **Tulsa, OK**: Trace of snow on May 2nd was the latest date of observed snowfall and first snow observed in May.
- **Rochester, MN**: Storm total snowfall of 7 inches marked the largest May snowstorm for the city.
- **Twin Cities, MN**: 0.5 inch accumulated on May 3rd, the 8th highest daily snowfall for month of May.
- **Topeka, KS**: Trace snowfall on May 2nd, only 3rd occurrence of May snowfall.

On October 3rd–5th, an early-season blizzard hit the Northern Rockies and Plains, dropping up to three feet of snow in some locations. Wind gusts over 70 miles per hour were also reported, with 25,000 homes losing power. The Black Hills Regions of South Dakota received the heaviest snowfall. During the three-day event, Rapid City received 23.1 inches of snow, breaking the maximum 1-day snowfall total for the month of October, the October monthly snowfall record (previous record was 15.1 inches in 1919), and ranked as the second highest 3-day snowfall total for any month, behind the 25.6 inches that fell in April 1927. Casper, Wyoming received 16.2 inches of snow during the event, ranking as the 10th highest single-storm snowfall on record for the city and the most snowfall this early in the season. The largest impact from the storm was the loss of cattle. An estimated 20,000 head of cattle died during the storm. This early in the season, most cattle had not yet grown thick winter coats, making them susceptible to the cold, snow, and wind. The cattle loss accounted for approximately 15 to 20 percent of South Dakota's entire
cattle population. Warm and rainy conditions after the blizzard led to rapid snow melt, complicating the cleanup with fields and roads covered in mud. The storm received an initial rating of a Category 3, or Major Winter Storm, on the Regional Snowfall Impact (RSI) scale for the Northern Rockies and Plains region.

Tornadoes - Annual 2013
Issued: 15 January 2014

Annual Tornado Counts 1950-2013
Similar to 2012, tornado activity across the U.S. during 2013 was below average. During 2013, there were 742 confirmed tornadoes during the January–September period, with 149 preliminary tornado reports still pending for October–December according to NOAA’s Storm Prediction Center. This gives 2013 a preliminary tornado count of 891. Depending on the final confirmation rate, this could be the slowest tornado year since 1989 when 856 tornadoes were confirmed. The 1991-2010 annual tornado average is 1,253. Despite the below-average number of annual tornadoes, there were several large and destructive tornadoes and tornado outbreaks that led to significant damage and loss of life. There were 54 tornado-related fatalities and five severe weather and tornado outbreaks that resulted in at least one billion U.S. dollars in damage each.

The year started off with above-average tornado activity in January, when there were 75 confirmed tornadoes, well above the average of 35 for the month. February had a near-average tornado count, while the March tornado count was below average. Tornado activity remained below average during the climatologically most active time of year between April and July. However, several large tornado outbreaks did impact the U.S. during May, including the EF-5 tornado that hit Moore, Oklahoma. May was the deadliest tornado month of the year, with 41 reported tornado-related fatalities. Above-average tornado activity returned in November when a large late-season tornado outbreak hit the Midwest, with over 70 tornadoes confirmed. The monthly average number of November tornadoes is 58.
On May 15th, over 18 tornadoes were reported across northern Texas, and one in central Oklahoma, as a cold front moved through the region. The tornado that hit Granby, Texas was rated an EF-4 with winds between 166 and 200 miles per hour and killed 6 people and left over 100 injured. Over 200 homes were destroyed in the town. Nearby in the town of Cleburne, an EF-3 tornado, that was nearly a mile wide, destroyed numerous homes and left 7 people injured. Damage from this tornado was so extensive, a state of emergency was declared. The deadly tornado outbreak came on the heels of a relatively quiet tornado period over the last 12 months in the United States. The last time 6 or more fatalities were reported during a tornado was in April 2012. The Granby tornado was the deadliest tornado for the state of Texas since April 2007.

A massive, deadly, and historic tornado outbreak impacted the Central and Southern Plains between May 18th-20th. The severe weather was associated with a cut-off low pressure system and strong cold front that moved from the Colorado Front Range into the Great Plains. Ahead of the front, warm, moist, and unstable conditions filtered into the region. The front provided the necessary wind shear in the lower atmosphere for the storms that did spawn to begin rotating, with several of these super cell thunderstorms producing devastating tornadoes. On the 18th, there were 16 tornadoes reported across Kansas and Nebraska. On the 19th, there were 29 preliminary tornado reports in six states from Oklahoma to Illinois. An EF-2 tornado hit Harper County, Kansas, to the southwest of Wichita. At least 6 tornadoes were confirmed in central
Oklahoma, where an EF-4 hit near Shawnee, an EF-3 hit near Luther, and an EF-2 hit near Prague. The EF-4 tornado caused at least two fatalities in Pottawatomie County, Oklahoma.

On May 20th, there were 32 tornadoes reported, mostly in Oklahoma, Arkansas, and Missouri. The most devastating tornado of the three-day outbreak hit Moore, Oklahoma. The EF-5 tornado tracked 17 miles through the towns of Newcastle and Moore, and had a maximum width of 1.3 miles. Maximum winds were estimated at over 200 miles per hour. The tornado resulted in at least 2 fatalities. Thousands of homes, as well as businesses, hospitals, and schools were completely destroyed. Loss of life might have been much higher, but the 15-minute-plus lead time of the tornado warnings issued by the National Weather Service allowed people to attempt to prepare for the storm. This was the first observed EF-5 tornado in the U.S. since May 24, 2011, and only the 59th confirmed EF-5 (or F-5 prior to 2007) tornado in the 1950-present record. Damage from the storm is estimated to be in the billions of U.S. dollars and will rival the costliest tornado in U.S. history which hit Joplin, Missouri in May 2011. Moore was devastated by a tornado 14 years ago, when an F-5 tornado hit the town in May 1999 killing 36 people. The 1999 tornado caused over 1.1 billion U.S. dollars in damage. Additional information on the Moore, Oklahoma tornado is available in our supplemental information page, including 3-D animations of the storm, and through the National Weather Service.
On May 31st, a cold front moving through the Central and Southern Plains spawned severe weather from Oklahoma to Indiana. There were 30 preliminary reports of tornadoes in eight states. The hardest hit areas included the Oklahoma City Metro area, the St. Louis metro area, and locations north of Tulsa, Oklahoma. In the Oklahoma City area, three tornadoes were confirmed, including an EF-0 and EF-1 which hit part of Moore, Oklahoma. The deadliest tornado of the outbreak hit just west of Oklahoma City, in the town of El Reno. The EF-3 tornado was on the ground for 16.2 miles and had an estimated path width of 2.6 miles. The 2.6 miles width surpasses the Hallam, Nebraska tornado of May 2004 as the widest tornado on record for the United States and subsequently the world. The Hallam EF-4 tornado was 2.5 miles wide. Highways in the area had severe traffic congestion due to the rush hour commute, creating a very dangerous scenario. The tornado resulted in at least nine fatalities, seven of which were in automobiles. The fatality count might have been higher, but the tornado hit a relatively sparsely populated area on the south side of El Reno.
On November 17th, a powerful low pressure system moving through the Plains transported warm and moist air northward into the Midwest and Ohio River Valley. Temperatures reached into the 70s (degrees F) ahead of the associated cold front, creating unstable conditions across the region. There were over 70 tornadoes reported during the day. Severe weather, including strong winds and large hail were also reported across portions of the Northeast during the event. An unusual aspect of this outbreak was how far north it occurred during November. Typically this time of year, conditions are unfavorable for tornado outbreaks in the Midwest, with the Southeast and Gulf Coast states experiencing the most November tornadoes. In Indiana, there 28 confirmed tornadoes, marking the third busiest tornado day on record for the state, and the largest November outbreak in state history. In Illinois, 25 tornadoes were confirmed, the fourth most for any day on record and the largest November outbreak to impact the state. Fourteen of the tornadoes to hit Illinois were rated EF-2 or stronger, the second most for any day in the state, behind December 18, 1957. There were six reported fatalities during the outbreak, associated with three different tornadoes, all in Illinois. An EF-4 tornado hit near New Minden, Illinois and killed two people and injured another two. An EF-3 tornado, which formed north of Paducah, Kentucky, was on the ground for 42 miles, with a maximum path width of 500 yards and winds of 145 mph. This tornado killed 3 people in Massac County, Illinois. The third fatal tornado occurred near Washington, Illinois. The EF-4 tornado had winds of 190 mph, a path length of 46.2 miles, and a maximum width of over 800 yards. This tornado was responsible for one fatality and over 120 injuries.
2013 National and Regional Center Summaries
National Water and Climate Center Overview
The National Water and Climate Center (NWCC) is part of the Natural Resources Conservation Service (NRCS) within the United States Department of Agriculture (USDA). The Center's mission is to “lead the development and transfer of water and climate information and technology that support natural resource conservation.” A primary goal of the NWCC is to be “a globally recognized source for quality snow, water and climate information and technology.”

The Center’s Snow Survey and Water Supply Forecasting (SSWSF) Program provides water and climate information and technology support for natural resource management in 12 western states (Alaska, Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington and Wyoming). Since its inception in the 1935, the Program has grown into a network of over 1160 manually-measured snow courses and 885 automated Snow Telemetry (SNOTEL) sites. The Program provides streamflow forecasts for 632 points in the West.

The Center also operates the Soil Climate Analysis Network (SCAN) project. Started in 1991, SCAN is a comprehensive, nationwide soil moisture and climate information system comprised of over 200 stations. It is designed to provide data to support natural resource assessments and conservation activities.

Staff
The NWCC is organized into three branches under the Center’s Director, Mike Strobel. Team leads are Cara McCarthy (acting), Water and Climate Services; Tony Tolsdorf, Water and Climate Monitoring; and Laurel Grimsted, Information Systems. The staff includes forecast and modeling hydrologists, database administrators, and technicians who support the centralized Electronics Maintenance Facility.

The Center also provides climate services for the NRCS and other cooperating USDA agencies. This function is under the supervision of the Center Director. Key staff members are:

- Jan Curtis, Meteorologist and Applied Climatologist
- Open, Natural Resources Specialist

NWCC Participating in Regional Climate Hubs
In February, USDA Secretary Vilsack announced the formation of seven Regional Climate Hubs. The goal of the Hubs is to deliver science-based information to farmers, ranchers and forest landowners to help them adapt to climate change and weather variability. The Hubs will build capacity within USDA to provide information and guidance on technologies and risk management practices at regional and local scales.
NWCC Director, Mike Strobel, is a Co-Director for the Pacific Northwest Regional Climate Hub. “This is a great opportunity to take relevant research on climate change and put it into the hands of those people who manage our land resources. Providing tools and training on how to adapt practices and operations to meet changing climate trends and increased variability will assist producers in making good decisions on resource management.”

Examples of climate and weather impacts the Pacific Northwest team is examining include: reduced snowmelt, more frequent wildfires, and higher temperatures and drought.

SCAN and the “Network of Networks”
Mike Strobel is working with the National Integrated Drought Information System (NIDIS) group to produce an evaluation of existing and available soil moisture networks that can be coordinated into a single, national network. SCAN provides a framework for linking soil moisture to detailed soil classifications and in the operation of a nationwide network. Using SCAN and other networks, a set of standards and specifications will be established for providing consistency between networks so that shared data will have similar depths, parameters and data formats.

Report Generator Data Retrieval Tool
In March, NWCC introduced a new version of the Report Generator data retrieval tool to integrate data and interpret them dynamically. Report Generator is a web-based tool that allows users to create custom reports using NRCS and external data sources.

The tool uses long-term snowpack, precipitation, reservoir, streamflow and soils data from a variety of quality-controlled sources to create reports. Data from tabular reports may be exported to different sources, including comma-separated value (csv) files or Excel spreadsheets. Charts can be saved to Adobe pdf or graphic formats.
Spatial Climate Services
The NWCC coordinates and manages datasets produced in cooperation with Oregon State University’s PRISM Climate Group. This cooperative effort produces spatially-distributed precipitation and temperature data at 800-meter resolution for the entire United States and its possessions. These data are used in the Conservation Toolkit, the Conservation Effects Assessment Project (CEAP) evaluations and programs, animal waste analysis programs, wetlands evaluations and mitigation, as well as direct input to conservation planning and evaluations.

To meet the need for a near real-time data quality control (QC) system, the PRISM group is finalizing development of an improved, operational system for the SNOTEL network called First Look. The system components in this two-year project include: (1) Operational single-station QC checks, (2) In-situ SNOTEL checks, such as comparing snow-water equivalent (SWE) to precipitation, and (3) Correlation-based spatial QC checks. A map-based web portal will allow NRCS data editors access to the final QC values and flags.

Connecting NWCC to Customers
As part of its outreach activities, NWCC is now sharing information with customers via various social media outlets. The GovDelivery system allows NWCC to reach targeted audiences with topic-specific bulletins related to water supply and drought monitoring activities. Weekly bulletins currently reach over 7,500 subscribers. The NRCS YouTube channel features monthly videos on streamflow forecasts for the western states, and the Twitter feed provides up-to-date water supply information to followers.

SnowNews, the quarterly newsletter of the NWCC, continues to be a popular publication. It highlights recent activities at the Center and in the Program, and introduces new projects, products and resources.
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 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. There are currently 9 full time employees at the Center, 2 undergraduate interns, and 2 graduate students (Ph.D.)

**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. Each month, the center receives hundreds of customer contacts. These contacts include applications such as engineering, legal, insurance, media, education, transportation, agricultural and other decision-makers. Key service activities include:

- a collection of a *quality set of near-real time data* for decision making situations
- development of a *framework for climate data distribution and management (ACIS)*, in conjunction with other Regional Climate Center staff (rcc.acis.org)
- 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
- development of a framework to *evaluate the impacts associated with climate events* (cir-exp.unl.edu).

**Regional Mesonet**
Through collaboration with state partners, the HPRCC maintains a network of more than 200 weather stations across a ten-state area 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. 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 drought monitoring and assessment and to meet the
water accounting requirements regarding waters of the North Platte (Supreme Court Decree) and
Republican Rivers (interstate Compact). Several crop decision aids utilize the AWDN data and
irrigation scheduling tools have been developed in-house. The Center maintains hundreds of
subscribers accessing AWDN information online in customized reports of raw and/or
summarized weather data. The HPRCC has partnered with the UNL Department of Agronomy
and Horticulture to develop SoyWater – a crop water use tool for soybean growers
(www.hprcc3.unl.edu/soywater/). This tool makes use of the many AWDN stations across
Nebraska in a real-time and user-defined environment. A new project is underway to add corn
water use to this tool, termed CornSoyWater.

Applied Climate Research
Staff at HPRCC have authored or co-authored a total of 34 peer-reviewed journal articles and
reports since 2009. Topics for these papers are wide ranging, and include: data quality control
techniques, climate variability, soil moisture, evapotranspiration, and land use influence on
climate trends. More about our research can be found at: http://www.hprcc.unl.edu/research.php.
There are currently two Ph.D. students studying under the direction of Dr. Shulski. Topics
include winter season severity in the Central Plains, and corn production and recent climate
trends in the U.S.

The Center is part of a large research team in the North Central U.S. investigating the influence
of a variable and changing climate on regional corn production – termed Useful to Usable:
Transforming Climate Variability and Change Information for Cereal Crop Producers
(agclimate4u.org). The USDA funds are being utilized to develop decision support tools based
on user need. HPRCC has a long-standing collaboration with the National Drought Mitigation
Center (NDMC). The two centers, along with UNL Extension service, are engaged in the EPA-
funded Climate Masters of Nebraska project. Similar in nature to the Master Gardener program,
it is an adult education program developed to teach participants about climate change and
understanding their carbon footprint (climatemasters.unl.edu). The Center also collaborated with
the NDMC on their new Drought Risk Atlas project, providing serially complete data for the
contiguous U.S. (droughtatlas.unl.edu).

Community Engagement
HPRCC is actively engaged in various types of outreach activities across the region. Staff
provides classroom visits around the area, which teach students about weather and climate.
Hands-on guides have been developed to learn how to build weather instruments and observe the
weather. Additionally, HPRCC attends and presents at local and regional hands-on educational
events, including such venues as severe weather symposia, ‘NaturePalooza Nebraska’, and
‘Dinosaurs and Disasters’.

The HPRCC hosts an annual workshop on Regional Climate Services and invites regional
climate partners, including state climatologists, National Weather Service, National Drought
Mitigation Center, North Central Climate Science Center, Northern Plains USDA Climate Hub,
and University Extension. The 2013 workshop took place in Nebraska City, NE in September.
HPRCC has participated in the NOAA/NIDIS-led tribal engagement training in the Missouri
Basin states. Workshops have occurred around the region over the past two years and this
opportunity gives staff interactions with local tribes to learn about specific needs and interests. The Center also participates in events such as the American Indian Alaska Native Climate Change Working Group and the Institute for Tribal Environmental Professionals workshops. Most recently, the Center has worked with Nebraska Indian Community College for K-16 educational outreach.
State Climate Office 2013 Summaries
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.

2013 Conditions
Since October 2010, the AOSC has been posting a monthly summary of climate information which includes information from many sources such as NCDC, CoCoRAHS, AOSC and newsreports. http://nsstc.uah.edu/alclimatereport/. Responses from stakeholders have been universally positive. We now have done so for a third entire year of 2013 and this has increased our exposure, particularly with the in-state media as many stories have followed from these postings.

Of key interest are the stories that are included about specific events or features from the past. Also popular is the listing of all record events (though this is a little misleading as we note because some of the NOAA period-of-records are shorter than is actually the case, so “records” tend to occur more frequently than in reality.) Moisture indices are important as we experienced drought, especially in the southern portion of the state for much of the year.

For the second year in a row, severe weather (tornadoes and hurricanes) was scarce. Drought conditions were not severe either. The most unusual feature of the climate of 2013 was the very cool and wet summer that followed a modestly cool spring. Several records for monthly rainfall were established. For the state as a whole, not one station recorded a daily high of 100°F – only the sixth time of this occurrence (all being in the last 50 years.)

Drought Monitor
While there had been an informal collaboration-of-opportunity when preparing the Alabama drought level lines of the Drought Monitor each week, but in 2012 we continued to formalize a state-wide process, and in 2013 a bill was introduced to the state legislature to codify the procedure (did not make it through the session this year). On Monday a.m., the SC emails all entities involved in drought monitoring and impacts at the four NWS offices, the State Office of Water Resources, other state agencies, industry and municipal users with a preliminary assessment. Through the day on Monday and morning of Tuesday, information is passed among
the players and by Tuesday afternoon the SC sends to the DM our consensus recommendations. This centrally-planned process has helped greatly in expressing the best recommendations we can generate. A bill is being considered in the state legislature this year that will codify the Drought Monitor procedure and identify the State Climatologist as a formal position in State Government.

**Historical Climate Network upgrades**
Due to NOAA budget cuts, there is considerable uncertainty about the continued funding of the operation and maintenance of the 17 Regional Climate Reference Network stations in Alabama. One (Guntersville) was removed in 2013 as the owner sold the land to a development. At this time, I am trying to put together enough funding to pay for the operations and maintenance for FY15.

**CoCoRaHS**
On 1 November 2007, Alabama became an official member of the CoCoRaHS network. As of 12 Mar 2009 there were 670 stations registered, as of 16 Apr 2014 there were 907, an increase of 34 over the same date last year. 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.

**AWEP Program 2013**
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. In 2010, the project began and there are now some completed projects as a result of this effort. The photo above depicts one of the first ponds to be completed under the AWEP program located in Madison County on the Bragg Farm with Richard McNider (former SC), Dennis Bragg and the current SC. The Farm Bill of 2014 includes further AWEP funding.

**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 heavily involved in the agricultural community by assessing water resources and the potential for irrigation expansion. In 2012 and 2013 bills initiated by our efforts to enhance irrigation opportunities with tax credits was passed by the state legislature and signed by the governor. Dr. Richard T. McNider of UAH, who was the lead scientist on the project and former State Climatologist, is pictured below to the right of the Governor with the current State Climatologist looking over his shoulder at the signing ceremony.
In 2013 an analysis was performed of the success of the program. In two independent studies, it was shown that 156 farming operations took advantage of the program costing the state $719,000 in lost tax revenue. However, through the enhanced economic activity, this loss was recovered in the first year. By the 20th year the state tax receipts will recover between $9 and $15 million dollars for a return on investment of over ten to one.

Various economic interests contacted the AOSC in 2013 or information and speaking engagements related to climate change legislation. The SC has appeared before the U.S. Congress at hearings on energy and climate (photo at right before the U.S. House Science Committee, 11 Dec 2013). The SC also appeared before state legal hearings (in and out of Alabama) on various climate issues as states struggle with legislation on carbon emissions. 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 that produces more electricity than it consumes, exporting over 61 million MW-hrs (30%) out of state in 2010. Contrast this export activity versus a state such as California which is dependent on imports of 55 million MW-hrs of electrical power. This export “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 and state testimony in 2013, for the development of policy.

http://vortex.nsstc.uah.edu/aosc
Annual 2014 Report for the Alaska State Climate Center

Peter Q. Olsson, Alaska State Climatologist
The Alaska State Climate Center (ASCC) is co-located with the Alaska Experimental Forecast Facility (AEFF) at the University of Alaska Anchorage (UAA) at Merrill Field in Anchorage, Alaska. Peter Olsson is the State Climatologist at the former and Chief Scientist at the latter facility. This co-location was accomplished in 2011 in part as a cost sharing measure, but also as an acknowledgment that the ASCC and AEFF missions have a very significant overlap.

1.0 The ASCC Mission
The ASCC mission as defined by UAA is largely one of service to the community. However, interests of the ASCC and AEFF frequently overlap, merge, and then become projects where both entities are involved. Being a state-funded entity (by Alaska Statute Law), the ASCC makes an effort to maintain neutrality on issues of climate change, while simultaneously remaining consistent with our current knowledge of climate science. This can at times be a difficult path to tread. Also, the ASCC no longer charges for services, including data certification. Past experience has shown that the labor cost of maintaining a charge-back system and dealing with various forms of payment within university constraints was a losing proposition. Also, free certification of data helps to keep the SC from being subpoenaed to testify about data provenance. Staying out of court is a good thing!

2.0 Data Provision
One of the chief functions of the ASCC is climate data provision to a wide variety of clients (you know the usual suspects). In 2004, when the ASCC rose as a phoenix from the ashes, data product requests—mostly CDs and LCDs—were hardcopy, often distributed via fax. (We no longer accept requests or deliver data via fax.) With the pervasive availability of internet access and use of search engines, many common data needs are met by savvy would-be clients without our intervention. However, since the Anchorage NWS forecast office’s phone menu contact for past weather data is the ASCC, we still have considerable, if brief, contact with clients that essentially need LCDs. GHCN data is apparently harder to discover and acquire from NCDC; about 25% of the hundred-odd data requests the ASCC receives each year end up being satisfied by GHCND data provided by ASCC staff.

Alaska is unfortunately a fairly observation-sparse region. It is common to receive requests site-specific for observational data that do not exist. (It is not uncommon in Alaska for areas of up to 10,000 km2 to have no robust observations.) The answer “there is no data” is acceptable for a few clients, but most want something they can use. This triggers a higher level of involvement by ASCC staff. We typically go through assessments of 1) what clients think they need, 2) what we think they probably really need, and, 3) what data sets are available that most closely fit their needs and are most proximal to their location.

Once we get some convergence on these three issues, we then provide both data (if it comes to that) and an honest assessment of the appropriateness/applicability of available data. For example, an automated NDBC C-MAN coastal observation is probably not going to provide useful guidance for conditions on the side of a volcano at 3000 m elevation, even if it is only 50
km away. (An all-too-common issue we deal with is helping clients understand that vertical proximity is often more important than horizontal proximity.)

Iterations of this can evolve into a very protracted process, especially if the client is a researcher, and modifies his/her research questions, based on the data assessment and the recommendations of the ASCC. The SC also provides certification for certain climate records. During the past year 10 requests for certified data were filled.

2.1 Project Involvement
Occasionally, during the data inquiry and determination process, the ASCC becomes more involved as the need for direct climatological/meteorological expertise in the project becomes apparent. Actual manhours of commitment to a given project varies from project to project. Some projects just need to get launched, and others need an ongoing involvement. Determining which projects to take on depends largely on overlap with existing ASCC/AEFF efforts. (Clearly, the mesoscale climatological predisposition of the State Climatologist is a factor here as well.)

• Forecasting spring escapement of Chinook Salmon into the Yukon River using large-scale historical wind, temperature, and sea-ice coverage data.
• Studying the occurrence of ice falls and ice avalanches on volcanoes in the Aleutian/Alaska Range.
• Understanding the dynamics of wind events in southcentral coastal Alaska river valleys that give rise to cold-season dust storms and associated air pollution events.
• Local wind regimes in the Port of Valdez (Prince William Sound) that impact risk of spills during crude-oil transfer onto oil supertankers at the Trans-Alaska Pipeline Terminal.
• Using climatological wind statistics to assess the possibility of fugitive dust transport in relation to proposed coal strip-mining projects.

For some of the above-listed projects, ASCC involvement will probably be ongoing for some years to come.

2.2 Internal Projects
In addition to the projects listed in Section 2.1, the ASCC has internal projects: collaborations with other UAA researchers planned from the ground up to have major involvement of the ASSC.

• Cold-season surface-based temperature inversions are ubiquitous in Alaska, especially in the Interior. While less common in the North Gulf of Alaska (NGOA) coastal regions with marine airmass influence, they are pervasive in the river valley floors. This is significant because many Alaskans live on these valley floors and are strongly affected by temperatures frequently 10° to 15° C colder than valley-side locations only 150 m higher than the valley floor. This past cold season, the ASCC started an ongoing multi-year investigation into this phenomenon. Eagle River Valley, a smaller glacier river valley (and home to the State Climatologist) was instrumented with Hobo temperature data loggers along a transverse cross-section at 10 m elevation intervals, with measurements every 5 minutes. This results in a high-resolution (in both elevation and time) data set that will provide information on instantaneous inversion strength and inversion depth.
and the time evolution of these quantities. Besides providing insights into the “shaded valley” situation, it will also help provide guidance on how to extrapolate Alaska’s climatological temperature record, much of which comes from valley-bottom locations.

• The researchers affiliated with UAA School of Engineering and the ASCC are embarking on a project to provide an upgraded study of snowload calculations to be implemented structural design. The last snowload document for Alaska—still being used by many engineers—was produced by the ASCC in the 1970s and is known to contain computational errors. The current plan is to use historical snowdepth data at as many sites as possible and compute engineering snowload factors for a variety of sites (~100) across the state.

3.0 Outreach
Probably much of what the ASCC does can be considered outreach in some form or another. The ASCC maintains (though not as frequently as we should) an ASCC website: http://climate.uaa.alaska.edu which has information on links to NCDC and National Data Buoy Center (NDBC) data sources.

• The SC gives guest lectures in a formal setting to various graduate and undergraduate classes at UAA about high-latitude mesoscale climate, subarctic and arctic climate change, and climate modeling (uses and misuses).
• Additionally, the SC gives talks in community forums and other less formal settings about disparate issues such as the state of climate modeling, the processes of dust storm formation, climatology in mountainous regions, glacial recession, and the role of radiation in high-latitude climate.
• The SC occasionally appears on television to comment on issues, such as how the recent NAS report pertains to Alaska.
• The ASCC worked with Televisio Brazilio (roughly equivalent to PBS) this last winter on an hour-long Portuguese-language special investigating high-latitude climate change. The program was aired in Brazil. Much—though not all—of the 30-minute interview ended up on the cutting room floor.
• By commission of the Prince William Sound (PWS) Citizens Advisory Council, the ASSC/AEFF is developing a series of white papers discussing weather phenomena in PWS: winds, cloudiness, and temperature. Included in these papers are detailed climate analyses for the four sites in PWS that have a long(ish)-term and fairly complete climate record.
The Alaska Climate Research Center (ACRC) is part of the Geophysical Institute, University of Alaska, Fairbanks. It was established by the State of Alaska via Title 14, Chapter 40, Section 085. Specific information can be found in this statute.

KEY PERSONNEL:
Gerd Wendler, Director, Professor Emeritus
Martin Stuefer, Assistant Director, Associate Professor
Kevin Galloway, Webmaster
Blake Moore, Programmer

PURPOSE:
The purpose of the center is threefold:
- Dissemination of climatological data (free of charge)
- Research on climate variability and climate change in Alaska and Polar Regions, and
- Education

Dissemination:
For nearly three decades we have made climatological data available to the public, research organizations and interested industries. Today this is mostly accomplished via our website (http://akclimate.org/) which received in 2013 over 200,000 unique visitors. On a daily basis we receive on average 6000 visits. Analyzing by domain, “net” is the most frequent source of visitors, followed by “edu”. From the international realm France was as in 2013 the country most interested in our data. Over the course of a year, winter is the busiest season, probably due to the fact that frequently very cold temperatures (down to -40°F and colder) occur paired with ice fog, which makes driving difficult, if not dangerous.

In May 2013 we migrated our website to a new system, allowing for more ease in navigation and maintenance. This change impacted how we calculate our website statistics. In 2013 we had 583700 visits to our website, compared to 628945 in 2012. Some of this trend may be due to the increase in mobile browsing, which is our next step in sharing our climate work.

The ACRC website contains many summaries, products, meteorological and climatological information. Furthermore, from our home page, users can select any number of links: Fairbanks weather and climate, our popular webcam and on--- campus weather station, climatological data, up---to---date summaries, Alaska weather, information for tourists, seasonal and other weather and climate links, and a ‘spotlight on climate’ section giving a list of the latest features posted.

Specific requests of data, normally received online, by telephone, and sometimes by walk---ins, are filled free of charge. It should be noted that we do not make predictions on future climate change, nor assess the socio---economic and biophysical impacts of such predicted climate projections. Our focus is on observations.
On our website we publish monthly and annual reviews of the observed climate, and in conjunction with ACCAP (https://accap.uaf.edu/) we supply a seasonal review. As an example we discuss here shortly a summary of the climate of 2013 for Alaska; more details can be seen from our website.

The mean average annual temperature in 2013 was 33.8°F, a slight positive departure of 0.7°F from the 30--year normal of 32.9°F. This is in stark contrast to the previous year, when Alaska was substantially below normal with a deviation of -2.9°F. Barrow in Northern Alaska was relatively the warmest with a deviation of +2.6°F, continuing the trend of warming observed in Arctic Alaska over the last decades, while the largest negative deviation was observed at St. Paul Island with a modest -1.0°F, continuing the cooling trend observed for the Bering Sea (Wendler, Chen and Moore 2012). The following Figure 1 gives the temperature deviations from the mean (1981-2010) for 2013.

![Figure 1: Isoplete presentation of the temperatures deviations from the normal (1981---2010) for 2013 based on all first order Alaskan meteorological stations.](image)

It is interesting to note that the strong decrease in sea ice in the Beaufort and Chukchi Seas affected most strongly the autumn temperatures, with monthly temperature deviations of 7.5°F and 6.8°F, respectively, for October and November at Barrow. In summary, most of Alaska was above normal for 2013, which is in contrast to the two previous years, which had been too cold.

**RESEARCH:**
A substantial number of publications on the climate of Alaska and Polar Regions have been produced over the years. In 2013 we published one new journal article, namely:

L. Chen was the summer student, who worked with us the previous year. As the article appears also in an open access format, it can be downloaded from our website. Another paper, on the strong warming in Northern Alaska and increase of open water in the adjacent seas has been submitted. It is interesting insofar, that the sea ice extent in the Arctic Ocean showed a new absolute minimum in late summer of 2012. There are two additional articles concerning the climate of Alaska authored or co-authored by the ACRC’s Assistant Director, which were funded by different grants. They are:


EDUCATION:
As in previous years, we have been giving talks and seminars on the climate and observed climate change in Alaska and Polar Regions.
Office of the Arizona State Climatologist

Nancy J. Selover, PhD. State Climatologist
State Climate Office
School of Geographical Sciences & Urban Planning
Arizona State University
Tempe, Arizona 85287-1508
Email: selover@asu.edu
Phone: 480 965 6265
Fax: 480 965 1473
http://azclimate.asu.edu/

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. The office includes the State Climatologist, Dr. Nancy J. Selover, one part-time student worker, and two affiliated faculty in SGSUP (Drs. Anthony Brazel and Randall Cerveny). The office is now a core partner of the Center for Integrated Solutions to Climate Challenges, one of the eight Walton Sustainability Solutions Initiatives, within the Global Institute of Sustainability at ASU. Our mission is still 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.

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
We maintain an ASCO web page (http://azclimate.asu.edu/) to provide 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 for the Phoenix area, daily North American Monsoon updates (in summer), and links to climate education and safety information and other climate data resources. This year the website was hacked and the University dropped it off the University web-server. The scripting was changed from php and java to WordPress, reducing most of the real-time data updates to simple links to the weather data. The website was moved to the Global Institute of Sustainability webserver. Due to extensive delays in regenerating the website, it was only operational for 4 months of the year.

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 the forms available on the website, or from the State Climatologist contact information available through numerous links on the University website. The data are served back through the phone, fax, e-mail, postal service, or the Internet.

Information Services
In 2013 we continued to have most of our data requests through the e-mail resulting from the State Climate contact information available through the University or re-direct from the webpage. I have no statistics for the web hits as those data disappeared when the website was taken down. Data users, other than web downloads, include university researchers, state and
local government agencies, the public, private industry, the media, and an increasing number of requests from the legal community. We did 22 media interviews on drought, monsoon, extreme weather, climate change, extreme heat, AZ climate, water resources, urban heat island, wildfire, extreme cold, and the climate outlook, of which 7 were TV, 2 radio, 11 newspaper, 1 school project, and 1 Internet article, and we were involved in 35 legal cases as consultants or expert witnesses. The trend this year is an increase in e-mail and fewer phone data requests. This year we generated monthly summary products for temperature and precipitation records, and continued updating the Climate of Phoenix with current data. We produced monthly reports on drought for the Arizona Department of Water Resources webpage, climate summaries for State Climate Office website, AZ temperature and precipitation for State Climate Office website, AZ-NM temperature and precipitation for CLIMAS Southwest Climate Outlook publication, heating and cooling degree days for AZ Commerce Dept.

**Research**

DOC-NOAA – Co-PI on Evaluation of Drought Risks and its Impact on Agricultural Land and Water use to Support Adaptive Decision-making. PI = Soe Myint $300,000  
NASA – co-PI on Using Remote-Sensing to Understand the Impacts of Droughts on Agricultural Land Use and Water Consumption to Support Adaptive Decision-making in Arid Environments. PI = Soe Myint $199,953

**Outreach & Service**

- Climate Bootcamp – dissemination of the Southwest National Climate Assessment report draft and conducted a town hall on the assessment, as part of the draft review process.  
- Taught summer Weather Camp at the Arizona Science Center June 17-21, 2013. A 5-day hands-on weather class for 8-9th grade level. Co-teachers included Phoenix NWS MIC and WCM.  
- Co-Chair of Technical Monitoring Committee of State Drought Task Force  
- Recording Secretary of Arizona Flood Warning Multi-Agency Task Force  
- State Coordinator – CoCoRaHS – Community Collaborative Rain, Hail & Snow Network, citizen scientist precipitation observers.  
- Member of State Hazard Mitigation Plan Update team  
- Navajo Nation Hydro-meteorological Network Committee  
- Gila River Indian Community Hazard Mitigation plan team  
- Co-President Central Arizona Chapter of American Meteorological Society  
- Member of American Meteorological Society Applied Climatology Committee – planning of January 2014 Applied Climatology Conference  
- Member of WERA1012 – a planning committee within the Western Association of Agricultural Experiment Station Directors, with the task of Managing and Utilizing Precipitation Observations from Volunteer Networks  
- **Marcus Fund for Physical Geography Award Committee – Association of American Geographers** – field research award for graduate/undergraduate students in hostile environments

Reviewer of papers, chapters, reports for the:  
- Climate Literacy and Energy Awareness Network – How cities affect climate paper
• Institute of Engineering & Technology Journal– Ambient air temperature and transformers paper
• AGU Journal – Learning about climate change paper
• CRC Press – Book Proposal – Climate change impacts and challenges at farm level paper

24 Presentations to Community and Educational Groups on drought, climate change, monsoon, UHI, water resources.
• AZ Climate Hazards – AZ Dept of Emergency Management quarterly training mtg - Feb 2013
• Southwest Climate & Climate Change – Fulbright Scholars – Feb 2013
• Arizona Climate Resources – Maricopa Community Colleges – Feb 2013
• Cultivating Green Infrastructure – Sustainable Cities Network – March 2013
• Climate Change Now – UHI – Chapman Conference on Communicating Climate Science June 2013
• Urban Heat Island – Arizona Geographic Alliance Teacher Workshop- June 2013
• Climate Change in AZ – American Planning Association – Arizona Chapter – Sept 2013
• Climate Change and the Home Insurance – LexisNexis – Sept 2013
• Climate Change & Drought in the SW – AZ Wildlife Biologists – Oct 2013
• Climate Change & GHG Emissions – Starwood Hotels Global Partners – Oct 2013
• Arizona Climate – Pima County Drought Impact Group – Pima County Public Works Dept. Nov

Monitoring and Impact Assessments
• Monitoring temperature and precipitation in the Petrified Forest National Park to inform park archaeologist as to weathering conditions for petroglyphs and other historical cultural assets.
• Prepare monthly statewide temperature and precipitation updates and calculation of watershed SPI for drought monitoring for the Governor’s Drought Task Force.
• 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.
• Statewide coordinator for CoCoRaHS precipitation monitoring in Arizona (829 observers).
• Maintenance of Arizona USRCRN climate stations to fill in for NOAA maintenance budget shortfall
• Translating and disseminating climate variability and urban heat island research for policy-makers in the cities and tribes in the Phoenix metropolitan area.
Office of the California State Climatologist

Office of the State Climatologist
Michael Anderson, State Climatologist
California Department of Water Resources
Division of Flood Management
3310 El Camino Ave Rm 200
Sacramento, CA  95821
Phone (916) 574-2830
http://www.climate.water.ca.gov
Email: Michael.L.Anderson@water.ca.gov

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), Western Regional Climate Center (WRCC), and the California Nevada Applications RISA, the OSC provides expertise and a growing range of climate services for California.

Work continued on many fronts over the past year. The top story however is the drought. For the past three years, California has received below average precipitation. Based on water year totals, individual years are unremarkable. However, during this three-year stretch conditions have been wetter than the wettest year early in the water year, the driest calendar year in 120 years has been recorded, and the lowest snowpack for the northern region of the state was achieved for the April 1 traditional peak for 2014. The State Climatologist serves on the Department of Water Resources’ drought management team which plays a leadership role in the State’s response to the drought. Updates of hydrologic conditions and expectations for the next water year are among the services provided by the State Climatologist.

One outcome of the recent drought is a newly formed bi-monthly meeting of representatives from each of the National Weather Service (NWS) Weather Forecast Offices, United States Drought Monitor authors, California and Nevada State Climatologists and the California Nevada River Forecast Center to discuss the California depiction in the Drought Monitor Product. Improved information sharing and coordination has resulted from this effort led by NWS employees.

The California State Climatologist is also partnering with the California Nevada Applications (CNAP) RISA and NOAA for a National Interagency Drought Information System (NIDIS) pilot project in California. Four activities are beginning focusing on different geographic areas of California: south-coastal urban, Klamath basin, Russian basin, and Central Valley. Anne Steinemann of the CNAP RISA is acting as the State coordinator of the projects. The projects are in their second year and look to develop new data serving methods tailored to each region’s specific needs. Two drought workshops were held in 2014 to identify information needs and opportunities for NIDIS and California. The California State Climatologist presented at both workshops and coordinates between DWR and the NIDIS Management Team.
A seasonal forecasting work group has also formed between representatives from the DWR and researchers associated with CNAP and NASA. Topics of discussion range from seasonal to water year forecasts and decadal scale variability.

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. In addition, four coastal atmospheric river observatories are scheduled to be installed. The first at Bodega Bay Marine Laboratory became operational in March of 2013. A new five year agreement is in place to evaluate the network and continue the development of decision support tools. A Center for Western Weather and Water Extremes has been set up at Scripps Institute of Oceanography to facilitate work in California and potential expansion across the Western United States.

California is now in year 6 of CoCoRaHS. Over 1,000 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 53 of California’s 58 counties. Approximately 11,000 reports are submitted per month from California’s CoCoRaHS volunteers. Observers from the Department of Water Resources Volunteer Climate Observing Network were invited to become members of CoCoRaHS as a way to continue submitting observations. The Department has decided to end its volunteer observing program due to lack of funds. A summary of CoCoRaHS activity is provided in the State Climatologist monthly summaries. A new National Weather Service State Coordinator came on board during the past year bringing renewed enthusiasm and energy to the group. A quarterly newsletter is now being produced by the new coordinator.

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 new Center for Western Weather and Water Extremes at Scripps Institute of Oceanography. Discussions were held on extremes and regional climate monitoring needs for resource management. The State Climatologist presented and participated in the meeting.

The State Climatologist has also been involved in the Department’s climate change matrix team, the Climate Change Technical Advisory Group, the FloodSafe’s Central Valley Hydrology Study and Central Valley Flood Protection Plan, the national Hydrologic Frequency Analysis Work Group and the National Climate Assessment water management indicators work group. The climate change matrix team meets quarterly to discuss all things climate change related to the Department. The Climate Change Technical Advisory Group is a collection of 15 agency, academic, and private practice personnel with expertise in climate change. The California State Climatologist is a permanent member on the committee while other seats are 3-year commitments. The group will provide input and feedback on climate change issues relevant 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. The climate change working group developed a threshold method to account for climate change in flood management.
planning. The document is available on the CVFPP website. The national Hydrologic Frequency Analysis Workgroup is a collection of agency, academic and private practice personnel who are investigating the possibility of updating the national flood frequency analysis guidelines. The National Climate Assessment water management work group is providing guidance for the NCA on the development of metrics for climate change that are appropriate for water management at the national scale.

The California State Climatologist also serves on the American Society of Civil Engineers Environmental Water Resources Institute’s Hydroclimate Committee which works to raise awareness of links between climate and water management and associated research. Symposia have been held at the past four World Water Congress meetings.

Work continues through the University of California Office of the President Climate Services Contract. Activity ranges from water year outlook workshops to modeling studies for flood management to field monitoring installation programs. The contract greatly expands the capabilities of project execution for the State Climate Office. The contract has been renewed for the 2014 to 2019 period.

Data serving for California climate data is undergoing a facelift with improvements being developed for data served on the California Data Exchange Center. This effort will continue over the next few years. Map-based products and tools are in development with the assistance of an external contractor. Collaborative work with NASA has produced a weekly satellite data product for snowpack tracking and continued research efforts by NASA to support water management in California. A workshop highlighting past work and to discuss future opportunities was held in Sacramento in March 2014.

Travel and presentations were prominent again this past year. Presentations and/or session moderating duties included meetings for the California Cooperative Snow Surveys Annual Meeting, and American Society of Civil Engineers Environmental Water Resources Institute World Water Congress. Out-of-state travel was limited this past year due to budget issues and will continue to be a challenge.

Looking ahead to the coming year, the California OSC plans to continue coordination of activities with the WRCC and the California Climate Data Archive, and continued 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. Efforts will likely focus on extremes due to the NIDIS pilot activities and continued investment in the FloodSAFE program.
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 Research, and Climate Services, the Center responds to many climate-related questions and challenges. The Center monitors climatic conditions on both broad, regional scales and very local scales using data gathered by public sources (National Weather Service, USDA, USDI etc.) but also by monitoring networks deployed by the Center. Data resources are combined to provide higher granularity and as much local detail as possible in a state with great topographic and climatic diversity. 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 2013 were:
1) Provide comprehensive climate monitoring for the Fort Collins campus weather station. 2013 marked the 125th year of continuous uninterrupted weather observations and climate monitoring on the campus of Colorado State University. Wendy Ryan produces a comprehensive well-publicized narrative and graphical climate summary on the first business day of each month. This local report tracks local climate anomalies and extremes affecting the university and the Fort Collins community.

2) Manage, maintain and enhance the Colorado Agricultural Meteorological Network (COAGMET) to provide timely local weather and climate information to support the Colorado agricultural industry. In a water short state like Colorado, an important focus of CoAgMet is on measuring detailed weather variables affecting variations in crop water use...
and evapotranspiration. Graphical analyses of seasonal accumulation of reference ET is now routinely incorporated into weekly drought monitoring activities. Soil moisture monitoring was added at several more stations in primarily dryland agricultural areas. CoAgMet data are incorporated in the Colorado ‘Hydrodatabase’ for input into the State’s river basin decision support systems. Customized ag decision support applications have been developed to automatically query nearest CoAgMet station data.

3) Coordinated climate monitoring, drought tracking and early warning: 2013 started very dry again over most of the state. Each time strong winds blew, major dust storms kicked up over SE Colorado reminiscent of those documented from the 1930s and 1950s droughts. Conditions then improved greatly during spring over north central Colorado with the help of a series of cold spring snowstorms. A return to hot, dry weather statewide in June led to several more catastrophic large wildfires and more dust storms. Higher humidity, lighter winds and more numerous thunderstorms in July and August gradually reduced the area of Colorado experiencing extreme or exceptional drought. Further improvement was noted in September when flooding rains hit parts of the state, but southeast Colorado continued to suffer with the driest consecutive 3-year period in recorded history.

4) Track the pulse of long-term climate trends and variations for 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. The Colorado Climate Trends website continues to serve this information in graphical and tabular formats for the best long-term observing sites in Colorado.

5) Document rainfall patterns associated with September flooding. Priorities were quickly adjusted when heavy rains up to 18-20” in 6 days fell over Boulder, Colorado and nearby areas of the Front Range. Subsequent flooding claimed 10 lives and caused damage upwards of $2 billion. A “Colorado 2013 Flood” website was quickly developed and an aggressive public-private data collection effort was pursued to assess and summarize rainfall patterns from this unusual storm. Data from over 2600 gauges were assembled, and the resulting rainfall maps represent what is likely the most comprehensive rainfall assessment for an extreme event in U.S. history. A comprehensive report on this storm event is forthcoming.

6) Engage the citizens of Colorado in backyard climate monitoring through the Community Collaborative Rain, Hail and Snow network (CoCoRaHS) and related activities. http://www.cocorahs.org Communications efforts to encourage existing volunteers, especially from rural areas were utilized to increase rainfall reporting in 2013. A targeted recruiting effort aimed at the Denver metro area (in particular, Aurora) paid off royally when very heavy rainfall developed September 9-15, 2013. In all, some 1150 rain gauge volunteers from Colorado alone provided backyard observations to help document timing and spatial extent of these heavy rains. CoCoRaHS also continued to grow in numbers and impact nationally helping document the local detail of rain and snow nationwide and in parts of Canada. Evapotranspiration monitoring via CoCoRaHS was expanded as well. Observer training and data quality control were also high priorities occupying staff time.

7) Broadly disseminate climatic information, expertise and applications, and assist others in applied climate research. The staff of the Colorado Climate Center continues to provide climate services – generally at no cost to any users requesting climate data and/or expertise. Weekly climate, water and drought assessments were conducted year-round. Climate Center staff participated in youth water festivals in all parts of the state, and participated in many meetings and conferences. Nearly 100 invited talks and presentation were given.
Publications:
Recent publications are available from the CCC’s web site at (http://ccc.atmos.colostate.edu/publications.php)

ARSCO Qualifications:
The Colorado Climate Center is designated by the AASC as the official state climate office for Colorado. The following section describes ways in which CCC addressed the ARSCO qualification requirements during the past year:

Communication Capabilities:
Communication and outreach are very high priorities for the Colorado Climate Center. The CCC website and links are a critical part but not our only communications capability. Webinars (live and archived) have become a routine means of communication. Climate, water and drought assessments were issued every week and conducted as public webinars on about half of the weeks of 2013. YouTube has been used more and more as a means of communication along with Facebook and Twitter. 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. Climate change was a common media topic, especially during and after the large fires and extreme floods of 2013. 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. CCC is one of the primary data providers to the Colorado Water Availability Task Force and State Flood Review Task Force providing year-round updates on water supplies and flood potential to state agencies.

Information Services:
Information services are central to the function of the Colorado Climate Center. Office staff responds to requests for climatic data and expertise. 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. An example of unique climate information services is 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. 2013 saw a return to more “average” values after the record breaking high ET rates of 2012. The Community Collaborative Rain, Hail and Snow network (CoCoRaHS), first started in 1998, is now a provider of climate information services on a national basis. Various precipitation summaries and raw data access make it very easy to track recent precipitation anywhere in the U.S. Many private and public entities access and use CoCoRaHS data to improve precipitation mapping and tracking.
Research:
Current and ongoing research at the Colorado Climate Center is focused in these areas.
1) Detection, interpretation and communication of the variability and trends observed in climate time series. This is ongoing work serving the mission of the Center and the needs of Colorado.
2) Drought monitoring and drought early warning. We lead a weekly intensive coordinated process that provides guidance to the U.S. Drought Monitor. Becky Bolinger (formerly Smith) continues PhD work on water balance and climate predictability over the Upper Colorado River Basin. Morgan Phillips completed and MS thesis modeling snow sublimation over the Upper Colorado. Peter Goble is beginning MS research exploring ways to better incorporate soil moisture data in drought monitoring and early warning. Much of this work is supported through the National Integrated Drought Information System (NIDIS)
3) Precipitation characteristics and statistical properties. The CoCoRaHS network continues to provide a large and growing data set for exploring precipitation characteristics. Current emphasis is in determining how much can be learned from a short period high density network compared to a low density long-term network in terms of precipitation frequencies and extreme events. Water balance research combining rainfall data with ET references is beginning. In 2013 we completed a project with the Colorado Water Institute examining factors affecting ground water levels and use in the South Platte River Basin. This research is supporting water policy and administration in the basin.
4) Weather Instrument intercomparisons. Thanks to the historic facilities available at the Fort Collins campus weather station, we maintain a number of ongoing studies instrument intercomparisons including snow sensors, rain gauges, and temperature measurement systems including comparisons of precipitation and temperature between NWS COOP stations and NOAA Climate Reference network stations.

Outreach:
Face-to-face climate information delivery has become a mainstay of the Colorado Climate Center. Activities ranging from webinars, school programs, field trips and guest lectures at various Colorado universities to AMS and NWS WeatherFests, Conservation District meetings and many workshops and professional conferences, we are reaching thousands with climate and water information each year. Here are some examples of meetings that we now participate in every year: Colorado Water Congress, the Colorado Foundation for Water Education, the Colorado Science Convention, the Colorado Farm Show, the South Platte Forum, the Arkansas Basin Water Forum, the Colorado Association of Conservations Districts, Four-States Irrigation conference, and the Upper Colorado River Water Forum.

The Community Collaborative Rain, Hail and Snow network (CoCoRaHS) http://www.cocorahs.org continues as a very large outreach effort through informal partnerships with other state climatologists and the National Weather Service. The network has approximately 19,000 active participants from all 50 states and 8 Canadian provinces who help measure and report precipitation from across the country. Hundreds of new volunteers are added every month. A similar number of people of all ages are not active data collectors but continue to receive our monthly e-newsletters. We continue to add new training and informational content via the CoCoRaHS YouTube channel: http://www.youtube.com/cocorahs/.
The Office of the Delaware State Climatologist (ODSC) is located within the College of Earth, Ocean, and Environment at the University of Delaware. The ODSC works in conjunction with the Delaware Environmental Observing System (DEOS), and the Delaware Environmental Monitoring and Analysis Center (DEMAC) to provide environmental data services to Delaware and the surrounding region.

The ODSC 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 via our web page (climate.udel.edu), as well as conduct newspaper, radio, and television interviews and give many public lectures. The ODSC also serves in the Technical Assistance Center of the Delaware Emergency Management Agency during critical weather events. The State Climatologist is also a statutory member of the Water Supply Coordinating Council (WSCC), and presents water related climate information at quarterly meetings. The following represent current initiatives of the ODSC.

**The Delaware Environmental Observing System (DEOS)**
The ODSC and DEOS continue to work together to develop real-time weather, climate and environmental data systems to meet the needs of a growing constituency. For over 10 years, DEOS has provided real-time environmental observations for Delaware and the surrounding region. Today, DEOS operates and maintains over 50 environmental monitoring platforms and aggregates and disseminates data from over 200 additional environmental sensing systems throughout our region. These data are used for a number of purposes including forecast model initialization, emergency management, coastal flood monitoring and irrigation scheduling to name just a few. DEOS monitoring and data services are utilized across many sectors throughout the Mid-Atlantic Region. ([http://www.deos.udel.edu](http://www.deos.udel.edu)).

Our core meteorological network has now grown to a total of 52 stations (45 installed and maintained by DEOS) located in the three counties of Delaware, Chester County in Pennsylvania (in cooperation with Chester County Emergency Management), and Cecil County in Maryland. Data from the core network and approximately 203 additional environmental observing platforms is collected, visualized, disseminated in real-time and archived by DEOS. The data collected by the core meteorological stations include air temperature, relative humidity, wind speed and direction, total solar radiation, atmospheric pressure, precipitation, and in many cases soil temperature and soil moisture. More than 28 of the core stations also measure snow depth (described more below). The additional 203 observing platforms observe other environmental...
variables including stream flow, tidal water level, water quality, groundwater well level, and ocean and bay characteristics (from buoy data).

**The Delaware Coastal Flood Monitoring Project**

Surrounded by the Delaware Bay, the Delaware River, and the Chesapeake Bay, the Delmarva Peninsula is very vulnerable to coastal storms. Much of the damage during tropical and extra-tropical weather events is associated with severe coastal flooding. The Delaware coastline is extremely susceptible to such events, examples being the great March, 1962 storm and post-tropical cyclone Sandy.

The Delaware Coastal Flood Monitoring System (CFMS) extends along the Delaware coastline from Lewes, DE to New Castle, DE and was used during several nor’easters in 2013 and 2014 ([www.coastal-flood.udel.edu](http://www.coastal-flood.udel.edu)). The system sends a warning of forecast tidal levels to users via the DEOS Alerts System, directs them to the CFMS web site where all information on the coming event is available. The CFMS website provides the user with a map showing the potential coastal inundation for the upcoming storm for 15 communities along the Delaware Bay shoreline, as well as road elevation profiles of key evacuation routes relative to the predicted inundation level. Also provided on the CFMS website are links to forecast and warning products from the National Weather Service and real-time conditions from local and federal stream gauges, tide gauges, weather stations, and wave buoys important to Delaware.

**The DEOS Snow Monitoring Network**

DEOS supports the Delaware Department of Transportation (DelDOT) Snow Removal Reimbursement Program with at least one snow depth measurement in each of the 12 transportation maintenance areas statewide. The three northernmost areas include three snow depth monitoring systems and the southern districts have varying numbers resulting in 26 operational snow monitoring stations across the State (additional snow research sites are also contained within the network). Sonic ranging depth sensors are installed at each location during October through April. Storm total snowfall is available in real-time and archived on the DEOS snow monitoring website. The 2013-2014 snow season resulted in $2.7 million being reimbursed to civic associations throughout Delaware. This money helps defray to snow removal costs of neighborhoods and developments and expedites the snow removal process, particularly during major snowstorms. In addition, the snow monitoring network’s data are used operationally by DelDOT to deploy snow plows and other snow removal equipment within each maintenance area during an event. This snow season cost the State of Delaware Department of Transportation over $17
million, including snow removal reimbursement costs noted above. Thus the DEOS snow monitoring network is an extremely valuable resource for the state.

The Delaware Irrigation Management System (DIMS)
DIMS serves as an irrigation scheduling tool for the agricultural community of Delaware. It uses daily meteorological data from the DEOS network to obtain reference evapotranspiration and rainfall that are used to calculate crop water requirements for user-defined farm fields. DIMS provides a user interface where growers can enter their field specific information (i.e., crop type, field location, planting date, etc.) and using that information, DIMS automatically determines the NRCS soil texture classification and nearest DEOS meteorological station for each field. Crop water requirements are updated daily and allow users to enter their own irrigation and rainfall data to make the system provide more accurate results. DIMS was launched in Spring 2012 for use with corn, soybean, and several vegetable crops and is currently used for over 100 center pivot irrigation systems statewide.

The Delaware Community Collaborative Rain, Hail, and Snow (CoCoRaHS) Network
The State of Delaware transitioned from the DEOS Environmental Monitors Program (DEMs), and joined CoCoRaHS on September 1, 2009. Kevin Brinson, Associate State Climatologist, serves as the CoCoRaHS coordinator for the state. Presently, the state is homogeneously covered by about 31 active observers.

Additional State Sponsored Research Projects
The ODSC is currently involved in State funded research projects to develop a new Coastal Storm Severity Index for the Mid-Atlantic region, to compile a high water mark database and reporting system for coastal flooding events in Delaware, and to develop a web portal to disseminate climate change projections and climate data for Delaware.
Role
The Office of the Georgia State Climatologist within the Environmental Protection Division functions to collect, disseminate, and interpret climatological and meteorological data. It daily serves the State in responding to public and private entities on issues related to Georgia’s climate, as well as offering correspondence with educational institutions as it relates to atmospheric science. An important role of the climate office is to stay apprised of current meteorological patterns and atmospheric conditions as it relates to (but not limited to) droughts, the ENSO (El Nino-Southern Oscillation) forecast, and the short, middle, and long-term seasonal outlooks. In addition, the office internally produces composite maps containing climatological information, such as precipitation and temperature.

Information Services
The GA EPD climate website contains monthly summaries, meteorological and climatological data resources, and other useful links for public dissemination of information. Specific requests for climatological information and data are frequently received from media, private and public sources and addressed on an ongoing basis. The Georgia SC monitors climate conditions within the state and provides input on drought and their impacts to the U.S. Drought Monitor.

Data Product Development
The Georgia Climate Office is currently increasing our available data products. Sean Miller successfully generated a GIS display tool for viewing of climate information across the state of Georgia and the Southeast U.S. These plots encompass a number of climate related parameters, including mean temperatures and anomalies, rainfall amounts and departures, stream flows, archived storm reports, and other specialty plots for high impact weather and climate events affecting Georgia. Many of these products are utilized to provide weekly input from the state on the US Drought Monitor. Our future goals are to include as many of these plots as possible on the SCO website such that members of the public will have access to these data.

Outreach
The State of Georgia Climate office upholds an outreach focus. The office maintains very open communication with news media outlets across the entire state. Data and analyses are disseminated via the internet, email, telephone, regular mail and in person through interviews and presentations. Staff participate, to the extent possible within staffing and budget limits, in as many outreach efforts as possible. These outreach efforts range from elementary school presentations, children 4-H programs, guest lectures at various Georgia universities and participation on climate-related discussion panels. The Climate Office also seeks to take advantage of social media and thus has established, and maintains, a growing Facebook page.
The Hawaii State Climate Office (HSCO) has been dedicated to completing several projects and handling a variety of requests.

A primary goal we strive to achieve at the HSCO is to support others with a variety of weather data requests. The requests that we handled this year came from a wide assortment of fields; from professionals in the community to professors to students. This year our most frequent venture was to provide general climate data in excel document format. For example, we provided the precipitation and temperature data for areas on the Island of Hawaii. Also, we have provided hail data to an insurance company concerning several events producing damage to properties on Oahu. On the other hand, we also gave assistance to Dr. Giambelluca and his team in their efforts to update the Rainfall Atlas of Hawaii. Additionally, we assist the DBEDT in updating their “Data Book” containing climatological averages in the state of Hawaii for their annual state report.

In terms of recent publications, Dr. Chu has recently submitted his latest work to the International Journal of Climatology, concerning trends in precipitation extremes and changes in return levels in the Hawaiian Islands under a changing climate (Chen and Chu, 2014). For example, a rare storm with daily precipitation of 300 mm (20-year return period) in 1960 has become a rather common storm event (3 to 5-year return period) in 2009 on the Island of Hawaii.

This year the HSCO has undergone a change in personnel. Andre Marquez, a PhD student from INPE in Brazil, joined our staff in September 2012 and focused his efforts in our dynamical downscaling project. Andre attended a two-week WRF training course at NCAR in February 2013 to polish his necessary WRF skill set. Using his acquired skillset, Andre created a WRF training course and personally tutored our team in downscaling techniques. However recently returning to Brazil, the lead role in the dynamical downscaling project has been inherited by Chris Holloway. Chris came aboard in October 2012 as an undergraduate assistant, and is currently working towards a MS in Meteorology as of August 2013. Kristine Tofte has also come aboard as a valuable member of our climate research team. Traveling from Norway, Kristine began her efforts in the Meteorology MS program in August 2013 and is currently pursuing a study of Hawaiian fog characteristics and their trends.

One of the main focuses of our present endeavors is to perform dynamical downscaling for projecting future climatological parameters for the islands of Oahu and Kauai. We have obtained funding from the Honolulu Board of Water Supply, in addition to funding from the Kauai Department of Water Supply. Under the supervision of Dr. Chu, Chris Holloway is leading the effort, teamed by Andre Marquez, Chris O’Connor, and Chris Wrenn. Because global climate models have a coarse horizontal resolution, and the island is small and contains terrain complex, simulations from climate models cannot be used directly for Hawaii. Dynamical downscaling is achieved by using a high resolution regional model (WRF) that is initialized with the output from global climate models. Having downloaded and processed a suite of the latest CMIP5 climate models for projection of future climate in the North Pacific, we are currently working on...
optimizing model outputs. This pertains to the configuring of the WRF model for initial conditions and running the regional model with multiple-nested domains in very fine resolutions (down to 1 km for Oahu and Kauai).

Another project we have been focusing our efforts towards comprises recent precipitation trends in Hawaii related to the La Niña phenomenon. Chris O’Connor is leading the effort alongside Dr. Pao-Shin Chu, Dr. Pang-chi Hsu, Dr. Rashed Chowdhury, Dr. Yuqing Wang, and Kevin Kodama of the Honolulu National Weather Service. Funding was obtained from NOAA through the SCEP program. Traditionally, Hawai’i receives greater than normal precipitation during La Niña winters. However over the past few decades we have recorded a reduction in precipitation during the La Nina events, verified by a change-point analysis using the Pettitt test. Our research considers the influences of this drying trend by examining the atmospheric tendencies using NCEP Reanalysis 1 data. A moisture budget analysis has been performed to reveal the key importance of circulation changes, which are found to be the main contributor to the precipitation shift experienced in the last thirty years. Also explored in our research is the Central Pacific and Eastern Pacific El Niño events highlighted by Dr. Jin-Ji Yu of the University of California in Irvine. El Niño typically brings to Hawai’i drier than normal precipitation conditions. Our research shows that Central Pacific El Nino events have the ability to produce wetter than normal conditions for the Hawaiian Islands.

Hawaiian weather and climate in 2014 has been interesting, and on a positive note we have experienced a lifting of drought conditions that were plaguing the state throughout 2012 and the early parts of 2013. In the fall of 2012, regions of Hawaii were suffering extreme drought conditions reaching the highest level of concern (D4) according to the Hawaii Drought Monitor provided by the Hawaii’s Commission on Water Resource Management. The persistent drought conditions have been reduced in the last 15 months throughout the state thanks to a good amount of rain received during the previous two wet seasons. Nevertheless there are still parts of the state under abnormally dry conditions, including the western parts of all islands.

In terms of significant weather events, Hawaii received the biggest winter swell event in the last decade on the northern shores of the islands. Wave heights reached upwards of 50 feet in the areas where the energy was most focused. Unfortunately, two surf related deaths were endured on the island of Oahu this year. One coming from a winter swell event on November 13, 2013, a surfer was lost in the churning waters on the north shore of Oahu at Chun’s Reef. The other incident occurred on the south shore of Oahu, where a surfer died from injuries suffered at Ala Moana Bowls on June 6th, 2013. In total there were two deaths and six injured due to surf related incidents this year. Fortunately, damages from other types of weather related occurrences were very minimal this year and only totaled to $31,000.

**References**

- Storm Events Database, NOAA National Climatic Data Center, http://www.ncdc.noaa.gov/stormevents
Climatic information is essential to every citizen of Idaho. To help people obtain the climatic and water data and information necessary to planning and every day work, the State Climatologist Program strives to acquire, archive, process and disseminate, in the most cost effective manner possible, climate and weather information which is or could be of value to policy and decision makers in the state and to provide climatic services which are important to the people of Idaho.

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

- Collaborate with state and federal agencies responsible for monitoring and forecasting water availability for Idaho
- Assist Idaho weather information users to obtain historical Idaho weather data from the National Climatic Data Center
- Maintain a data bank of climatological and hydrological research data and information
- Assist data users by formatting climate data into usable forms.
- 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 publication 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 190 observers.
- Responded to numerous e-mail/phone requests for climate data/information/services.
- 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 Sno-Tel site.
- ISCS provides numerous reports including Intensity-Duration-Frequency spreadsheets for many cities in Idaho.

**Research:**
- Presented snowmelt research at Western Snow Conference, 2013
- Develop hybrid remote sensing-ground sensor method to quantify watershed snow-covered area.
- 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: Participation and collaboration of the following outreach activities:

- Interact with federal and state stakeholders regarding annual climate, and water resources conditions.
- 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).
- Climate Presentations to local schools.
- Interviewed by print, radio and television media contacts.
- Serve as a climate expert on Idaho Public Television talk shows.

Monitoring and Impact Assessment:

- ISCS helps monitor current and historical precipitation through the CoCoRaHS network (http://www.cocorahs.org/) 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
Illinois State Water Survey
Prairie Research Institute
University of Illinois Urbana-Champaign
2204 Griffith Drive
Champaign IL 61820-7495
jimangel@illinois.edu
http://www.isws.illinois.edu/atmos/statecli/
Telephone 217-333-0729  Fax 217-244-0220

Dr. Jim Angel, State Climatologist for Illinois

The State Climatologist Office (SCO) for Illinois is located at the Illinois State Water Survey (ISWS) in Champaign, Illinois, under the Prairie Research Institute on the campus of the University of Illinois. The office also operates the NWS coop site for Champaign-Urbana. The office is co-located with the Midwestern Regional Climate Center.

The outstanding climate issues during this time were record rainfalls in the late spring, followed by a late summer drought, and a severe winter. As a result, the SCO was heavily engaged with the local and national media during these events, participated in several NOAA-sponsored webinars, posted regular updates on the web site and blog, and was invited to a number of talks around the state.

Climate Services
The SCO maintains a web site http://www.isws.illinois.edu/atmos/statecli/, a blog http://climateillinois.wordpress.com/ and Twitter account https://twitter.com/jimangel22 devoted to climate data and information on a wide variety of climate topics. The web site covers standard products such as climate maps and datasets while the blog and Twitter accounts provide a means for reporting climate conditions as they develop. Since its beginning in 2011, the 370 posts on the blog have generated 265,000 views.

The SCO is actively engaged in providing information services within Illinois. In the past year, the media contacted the office over 150 times. Each month the SC prepares a press release on conditions around the state. The widespread interest in the wet spring, dry summer for 2013 and the outlook for 2014 led to 40 public talks in the last year.

The Illinois SCO engages in a number of outreach activities. The SCO writes regular contributions to the monthly ISWS Water and Climate Summary. The office provides both data and information 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.

The SCO 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, and d) occasional guest on the Illinois Gardener program on WILL-TV.

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

The SCO works closely with the American Association of State Climatologist (AASC) on a variety of climate issues in conjunction with other state climatologists, regional climate centers, the national climate center, and the National Weather Service.

The SC, Jim Angel, is a member of the American Meteorological Society (AMS) and the American Association of State Climatologists. He is a member of the AMS Applied Climate Committee and an editor for the Journal of Service Climatology.

Research
The Illinois SCO maintains an active research program, with applied research focused on Illinois and the Midwest. Three articles were published in the past year, addressing the topics of extreme climate records as well as survey results on climate change. Recent projects include an examination of climate change issues in the Chicago area and developing climate tools for the USDA Useful to Useable (U2U) project with Purdue University.

References


IClimate is an American Association of State Climatologists (AASC) Recognized State Climate Office (ARSCO). In addition to permanent staff the office provides work opportunities to graduate and undergraduate students in research project, client/climate information developments and interactions.

Research

Research at IClimate continues to focus on landsurface interactions, urban climate, agroclimate/crop modeling, tropical systems and applied climatology. Dev Niyogi, Olivia Kellner, Xing Liu, and Elin Karlsson continued with designated research tasks/involvement in the Useful to Usable (U2U) USDA/NIFA funded project working to transform climate variability and change information into tools for cereal crop producers. IClimate research findings were presented at several major conferences across the United States and a number of manuscripts covering research findings were submitted and accepted for publication in 2013.

Additionally IClimate continues to be involved in several research projects primarily supported through NSF, USDA, and other federal agencies on topics related to climate change education, land use land cover impacts on hydroclimatic changes, and severe weather.

The development of a regional drought information portal and an environmental cyber-infrastructure prototype for heterogeneous data access and processing is on-going. IClimate continues to work on drought characterization, explore cyber-infrastructure for data collection, and share visualization methods leading to improved practical applications.

Through improved decisions support tools, training, and resource materials IClimate partners in the Useful to Usable (U2U) project which seeks to improve the resilience and profitability of farms in the Midwest amid variable climate change.

Projects are underway related to the design framework of land use planning as a tool for climate change adaptation in greener cities. A series of projects are also underway related to climate literacy and education for middle schools and informal educators. Details regarding these projects and resulting publications can be found at http://landsurface.org.
Outreach

IClimate receives many requests to speak to conferences, professional organizations, and trade shows. Examples of talks given in 2013 include the Midwest Regional Turf Expo, the Indiana Crop Improvement Association, an ADM Grain conference, and a talk to Syngenta Brazil when visiting the campus in early August 2013. November 2013 Olivia Kellner made a trip to the Dunes National Lake shore to give three short talks covering climate change, Midwest and Indiana climate change, and climate change education resources at a day-long “Climate Clinic for Educators” sponsored by Chicago Wilderness.

Unique climate questions came from sectors as diverse as producers for Animal Planet, a local hospital emergency room, Home Depot, and the Institute of World Politics.

Additional efforts to better serve stakeholders include the development of weekly climate summaries. These summaries include two-week temperature and precipitation data tables, teleconnection data, and weekly CPC outlooks and are posted to the main webpage. Communication and establishment of research efforts with Purdue Joint Transportation Research Program were also made in 2013.

Ken Scheeringa continues as the IClimate state co-manager of CoCoRaHS Indiana. Megan Bird became the new state co-manager representing NWS Indianapolis. By the end of our seventh year more than 2020 volunteers had joined CoCoRaHS Indiana with an average 530 actively reporting in 2013. Weekly and monthly Indiana total precipitation GIS maps based on CoCoRaHS observations continue to be posted to our web site: [http://www.iclimate.org/precip/images/precip.asp](http://www.iclimate.org/precip/images/precip.asp).

The Indiana Climate Services Team held conference call meetings in 2013. A typical agenda begins with a discussion of weather concerns and trends in the state based on observations, forecasts, and seasonal climate outlooks. Next a progress report on climate tools in development by individual team members is presented to the group. A summer meeting date is chosen so the team can meet at least once annually in person. These activities aim to move the team closer toward its goal to integrate projects among the partners and sectors into practical operational applications of benefit to Indiana residents.

IClimate volunteered to collate and publish the AASC 2012 Annual Newsletter. A special thanks is due Olivia Kellner for her extensive editing and publishing efforts to assemble the organization’s annual newsletter. IClimate will also publish the 2013 newsletter now in preparation.

Arthur Mahan became the longest serving cooperative observer in Indiana history on 28 Sep 2013. His state record now extends beyond 65 years 6 months and counting.

Monitoring and Impact Assessment

IClimate completed an AASC SCEP grant to compile current weather statistics and impacts into weekly and monthly state climate reports through July 2013. The grant has expired but IClimate
continues this effort as an unfunded activity. A highlights version of the monthly summary is sent to MRCC at the end of each month. The full monthly report is posted to our IClimate web site:
http://www.iclimate.org/summary.asp and to the AASC web site:

Reference evapotranspiration monitoring using ETgages continued during the 2013 growing season at 7 Purdue research farm automated weather stations and at 2 non-automated farm stations. The automated measurements are updated hourly into the IClimate web database. The NWS offices in Indianapolis (IND) and Northern Indiana (IWX) continued onsite daily manual collection of ETgage data in 2013. Their data are posted to the CoCoRaHS RefET web page.

In a new initiative Purdue Ag Research Programs allocated an annual maintenance fund in 2013 for the 7-station Purdue automated network. Ag Research Programs will also set aside additional funds to support the establishment of new automated stations in the next few years at two additional Purdue research farms.

In 2013 the MRCC converted their subscription MACS system into the free cli-MATE web site. This is of great advantage to IClimate in that extensive data requests can now be deferred directly to this new resource. IClimate continues to routinely access cli-MATE when compiling the weekly and monthly weather impact summaries and in response to more challenging client requests.

Ken Scheeringa continues into his 25th year as observer at the IN41 station of the National Atmospheric Deposition Program (NADP), which monitors precipitation chemistry at over 200 locations nationwide.

Education

The first “Dynamics of Climate” conference was held at Purdue in May 2013. At this conference, “Dynamics of Climate: A Toolkit for Informal and Formal Educators” was introduced to educators from around the country over the course of three days inclusive of panel discussion led by climate change experts from Purdue and other institutions and science education teachers. Dev Niyogi (co-PI) and Olivia Kellner are part of the toolkit development team. The positive feedback resulted in a no-cost extension to the NSF grant which allowed for planning of another workshop geared more towards middle school and high school teachers for June 2014.

Through separate NSF and NOAA grants, IClimate continues working with a network of teachers and educators in developing and delivering a curriculum and professional development material on climate science with a focus on the Midwest. The website http://iclimate.org/ccc continues to be used by teachers to access climate change curriculum modules that can be integrated into middle school activities.
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 138 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).

Work has continued in developing a monthly data base of historical Iowa precipitation records with just over 20,000 station-years compiled. Preliminary work in developing statewide averages of various weather statistics beyond average monthly temperature, precipitation and snowfall is also in progress. These new averages include the number of days per year reaching or exceeding maximum temperatures of 90°F or 100°F and minimum temperatures at or below 0°F, dates of last spring and first fall freeze, as well as extreme annual maximum and minimum temperature and maximum daily precipitation amount. The first version of these historical metrics has been completed with plans for expanding the number of locations used in these statistics underway in 2012 and continuing in 2013 and 2014.
Outreach:
The office maintains very open communication with the news media with a total of 425 news media contacts this past calendar 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 2,132 inquiries were answered during the past year. Most inquiries were received from government agencies (57%), the news media (20%), attorneys (7%) and insurance (2%). Virtually every major branch of State government utilizes the Iowa SC Office data on a regular basis. Total contacts, and especially news media and insurance contacts, were down from 2012 owing to fewer severe storms and much lower drought severity in 2013.

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 and continuing to the present. Occasional special storm event summaries have also been prepared for the MRCC as part of these grants.

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. In January 2012 the Iowa SC became co-chair of the NOAA Data Stewardship Team and in July 2013 became the co-coordinator for the Community, Collaborative Rain, Hail and Snow Network in Iowa. The Iowa SC made 19 climate presentations during 2013 to various agricultural groups, community service organizations and government agency meetings. Finally, the Iowa SC attended the AASC annual meeting in St. Louis, MO in July 2013.

Monitoring and Impact Assessments:
The Iowa State Climate Office is a member of the Governor’s Drought Task Force and Flood Task Force and the State of Iowa Hydrology Working Group. 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 also assists the Iowa Homeland Security and Emergency Management Division in their operations and occasionally provides guidance for county and regional emergency response offices. Special weather summaries and analyses are also prepared for the USDA and U.S. Geological Survey and the office is a regular contributor to the U.S. Drought Monitor. The office also contributed to a regional assessment of the 2012 drought and provided weather summaries for a dozen issue of the Iowa DNR’s Water Summary Update in 2013.
As always, there were many notable extremes of the weather in Iowa in 2013. The most significant was a record wet April and May and near record cold spring season. The wet and cold spring resulted in considerable delays in planting and crop development but also eliminated the last remnants of the 2012 drought. A much drier weather pattern began in June over southern and western Iowa and became very pronounced over most of the state through July and August. However, major crop stress was avoided thanks to plentiful subsoil moisture reserves from the wet spring and the lack of excessive heat through the critical pollination season. The heat finally arrived late in August with above normal temperatures prevailing into mid-October. The unusually late season warmth helped speed crop maturity which was lagging from late planting and cool early summer weather. The first widespread freeze was also delayed until well into October. Harvest weather was nearly ideal. Winter came early with several occurrences of sub-zero cold in November with soil freeze-up coming about two weeks earlier than usual.

Thanks to the cold spring the severe weather season got off to a late and very slow start. The first tornado of the year did not occur until May 19 and brought to an end a record long tornado-free period in Iowa of 359 consecutive days. It looked as if the state might have an earliest ever end to the tornado season (and a modern-era record low annual tornado total) with no tornadoes after June 26. However, a late season outbreak on October 4 brought 11 tornadoes to western Iowa. Overall 2013 was a cooler than normal year with well above normal precipitation across northeastern Iowa and below normal precipitation over the western and southern one-thirds of the state.
The Kansas Weather Data Library, which serves as the State Climate Office, observed its 38th year of operation in 2014. As a part of the Department of Agronomy, the office receives funding to support both undergraduate and graduate students and provide opportunities for them to participate in a variety of research and service activities, including participating statewide, regional, and national meetings.

The WDL currently supports two graduate students, a post doctoral, and a visiting scientist, in addition to full time positions in Kansas Mesonet network management, programming/web development, and weather station maintenance. The Kansas Climate Office has developed strong relationships with the seven National Weather Service Offices that serve Kansas. These include Pleasant Hill, MO, Topeka, KS, Springfield, Mo, Wichita, KS, Hastings, NE, Goodland, KS, and Dodge City, KS. This has included coordination with the CoCoRaHS program, support for Cooperative Observer Network awards, and other activities. The Weather Data Library also enjoys a collaborative working relationship with the High Plains Regional Climate Center. This has included participation in regional workshops, submission of monthly climate reports for KS, and transfer of data from our Mesonet for use by the Regional Climate center.

In addition, the Weather Data Library serves as the home of the Kansas Mesonet. The Kansas Mesonet is a network of automated weather stations. K-State Research & Extension weather stations are at the root of the Kansas Mesonet. These stations were established in 1986 at KSRE research centers and experiment facilities around the state. Most were co-located with National Weather Service Cooperative Observing Stations. Since that period our network has grown and we now collaborate with the Kansas Water Office, Big Bend Groundwater Management District, the Equus Beds Groundwater Management District, USDA Soil Climate Analysis Network, Highland Community College, and Rock Springs 4H Camp.

Information Services

The Weather Data Library provides weather and climate information through a variety of means. Communication by way of telephone, fax and email are common, but our primary delivery of information is by way of the web. Last year, we launched a new website to our Mesonet (http://mesonet.k-state.edu) which provides a link to near real-time data, as well as historical summaries, and various products for various end users.
Research

Faculty and students associated with the Kansas Climate Office are involved in various applied research projects. A current project is to investigate the evapotranspiration estimation uncertainty under advective conditions in Kansas semi-arid climate region. Applied climate change research continues to assess impacts of climate changes on crop yields, irrigation, and cropping system. In addition, our research also includes studies on the impact of climate on native prairies, historical drought patterns, and Kansas drought assessment.

Faculty, stuff, and students affiliated with the Kansas Climate Office presented research papers at annual meetings of American Society of Agronomy and the Ogallala Aquifer Research Workshop. We also presented papers at number of state and regional professional meetings and workshops. In addition, faculty also made invited presentations nationally and internationally.

Outreach

The Weather Data Library provides outreach in a variety of ways. Media outlets are a major component. In addition to frequent interviews for radio, TV and newspapers on various weather and climate topics, we produce 3 weekly audio clips on weather and climate phenomena. These air on the local radio station, are distributed to 75 other stations, and are accessible on the website at http://www.ksre.ksu.edu/News/. Other regular feature is participation in a weekly agricultural weather program, broadcast across the state, which covers current conditions and developing situations of interest to the agricultural community.

Additional outreach activities include presenting at various workshops, and events including the Governor’s Water Conference, Regional Drought Conferences, Farm Profit Seminars, and historical society events. Outreach to K-12 has included teacher workshops, participation in the STEM program, and an annual Kids Field Day.

Network Monitoring and Impacts

Expansion of the Kansas Mesonet continues. The latest stations added included collaborations with the KSU Horticulture Department, Highland Community College, and Rock Springs 4H Camp. Increased focus is being put into the future growth of the Mesonet, as well as enhanced data analysis for quality control. During the recent years, we have provided weekly updates on drought conditions to the Kansas Water Office for use in their reports. We also actively participate in the Drought Monitor discussions, and provided information for the NWS Central Regional Headquarters climate assessment products.

The Kansas Climate Office has also provided monthly climate summaries to the High Plains Regional Climate Center for inclusion in their regional reports.
Kentucky Climate Center
Department of Geography & Geology
Western Kentucky University
1906 College Heights Boulevard
Bowling Green, KY 42101
Phone: (270) 745-5983 Fax: (270) 745-6410
stuart.foster@wku.edu
http://www.kyclimate.org

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

The Kentucky Climate Center (KCC) observed its 36th year of operation in 2013. 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 geoscience, meteorology, and computer science.

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 (http://www.kyclimate.org/), 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. In addition, the KCC maintains the Kentucky Mesonet website (http://www.kymesonet.org/).

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 meso-scale atmospheric heat content variations, temperature bias due to station exposure and instrumentation and assimilation of Kentucky Mesonet data in forecasting. Modeling research continues to assess impacts of model physics parameterization scheme selection on forecasts, impacts of model initialization dataset on forecasts, 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 Tellus A, International Journal of Climatology, Climatic Change, BAMS, Journal of Applied Meteorology and Climatology, Applied Geography, Applied Engineering Agriculture.

Faculty, staff, and students affiliated with the Kentucky Climate Center presented research papers at the annual meetings of the American Meteorological Society and American Geophysical Union. They have also presented invited papers at various universities and papers at number of state and regional professional meetings and workshops.

Faculty also served as a member of the National Climate Assessment and Development Committee (NCDAC). This body has overseen preparation of the Third National Climate Assessment Report submitted to the President and the Congress.

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.

In addition, KCC representatives play an active role on the Kentucky Drought Mitigation Team organized through the Kentucky Division of Water within the Kentucky Cabinet for Energy and Environment and the Mammoth Cave Biosphere Reserve Advisory Council. The KCC is also represented on the recently formed South Central Kentucky Innovation and Technology Council. Representatives of the KCC were featured speakers at various events held throughout the state, including events held by the Kentucky County Judge Executive Association, the Agribusiness Association of Kentucky, the Kentucky Transportation Cabinet, the Kentucky Stormwater Association, and selected Area Development Districts. Representatives were also engaged in outreach to county governments. The KCC also maintained an active working relationship with NOAA National Weather Service forecast offices throughout Kentucky.

The KCC presented two webinars as part of a monthly series of webinars highlighting current climate issues and outlooks in the Midwest and Great Plains. These webinars are archived and available through both the Midwestern Regional Climate Center and the High Plains Regional Climate Center.

Monitoring and Impact Assessments

Expansion of the Kentucky Mesonet (KM) continued. Sixty five research-grade automated weather and climate monitoring stations are currently operational throughout the state. One of the mesonet stations also serves as an eddy-covariance flux measuring site. Five mesonet stations include probes for monitoring soil moisture and temperature. This year Kentucky
Mesonet also established a test site where instruments can be tested side-by-side. Currently, we are testing performance of three different rain gauges.

Mesonet staff maintains strong relationships with NWS forecast offices serving Kentucky, media, and various public and private entities. Basic data from the KM are freely available to the public via the KM website.
The Michigan Climatological Resources Program (MCRP), 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 Aaron Pollyea, Mike Kiefer, and Dana Doubler. MCRP also notes the retirements of long term staff members Peter Kurtz and Cathy Sernick and wishes to express its gratitude for their many years of dedicated service.

ARSCO Qualifications
The MCRP 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 worldwide 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
With record or near record heavy precipitation totals across the state in 2013, the number of requests for climate information, interviews, and speaking engagements remained at a relatively high level. The total number of formal public requests for climate-related data and information in 2013 was 104, which was down from 121 in 2012 by still above the five year average. Most of the requests were received via phone or email. The majority of the requests were from law firms, the insurance industry, and other researchers. The average amount of payment received per billable request was $48.23, which was up from $40.46 in 2012. These numbers continue to suggest at least a temporary leveling off of a long term declines in the number of formal data requests. In contrast, use and data access from our internet sites, climate.geo.msu.edu, www.agweather.geo.msu.edu/mawn and www.enviro-weather.msu.edu continued at high levels with an average of 19,708 hits per day. The average was down slightly from the record high of 20,882 hits per day in 2012 but still far above the five-year average.

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 2013, the MCRP staff provided 32 interviews to print, radio, and television media (including 6 TV and 9 radio) and 43 talks or seminars to the public (up from 29 in 2012). 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 2013, 32 columns were written. MCRP continues to serve as state-level coordinator of Michigan’s Community Collaborative Rain, Hail, and Snow (CoCoRaHS) network.

Research
MCRP maintains an active research program addressing climate-related issues in the state and region. Current projects involve investigation of past and projected future climate changes in the region and potential 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 2013, staff at MCRP authored or co-authored 2 refereed articles, 2 book chapters, and 8 non-refereed articles and technical reports. MCRP was associated with 6 new external grants during 2013 (totaling $459,833), 6 grants in force from previous years, and 19 new grant proposals submitted.
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 Ecological and Water Resources, 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 millions of data points. The database features data collected by Minnesota’s high spatial density precipitation monitoring program, formed in the early 1970s. 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, email, telephone, office visits, meetings, and public appearances.

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 (including the media)
- 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 email 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 email – the MN_SCO answers dozens of phone calls and emails per week from customers with climate questions.

**Research:**
- In 2013, the MN_SCO was called upon to provide data sets and counsel to numerous researchers investigating topics involving atmospheric science.
- The MN_SCO participates in three advisory committees tasked to provide guidance concerning climate change adaptation research and outreach.

**Outreach:**
- Staff give frequent interviews to electronic and print media.
- Staff are commonly requested to attend multi-agency, multi-disciplinary meetings where a climatological perspective is required.
- Staff make public appearances addressing matters of weather and climate.

**Monitoring and Impact Assessments:**
- The MN_SCO works with the National Weather Service to coordinate Minnesota’s role in the CoCoRaHS program.
- 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.
- The MN_SCO is in frequent communication with authors of the U.S. Drought Monitor.
The Missouri Climate Center 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, I serve as 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 2013, 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. Throughout 2013, the Missouri Climate Center posted timely monthly weather and climate impact reports for the state of Missouri as part of the State Climatologist Exchange Program.
- 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 30 automated weather stations associated with the Missouri Mesonet. 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 19 real-time weather stations in Missouri associated with the Missouri Mesonet.
- 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 500 Missouri agricultural producers and agents are enrolled.
Information Services:
- Submitted 12 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 soil temperature data to the Midwestern Regional Climate Center for generating daily and weekly 4” soil temperature maps: [http://mrcc.isws.illinois.edu/MESONET/Regional/stmp_04in_7day.png](http://mrcc.isws.illinois.edu/MESONET/Regional/stmp_04in_7day.png)
- Run the rice model program to predict rice growth stages: [http://agebb.missouri.edu/weather/reports/ricedds.asp](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/](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](http://ppp.missouri.edu/newsletters/ipcmindex.htm)
- Campus weather station and forecast linked to College of Agriculture web site: [http://cafnr.missouri.edu/](http://cafnr.missouri.edu/)
- The real-time stations are providing 5-minute weather conditions to the Meteorological Assimilation Data Ingest System (MADIS);

Research:
- The Extension Commercial Agriculture Automated Weather Station network has provided opportunities for educational programs, teaching, research, innovation, discovery and service to communities. It has led to the development of state-of-the-art information delivery systems, including transitioning 20 weather stations to wireless telecommunication and real-time weather data dissemination for local, state, and national outlets as well as public, private and federal entities. In 2013, the average number of actual internet visits made to our 20 real-time weather web sites was over 337,000 per station, or, over 6,000,000 visits.
- Providing real-time weather status to 20 weather stations in the Commercial Ag Automated Weather Station network for Integrated Pest Management;
- Provide climate data for graduate students and faculty research projects
- Continued participation in a multi-state 5-year USDA/NIFA grant awarded in 2010. Grant title: Useful to Usable (U2U): Transforming Climate Variability and Change Information for Cereal Crop Producers.

Outreach: Education, Awareness, and Contact Activities


Weather presentations to numerous field days across the state;

MU’s Annual Crop Management Conference; Topic: Using Weather Related Tools for Decision Management

Gave 30 presentations across the state on several climate topics including “Drought” “Historical Climate Trends in Missouri” and “Climate Change”.

Weather updates for MU Extension Quarterly Ag-Marketing Teleconferences;

Weekly weather updates 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 North Central 1179 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 Media Group, and numerous local television, radio, and newspaper outlets across the state;

Participated in NOAA Climate Service and Drought webinars hosted by the National Weather Service Central Region.

Participated in NOAA Climate Service and Drought webinars hosted by the National Weather Service Central Region.
The Nevada State Climate Office (NSCO) was established under Nevada Revised Statute 396.595. Our mission statement is:

The Nevada State Climate Office serves the people of Nevada by maintaining descriptions of, reporting on, and providing access to information on the climate in the state, including atmospheric conditions and levels of precipitation. The Office collaborates with, advises, and promotes climate data collection, interpretation, and research in conjunction with local, state, and federal agencies and the governor’s office and is responsible for drought planning in the state. The Office participates within and serves as a member of the national and regional network of state climatologists.

ARSCO Qualifications: The NSCO is the AASC-designated state climate office for Nevada. The following activities during 2013 address each of the Office’s ARSCO qualifications.

Communications capabilities
- The NSCO website (http://www.climate.unr.edu) is still active and provides basic information related to the current drought conditions, seasonal forecast information, weather conditions and the activities of the Nevada State Drought Response Committee. The website is slated to be completely redone by a professional web design group at UNR in the near future (hopefully summer 2014).
- A 65" monitor and video software system is now operational in the Departmental "glass case" outside the NSCO. A wide range of different climate and weather related information is currently displayed on the monitor and updated regularly. The monitor seems to be very effective at capturing the attention of the hundreds of students, faculty and others that walk through the lobby of Mackay Science every day.

Outreach
- In 2013, I participated in a significant number of operational meetings related to flood, drought, and other climate related issues. As the State Climatologist, I lead the Nevada Drought Response Committee (DRC) and we held operational meetings every 2-4 weeks at the emergency operations center in Carson City from July through October 2013. The purpose of these meetings is to communicate with the three drought task forces (designated by the DRC) throughout the state and determine when to declare drought in different parts of the state based on the Nevada Drought Plan. I am actively revising the DRC drought response plan to more accurately represent the current functionality of the
DRC and the new drought disaster declaration policy implemented by the U.S. Department of Agriculture. The DRC also put together and hosted a one-day drought-planning workshop for the agriculture community. We are currently writing a report containing the outcomes of the workshop and recommendations for future actions.

- The DRC produces reports to inform the Nevada Governor and his staff regarding the current drought status, a summary of known impacts to agriculture, residential and industrial areas, and the environment. We also provide him with a drought and climate forecast and an update on any official drought declarations by the Federal Government.
- I also participate in regular monthly meetings with the hydro partners (organized through the Reno NWS) and the CA/NV regional drought group organized through the NWS RFC in Sacramento CA. The purpose of these two groups is to develop a coordinated consensus of the drought conditions in CA and NV and communicate our findings directly to the U.S. Drought Monitor authors.

Research

- In 2013, I continued to build a new research program in paleoclimate modeling here at UNR and built a new climate lab in rooms MS 132 and MS 133 to provide our students (and us) with the space they (we) need to continue to grow our research program. In terms of space, we are currently near the maximum carrying capacity for our new lab and have to either acquire new additional space or postpone the recruitment and hiring of three new Ph.D. students in 2014.
- The NSCO has a number of research projects aimed at developing a better understanding of the frequency and magnitude of previous short- and long-term droughts, why they occurred, and how our modern water resource infrastructure would respond to some of the longer-term megadrought conditions that we know happened in the past. It is really important to us that we conduct high caliber research that can be used to help answer practical and relevant questions related to our current water resources and climate change related issues in the state.
- I have continued to collaborate with research scientists affiliated with the Comer Science and Education Foundation (CSEF). I remain a very active member of Dr. Wallace Broecker’s paleohydrology group within the CSEF Abrupt Climate Change Initiative. Dr. Broecker’s group now consists of the following 14 people: B. Boos, D. Battisti, D. Boyle, W. Broecker, J. Chiang, L. Edwards, D. McGee, J. Oviatt, A. Putnam, J. Quade, S. Stine, A. Torfstein, G. Winckler, and X. Wang. In 2013, I was again invited to present and attended the annual CSEF Abrupt Climate Change Conference and was able to continue my collaborative relationships with several other members of this group; most notably with Aaron Putnum (Columbia University), Jay Quade (University of Arizona) and Sean Birkel (University of Maine). Together, along with Scott Bassett, we are carrying out a new collaboration in the Great Basin that involves comparing the paleoclimate estimates from our paleolake modeling with the University of Maine group’s paleoclimate estimates from paleoglacier modeling. We are working to integrate the two efforts to develop a new loosely-coupled glacier and watershed hydrology model to investigate glacial moraines and paleolake levels at Lake Russell, the Tarim basin in China, and a to be determined basin in Mongolia.
- A major project was initiated to digitize all of the archived "paper" data sheets and metadata for the historical NSCO meteorological network. Two undergraduates and an
intern worked through 2013 and will continue through most of CY 2014 on this project. A GIS database exists on our server to store the digital information and make it available (eventually) to the general public.

**Information services**

- The NSCO has provided numerous interviews regarding the current climate and drought conditions with the Las Vegas Sun, Reno Gazette Journal, Clear Sky Group, and Ruby Radio in Elko, NV, Fox News Channel 11.
- Presentation to the Nature Conservancy in Reno (3 DEC 2013)
- Presentation to Washoe County Emergency Managers (15 November 2013)
- Presentation to Walker River Irrigation District Managers (12 November 2013)
- Interview by Kelsey McCutcheon- UNR journalism student (20 September 2013)
- Interview by Michele Fuetsch – Transport Topics Magazine (13 September 2013)
- Half hour television interview by Sam Shad on Nevada Newsmakers (4 September 2013)
- Presentation to Drought Information Assistance Workgroup (1 April 2013)
- Presentation to American Society of Civil Engineers, Luncheon Keynote speaker (5 March 2013)
- The NVSCO continues its state mandated responsibility of providing a quarterly state climate summary. We are currently redesigning the entire report format, content, and scope with the goal of providing a much more timely product on the current climate conditions. We expect the new format to become operational in the 3rd quarter of 2014. Ultimately, we would like to move from quarterly to monthly reporting in the future with improved coverage of eastern and southern Nevada.
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 through 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, through outreach and academic publications, and in person through interviews and presentations. The NHSCO has continued to maintain a website (www.unh.edu/stateclimatologist/) that allows users, with various interests and skill levels, direct access to climate data from a variety of data repositories. The NHSCO website was recently redesigned and updated to include educational resources and information on citizen science programs. The NHSCO also hosts a Twitter page (@nh_sco) followed by national and state government offices and officials, news and nonprofit organizations, educators, students and weather enthusiasts. These online media outlets and others are the primary venues for publication of state and regional climate summaries, datasets, analyses and graphics as well as formal reports on weather conditions, significant events and impacts.
Information Services:

Throughout the year, the NH State Climatologist provided weather and climate information, including data, seasonal summaries and outlooks as well as expert analysis of severe weather events, to individuals, organizations, state agencies and the public. The NHSCO regularly responds to data requests, produces formal reports, fact sheets, public information statements and website content and has maintained a regular presence in local print, radio and television media. The NHSCO also produces weather and climate impact summaries and reports for state agencies and the media.

The NH State Climatologist regularly works with UNH Media Services to produce and disseminate information on significant weather and climate events. This work includes data compilation, analysis and visualization for, as well as writing, press releases. The NH State Climatologist also serves as a media expert in weather and climate for the University of New Hampshire and regularly corresponded with the media by email, telephone and in person. She regularly conducted interviews by telephone, Skype, as well as in studio and on location. Media engagement included interviews for print and online media, appearances on talk radio programs, and local television broadcasts. Topics in weather and climate of particular interest to the media and the public in 2013/14 included: New England hurricanes, 2013/14 winter weather within the context of climate change, and local and regional climate change impacts following the release of the 5th IPCC assessment and the 3rd National Climate Assessment.

Research:

The NH State Climatologist and colleagues presented results of ongoing research at regional and national conferences and published research results in peer-reviewed literature. The NH State Climatologist is a participant in the science and outreach sectors of the NH-EPSCoR project “Interactions among Climate, Land Use and Ecology Services.” Collaborative research on the influence of politics and weather on public perceptions of climate change continued with the publication of Hamilton and Stampone (2014). Ongoing research was presented at the AMS 21th Conference on Applied Climatology and is under review.

Outreach:

The NHSCO is involved a variety of outreach programs and activities and regularly gives presentations to schools, organizations, businesses and academic institutions. Speaking engagements include public lectures on climate change impacts on winter recreation and technical presentations on the effects of regional climate change on state water resources. As a co-coordinator for NH CoCoRaHS, the NH State Climatologist worked with the UNH Leitzel Center to recruit and train K-12 teachers to participate in CoCoRaHS with their students. The NH State Climatologist also serves on the Mount Washington Observatory (MWObs) Board of Trustees holding positions on both the Scientific and Technology Advisory Committees.
**Monitoring and Impact Assessment:**

The NHSCO continues to work 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 the NH CoCoRaHS network. In addition to hosting a CoCoRaHS station, the State Climatologist is a NWS COOP observer and is the point of contact for the two NOAA Climate Reference Network (CRN) stations located in southern New Hampshire.

The NHSCO also collaborated with state agencies, providing climate data and analyses for state environmental management and planning activities. The NH State climatologist remains an active member of the NH Drought Management Team and worked with NHDES and UNH faculty to complete revisions the state drought management plan. The NH State Climatologist also serves on the Scientific Advisory Panel for the NH Coastal Hazards Commission and is a member of the NH Climate and Health Working Group facilitated by the NH Department of Health and Human Services.
The Office of the New Jersey State Climatologist (ONJSC) has experienced another successful year of providing climate services to meet the ever-growing needs of the 8.7 million Garden State residents, stakeholders and decision makers. As we serve all within the NJ community and, on occasion beyond, we continue to be mindful of our mission to: 1) gather and archive NJ weather and climate observations, 2) conduct and foster research associated with NJ’s weather and climate, and 3) provide critical climate services to all seeking assistance. Our main website is <http://njclimate.org>.

The ONJSC operates the New Jersey Weather and Climate Network, or NJWxNet. This unique network of 56 weather stations http://njweather.org serves as a one-stop Internet resource for New Jersey weather and climate data. The NJWxNet includes 32 NJ Mesonet sites, monitoring a rich suite of atmospheric and surface variables, and 24 NJ SafetyNet stations, monitoring a subset of important variables primarily at public safety agencies. In April 2014, a new NJWxNet website was launched that includes five-minute observations (previously hourly) collected and displayed in real time as colorful maps and tables on the NJWxNet web site. We also access data from NWS, USGS, NJDOT and other networks to augment our observations. We continue to improve metadata and network quality control.
Over the past year, support for general ONJSC and NJWxNet activities has come from the NJ Department of Environmental Protection, NJ Office of Emergency Management, US Forest Service, and Global Science and Technology Inc (via a National Weather Service grant). Using NJWxNet data, we continue working with NJ agriculture extension colleagues to develop indices for blueberries and apples and with these individuals and others at Cornell on a grape growth index. We continue to partner with the US Forest Service on data gathering and display associated with fire danger monitoring. Considerable attention has been paid to the quality control of NWS Cooperative Station observations at critical stations with lengthy records.

New Jersey’s sixth year in the Community Collaborative Rain, Hail and Snow Network saw more than 250 observers actively participating and submitting vital observations. Our color-filled state and regional maps of precipitation, snowfall, snow cover and snow water equivalent continue to be popular. In addition to the NJWxNet and NJ CoCoRaHS, the ONJSC maintains a comprehensive archive of historical data, metadata and climatologies from NWS 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. One of the most popular pages includes snowfall observations for any event depositing 2” or more snow at any location in the state. This included 20 events this past winter, six of which deposited 10” or more somewhere in the state. Both are records since we began to post such data the past 10 years. Thus far, this snow page has been accessed over 50,000 times, often being used to resolve snowplowing contracts that are based on increments of snowfall. In general, the 2013/14 winter was the most disruptive for NJ residents since the 1993/94 winter.

Research endeavors within the ONJSC range from student projects on topics such as climatologies of dewpoint, tropical rainfall and tornadic events to collaborative efforts with Rutgers colleagues and state and federal agencies. The ONJSC made significant contributions to the latest NJ Office of Emergency Management (NJOEM) Hazard Mitigation Plan. We also filled a NJOEM request for a report regarding climatological conditions and probabilities for late January and early February in preparation for the Super Bowl XLVIII. This outside event was held in the Meadowlands of northeast NJ on what proved to be a mild February 2 evening. Travel out of the region the following day was greatly impacted by a snowstorm.

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. In collaboration with colleagues within the Rutgers Climate Institute, the first state of the climate report was produced in late 2013 <http://climatechange.rutgers.edu/resources/state-of-the-climate-new-jersey-2013>.

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 ONJSC gave approximately 450 interviews to the media between May 2013-April 2014.
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 tabular 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, ocean influences on state weather and climate.

Outreach
- Several hundred media interviews each year.
- Presentations to numerous schools, civic organizations, senior centers, etc.
- Conference presentations in the past year to groups such as Shrewsbury River Flood Warning System Stakeholders, Whitney Symposium: Upward Bound Program, The Nature Conservancy, New Jersey Chapter, New Jersey Emergency Preparedness Conference, and the AMS Sandy Conference (not an inclusive list).
- The NJ State Climatologist is a member of the National Academy of Sciences Board of Atmospheric Sciences and Climate, the NWS StormReady Community Program advisory board, the Liberty Science Center Education and Teaching Advisory Committee, the Sustainable Jersey climate, forestry and urban heat committees.

Monitoring and impact assessment
- 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.
- State of the Climate report was released: <http://climatechange.rutgers.edu/resources/state-of-the-climate-new-jersey-2013>
New Mexico Climate Center

Department of Plant and Environmental Science
New Mexico State University
MSC 3Q, P.O. Box 30003
Las Cruces, NM  88003
Ph: (505) 646-2974
Email: dwdubois@nmsu.edu
Web: http://weather.nmsu.edu

David DuBois, State Climatologist
Stanley Engle, Data Management Specialist
Elizabeth Smith, Graduate Student Assistant
Yizhi Zhao, Graduate Student Assistant
Rebecca Armenta, Graduate Student Assistant

General Information
The New Mexico Climate Center (NMCC) resides within the Department of Plant and Environmental Sciences at New Mexico State University in Las Cruces, New Mexico. The climate center is comprised of one faculty position, a staff position, and graduate student assistants. 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, state, and private observing stations throughout New Mexico. Additionally, the NMCC maintains a network of automated weather stations throughout the state that are used primarily for agricultural decision making. Recently, the NMCC set up an FTP server that receives data from a network of Davis Vantage Pro2 weather stations across New Mexico. Once the FTP server receives the data, it is available for viewing. Many requests for data and information were also answered by phone and email. In addition, the NMCC provided a variety of web based tools for decision support in the areas of drought, air quality, agriculture, hydrology, construction, and economic development. The Center also supported the Drought Task Force’s Drought Monitoring Work-group during monthly conference calls.

Product Development
Several products for the NMCC website are currently in development. An almanac and statistical database is being designed to store and display the statistical data for weather station networks not available in SC-ACIS. The current daily/hourly data lister product is being modified to support higher frequency data and to be able to ingest data using the HTTP protocol. Further, this product will support data comparisons between nearby weather stations and it will also provide ET/GDD forecasts using the National Weather Service point forecast data.
Research
Our group continued research in air quality and climate to support programs at the New Mexico Department of Health and New Mexico Environment Department. This year we focused on a study to determine sources of windblown dust across southwest NM and northwest Chihuahua using a combination of satellite remote sensing and modeling. We also used a portable wind tunnel to determine dust source strength across the region. Funding from CLIMAS RISA was also used to support the research and activities for the students and staff at the NM Climate Center.

Outreach
Much of our outreach focused on drought and its impacts to NM. In fact every presentation that we gave had some of all of it on drought. We continued our outreach using Twitter (@nmclimate) and Facebook for providing climate and drought information to the public. We maintained our air quality blog. We participated in numerous outreach activities in public schools and community events including the Las Cruces Water Festival, which helps promote awareness of water issues for school kids.

Community Involvement
We continued supporting the cities of Las Cruces and Silver City in projects dealing with sustainability, K-12 and informal climate education, climate adaptation, urban dust control, and stormwater management.

Dr. DuBois serves as the state coordinator for CoCoRaHS and arranged for various recruitment events and two state newsletters.

We participated in a volunteer fair in Las Cruces to recruit CoCoRaHS observers and also to recruit volunteers to help with other community involvement opportunities.

Activities
Dr. DuBois continued to chair the NM Drought Monitoring Workgroup during their monthly meetings and quarterly presentations to the Governor’s Drought Task Force.

Dr. DuBois served on the Joint Advisory Committee for the Improve of Air Quality in the Paso del Norte and gave two presentations this year on windblown dust and the work completed for the Border Health Office.

Hosted a tree ring workshop for state and local water planners and brought in Dr. Connie Woodhouse from University of Arizona to speak.

Publications
Requests for Services: Direct requests from clients via email and phone during 2013-2014 resulted in a 1% increase in time spent directly responding to requests for services from clients as compared with the previous year. This is the first year of steady requests after several years of decreases.

Website Usage: The volume of visits (sessions) increased by 66.6% over the previous year. Overall, the SCO website has received nearly 1.5 million page views over this period.

Climate Database Usage: Users requested more than 2.3 million data queries through the CRONOS interface – a decrease of over the previous year by almost 50%. With the development of more sophisticated applications and products, end users now have access to more value added information and services. We averaged 2.3TB of internal climate data transfer each month with ~ 1 billion data records selected updated, or inserted each month.

CRONOS API: An application programming interface (API) continues to be developed to allow authorized users to access CRONOS data without going through the web interface. This tool allows for development of web services that will facilitate internal and external data use, allowing staff, students, and collaborators access to data for research and product development without requiring SQL expertise. In the past year, there were over 2.96 million API queries, which represents a decrease of 4.3% over the previous year.
Environment and Climate Observing Network (ECONet) - the NC Mesonet

Station Maintenance: 93 site trips were made over the past year to perform routine or emergency maintenance covering over 14,000 vehicle miles.
- Eight wind monitors were replaced due to damages and upgrades.
- Seven integrated wind/temperature/humidity/pressure probes were repaired or replaced.
- 44 radiation sensors were recalibrated or replaced for annual maintenance.
- Eight soil temperature sensors were replaced due to sensor failures.
- 10 soil moisture sensors were replaced due to failure.
- One telephone modem was replaced due to damage.
- Four enhanced temperature and humidity probes were installed.
- The station located at Mt. Mitchell continues to be our most challenging site, with another complete tower collapse.
- Leaf wetness sensors were installed at all ECONet stations

Climate Support for Agriculture and Water Resource Management
In 2012, we continued out support for operational Peanut Disease Advisories, Thrips Risk assessments, Late Blight monitoring in potatoes and tomatoes, and dispersion and technology support for the national ipmPIPE for Cucurbit Downy Mildew. Each of these projects are in collaboration with partners in NCSU Plant Pathology. We also continued our weekly drought monitoring to support water and agricultural management. Programs focused on support agriculture and water are available at:
  - http://www.nc-climate.ncsu.edu/products/ag
  - http://www.nc-climate.ncsu.edu/products/water

Climate Support for Forest and Natural Resource Management
Fire Weather: With support from NC Forest Service, we developed a Fire Weather Intelligence Portal that includes map-based web tools to visualize fire risk using the National Fire Danger Rating System and inputs from all CRONOS observations. This tool was released in June 2013 for broad fire community testing and use. http://www.nc-climate.ncsu.edu/fwip/

Defense Coastal / Estuarine Research Program (DCERP): In Summer 2012, the SCO joined a team of scientists headed by RTI International in the second phase of the Defense Coastal / Estuarine Research Program. As part of DCERP, four module groups are working to assess the impact that climate change will have on ecosystems using Marine Corp Base Camp Lejeune as the study domain. Our role is to assess the climate sensitivities of each ecosystem of focus and produce fine resolution climate change projections and historical climate conditions over the base for these modeling efforts. More information is available at http://dcerp.rti.org.

PINEMAP: Climate Support for Southern Conifer Management: In collaboration with 42 other investigators from across NC State University and the southern US, we successfully proposed in 2010 a 5-year project to USDA for research, extension, and educational activities to improve the management of pine trees in the southern US. We serve as the conduit to the other State Climatologists, developers for a decision support system, and the climate extension resource for all partners.
During May 2013 through April 2014, SCO scientists engaged with several different sectors by co-hosting and/or presenting at various workshops, conferences, meetings, and symposium, including:

- Co-organized and presented at two PINEMAP workshops on climate and climate change for natural resource extension professionals
- Hosted and presented at Regional Climate Variations and Change for Terrestrial Ecosystems Workshop (http://www.esajournals.org/doi/abs/10.1890/0012-9623-95.1.96)
- Led S-290 training on basic weather processes for NC Forest Service

Educational Outreach

Undergraduate & Graduate Student Training
- SCO supported 11 undergraduate and 2 graduate students over the past year.

Invited Presentations and Visitor Programs
- Total Direct Educational Outreach Contact Hours: 44,702
- SCO staff provided 35 presentations by invitation
- SCO provided tours and programs for 22 visitor groups
- SCO participated in several large group events, including StormFest, NC Science Festival, and Chowan Edenton Environmental Group Green Fair

SCO Climate Blog: The State Climate Office has continued to routinely communicate news and scientific information via its Climate Blog (http://nc-climate.ncsu.edu/climateblog). Currently, 538 individuals and group listservs are receiving notifications of new blog entries, which is an increase of 13 from a total of 525 at this time last year, with hundreds more reached via science teacher and Cooperative extension email lists. In the past 12 months, 51 separate blog posts have received more than 16,000 combined views. These posts have covered a wide range of topics, including:
  - monthly and seasonal climate recaps and outlooks,
  - summaries and climate perspectives about recent weather events,
  - weather and climate basics, and
  - student projects and research.

These blog posts have used multimedia such as interactive charts, maps, and videos. Last September, video blogs were featured in a four-part series titled “Century Since the Storm”, which looked back at the hurricane that struck North Carolina in 1913. This variety of media provides new ways to access and visualize information.

SCO Twitter Account: We currently have 257 followers for the SCO Twitter account, @NCSCO, which equates to 116 new followers compared to this time last year. From May 1, 2013 through April 30, 2014:
  - 66 of the tweets sent out directly from @NCSCO were “re-tweeted”,
  - 25 of our tweets were “favorited”,
@NCSCO was “mentioned” 69 times in the tweets of other Twitter accounts, and
@NCSCO was “mentioned” in many tweets that were later “favorite” or “re-tweeted” by followers of other Twitter accounts.

Centennial Campus Magnet Middle School Internship: SCO hosted four 8th grade student interns from Centennial Campus Magnet Middle School (CCMMS) from mid-October 2013 through early March 2014. This is the 11th year of the internship program, where students spend an afternoon every week in the SCO to learn about NC climate and develop their own research projects.

Community Collaborative Rain, Hail & Snow Network (CoCoRaHS): We led the establishment of CoCoRaHS in North Carolina in 2007 and over the past year we have been trying to recruit new volunteers for the program, especially encouraging participation from local schools and areas with data gaps. North Carolina won the coveted CoCoRaHS cup in 2014 for the most number of new volunteers during March 2014. NC has won this award 3 out of the past 4 years.

Research Activity, Presentations and Publications
- Staff and students contributed to 10 applied research projects (detailed in full report online)
- 3 manuscripts were successfully published in peer-reviewed journals
- 4 manuscripts are in development or currently in submission
- 9 presentations were given at 4 scientific conferences
- 6 staff and students attended 4 scientific meetings and conferences
North Dakota State Climate Office
Adnan Akyüz, Ph.D.
State Climatologist, North Dakota
Assistant Professor of Climatology
231 Walster Hall, North Dakota State University
Ph: 701-231-6577/ Fax: 701-231-7861
E-Mail: Adnan.Akyuz@ndsu.edu
Web: http://www.ndsu.edu/ndsco

Mission Statement: The mission of the North Dakota State Climate Office 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 an Automated 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.

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.

- Answers e-mails requesting climate information or asking climate related questions frequently.
- Regularly answers to telephone requests
- Frequent media contacts
Peer Reviewed Publications

Peer Reviewed Reports

Conference Proceedings and Abstracts:

Popular Extension Publications

Professional/Invited Presentations (Total=21):

Presentations at Professional Meetings (Total=2)
1. “North Dakota Agricultural Weather Network Impact on ND’s Agricultural Sector”. High Plains Regional Climate Center and State Climate Center Interaction Meeting. Sep 19, 2013. Nebraska City, NE.
**Invited Outreach Presentations (Total=19)**


3. “Climate Variability”: State Board of Agricultural Research and Education (SBARE) Board Meeting. Sep 13, 2013. Fargo, ND.


11. “Hail Climatology of the Region” at Rain Hail Insurance Meeting. Apr 18, Fergus Falls, MN.


**List of radio and TV presentations and spots made:**

There were total of 57 media appearances made in 2013.
While drought remained a major player in Oklahoma's weather during 2013, as it has for the last several years, it was upstaged by the ferocity of the state’s spring severe weather season. More than 60 tornadoes struck the state during May over the span of two weeks, including the violent EF5 twister that tore through southwest Oklahoma City and Moore on May 20, killing 24 including seven elementary school children. Two residents were also killed the day prior associated with an EF4 tornado that formed in east Norman and traveled into adjacent Pottawatomie County. More than 225 injuries were reported with the tornadoes of those two days. Still reeling from the devastation of the May 19-20 events, another bout of severe weather struck May 28-31 with dozens of tornadoes reported. The most significant of those tornadoes was the massive El Reno storm on May 31 that grew to a width of 2.6 miles, the widest known tornado touchdown on record anywhere on earth. Winds in that tornado were measured by mobile Doppler radar in excess of 296 mph. The tornado is infamous for killing four storm chasers, the first known deaths from that particular activity. While the tornado was originally rated an EF5, it was later downgraded to EF3 due to the lack of identifiable EF5 damage and the inability to use Doppler radar estimated winds in the rating. Eight people lost their lives directly tied to this tornado. The storm structure that generated the twister later dumped heavy rains in the Oklahoma City area, killing an addition 13 due to flash flooding.

Oklahoma's weather during 2013 saw a dramatic transition from the warm and dry climate of 2010-2012 to a substantially cooler and wetter version. Beneficial rainfall across the eastern two-thirds of the state through the summer kept temperatures at a reasonable level, although dry conditions continued to dominate the west and the Panhandle. By mid-August, the rains began to dwindle once again and dry conditions slowly began to transition back into the eastern areas of the state. According to the U.S. Drought Monitor, 95 percent of Oklahoma was considered in at least Extreme (D3) drought at the beginning of 2013. By the end of the year, only five percent of the state existed within that category, and only 38 percent of the state was considered to be within any drought category.

Notable Staff Transitions and Institutional Updates
Several notable staff transitions occurred with the close of 2013. Dr. Renee McPherson, who served many roles in her 22 years at OCS, moved into a full-time faculty position in the Department of Geography and Environmental Sustainability (DGES). She will also continue on as Director of Research for the South Central Climate Science Center (SC-CSC). During the past three years in her role as State Climatologist, she worked with research colleagues to bring
almost $30 million in new funding to Oklahoma for climate-related research. With Dr. McPherson’s departure, Gary McManus assumes the role of State Climatologist. Dr. Mark Shafer also transitioned into a faculty position with DGES in 2014 but will remain at OCS as both Director of the Southern Climate Impacts Planning Program (SCIPP) and Associate State Climatologist.

The Oklahoma Legislature awarded OCS $1.2 million in one-time funds to replace virtually every piece of equipment on its Mesonet towers. That will be a two- to three-year process, but will ensure an upgrade to fresh sensors and position the Mesonet to measure the state's weather for the coming decades. On December 31, 2013, the Mesonet celebrated 20 years of providing weather information to the citizens of Oklahoma, having recorded over 5 billion observations over those two decades. In October, the Oklahoma Mesonet received a special award from the National Weather Association “for operating a comprehensive observing network with a 20 year legacy of exemplary service for the residents of Oklahoma that earned the title of America's gold standard network from the National Research Council.”

SCIPP was awarded their 2nd 5-year grant in September 2013. The first 5-year grant started in 2008 and concluded in 2013.

**Information Services**

OCS Climate and Data Services fulfilled hundreds of information requests during 2013. Fees from data requests totaled $43,902. OCS routinely serves over 30 Terabytes of information from several billion hits to its web pages. In addition to OCS’ full website, it also provides iPhone and Android apps as well as a mobile website for smartphone users. The Mesonet Android app was released to the Google Play Store in December and has all of the same features as the Mesonet iPhone App, including local weather conditions, maps, radar, advisories, and the Mesonet ticker.

Work was completed on the new Mesonet Long-Term Averages Graphs product on the Mesonet website ([http://www.mesonet.org/index.php/weather/mesonet_averages_graphs](http://www.mesonet.org/index.php/weather/mesonet_averages_graphs)). The product allows users to create highly customizable graphs of current-year and past-years data, in addition to a longer-term average.

**Outreach**

OCS’ public safety outreach program, OK-First, provided training to 298 emergency management personnel in a total of 17 classes during 2013. OK-First also held the third annual OK-First Advisory Committee meeting in November with 13 of 16 committee members in attendance. The results of that meeting led to the production of an entirely new OK-First

---

**About OCS**

The Oklahoma Climatological Survey, a research unit of the College of Atmospheric & Geographic Sciences at the University of Oklahoma, was established in 1980 to provide climatological services to the people of Oklahoma, conduct research on the impacts of climate on human activities, and serve as a support facility for the State Climatologist. OCS has a legislative mandate to acquire, process, and disseminate climate and weather data and information for use by the state's citizens. The Survey maintains an extensive array of climatological information, operates the Oklahoma Mesonet, and hosts a wide variety of educational outreach and scientific research projects.
Participant Agreement document for use during 2014. New rules included re-certification training and testing requirements to receive initial certification through the program.

SCIPP continued to work closely with stakeholders within water resources, agriculture, ranching, and other areas affected by the ongoing drought, to provide updated drought information. Throughout the spring and summer, SCIPP produced weekly drought briefing videos that highlighted changes in that week's US Drought Monitor and the 8-14 day outlook. Likewise, SCIPP co-hosted several drought forums, including one in Goodwell, Oklahoma, to discuss ongoing drought impacts.

The Newcastle-Moore-Oklahoma City area has been hit by three large tornadoes over the past 15 years. On May 3, 1999, an F-5 tornado tore through Bridge Creek and Newcastle, moving into SW Oklahoma City and Moore. On May 8, 2003, an F-4 tornado hit portions of Moore. Some areas hit were also previously hit in 1999. On May 20, 2013, an EF-5 tornado once again ripped through Newcastle, SW Oklahoma City and Moore. With 3 large tornado events happening in a rather short period of time, SCIPP researchers interviewed several emergency managers, hospital administration, and non-profit organizations to understand how these past tornado events (1999 and 2003) helped to change (or not) their pre- and post-disaster plans before May 20, 2013.

K-12 outreach participated in dozens of activities attended by thousands of students and adults. K-12 also held the 3rd Annual Mesonet Weather Camp, attended by 24 participants from nine states. K-12 hosted their first “Meteorology from Atmosphere to Zulu” camp for 9th and 10th graders and welcomed 28 participants from 12 Oklahoma counties. Campers were challenged with contouring surface and upper air maps, forecasting low temperatures daily for Oklahoma City, charting upper air data on skew-T diagrams, and presenting group projects about weather careers.

OCS co-hosted the Science of Climate Change and Variability workshop at the Biological Station at Lake Texoma attended by 34 teachers. Oklahomans for Excellence in Science Education (OESE) invited OCS to provide speakers to help teachers better understand what scientists know about climate change and discuss how to teach these topics in their classrooms.

Forty drought presentations were made across the state during 2013, including two invited talks at the Oklahoma Legislature. OCS staff also made several presentations covering topics such as climate change and the Dust Bowl. OCS sent 171 "Mesonet Ticker" e-mails and 15 press releases detailing Oklahoma weather and climate themes. The Mesonet was mentioned over 500 times in the state's two largest newspapers. OCS personnel were featured in numerous print, television and radio pieces from local to national scale.

Agricultural outreach produced 12 Mesonet Connection publications exploring relevant issues surrounding climate and weather. Al Sutherland and Gary McManus produced weekly Mesonet Weather segments for OETA’s SUNUP-TV program, airing most Saturday mornings. Agricultural outreach also staffed a Mesonet booth at numerous meetings and conferences across the state, as well as providing informational talks concerning climate, weather and Mesonet products.
**Research**

Oklahoma Mesonet data was used in at least 16 peer reviewed articles during 2013. A listing of the many ongoing research projects, details about our research partners, and many of the peer reviewed publications that have utilized Oklahoma Mesonet data can be found on the Mesonet’s research page (http://www.mesonet.org/index.php/site/research).

As part of the ongoing efforts to produce soil moisture products utilizing the Oklahoma Mesonet's new plant available water product, OCS developed scripts to determine the current deficits in soil water that would be available to plants (http://www.mesonet.org/index.php/weather/category/soil_moisture).

To advance understanding of how socio-ecological systems can adapt sustainably to climate change, Oklahoma has been awarded $20 million over five years from the National Science Foundation Experimental Program to Stimulate Competitive Research (EPSCoR). The award will facilitate research and learning opportunities for college faculty, college students and K-12 students. This project received an additional $4 million in funding from the Oklahoma State Regents for Higher Education. The SC-CSC is a major participant in the award, with Dr. McPherson serving as the University of Oklahoma science lead. The research infrastructure improvement proposal establishes unique observing capabilities, especially for social sciences, as well as prediction and decision support capabilities for the state.

**Monitoring and Assessments**

During 2013, we completed 1,892 laboratory calibrations of sensors. Technicians made a total of 1,115 site visits to Oklahoma Mesonet stations, Little Washita and Fort Cobb ARS stations, repeaters and bases. The Field team resolved 256 problem trouble tickets and 807 total rotation tickets during 2013 in the three networks.

Following numerous requests from Oklahoma’s second largest metropolitan area, a new Mesonet site was installed in Tulsa on June 26th, also becoming the first trial of a site and base using Wi-Fi for communications.
The Oregon Climate Service (OCS) is the official AASC Recognized state climate office (ARSCO) for the state of Oregon. OCS staff are also a part of the Oregon Climate Change Research Institute (OCCRI) and participate in the NOAA-funded PNW Climate Impacts Research Consortium (CIRC).

The focus of the past year has largely been on communicating and supporting the evolving drought conditions. October 2013 - January 2014 was the fourth driest start to the water year on record. As of April 2014, nine Oregon counties (Jackson, Josephine, Grant, Wheeler, Crook, Klamath, Lake, Harney, Malheur) have official drought declarations. Mt. Ashland ski resort in southern Oregon did not open for the first time in its 50 year history. The snow that didn’t fall in the mountains made a rare double appearance at the low elevations in the Willamette Valley. Benton, Lincoln, Linn, and Lane Counties were declared Federal Disaster Areas because of the storms February 6-8 2014. OCS staff provided historical context for these events, noting that the last time 14” inches of snow had fallen was 21 years prior, in February 1993.

**Routine activities**
Staff answer about 10-15 requests per week by phone, e-mail, and personal meeting. Requests often increase in periods of active weather, or at end of season/year. Staff monitor and weigh in on drought monitor activity. OCS staff are sometimes asked to review climate pieces of documents produced by state and federal agencies.

**Highlights**

**Drought 2013-2014**
- April 2014: Kathie Dello and Phil Mote were contacted by Senator Merkley’s office to brief the Senator on drought conditions. We assembled a meeting at his office in Eugene, OR that included Oregon Water Resources Department (OWRD). OWRD was able to talk about the evolving situation in the Klamath and how water would be allocated this year per the new Klamath Basin Agreement.
- March and April 2013: In partnership with the Climate Impacts Research Consortium, we hosted drought briefing webinars with the Natural Resources Conservation Service (NRCS)
and NWS Medford. Each webinar was attended by up to 40 separate IP addresses with minimal advertising.

- October 2013: we helped to organize an Inland Northwest Drought Forum in Boise, ID (included eastern OR). The forum was co-hosted by the Climate Impacts Research Consortium and the Idaho Department of Water Resources.
- Ongoing: With drought conditions developing in Oregon, OCS hosts a weekly drought coordination call for the purpose of distilling and submitting input to the US Drought Monitor.
- Ongoing: Kathie Dello is a member of the state Water Availability Committee, and a voting member of the state Oregon Drought Council.
- Ongoing: Media requests increased dramatically from the period where California declared severe drought in mid-January through early March. Staff gave at least one media interview a day, including two stints on Oregon Public Broadcasting’s live show Think Out Loud, NPR’s Morning Edition, various other OPB appearances and other print, radio, and TV outlets.

**National Climate Assessment**

Phil Mote was a convening lead author on the Northwest Chapter of the third National Climate Assessment and a member of the National Climate Assessment Development and Advisory Committee (NCADAC)

**Oregon Hazard Mitigation Plan 2015 update**

Kathie Dello assisted the Oregon Department of Land Conservation and Development (and other agencies) with an update to the Oregon Hazard Mitigation Plan by writing portions of the the windstorms and climate change chapters.

**CoCoRaHS**

Kathie Dello continues to coordinate the CoCoRaHS network for Oregon, including enhanced partnerships with Oregon State University Forestry Extension.

**2014 AASC Annual Meeting Planning**

OCS is looking forward to co-hosting the 2014 Annual Meeting with the Office of the Washington State Climatologist at Skamania Lodge in Stevenson, WA. The meeting will run from July 8-11, 2014.

**Outreach**

Outreach is a major component of OCS activity. We typically use the following platforms:

- Twitter: The microblogging service has been an effective way of getting quick bits of timely climate and weather information out to interested parties. These people include local media, the general weather/climate-interested. There are 362 followers and local media outlets will pull directly from the feed. Contextual tweets are among the most retweeted/favorited by other users.
- Public presentation: Staff are asked to give presentations on Oregon climate. This can include historical climate, events of interest, current conditions, and the science and impacts of regional climate change. The audiences range from general public to decision-makers.
- Media: Staff gave over 75 interviews to print, TV and radio media over the past year. Weather and climate stories featuring OCS leadership are often cited in the daily OSU media digest.
These interviews are either requested by media (direct phone call) or follow a press release. Press releases are crafted in partnership with the Oregon State University News and Communications office. Popular topics in the past year aside from drought included two large Willamette Valley snowstorms, the extremes of 2013, and the summer wildfire season. We participated in a neat story with Climate Progress on Oregon’s wildfires using Google Glass.

**Relevant papers:**
2013 ARSCO Summary
Paul Knight, Pennsylvania State Climatologist
606A Walker Building
University Park, PA 16802
Ph: (814)863-1842  Fax: (814)865-3663
psc@meteo.psu.edu  http://climate.met.psu.edu/

The Pennsylvania State Climate Office database continues to incorporate observations from more than a half dozen separate networks within the Commonwealth. During the last year, the database has been reorganized allowing for the incorporation of more tools to the web interface. 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 2013, over 700 volunteer observers had enrolled and typically, about 250 faithfully report each day.

**Information Technology Capabilities:**
- About a dozen web data requests were logged each month (besides those by phone and the occasional US mail)
- Primary users are commercial, educational and government organizations
- The entire North American Regional Reanalysis data set (approximately 4.7 terabytes) is updated routinely so that the data have been completed through 12/31/13. This constitutes a 33-year data set. We have added select fields from the CFSv2 global analysis (1979-2012) (approximately 2.5 terabytes).

**Communication Capabilities:**
- The web server is now separate 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 and display. Our web server has been secure since January 2013 after a serious breach into our database during the previous year.

**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 Assessment:**

- The number of visitors to the site has increased about 20% while page views and site visit duration are down slightly from 2012. The following charts show the 2013 user volume, distribution and domains:
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 assured us of 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 ninth 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 updated with poor quality stations removed.

Special Projects:
- Collaboration with experts at Kansas State University continues with the refinement of environmental data monitoring systems for a Wheat Scab project
- 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. An additional project was included to study the F.A.S.T. bridge sprayer by Boschung with Dual-Pol radar data.
- Collaboration continues between ZedX, Inc. and the state climate office in providing forecast charts and commentary for the Soy Bean Rust and other rust spores (corn and wheat stem) with USDA.
- A project has been funded in collaboration with USDA-ARS and the Dept. of Soil Sciences to develop a fertilizer-forecasting tool for the Pennsylvania region so that nutrient run-off can be minimized and the efficacy of the nutrient can be maximized. This project has added 4 weather stations to the sub-hourly network.
- GS&T approached the climate office about joining the National Mesonet Program by contributing metadata from the COPAMS (DEP’s air quality network) as well as sub-hourly data sets.

SCEP:
- The Pennsylvania State Climate Office contributed monthly state weather summaries including its societal impacts to the Northeast Regional Climate Center during all of 2013 as per Task 2.1 of the 2013-2014 NCDC-SCEP agreement.
South Carolina Office of Climatology
Hope Mizzell, State Climatologist
Wes Tyler, Assistant State Climatologist for Service
Mark Malsick, Severe Weather Program Liaison
Administrative Assistant (Vacant)
Ivetta Abramyan (Intern)

Street Address: 1000 Assembly Street, Columbia, SC
Mailing Address: P.O. Box 167, Columbia, SC 29202
Ph: 803-734-9568    Fax: 803-734-9573
Mizzellh@dnr.sc.gov http://www.dnr.sc.gov/climate/sco

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 late 1800s. 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 2013:

Communication Capabilities:
- The office expanded the SCO website (http://www.dnr.sc.gov/climate/sco). Products were updated as needed.
- The office expanded the email notification system focused on severe weather notification and tropical advisories. The address list increased from 1506 in 2012 to 1,794 in 2013. The breakdown of subscribers is Agriculture 2%, Commercial 10%, Education 5%, Government 50%, Health 2%, Medical 1%, Personal Interest 29%, and Utility 1%.

Information Services:
- During 2013, the SCO averaged 40 monthly phone and email requests for climate data and 36,000 information retrievals from the SCO web site.
- Staff assisted SCDNR Law Enforcement, SC Highway Patrol, and County Solicitor Offices with 40 watercraft, vehicle, and criminal investigations.
- Media inquiries averaged 11 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.

- SCO provided 24 special weather event summaries during 2013. Examples include the severe weather event on March 18, affects of Tropical Storm Andrea on June 7, Savannah River watershed heavy rains and record flooding of Lake Hartwell, and the record setting snowfall of November 12.
- The Drought Response Program requires regular correspondence with 48 Drought Response Committee Members, four major power companies, and over 500 water utilities. Correspondence during drought events includes drought projections, official declarations, and suggested response. During 2013, the SC Drought Response Committee was convened once via a teleconference.
- 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 and providing a Climate Update at the Annual Meeting.

**Research:**

- 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.
- Staff finalized the Climate Connection Workshop Series Final Report which is available online [http://www.dnr.sc.gov/ccworkshops/](http://www.dnr.sc.gov/ccworkshops/).
- In partnership with the Columbia NWS, staff completed research focused on identifying the relationship between Southeast Cold Air Outbreaks and Extreme Negative Arctic Oscillation Anomalies.
- Staff began a project focused on documenting historical weather events that shaped SC History.

**Outreach:**

- The SCO provided approximately 40 annual presentations to various governmental, private sector, and civic organizations.
- Staff attended state and national conferences such as the American Meteorological Society (AMS) Annual Meeting, the AMS Washington Forum, the National Weather Association’s Annual Meeting, the Southeast Regional Climate Center’s Technical Advisory Committee’s Annual Meeting, and the American Association of State Climatologists Annual Meeting. Staff serves on the Palmetto Chapter of the American Meteorological Society.
- The SC State Climate Office hosted a “Partnership Meeting” for the four National Weather Service forecast offices serving South Carolina.
- The Assistant State Climatologist serves as commissioned law enforcement officer to assist SCDNR during weather emergencies.
- The State Climatologist serves on the American Meteorological Society’s Climate Services Committee.
**Monitoring and Impact Assessment:**

- The SCO produced and mailed certificates of recognition for CoCoRaHS observers reporting since the program's inception in 2008 (111 observers were recognized for their 5 years of service).
- 18 CoCoRaHS observers provided reports every day during 2013 and 130 observers reported at least 90% of the time. Through a Harry Hampton grant the office distributed 30 complimentary rain gauges to new CoCoRaHS observers.
- 52 GIS contour maps of the 1981-2010 SC Climate Normals (Maximum, Minimum Average Temperature and Precipitation) were produced and added to the website.
- Staff worked closely with the National Weather Service to monitor the COOP and ASOS data networks to maintain the quality of SC climate observations.
- Staff completed a short summary of Tropical Storm Andrea (June 2013).
- As a member of the State’s Emergency Operations Team, SCO staff participated in quarterly hurricane task force meetings, the annual full scale state hurricane exercise, the Governor’s Hurricane Roundtable Exercise, the Hurricane Season After Action/Lessons Learned Review Conference, and the Governor’s and the SC Adjutant General forecast products briefing. The Severe Weather Liaison issued 23 weather outlooks, 8 strong thunderstorm/tornado advisories, 30 tropical advisories/updates, and 4 winter weather advisories. He issued customized forecast information for the DNR Governor's Cup Billfish Tournaments, the SC Forestry Commission, SC Department of Transportation, SC Department of Public Safety, and the University of South Carolina’s Event Planning Department.
South Dakota Office of Climate and Weather
South Dakota Mesonet

**Dr. Dennis Todey – State Climatologist/Associate Professor**
**Laura Edwards – Extension Climate Field Specialist – SDSU Extension**
**Nathan Edwards – Network Engineer**
**Ryan Vanderleest – Data Management**

Agricultural and Biosystems Engineering
SAE 213 Box 2120
South Dakota State University
Brookings, SD 57007
Tel: (605) 688-5678  Fax: (605) 688-6764
climate@sdstate.edu
dennis.todey@sdstate.edu
http://climate.sdstate.edu

The South Dakota Office of Climate and Weather is part of the South Dakota State University Extension in the Department of Agriculture and Biosystems Engineering. The mission of the state climate office overlaps well with the mission of extension to provide science-based data and information and education to the people of the state to support the economy, livelihood and wellbeing of people in the state and to help provide information for decision-making throughout the state. As part of the SDSU Extension, the state climate office has connections across 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. Nathan Edwards and Laura Edwards are located remotely in the Aberdeen Regional Office of SDSU Extension.

**Personnel**

Dr. Dennis Todey continued as state climatologist and director of the climate office completing his 11th year in this position. Dr. Todey has served as the president of the American Association of State Climatologist and is the current ARSCO representative.

Laura Edwards completed her second year as extension climate field specialist in the Aberdeen Regional Office. She helped coordinate SDSU extension activities and reporting with the state climate office particularly with the agricultural community. She has also become co-state coordinator for Cocorahs. Many educational and news releases are coordinated between the climate office and SDSU Extension.
Nathan Edwards also completed his second year as the network engineer overseeing the South Dakota Mesonet network maintenance, data collection, and developing station support. He has also taken some responsibility in revamping data management in the office.

Ryan Vanderleest is in his second year managing databases and processing for the office helping transition to new data transfer streams and helping redeveloping the climate web site along with mobile data applications.

**Reporting - Events**
The South Dakota Climate Office joined in work following the October Plains Blizzard in 2013. In early October 2013 up to 30 inches of snow fell on the plains of western South Dakota with up to six feet in the northern Black Hills creating a huge travel issue and devastating to livestock in the region. Dr. Todey became an ad hoc forecaster to a group of federal partners attempting to complete a Missouri River Association of States and Tribes Meeting in Deadwood and leave ahead of the storm. Post storm event Dr. Todey was part of a state disaster team coordinating recovery efforts and collecting information on livestock losses from the storm.

2012 drought report
The state climate office was at the forefront along with SDSU extension during the drought of 2012. Weekly reporting on drought conditions and bi-weekly meetings with the state drought task force updating on conditions and outlooks were a large time consumer during the summer.

Work began on a NIDIS pilot for the Missouri Basin region. Several initial planning meetings gathered state and federal partners to plan the kick-off meeting. This was delayed from October 2013 to February 2014 because of the federal government shut-down.

Dennis Todey and Laura Edwards were heavily involved in regional work in conjunction with NOAA, USACE, USGS and other states on developing a report on the need for soil moisture and snow pack monitoring in the Plains of the Upper Missouri (WY, MT, ND, and SD). The outcome of the work was a draft report on needs and costs for improving this monitoring. This report is currently being utilized for potential federal appropriation on monitoring and as a guide for USDA work on soil moisture monitoring nationwide.

Working as part of SDSU Extension Laura Edwards and Dennis Todey cooperated on several weekly reporting efforts during the 2013 growing season including:
- Weekly Outlooks to SDSU extension Agronomy
- Weekly radio spots as part of IGrow Radio – SDSU Extension
- Bi-weekly news releases on crop conditions and updated climate outlooks

The SCO also reported on climate information weekly during the summer fire season. In cooperation with the South Dakota School of Mines and Technology (state fire meteorologist) and South Dakota Wildland Fire Suppression, we published a weekly discussion of fire conditions, weather and climate impacts on potential fire issues.

Drought conditions from 2012 carried over into early 2013 with D3-D4 still existing in western South Dakota during early 2013. The SCO and SDSU Extension continued to engage in
discussions on the USDM list especially helping coordinate South Dakota impacts and thoughts on DM working with the National Weather Service Drought Focal Points in the state. We also continued to interact with people at local levels pushing for collecting more drought information.

We reported on various records throughout the state including precipitation records from the blizzard and records from the year as a whole. Several stations set annual precipitation records in western South Dakota including Lemmon, Ludlow and Lead. Lead set an annual precipitation total of 49.52”. This has been determined to be the largest annual total in state history and is currently going through documentation for recognition as a state annual record.

**South Dakota Mesonet**
The state climate office manages, archives and supplies data from a 36 station automated weather station network across the state. Nathan Edwards continued work on the network in 2012. In 2013 the main activities continued trouble-shooting to stabilize poor-reporting stations and beginning work longer-term station management planning.

Currently about half of the stations have local sponsorship. Sponsors include:
- East Dakota Water Development District
- Several cities and counties
- Private agricultural firms
- Ag and electrical cooperatives
- Private individuals
- Pesticide applicators

Three dormant stations received sponsorship and were brought back on-line. Two new stations (Britton and Redfield) were deployed.

The SD Mesonet was also able to be the basis for a small grains disease model in collaboration with the SDSU Plant Science Department and North Dakota State University. The model is being rolled out in 2014.

**Traditional and Social Media**
The South Dakota State Climate Office and SDSU Extension have begun efforts to expand their traditional media presence with social media. Dennis Todye and Laura Edwards shared work on SDSU Climate on Facebook posting over 75 events throughout the year. Dennis also created several blog posts for the combined U2U/Sustainable Corn Blog, which were also shared via Facebook. Laura Edwards and Dennis Todye did numerous radio and TV interviews and well as creating weekly press releases. Many were part of the SDSU extension created a network called iGROW radio to deliver daily information via radio across the state. Dennis Todye and Laura Edwards collaborated on weekly weather/climate updates for iGROW radio.

The SCO overall did over 100 media interviews ranging from record precipitation to winter conditions and usual outlooks for farmer/producers in state and regional print, radio, TV and other media.
Research
Dr. Todey was part of two other ongoing USDA-funded projects during 2013. These were funded to do work on climate change issues and the corn system across the Midwest. The Corn CAP through Iowa State (www.sustainablecorn.org) will collect data on greenhouse gas emissions from crops, assess people’s understanding of climate and climate needs for their operations, develop tools to help producers use climate information and do climate education at multiple levels. The 2nd project (U2U – Useful to Usable) through Purdue (www.agclimate4u.org) is working on surveying of climate attitudes, tool development for agricultural producers and also some climate education. Data from these will be reported at the annual meeting and subsequent publications. The U2U project through Purdue included four other state climatologists (IN, MI, IL, and MO) and two regional center directors (MRCC and HPRCC). Laura Edwards worked on the extension portion of the Corn CAP conducting farmer interviews for the project.

Two new tools were released from the U2U project this year including the Ag Climate Viewed and the GDD Module. Both can be found at the U2U web site.

Laura Edwards conducted field research on drought-tolerant corn through a grant with Pioneer looking at components of the water balance.

The SCO contributed to a study relating various climate measurements on snow melt run-off into the Upper Missouri Basin through the US Army Corps of Engineers. This was an outgrowth of work from the Flood of 2011 on the Missouri looking at potential future issues on streamflows.

The SCO continued work with USDA Risk Management Agency to develop a web tool in response to the wet conditions across the northern Plains. Because of the recent wet period over the last 20 years many crop insurance claims have occurred because of excessive wetness. The web tool is designed to display summarized data for RMA, crop insurance companies and producers how precipitation compares to historical levels.

Outreach
Dr. Todey has been very active in collaborating with NOAA Central Region on regional climate activities including continued work on regional drought webinars. Documenting impacts and conducting several of the webinars were activities during the year. Monthly webinars were conducted throughout the year for the Great Plains and Central Region. Average attendance was 50-60. A review of the webinars is in process. Additional coordination with federal and state agencies occurred because of the wet fall across the northern plains watching for potential flooding. No specific products were developed. The goal was to make sure all agencies were communicating, agreed on the situation and potential issues and were prepared for additional work if conditions warranted.

Working with several other SCs, RCCs the NDMC and federal agencies we have developed 2 page drought impact and outlook publications for decision-makers in the Great Plains and Midwest.
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. Various issues with campus IT have delayed development and deployment of a new version of the web site. The state climate office has developed a new mobile page for display of the SD Mesonet Data. This page is available at http://climate.sdstate.edu/mobile.

The web site and individual responses continue to supply data for various users in the state and outside the state. Over 50 individual data request and several legal data requests have been supplied by the SCO during the last year. Dr. Todey was called to testify for two legal cases.

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. He has been invited to over 50 talks in the state and region including talks in MN, IA, and ND during the year.

The SCO continues as the state coordinator for Cocorahs – Laura Edwards has become state co-coordinator. The three National Weather Service Offices are regional coordinators. During the recent wet period South Dakota has had over 250 reports on various days, over half the “active” reporters. SD Signed up more to 60 new observers this year through efforts during “March Madness”, a rain gauge promotion at the Dakotafest Farm Show and several other individual local events.

**Education**
As part of the Sustainable Corn Project Dr. Todey is working on developing educational modules talking about climate and agriculture and potential changing climate issues.

Dr. Todey conducted part of teacher education classes through the South Dakota Discovery Center and though a watershed group. The sessions focused on water cycle and climate and student climate activities.

Dr. Todey does several in-class talks about climate, agriculture and impacts affecting changing climate on their interaction. He also team-taught a graduate course on land-surface climate and interaction with crops.

Dennis conducted a class for a lifelong learning course in Sioux Falls and Brookings as well as talking to service groups about various climate issues.

**AASC Executive Council**
Dr. Todey served as past-AASC president in 2012-13. He represented AASC at meetings with the Climate Prediction Center, coordinating with new states and discussion with NOAA and interactions between AASC, USDA and other federal agencies. After completing work as past-president, Dr. Todey took over the ARSCO coordinator position on the executive council.
Texas Annual Report, 2013

Highlights
The Texas State Climatologist received two awards during 2013, and the office established a Facebook presence.

Physical Location and Funding:
The Office of the State Climatologist (OSC) is housed in the Department of Atmospheric Sciences, Texas A&M University. During 2013, the OSC team included:

John Nielsen-Gammon  Texas State Climatologist
Brent McRoberts  Graduate Research Assistant
David Coates  Graduate Research Assistant
Matthew Raper  Graduate Research Assistant
Andrew Cook  Undergraduate Assistant

Operating funds are provided by Texas A&M University, with additional external grant funding for particular research projects. Cost recovery is available for large data requests.

Communication and Information Services:
In 2012, the OSC unveiled a new web site: http://climatexas.tamu.edu. In 2013, the OSC expanded its web presence by creating a Facebook page, also called ClimaTExas. Collectively, these two web sites have greatly streamlined our ability to convey important weather and climate information to Texas. Along with increased web hits and followers, we have experienced a decrease in data requests made directly to our office. In addition to data access, our web sites provide weekly and monthly climate reports and other updates generated internally and externally.

Research: One peer-reviewed article from the OSC was published in 2013.

This paper analyzed the 2011 extreme summertime weather conditions in and around Texas, specifically the heat and associated drought. Much of the drought intensity was explainable through the effects of La Niña, though random weather also played an important role. Long-term climate change was found to contribute to the high temperatures.

We presently have three externally-funded research programs, all supported by the USDA. The first is designed to improve and expand our high-resolution SPI products for use throughout the central and eastern United States. Teaming up on this project with us are state climatologists R.
Boyles and D. Niyogi. The second is designed to produce probabilistic soil moisture and streamflow forecasts for agricultural planning purposes, and includes collaborators in the College of AgriLife Sciences. The third investigates the dependence of year-to-year tick population variations on climate variations, and includes collaborators in the College of AgriLife Sciences and the College of Science.

**Outreach:**
In addition to the regular reports posted on the OSC web site, and responses to requests for climate data, the OSC conducts outreach through speaking engagements, press interviews, and blogging.

The ongoing drought conditions in Texas have led to widespread interest in location-specific weather and climate information. The number of fulfilled invitations for speaking engagements remains high. The State Climatologist gave 40 invited speeches to audiences in Texas and elsewhere in 2012, amassing over 11,500 highway miles in the process. Two presentations were in the form of testimony at hearings of the Texas Legislature.

The OSC provided numerous interviews to newspapers, news radio, and other media outlets. During 2013, Nielsen-Gammon was the subject of six Texas A&M University press releases and three Texas A&M Agrilife Crop and Weather reports.

The OSC’s outreach activities were the subject of one award made during 2013. The Texas A&M Chapter of Sigma Xi named John Nielsen-Gammon the 2013 Outstanding Science Communicator. Nielsen-Gammon also received the inaugural Texas A&M SEC Distinguished Achievement Award for combined long-term activities in teaching, research, and service.

**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.

Beginning in 2012, the OSC has served as host and organizer for weekly Texas Drought Monitor Coordination Conference Calls. These calls, held every Monday afternoon at 2:00 PM CT, are attended by National Weather Service personnel, extension agents, agency representatives, and drought monitor authors. The State Climatologist prepares a draft of suggested changes to the Texas portion of the weekly US Drought Monitor, and those changes are then discussed and amended. A summary of changes is sent to the Drought Monitor author and a copy is posted on the OSC web site.

Since December 2008, with partial assistance from 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://climatexas.tamu.edu/](http://climatexas.tamu.edu/) as well as on [http://www.stateclimate.org](http://www.stateclimate.org).
### 2013

<table>
<thead>
<tr>
<th>Title</th>
<th>Publication</th>
<th>Link</th>
<th>Full Citation</th>
</tr>
</thead>
</table>
What caused the winter drought in western Nepal during recent years?

**Full Title:** What caused the winter drought in western Nepal during recent years?

**Publication:** Journal of Climate

**Link:** No link available

**Full Citation:**

Intensification of pre-monsoon tropical cyclones in the Bay of Bengal and its impacts on Myanmar

**Full Title:** Intensification of pre-monsoon tropical cyclones in the Bay of Bengal and its impacts on Myanmar

**Publication:** Journal of Geophysical Research

**Link:** http://onlinelibrary.wiley.com/doi/10.1002/jgrd.50396/abstract

**Full Citation:**

Supportive empirical modeling for the forecast of monsoon precipitation in Nepal

**Full Title:** Supportive empirical modeling for the forecast of monsoon precipitation in Nepal

**Publication:** International Journal of Climatology

**Link:** http://onlinelibrary.wiley.com/doi/10.1002/joc.3649/abstract

**Full Citation:**

Quasi-biweekly mode and its modulation on the diurnal rainfall in Taiwan forecasted by the CFS

**Full Title:** Quasi-biweekly mode and its modulation on the diurnal rainfall in Taiwan forecasted by the CFS

**Publication:** Weather and Forecasting

**Link:** http://journals.ametsoc.org/doi/abs/10.1175/WAF-D-12-00120.1

**Full Citation:**

Impact of rain snow threshold (RST) temperature on snow depth simulation in land surface model and regional climate model

**Full Title:** Impact of rain snow threshold (RST) temperature on snow depth simulation in land surface model and regional climate model

**Publication:** Advances in Atmospheric Sciences

**Link:** http://dlserv.jql.usu.edu/paper/LST_Snow_Final_Draft.pdf

**Full Citation:**
Scholarly Paper Presentations

2013

Invited Asian Lecture Tour Oct 24 – Dec 2, 2013 (3 – 18; titles for talks given for conferences; otherwise left blank as comprised 2 or more talks (scientific and extension) day depending on venue)


Resources and Disasters in Mountainous Regions: Building Resilience to Changing Climate, Kathmandu, Nepal, November 26-29

5. Indian Institute of Tropical Meteorology (Climate Change Centre), Pune, India, November 21st 2013

6. Indian Agricultural Research Institute (Centre for Environment Science and Climate Resilient Agriculture), New Delhi, India, November 18th 2013

7. APEC (Asia-Pacific Economic Cooperation) Climate Center (APCC), Busan, Republic of Korea, November 15th 2013

8. Far East University, Chungbuk, Chungcheongbuk-do, Republic of Korea, November 13th 2013.

9. Vietnam National University, Ho Chi Minh City University of Science, Department of Oceanology, Meteorology and Hydrology, Ho Chi Minh City, Vietnam, November 11th 2013

10. Vietnam Academy of Science and Technology (VAST), Ho Chi Minh City, Vietnam, November 10th 2013

11. Weather Risk Explore Inc., Taipei, Taiwan, November 8th 2013

12. Chinese Culture University (Atmospheric Sciences, Taipei, Taiwan, November 7th 2013

13. Academia Sinica (Center for Environmental Change), Taipei, Taiwan, November 6th 2013

14. National Taiwan Normal University (Earth Sciences) & Central Weather Bureau, Taipei Taiwan, November 5th 2013

15. National Taiwan University (Forestry & Civil Engineering), Taipei, Taiwan, November 4th 2013

16. National Central University (Atmospheric Sciences & Hydrology – Oceanography Institute), Chung Li, Taiwan, November 1st 2013


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. National Science Foundation (NSF) and NOAA 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.

With the loss of the VTSCO graduate research assistant in AY 2010, undergraduate interns provided the primary assistance in AY2013-2014.

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:
- the VTSCO website (http://www.uvm.edu/~vtstclim) served as the portal for disseminating information and research. An unfunded NOAA SARP grant was resubmitted in November 2013 to work with Dr. Michael Brewer and team at the Climate Monitoring branch of NCDC (initiated during a SCEP funded visit in February 2011) on the creation of a seamless geospatial data portal for this site.
- AMS (American Meteorological Society) Applied Climatology Committee member – national liaison to the NOAA Regional Climate Centers and the American Association of State Climatologists.
- provided free data, expert opinions and recommendations via the telephone, facsimile, electronic mail and regular mail.

Information services:
- provided 9 media interviews about the excessive rainfall in June 2013, flooding in Montpelier (State Capital), 2013-2014 winter to both print (The Bridge, Associated Press,
Times Argus, Burlington Free Press, Rutland Herald) and television media (FOX44 Television, WCAX (CBS affiliate), CBS-New York).

- handled 11 email requests. These were primarily for Vermont State Agencies, undergraduate and graduate students seeking specific weather information for policy making, manuscript preparation or class projects.

**Research:**

- Supervised NOAA PACE (Postdocs Applying Climate Expertise) Postdoctoral Fellow (Dr. Evan Oswald) who joined the University of Vermont in August 2013. Dr. Oswald continues to work on climate change research related to forest health, air quality and human health, in conjunction with the Vermont Department of Health and the Vermont Agency of Natural Resources.
- CDMP-related data collection of weather and climate data in personal diaries from the mid-1970s from a farm in upstate New York. Databases of the contacts, findings and progress of visits around the state were updated.

**Outreach:**

- 8 public presentations on climate change in Vermont and the impacts on specific sectors such as gardening.
- **Plenary Speaker**, Climate Change Adaptation: Stormwater Management and Aquatic Ecosystem Impacts Workshops, organized in conjunction with the New England Association of Environmental Biologists (NEAEB) Annual meeting
- conducted a Service-Learning activity with my advanced seminar class (Climatology and Natural Hazards) on rewriting the atmospheric hazards sections of the FEMA-mandated State Hazard Mitigation Plan for submission to FEMA in May 2013.
- expanded the Vermont Weather and Climate Research group to 71 members including University of Vermont, Lyndon State College, Vermont Emergency Management, VTrans, National Wildlife Federation, Audubon Society, NOAA/NWS, NOAA Climate Services, US Forest Service, USGS, Atmospheric Research, Vermont Agency of Natural Resources/DEC/Air Quality, Vermont Agency of Natural Resources/DEC/Water Quality, Vermont Agency of Natural Resources/Forests, Parks and Recreation, NESCAUM, USDA/Farm Service Agency, USDA/NRCS, Lake Champlain Basin Program. The Working Group meets every three months to quantify the weather and climate needs of state and federal agencies in Vermont and New Hampshire over the short and long terms.

Submitted NOAA SARP grant proposal to pursue research needs identified.
University of Virginia Climatology Office

Department of Environmental Sciences
University of Virginia
Clark Hall
291 McCormick Road
Charlottesville, VA 22904-4123
Ph: 434-924-7761  Fax: 434-982-2137
Email: wx@virginia.edu
http://climate.virginia.edu

Philip J. Stenger, Director and State Climatologist

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 part of the center’s Technical Advisory Committee.

The office provides information and conducts research on the atmospheric environment and the impacts 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 users.

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. The office has enhanced real-time lightning detection and storm development monitoring capabilities, through the Telvent System.

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 down load 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. The office’s monthly video production Climate Advisory, a brief discussion of relevant topics regarding the climate of Virginia, was televised statewide on Public Television, public access channels and agricultural information networks. This collection is made available through the YouTube website.
Research
The office was a long-term integral participant in the ShenAir Institute Research Program, which focused on the Shenandoah Valley of Virginia. Under this program, the office was involved with air quality climatology, development of an asthma alert system and demographic relationships to respiratory health. After the formal conclusion of the contract period, the office is continuing follow-up discussions, publications and impact planning based on this work.

At the request of a local law enforcement agency in Virginia, this office is continuing a program of research into relationships between crime and weather conditions, including influences from geographical location, demographics and other factors. This office has been training and involving students in this work. Though in the preliminary phase, useful results have already been developed.

Additional significant research efforts of the office include:
• Examination of the relationships between climatic regimes and exacerbation of respiratory distress in collaboration with researchers at the U.Va. Health Sciences Center.
• Investigation of the relationships between large-scale atmospheric teleconnections and tropical cyclone impacts in over the Mid-Atlantic region.
• Investigation into the definition of and potential secular changes in the timing of seasonal transitions.
• Development of criteria for comparison of perceived intensity of seasonal conditions.
• Drought and drought impact research and monitoring.
• Analyses regarding thunderstorm precipitation distributions and relationships to flash flooding during two major events in Virginia.

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, on-line and television media.
• The office serves as a lead scientific contributor to the Virginia Drought Monitoring Task Force, with periodic conferences, drought reports and analyses.
• A series of Video Climate Advisories regarding aspects of Virginia climate, produced for television and web-based distribution, including PBS and Farm Bureau networks are archived and available through the office website and YouTube.
• 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 continues to increase substantially each year.
• Presentation of education and training lectures for the Virginia Master Naturalist Program at numerous locations around the state on an ongoing basis. This includes core instruction requirements for the program’s many chapters around the state.
• Informational presentations before local government and advisory groups regarding climate-related topics of community concern.
• Involvement with school (K-12) and community groups regarding climate science.
• Work with graduate and undergraduate students at the University of Virginia and other institutions on degree research and class-related projects.
• The office has been recognized by the National Weather Association as an approved institution for seal holders to receive recertification education and experience. As such, it provides this service to local television weather forecasters.

Monitoring and Impact Assessment

• Continuing work and publication regarding human health impacts in relation to changing weather conditions.
• Provision of data and impact assessment for and service as a member of the Virginia Drought Monitoring Task Force as lead climatologist.
• 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 formally accepted by FEMA, and now provides the guidelines for planning across the state. Assessment work continues for ongoing updates to the plan and proposed projects for mitigation and response are undergoing review and recommendation.
• Investigation into perceived severity of winter/summer conditions in Virginia, with specific emphasis on potential secular changes.

Papers Published in 2013:


In Preparation / Review:


Stenger, P.J., J.M. Rawley, B.R. Kennett. Secular Changes in the Relationship of ENSO with Atlantic Tropical Cyclones Impacting the Mid-Atlantic Region.

This report summarizes the Office of the Washington State Climatologist (OWSC) activities during the last 12 months (May 2013 through April 2014). The objectives of OWSC continue to be as follows: (1) to provide climate data for Washington for users ranging from the public to state agencies to professional scientists, (2) to represent a resource in the analysis and interpretation of the past, present, and future climate of the state, and (3) to conduct outreach and educational activities on behalf of the residents of Washington State. The office is affiliated with the Joint Institute for the Study of the Atmosphere and Ocean (JISAO) of the University of Washington and receives the majority of its financial support from the State of Washington. It seeks additional support from federal agencies to conduct research on issues related to regional climate.

Outreach and Support

OWSC has continued their outreach and support activities in the last 12 months. One of our most popular products, the monthly climate newsletter that summarizes the previous month’s weather events and puts them into a climatic context, now has over 320 subscribers. OWSC has maintained their website (www.climate.washington.edu) with links to climate and weather information, and made some essential changes to it as well. A student assistant, Luke Chang, was hired temporarily to do some backend coding to upgrade and improve some of the OWSC-developed tools on the site. Other website adjustments were also made, most notably to the snowdepth plotting tool (http://climate.washington.edu/snowdepth/) and additions to our climate events page (http://www.climate.washington.edu/events/). We have remained a reputable source for climate data and information requests that require more detail than our website provides (over 70 in the last 12 months). Aside from these requests, OWSC has been retained as expert witnesses for an hourly fee on a number of court cases. In some cases, in which the retainer has been a state agency such as the Department of Transportation, OWSC has provided expert reports pro bono.
OWSC continues to be involved in the Community, Collaborative, Rain, Hail and Snow (CoCoRaHS) program. OWSC also maintains a Facebook page in an attempt to engage the public, which currently has over 200 “likes”. A Twitter account has recently been added (@WAsateclimate), and has a modest following of 24 users. There is much larger following for the weekly guest segment of the State Climatologist on KUOW – the Seattle affiliate of National Public Radio.

Numerous appearances have been made by OWSC in the last 12 months, including scientific presentations at conferences and state agencies, guest lectures at the University of Washington, outreach demonstrations, and talks to the general public. An abbreviated list follows:

- PNW Climate Science Conference (September 2013), Beachwatchers (October 2013), NWS Emergency Management Workshop (November 2013), PNW Weather Workshop (March 2014), PNW Marine Waters Workshop (March 2014), Paws-on-Science at Pacific Science Center (April 2014), Conference on Climate Change and Horse Keeping (April 2014)

A large amount of effort went to supporting the WA State Department of Ecology in their drought monitoring efforts over the past winter. Conditions were extremely dry from October through January throughout the state, prompting the state to convene the Water Supply Availability Committee (WSAC). OWSC served on this committee, and also helped to provide continuity to the committee since it has been several years since dry conditions were enough of a concern to convene the committee. In addition, OWSC wrote brief summary reports of each meeting to assist in smoother operations of the committee in the future. A drought declaration was not needed due to improving conditions, but remaining dryness in eastern WA will require close monitoring as we enter our dry season.


Recent OWSC research efforts have focused on daily records of potential evapotranspiration (pET) in the Columbia Basin of eastern WA. Findings include an increase in summer mean pET since the late 1980’s that resulted from an increase in solar irradiance. Part of this increase is due to increase in clear-sky fluxes (“global brightening” as manifested regionally) and part is due to a decrease in boundary layer humidity; whether these trends are likely to continue is beyond the scope of the study. Synoptic patterns associated with high and low pET summers are also examined, and a journal article is currently in preparation.

OWSC is a member of a team at the UW and NOAA that are producing seasonal predictions for the coastal waters of the Pacific Northwest on an experimental, but semi-regular basis. The forecast system (J-SCOPE) is based on dynamical downscaling using a high-resolution ocean numerical model, and NOAA’s CFS climate model for boundary conditions. The predictions are being incorporated in an Integrated Ecosystem Assessment (IEA) carried out by NOAA’s Northwest Fisheries Science Center, and have attracted the attention of a variety of stakeholders (e.g., commercial fishers and shellfish growers) with coastal interests.
Collaboration between OWSC and the Oregon Climate Service on historical extreme heat events west of the Cascade Mountains that has been described in previous annual reports was officially published in the last 12 months. Another study on designing optimal observing networks that OWSC has been involved in for several years was also published. This research resulted in additional federal funding for a small portion of OWSC salary to perform a related study for a different region that is now in review.

**Publications:**

**AASC Activities**
OWSC is jointly hosting the 2014 AASC Annual Meeting with the Oregon Climate Service (OCS) at Skamania Lodge in Stevenson, WA in July. OWSC and OCS have been working with the AASC executive committee to organize and plan the meeting over the last year. This has included a site visit, setting up a meeting website, participation in the monthly executive committee phone call, helping with the meeting agenda, and managing many other details.
The mission of the West Virginia State Climate Office (WVSCO) is to deliver climate products and provide professional consultation to stakeholders, in addition to providing climate information/education to the public. In the past year, the WVSCO has been contacted by various stakeholders including engineers, researchers, and government agencies. The WVSCO also has been contacted to provide legal counsel and draft reports used in court cases and has been called to testify when deemed necessary.

In addition to consultation, the WVSCO assists in climatic education, taking the opportunity to speak with media outlets and educational institutions when possible. Last year, the WVSCO was called to speak at the West Virginia Science, Technology, and Research Symposium and has been invited to future events such as the Friend of Blackwater Symposium. The office is also continuing talks to help communities become Storm Ready, while helping organize Storm Spotter Training Talks with the local National Weather Service office.

The WVSCO continues to remain active with the CoCoRaHS network and plans to partake in new recruiting activities to increase the number of volunteers. The office has attended WV Farm Bureau meetings and visited schools around the state to help booster visibility of the program.

2013 Weather in Review

Compared to the previous year, 2013 was rather “uneventful” in West Virginia. No major floods/droughts or severe winter storms. But one of the interesting aspects in 2013, was that WV received more snowfall in meteorological fall and spring rather than meteorological winter (Dec., Jan, and Feb.). A system brought snow to the state in March, and of course the remnants of Superstorm Sandy brought heavy snow in October 2012. The winter was actually quite mild and was a welcome reprieve after the hectic 2012.

Temperatures were near normal for the year as precipitation was slightly above normal for the majority of the state. Even though the precipitation on the whole was slightly above normal, it predominantly came during the summer months after a dry winter and early spring.
From January to March, 2013 precipitation totals were up to 2 inches below normal over much of the state (Figure 1), however, the totals were more sporadic entering late spring. The northern part of the state continued to be dry while the southern part and portions of the eastern panhandle started to receive more precipitation (Figure 2) during the late spring. Ample rainfall spread over the entire state during the summer months as some areas saw between 2-6 inches more than normal (Figure 3). Rainfall subsided during the fall until late November and December. Heavy rains during Thanksgiving into December allowed 3 month October-December departures to be above normal (Figure 4). Fortunately, temperatures were above normal in December so that most of the precipitation was in the form of rainfall.
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. The SCO distributes and analyzes data for climate monitoring, provides climate information and interpretation to residents of Wisconsin, develops “value–added” climate for a wide user community, and conducts applied climate research with University and State collaborators. The part-time office staff consists of Lyle Anderson (salaried office manager, data management), Dr. Edward Hopkins (data access and analyses, website graphical products), and Emeritus Professor John Young (Director, scientific analyses, public science outreach, and liaison to University researchers).

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. Recent progress on the site includes:

- Climate History: Graphics that demonstrate observed climate variability by year and location through the state are routinely updated for separate seasonal pages. Extensive records for seven cities illustrate interannual and interdecadal fluctuations and recent climate trends.
- Probabilities of temperature, precipitation and extreme events are being expanded. “Chaotic power law” characteristics of heavy rain and uncertainty in recurrence intervals are being developed.
- Climate Watch- month-to-month climate anomalies for most recent year-long interval.
- Continued development of sections on Water, Energy, and Agriculture applications.

Data Services: The SCO staff answers questions and fills data requests made by telephone, fax, email and office visits. Advice is also provided on web links to climate data and maps from regional and national centers. Nearly 380,000 contacts are made annually from the public, media, private sector (e.g., legal, insurance) and governmental agencies. These consisted of more than 375,000 website visits, 550 email requests, and 170 telephone inquiries in 2013. Most routine requests made by the general public are answered without charge. A minimal service charge plus staff time is assessed for special data requests that require significant time or scientific effort. Partial support for unsalaried science staff travel to the AASC meeting is provided by these fees.

OUTREACH
The SCO continues to make its presence more widely known to University colleagues and residents of Wisconsin. In addition to interviews with the electronic and print media in the state, John Young (http://experts.news.wisc.edu/experts/show/2067) gives lectures on climate variability, change, and impacts to the Department, other University groups, service and retirement organizations, and occasional conferences.
University of Wisconsin- John Young continues to be liaison with staff and students in the Department of Atmospheric & Oceanic Sciences (AOS), and campus science groups. In addition to AOS, he participates in the weekly Physics Department’s Chaos and Complexity Seminar and Applied Mathematics Seminar, is now an invited member of the “4th Tuesday” dinner group of senior campus scientists, and interacts with climate-related research faculty in other departments. He is an Affiliate Member of the Center for Climate Research. In the past year, he spoke to graduating AOS seniors on “Exploring the Intersections of Weather, Climate, and Impacts” and “Views of Climate Chaos”. His latest Physics talk in 2014 was “Variability, Uncertainty and Vulnerability in our Chaotic Climate”. Ed Hopkins’ role as “Dr. Data” has expanded to include assistance to student researchers from several departments, and consultation on data issues with the Center for Climate Research.

Climate Change and Variability- In 2013-14, Young continued to speak on themes of regional change, variability, extremes, and impacts to public and university groups. In addition to some television and newspaper interviews, the News page of the University web site published some interviews with him on specific Wisconsin climate events. Special attention in 2013-14 was on (a) trends in lake ice cover and winter temperatures in Wisconsin, (b) the exceptionally wet spring of 2013, (c) the subsequent renewed drought lasting into 2014, and (d) the record winter due to the “polar vortex”. Young interacted with University Extension affiliates on the drought issue, including assessment of both short-term and long-term aspects and the impact of frozen soil. He spoke at a special Climate Change Extension lecture series in Iowa County on “Understanding Wisconsin Impacts in a Changing Climate”. Hopkins gave talks on Wisconsin climate and extreme weather to public groups in southern Wisconsin, including a keynote address at a statewide conference of golf course turf managers.

Climate Change and Adaptation- In 2008, the SCO was recognized as a collaborator within the developing Wisconsin Initiative on Climate Change Impacts (WICCI), a multidisciplinary program involving university and government scientists that issued a major report in 2012. Young currently serves on the WICCI Outreach Committee. This collaboration is a basis for an expanded SCO mission in Wisconsin climate change science applications in the future, and collaborations with colleagues in the Center for Climate Research. Young also participated in the March 2014 “Midwest Climate Collaboration Meeting” hosted by MRCC in Illinois.

State Emergency Board- In 2013 the SCO continued to serve as ex-officio members of the State Emergency Board for the USDA Farm Services Administration, which reviews specific weather/climate events contributing to crop damage.

National Weather Service- SCO regularly interacts with staff members in three NWS offices regarding weather/climate extremes and climate issues.

RESEARCH
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. In April 2013, Young’s one-year collaboration with NCDC scientists K. Kunkel, T. Karl, and K. Redmond of
WRCC on future changes in Probable Maximum Precipitation resulted in an article published in *Geophysical Research Letters*. Continuing related work is done on campus with Prof. J.C. Sprott regarding power laws in chaotic precipitation records.

The SCO continues to collaborate with WICCI scientists from across the campus. Ed Hopkins is analyzing weather extremes reported at individual stations throughout the state and is a member of the State Climate Extremes Committee. He assisted Prof. S. Temple with the data basis for his heavily cited 2013 paper on phenological changes linked to climate trends. Preliminary collaborations included (a) using SCO precipitation data for careful river basin water budget changes with Prof. S. Kung, and (b) solar and climatological data for driving crop growth models for dairy industry applications. The latter research has resulted in five journal articles by V. Cabrera and colleagues in the Dairy Science Department.

**PROSPECTS AT END OF 2013 –**

- Continue working toward a more formal relation of the SCO with the University: improvement of our minimally funded office with funds for AASC dues, supplies, and one salaried individual.
- Major University changes during 2013-14 occurred, with a new Chancellor and a Letters & Sciences College Dean: possible opportunities and questions of improved funding opportunities in a prolonged era of decreasing State support.
- 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.

---

**Contact Information** –

Wisconsin State Climatology Office

1225 W. Dayton St.

Madison, WI 53706

Phone: 608-263-2374

Fax: 608-262-0166

Email: STCLIM@aos.wisc.edu

Meteorology and Space Science Building, on UW-Madison campus, home of Wisconsin State Climatology Office (photo by Hopkins)
The Wyoming State Climate Office (SCO; http://www.wrds.uwyo.edu/sco/climate_office.html) is a part of the Wyoming Water Resources Data System (WRDS; http://www.wrds.uwyo.edu) and together are the single largest providers of water- and climate-related data in the state. Established in 1967 and 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 provides 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

Providing Support for Resource Management in the State and Region

- Digitization of daily and spot Diversion records for Water Division IV. These data are made available to resource managers for determining available flow during various hydrologic conditions and the digitization expands upon last year’s project which consisted of capturing solely the districts encompassing the Upper Bear River Basin. The groundwork has been lain for expanding into other divisions and this will begin shortly when we will begin digitizing records from Water Division II. This area is also the next basins to be updated as part of the statewide basin water-planning update.
- Continued CoCoRaHS participation is helping us provide precipitation data for parts of the state where there is otherwise no non-modeled information. We have also used CoCoRaHS as a means of connecting with various stakeholder groups to let them know of our capabilities and what sorts of information we can provide to them that they may not have otherwise been aware of.
**Coordinating and supporting the collection of weather and climate data**

Over the past year, WRDS/SCO has continued to be involved in supporting and enhancing weather/climate data collection platforms in the state. WRDS/SCO has begun a cooperative effort with the Department of Civil & Architectural Engineering to monitor and report real-time precipitation and streamflow around Laramie to assist with flood warning and modeling.

WRDS/SCO continues to maintain and enhance the NWS COOP station (485435, Laramie 2NW) which it has done for more than 45 years. Continued enhancement of the station was done during 2013 upgrading some of the components.

CoCoRaHS continues to play an important part in operations at the WRDS/SCO. Record numbers of observers were active and record numbers of observations were reported. Emphasis has continued on invigorating observers and trying to get observers who have gone inactive back reporting.

With another effective March Madness campaign (resulting in Wyoming capturing the per capita trophy for recruiting a second year in a row) and active recruiting throughout the year, more than 135 new stations were added between 01 May of 2013 and 30 Apr of 2014.

**Weather and climate research, assessments, and data dissemination**

- Continued to offer ready access to a large suite of water and climate-related data via the World Wide Web. These web products continue to serve an increasing audience with the number of visitors being up around 33% compared to the previous year.
- The number of traditional (phone, email, mail, walk-in) requests has decreased again and was lower by about 20% compared to the same time period the year before. This is attributed to the continued increase in the amount of products being placed online. One thing noticed is that the number of specialized requests is going up. These are requests for data that require some extra packaging or data processing to produce the end product that the requestor is interested in.
- WRDS/SCO maintains a circulating Library containing over 21,000 documents on water and climate. The Library has weekly visits by students, faculty, and consultants. Digitization of historical Water Development Project Reports is nearing completion and efforts in this area will be concentrated on making new reports available online as consultants finish them. We are continuing to work at making older water resources related documents available online and this will be an ongoing project.
  - [http://library.wrds.uwyo.edu](http://library.wrds.uwyo.edu)
- Numerous interviews with media (radio and newspaper) related to the extreme temperatures during the winter and the heavy snowpack that was seen in several basins around the state. Work sessions held with City Council related to flood monitoring and the goal of putting more real-time instruments on important tributaries to provide advance warning of increasing flows.
- Like last year, there was a spin-off from the CoCoRaHS promotion in March that enhanced the overall visibility of WRDS/SCO and prompted invitations to speak to multiple groups and organizations.
Representative Publications

Service/Outreach Publications

- 2013 Public Water System Survey
- Wyoming section of: *Central Plains 2012 Drought Assessment*

Compiled by Tony Bergantino
AASC Current State Climatologists/Office Directors (updated spring 2013):

<table>
<thead>
<tr>
<th>State</th>
<th>State Climatologist/Office Director</th>
<th>ARSCO</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alabama</td>
<td>John Christy</td>
<td>Yes</td>
</tr>
<tr>
<td>Alaska</td>
<td>Peter Olsson (SC), Gerd Wendler (Director)</td>
<td>Yes</td>
</tr>
<tr>
<td>Arizona</td>
<td>Nancy J. Selover</td>
<td>Yes</td>
</tr>
<tr>
<td>Arkansas</td>
<td>Michael J. Borengasser</td>
<td>No</td>
</tr>
<tr>
<td>California</td>
<td>Michael Anderson</td>
<td>Yes</td>
</tr>
<tr>
<td>Colorado</td>
<td>Nolan Doesken</td>
<td>Yes</td>
</tr>
<tr>
<td>Connecticut</td>
<td>X. Harrison Yang</td>
<td>Yes</td>
</tr>
<tr>
<td>Delaware</td>
<td>Daniel J. Leathers</td>
<td>Yes</td>
</tr>
<tr>
<td>Florida</td>
<td>David Zierden</td>
<td>Yes</td>
</tr>
<tr>
<td>Georgia</td>
<td>Bill Murphey</td>
<td>No</td>
</tr>
<tr>
<td>Hawaii</td>
<td>Pao- Shin Chu</td>
<td>Yes</td>
</tr>
<tr>
<td>Idaho</td>
<td>Russell Qualls</td>
<td>Yes</td>
</tr>
<tr>
<td>Illinois</td>
<td>Jim Angel</td>
<td>Yes</td>
</tr>
<tr>
<td>Indiana</td>
<td>Dev Niyogi</td>
<td>Yes</td>
</tr>
<tr>
<td>Iowa</td>
<td>Harry Hillaker</td>
<td>Yes</td>
</tr>
<tr>
<td>Kansas</td>
<td>Xiaomao Lin</td>
<td>Yes</td>
</tr>
<tr>
<td>Kentucky</td>
<td>Stuart Foster</td>
<td>Yes</td>
</tr>
<tr>
<td>Louisiana</td>
<td>Barry Keim</td>
<td>Yes</td>
</tr>
<tr>
<td>Maine</td>
<td>George L. Jacobson</td>
<td>No</td>
</tr>
<tr>
<td>Maryland</td>
<td>Konstantin Vinnikov</td>
<td>No</td>
</tr>
<tr>
<td>Massachusetts</td>
<td>David Taylor</td>
<td>No</td>
</tr>
<tr>
<td>Michigan</td>
<td>Jeff Andresen</td>
<td>Yes</td>
</tr>
<tr>
<td>Minnesota</td>
<td>Greg Spoden</td>
<td>Yes</td>
</tr>
<tr>
<td>Mississippi</td>
<td>Michael Brown</td>
<td>Yes</td>
</tr>
<tr>
<td>Missouri</td>
<td>Patrick Guinan</td>
<td>Yes</td>
</tr>
<tr>
<td>Montana</td>
<td>Kelsey Jencso</td>
<td>No</td>
</tr>
<tr>
<td>Nebraska</td>
<td>Allen Dutcher</td>
<td>Yes</td>
</tr>
<tr>
<td>Nevada</td>
<td>Douglas P. Boyle</td>
<td>No</td>
</tr>
<tr>
<td>New Hampshire</td>
<td>Mary Stampone</td>
<td>Yes</td>
</tr>
<tr>
<td>New Jersey</td>
<td>David Robinson</td>
<td>Yes</td>
</tr>
<tr>
<td>New Mexico</td>
<td>David DuBois</td>
<td>Yes</td>
</tr>
<tr>
<td>New York</td>
<td>Mark Wysocki</td>
<td>No</td>
</tr>
<tr>
<td>North Carolina</td>
<td>Ryan Boyles</td>
<td>Yes</td>
</tr>
<tr>
<td>North Dakota</td>
<td>Adnan Akyuz</td>
<td>Yes</td>
</tr>
<tr>
<td>Ohio</td>
<td>Jeffrey C. Rogers</td>
<td>No</td>
</tr>
<tr>
<td>Oklahoma</td>
<td>Renee McPherson</td>
<td>Yes</td>
</tr>
<tr>
<td>Oregon</td>
<td>Philip Mote</td>
<td>Yes</td>
</tr>
<tr>
<td>Pennsylvania</td>
<td>Paul Knight</td>
<td>Yes</td>
</tr>
<tr>
<td>Puerto Rico</td>
<td>Amos Winter</td>
<td>No</td>
</tr>
<tr>
<td>Rhode Island</td>
<td>VACANT</td>
<td>No</td>
</tr>
<tr>
<td>South Carolina</td>
<td>Hope Mizzell</td>
<td>Yes</td>
</tr>
<tr>
<td>South Dakota</td>
<td>Dennis Todey</td>
<td>Yes</td>
</tr>
<tr>
<td>State</td>
<td>Name</td>
<td>Yes/No</td>
</tr>
<tr>
<td>---------------</td>
<td>-------------------------------</td>
<td>--------</td>
</tr>
<tr>
<td>Tennessee</td>
<td>VACANT</td>
<td>No</td>
</tr>
<tr>
<td>Texas</td>
<td>John Nielsen-Gammon</td>
<td>Yes</td>
</tr>
<tr>
<td>Utah</td>
<td>Robert Gillies</td>
<td>Yes</td>
</tr>
<tr>
<td>Vermont</td>
<td>Lesley-Ann Dupigny-Giroux</td>
<td>Yes</td>
</tr>
<tr>
<td>Virginia</td>
<td>Philip Stenger</td>
<td>Yes</td>
</tr>
<tr>
<td>Washington</td>
<td>Nick Bond</td>
<td>Yes</td>
</tr>
<tr>
<td>West Virginia</td>
<td>Kevin Law</td>
<td>Yes</td>
</tr>
<tr>
<td>Wisconsin</td>
<td>John Young</td>
<td>Yes</td>
</tr>
<tr>
<td>Wyoming</td>
<td>Tony Bergantino</td>
<td>Yes</td>
</tr>
</tbody>
</table>