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Inside

Global Warming: Frequently Asked Questions

By David Easterling and Tom Karl, National Climatic Data Center, Asheville, NC

This is the second of three parts of this article.

El Niños Related to Global Warming?

El Niños are not caused by global warming. Clear evidence exists from a variety of sources, including archaeological studies, that El Niños have been present for thousands, and some indicators suggest millions, of years. It has been hypothesized, however, that warmer global sea surface temperatures may be enhancing the El Niño phenomenon, which have been more frequent and intense in recent decades. Whether the occurrence of El Niño periods changes with climate change is a major research question.

Is the Water Cycle Changing?

Globally-averaged precipitation over land shows a statistically insignificant upward trend with most of the increase occurring in the first half of the 20th century. Further, precipitation changes have been spatially variable over the last century.

On a regional basis, increases in annual precipitation have occurred in the higher latitudes of the Northern Hemisphere and southern South America and northern Australia. Decreases have occurred in the tropical region of Africa, and southern Asia. Due to the difficulty in measuring precipitation, it has been important to constrain these observations by analyzing other related variables. The measured changes in precipitation are consistent with observed changes in stream flow, lake levels, and soil moisture where data are available and have been analyzed.

Northern Hemisphere snow cover extent has consistently remained below average since 1987, and has decreased by about 10% since 1966. This is mostly due to a decrease in spring and summer snowfall over the Eurasian and North American continents since the mid-1980s; however, winter and autumn snow cover extent has shown no significant trend for the Northern Hemisphere over the same period.

Clouds are also a key indicator of climate change. Surface-based observations of cloud cover suggest increases in total cloud cover over many continental regions. This increase since 1950 is consistent with regional increases in precipitation for the same period. Global analyses of cloud cover over land for the 1976-2003 period show little change.

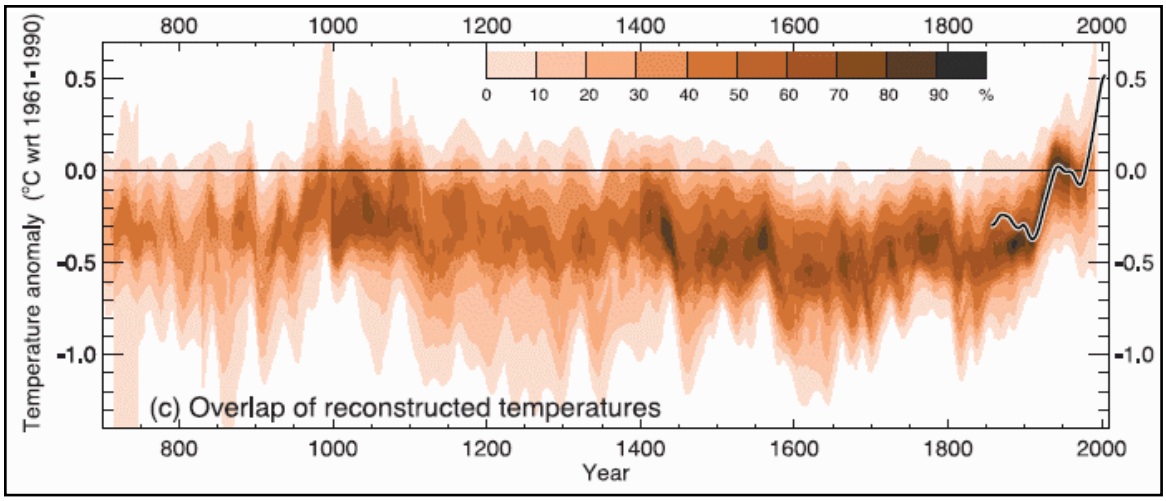
Is the atmospheric/oceanic circulation changing?

A rather abrupt and persistent change in the El Niño-Southern Oscillation (ENSO) behavior occurred around 1976-77. There have been relatively more frequent and persistent El Niño episodes rather than the cool La Niñas. This behavior is highly unusual in the last 130 years, the period of instrumental record. Changes in precipitation over the tropical Pacific are related to this change in the El Niño-Southern Oscillation, which has also affected the pattern and magnitude of surface temperatures. It is unclear, however, whether this apparent change in the ENSO cycle is related to global warming.

Is the climate becoming more variable or extreme?

Examination of changes in climate extremes requires long-term daily or even hourly data sets which, until recently, have

For the Northern Hemisphere temperature, recent decades appear to be the warmest since at least about 1000 AD



Intergovernmental Panel on Climate Change Fourth Assessment Report (AR4)
http://ipcc-wg1.ucar.edu/wg1/wg1-report.html

been scarce for many parts of the globe; however these data sets have become more widely available, allowing research into changes in temperature and precipitation extremes on global and regional scales. Global changes in temperature extremes include decreases in the number of unusually cold days and nights and increases in the number of unusually warm days and nights. Other observed changes include lengthened growing seasons and decreases in the number of frost days.

Global temperature extremes have been found to exhibit no significant trend in inter-annual variability, but several studies suggest a significant decrease in intra-annual variability. There has been a clear trend to fewer extremely low minimum temperatures in several widely-separated areas in recent decades. Scientists have not observed widespread significant changes in extreme high temperature events. There is some indication of decreasing temperature variability in recent decades.

In areas where a drought or excessive wetness usually accompanies an El Niño or La Niña, these dry or wet spells have been more intense in recent years. There is some evidence for increasing drought worldwide, however, in the United States as a whole, there is no evidence for increasing drought.

In some areas where overall precipitation has increased (i.e., the mid-high northern latitudes), there is evidence of increases in the heavy and extreme precipitation events. Even in areas such as eastern Asia, it has been found that extreme precipitation events have increased despite total precipitation remaining constant or even decreasing somewhat. This change is related to a decrease in the frequency of precipitation in this region.

Many studies show extra-tropical cyclone activity seems to have increased over the last half of the 20th century in the northern hemisphere, but decreased in the southern hemisphere. Furthermore, hurricane activity in the Atlantic has shown an increase in number since 1970 with a peak in 2005. It is not clear whether these trends are multi-decadal fluctuations or part of a longer-term trend.

How important are these changes in a long-term context?

Paleoclimatic data are critical for enabling scientists to extend our knowledge of climatic variability beyond what is measured by modern instruments. Many natural phenomena are climate dependent, such as the growth rate of a tree for example, and as such, provide natural 'archives' of climate information.

Some useful paleoclimate data can be found in sources as diverse as tree rings, ice cores, corals, lake sediments (including fossil insects and pollen data), speleothems (stalactites etc), and ocean sediments. Some of these, including ice cores and tree rings, provide scientists with a chronology due to the nature of how they are formed, and so high resolution climate reconstruction is possible

in these cases. There is not a comprehensive network of paleoclimate data as there is with instrumental coverage, however, so global climate reconstructions are often difficult to obtain. Nevertheless, combining different types of paleoclimate records enables us to gain a near-global picture of climate changes.

For the Northern Hemisphere temperature, recent decades appear to be the warmest since at least about 1000 AD, and the warming since the late 19th century is unprecedented over the last 1000 years. Older data are insufficient to provide reliable hemispheric temperature estimates. Ice core data suggest that the 20th century has been warm in many parts of the globe, but also the significance of warming varies geographically, when viewed in the context of climate variations of the last millennium.

The last Ice Age brought large and rapid climatic changes affecting the atmospheric and oceanic circulation as well as temperature and the hydrological cycle. This period marked the transition to the present Holocene period, which began about 10,000 years ago. Based on the incomplete data available, the projected temperature change of 3°F to 7°F (1.5 - 4°C) over the next century would be unprecedented in comparison with the best available records from the last several thousand years.

Look for the final installment of this article in the summer edition of the **National Cooperative Observer**. ❄

Mystic Lake Dam Helps Keeps the Wilderness Safe

PPL Montana's Mystic Lake Dam, a source of clean, renewable energy for more than 80 years, is also valued for its reliability as a weather data collection station.

Since August 1, 1924, Mystic has been supplying daily weather information— precipitation, temperature, wind speeds—to the NWS office in Billings. It's the oldest of about 70 official weather data collection sites in southern Montana.

Mystic Lake Dam Coop Site

"Every day at 4 in the afternoon, I log on to a secure Website and input the weather data measured by gauges supplied by the National Weather Service," said Ryan Olson, Hydro Foreman at PPL Montana's Mystic Lake hydroelectric plant.

"Generating electricity is the main thing we do here, but our weather data responsibilities help a lot of people who come to the region to fish, camp and hike," Olson said. "Weather can be extreme here—we measured as much as 8 feet of snow this winter and temperatures nearly 20 below zero in January."

Sally Springer, Observing Program Leader (OPL) for NWS Billings, comments, "Mystic is right on the edge of Beartooth Mountains and provides us with extensive coverage of weather conditions in Stillwater County," she said. "It gives a good representation of the area and is the last outpost in a remarkably expansive wilderness area. Ryan also includes unusual or interesting wildlife sitings, which we record as well."

Mystic's weather data is sent to Billings where's it's checked and entered into a computer system accessible to the public. The data is then archived at the National Climatic Data Center in Asheville, N.C.

"By gathering weather information, the staff at Mystic Lake provides an important service for the public and for meteorologists at the NWS," Springer said. ❄

"Weather can be extreme here—we measured as much as 8 feet of snow this winter and temperatures nearly 20 below zero in January."

True Tales from Coop Subscribers

This column is from our readers who have shared their real life weather tales. We welcome submissions. Send them to melody.magnus@noaa.gov

Twisters Keep Life Lively

From Debbie Shelton, Manassas, VA

I am a stay-at-home mom with two kids, Alex and Natalie. I enjoy volunteering with my church and the Junior Woman's Club of Manassas. Every time I tell people about being a cooperative observer, they are fascinated by it.

A tornado in Kansas was just one of many weather experiences that have affected me. I have been in severe storms here in Virginia, including the one in August 2003 when a tornado touched down here in Manassas.

Debbie Shelton

I rely heavily on my NOAA Weather Radio to alert me in such situations. I often call other friends and family members to tell them about weather conditions, especially when there are warnings in the area. I used to email people when I still worked full-time and I was known as the "office weather watcher" even before I became a cooperative observer. ❄

Winter in the Infantry

From Ken Pleger, Formerly 9th U.S. Infantry

I was in the 9th Infantry years ago during a winter to remember. Being a desk clerk, I didn't have to go out into the field every time they had an alert. I was in supply for the battalion. One night we had an alert and it was my turn to go into the field with the outfit. I borrowed my buddy's shelter half so I had a whole tent and away I went. It was January in Bavaria and the weather was much like Michigan, so I was comfortable with it.

Winter in Bavaria

We started out following the convoy to who knows where. Finally after about an hour's ride we pulled off into a small wood. I checked with our officers and found out we were going to be here the rest of the night, so I set up my tent and blew up my air mattress and crashed.

At the time we had about 6" of snow on the ground. Most of the rest of the guys slept in the back of the trucks or in the cabs.

In the morning, I heard the cooks starting to go to work and being a hungry GI, I decided to warm up my tent with my Coleman lantern and get dressed for chow; however, after I lit my lantern it didn't seem to want to warm up at all. I was in my nice warm mountain sleeping bag and I dropped off to sleep again.

All of a sudden I felt snow hitting me in the face. Thinking someone was playing a joke or one of the buttons on my tarp had come loose I looked up and watched as my breath condensed and fell back into my face as snow.

What I thought was 10 or 12 inches of snow outside my tent, turned out being my breath condensed on the inside of the tent. It had gotten down to below zero and everything was frozen including our trucks. We had to stay out another couple of days before we could go in and warm up, but it never got that cold again. ❄

"All of a sudden I felt snow hitting me in the face. Thinking someone was playing a joke or one of the buttons on my tarp had come loose I looked up and watched as my breath condensed and fell back into my face as snow. "

60 Year Helmut E. Landsberg Award

From left, Nolan Doeskin, Colorado State Climatologist; **Sally and Layton Munson**; Carl Burroughs, Hydrometeorological Technician (HMT); and Byron Louis, Data Acquisition Program Manager (DAPM).

The Helmut E. Landsberg Award was presented to **Layton Munson,** observer at Sedgwick, CO, for 60 years of service**.** Layton was the first person in Colorado to receive this award. Layton's wife, **Sally,** was presented a Special Service Award for her outstanding support of the Cooperative Weather program.

Layton has also received the Benjamin Franklin and the Edward H. Stoll Awards. He took his last observation September 30, 2007. The site was moved 1/4 mile south to his nephew Dennis Musgrave's farm.

55 Year Benjamin Franklin Award

Cooperative Observer **Edmund Somerfeld**, right, accepts the Benjamin Franklin Award from Michael Mercer, Meteorologist in Charge (MIC), at NWS Great Falls, MT. Edmund began taking observations near Power, MT, for the NWS in 1953 as a high school sophomore, but his fascination with weather led him to begin writing down weather readings in the late 1940s. Photo taken by Cooperative Program Manager (CPM) Richard Prewitt.

50 Year Edward Stoll Service Awards

From left are Nolan McNeill, former Missouri State Representative; **Jack and Becky Cunningham**; and Bob Corcoran, Anderson Mayor.

Jack Cunningham of Anderson, MO, was presented with the 50 Year Edward Stoll Award. Present for the ceremony were Bill Davis, MIC, WFO Springfield, MO; Lynn Maximuk, Director of NWS Central Region; David Racuh, District Director with U.S. Sen. Claire McCaskill's office; and Gene Hall, McDonald County Circuit Court. Photo by Larry Dooley, OPL.

Edwin Engel has been the Cooperative Observer for Loretta, KS, since 1958 when he took over from his father, **Anton**, who began the station in 1940.

The ceremony to present the award included Mike Looney, Chief of Services Division for NWS Central Region Headquarters in Kansas City; Duane Wolfe, CPM, NWS Dodge City, KS; as well as Edwin and Ruth's family and friends. Photo by Jesse Lee, OPL.

From left, Larry Ruthi, MIC, NWS Dodge City, KS, presents a 50 Year Edward H. Stoll Award to **Edwin Engel** and his wife **Ruth** of Loretta, KS.

75 Year Honored Institution Awards

David Johnson of the **Penn State Southeast Center of the Agricultural Experimental Station** accepts a 75 Year Honored Institution Award for the Landisville Station in Manheim, PA. The award was presented by Paul Head, CPM, NWS State College, PA. The Penn State Southeast Center conducts experiments on new growing methods in agricultural products. The Landisville station began taking observations on January 1, 1932.

Pictured from left are Observer **David Johnson** and CPM Paul Head. Photo by NWS OPL Victor Cruz.

Pictured from left are NWS State College, PA, OPL, Victor Cruz**, Safe Harbor Water Power Corp** staff members **Dwight Brenner, Mike Corradino, Steve Byers, Gary Broderick, Terry Kreider** and CPM Paul Head. Photo by Tom Russell, Chief Meteorologist of WHP TV, Channel 21, CBS News, Harrisburg, PA.

Steve Byers, Plant Manager, and the staff at **Safe Harbor Water Power Corporation**, Conestoga, PA, accept a 75 Year Honored Institution Award. The award was presented by Victor Cruz, OPL, and Paul Head, CPM, NWS State College, PA. Construction on the Safe Harbor Dam began in 1929 and was completed in 1931. Staff have been taking Coop Observations since December 1932. In one day, at maximum output, the Safe Harbor Hydroelectric plant generates approximately 10 million kilowatt-hours (kWh) of electrical energy. In a year's time, the plant averages over a billion kWh. This total is dependent on the yearly average of the river flow. The power flowing from Safe Harbor is used primarily to meet peak demands for electricity.

75 Year Honored Institution Awards

James Murakami, right, with the **Department of Atmospheric and Oceanic Sciences at the University of California**, Los Angeles (UCLA), accepts a 75 Year Honored Institution Award. The award was presented by Lead Forecaster Dave Gomberg, NWS Los Angeles. Photo by Dessa Emch, OPL.

50 Year Honored Institution Award

In addition to conducting guided tours daily, the park rangers at the **Mitchell Caverns** situated in the Providence Mountains in southeast California have been reporting the weather since March 1958. From left, Supervising Ranger **Darrell Bennett** stands by while NWS Las Vegas CPM Donald Maker presents the framed 50 Year Honorable Institution Award to State Park Superintendent **Kevin Forrester.** Photo by NWS MIC Kim Runk.

50 Year Honored Institution Award

A 50 year Honored Institution Award was presented to the **Kennecott Copper Corporation** for its service at the Garfield, Utah Cooperative Weather Station. The award was presented at a luncheon to honor the Smelter Laboratory Employees for their dedication and service. Dr. Larry Dunn, MIC, NWS Salt Lake City, UT, presented the award. In attendance were the Kennecott Smelter Laboratory Employees and spouses; Susan Nelson, Western Region Headquarters CPM; Steve Summy, OPL, Salt Lake City; and Eugene VanCor, HMT/CPM Salt Lake City. **Garth Gullick** and **Steve Butler**, Kennecott Copper Corporation, organized the luncheon and ensured all observers could attend.

From left are MIC Larry Dunn, **Garth Gullickson**, **Dale Cox, Kim Mikesell, Rick Ward, Todd Dykstra, Tony Weddick, Fred Krapschier, Mike Wilson, Steve Butler** and OPL Steve Summy.

40 Year Length of Service Award

Fred Tanner from Campo, CO, received his 40 Year Length of Service Award from Michael Nosko, Hydrometeorological Technician (HMT), NWS Pueblo CO. Photo taken in Fred's home, in his hunting trophy room.

35 and 25 Year Length of Service Awards
Letter of Appreciation

Michael Caropolo, MIC, Wilmington, NC, center, presents a 35 Year Length of Service Award to **Grover "Malcolm" Long** and **Sharron Y. Long** of Longwood, NC. Malcolm and Sharron have taken and reported their observations during hazardous weather conditions including hurricanes Diana, Fran, and Floyd. Photo by Gene Funderburk, OPL.

Tom Kellom, right, of Dubois, ID, accepts a 35 Year Length of Service Award from MIC Rick Dittmann, NWS Pocatello, ID. Tom's unrelenting service in weather observing and weather record keeping for the community of Dubois and the NWS provides valuable climatic information to the state and the nation. Photo by OPL Gary Wicklund.

Paul Head, CPM, NWS State College, PA, left, presents **Bill Caldwell** a Letter of Appreciation for his 33 years of observations at the **Laurel Creek Filtration Plant** in Milroy PA. Bill, who is retiring, has always been the go-to guy for cooperative observations at the institution. Photo by OPL Victor Cruz.

Robert Birdd Jr., of Hillsboro, WI, shows his 25 Year Length of Service Award. The award was presented by Tom Stangeland, Coop Program Focalpoint, NWS La Crosse WI.

25 Year Length of Service Awards

Phyllis Park and her son, **Deane**, were honored with a 25 Year Length of Service Award. Phyllis's husband, **Max**, started the Cooperative Station in 1982. When Max passed away, Deane took over as the Primary Observer at Three Springs, PA.The award was presented by Paul Head, CPM, NWS State College, PA. Photo by OPL Victor Cruz.

Roger Wadleigh from Cheraw, CO, holds up his 25 Year Length of Service Award. Photo by Michael Nosko, HMT, NWS Pueblo, CO.

25 Year Honored Institution Awards

Kalkaska Department of Public Works employees accept a 25 Year Honored Institution Award. Accepting the award are Supervisor **Craig Wood,** right, and Kalkaska Clerk **Mary Deb Rabourn.** The award was presented by OPL Keith Berger, right, and MIC Gary Campbell, far left.

From left, NWS State College, PA, CPM Paul Head, presents **Bill Caldwell**, the primary Observer at the **Laurel Creek Filtration Plant** in Milroy, PA, and Plant Manager **Michael Robinson** with a 25 Year Honored Institution Award. Bill has been the Primary Observer for 33 years. Photo by OPL Victor Cruz.

20 Year Length of Service Awards

Ben Fischer from Eads, CO, shows his 20 year Length of Service Award and pin. The award was presented by Michael Nosko, HMT, NWS Pueblo, CO.

Juanita Hays from Lamar, CO, shows her 20 Year Length of Service Award. Photo by Michael Nosko, HMT NWS Pueblo, CO.

A 20 Year Length of Service Award was presented to **Harold Weisbrook** of New Raymer**,** CO. His wife, **Elaine**, hold up his service pin. The award was presented by Carl Burroughs, HMT, Boulder, CO.

David Rueber of Kanawha, IA, shows his 20 Year Length of Service Award on a brisk, snowy March day. The award was presented by staff from NWS Des Moines, IA.

15 Year Length of Service Awards
Letter of Appreciation

From left, Paul Head, NWS State College, PA, CPM, presents a 15 Year Length of Service Award to **Jim Borst** for his dedication as the Secondary Observer at Sheffield Coop Station in Clarendon, PA. Cooperative Observations have been taken at the Sheffield site since November 1961. Photo by Victor Cruz, OPL.

Bob McLain of Castleton, IN, proudly displays his 15 year Length of Service Award. After years of working the evening shift and coming home afterwards to take his observation at midnight, Bob has adjusted to working days but still stays awake until midnight to ensure the observation is taken. That is dedication!

Dave Simmons, left, of Alexandria, IN, celebrated his 15th year in the Cooperative Weather Observation Program. Dave has also served as a severe weather spotter since 1992. Presenting the award was Dan McCarthy, MIC, WFO Indianapolis, IN.

Linard Spain, left, is shown receiving his 15 year Length of Service Award from Frank Taylor, OPL, NWS Atlanta, GA. The award ceremony was held at Linard's home in Embry, GA. Photo by Michael Griesinger, Meteorologist, NWS Atlanta, GA.

Gary Broderick, left, former Plant Manager of the **Safe Harbor Water Power Corporation**, accepts a Letter of Appreciation for his 17 years of observations at Safe Harbor Dam in Conestoga, PA. Cooperative Observations have been taken at the dam since December 1932. The award was presented by Paul Head, CPM NWS State College, PA. Photo by OPL Victor Cruz.

10 Year Length of Service Awards

Kelly (not pictured) and **Sandy Aderhold** of Neillsville, WI, were presented a 10 Year Service Award by HMT Brad Adams of NWS La Crosse, WI.

Joe Boos, Observer at Alamosa, CO, displays his 10 year Length of Service Award. Photo by OPL Randall Gray, NWS Pueblo, CO.

Brantley Boatright, Dispatcher for the Okefenokee National Wildlife Refuge, receives a 10 Year Length of Service Award from Mike McAllister, OPL, WFO Jacksonville, FL. Photo taken by Judy Drury, Office Assistant and Backup Observer.

Leana Anderson beams with pride as her husband **Dean** was presented with a 10 Year Length of Service Award and pin. Their son, Mark, started as the Primary Observer at the Williamsport, PA, Coop site with Dean acting as secondary Observer. Dean became the primary observer when Mark went to college. Photo by CPM Paul Head, NWS State College, PA.

Thomas Hoover from Rush, CO, receives his 10 year Length of Service Award from Randall Gray, OPL NWS Pueblo CO.

Daniel Jensen, left, from Leadville, CO, receives his 10 year Length of Service Award from Randall Gray, OPL, NWS Pueblo CO.

Dale and Peg Behrens, of Humboldt, IA, accept their 10 Year Award from Steve Teachout, HMT, Des Moines, IA. Dale and Peg are fascinated with the weather and they're looking forward to riding their motorcycle as soon as the weather allows them. They also spend a lot of time with their grandchildren pointing out clouds.

10 Year Length of Service Awards

Dennis, center, and **Dottie Feister,** Observers at Aguilar, CO, receive their 10 year Length of Service Awards from Randall Gray, OPL, WFO Pueblo CO. Photo by NWS Meteorologist Mark Wankowski.

Craig Hall, of Brooklyn, IA, shows his 10 Year Length of Service Award. Craig is hoping winter will end soon in Iowa! Photo by Steve Teachout, HMT, Des Moines, IA.

Dale Meyer, left, of Iona, ID, accepts a 10 Year Length of Service Award from Rick Dittmann, MIC NWS Pocatello, ID. Photo by OPL Gary Wicklund.

Van McKelvey, left is shown receiving his 10 Year Length of Service Award from Frank Taylor, OPL, NWS Atlanta, GA. The award ceremony was held at Van's home in Cedartown, GA. Photo courtesy of Scott McKelvey, Van's son.

Ken Litchfield of Athens, IL, accepts a 10 Year Length of Service Award. The award was presented by HMT John Parr of NWS Central Illinois.

Richard Thompson, center, and his wife, **Francis,** were awarded 10 Year Length of Service Awards and pins for their dedicated service at Philipsburg, PA. Helping to show the awards is Paul Head, NWS State College, CPM. Richard recently retired from his post at Penn State University in the Department of Mineral Earth and Science. Photo by OPL Victor Cruz.

Dave Pahlas, of Decorah, IA, accepts his 10 Year Length of Service Award. The award was presented by Tom Stangeland, Observer Focal Point, NWS La Crosse, WI.

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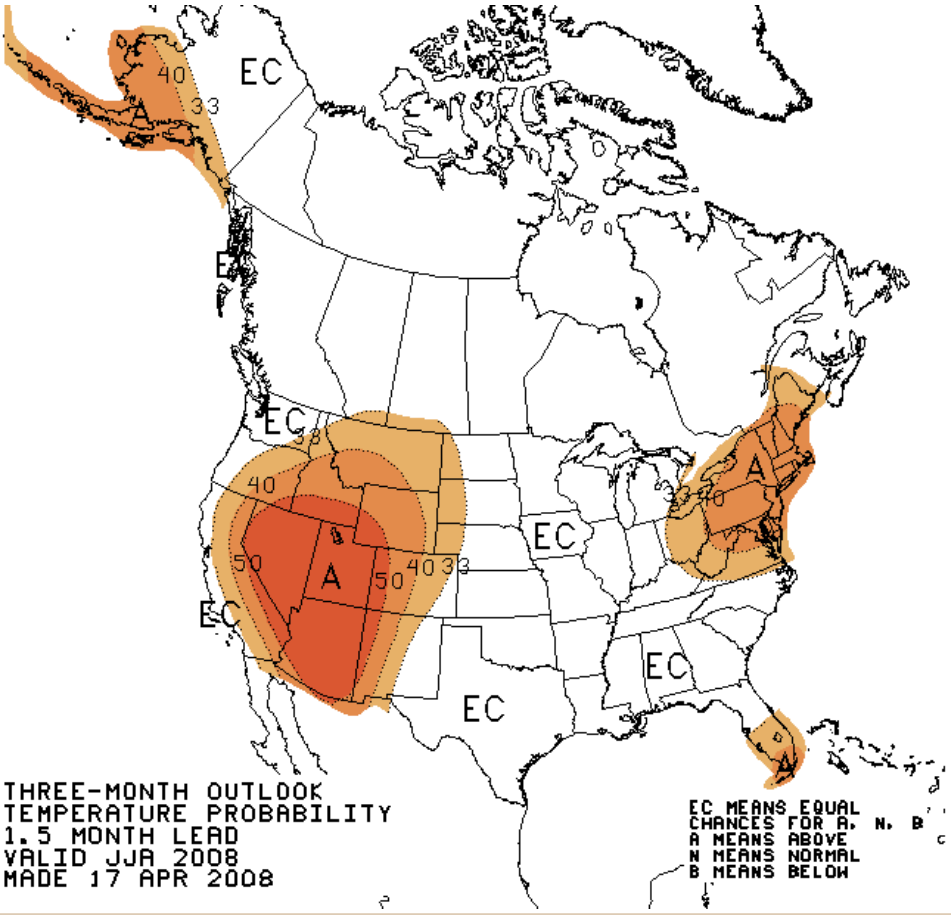
June, July, August Temperature Outlook From the Climate Prediction Center



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