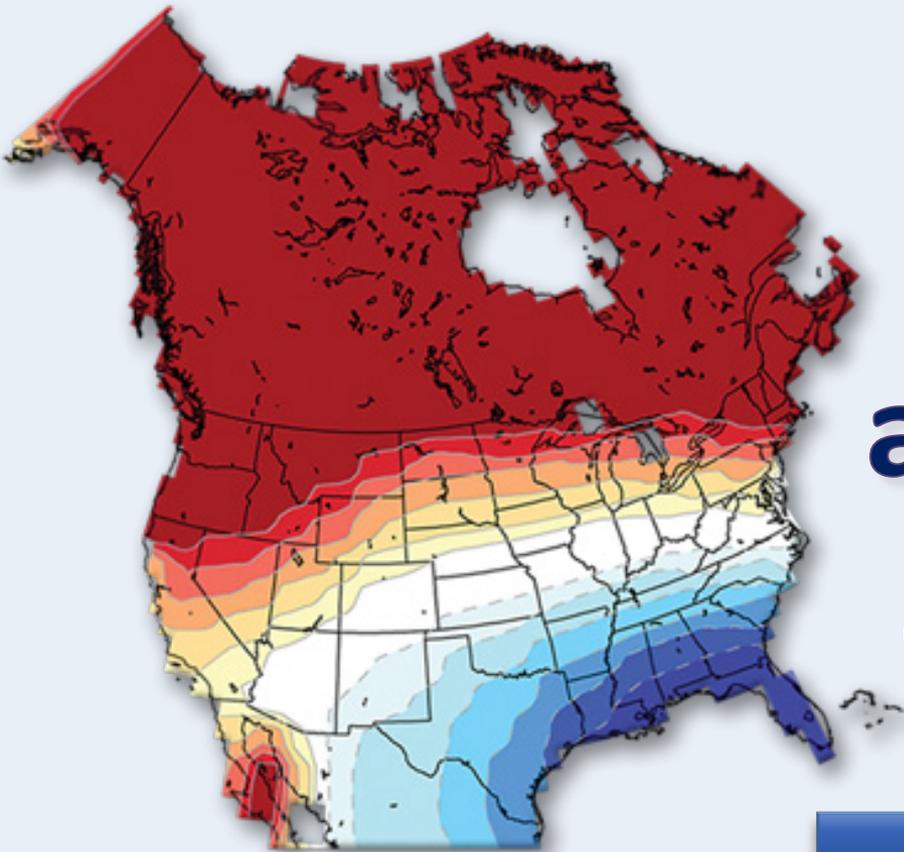


State of the Climate in 2010 and New Climate 30-Year Normals



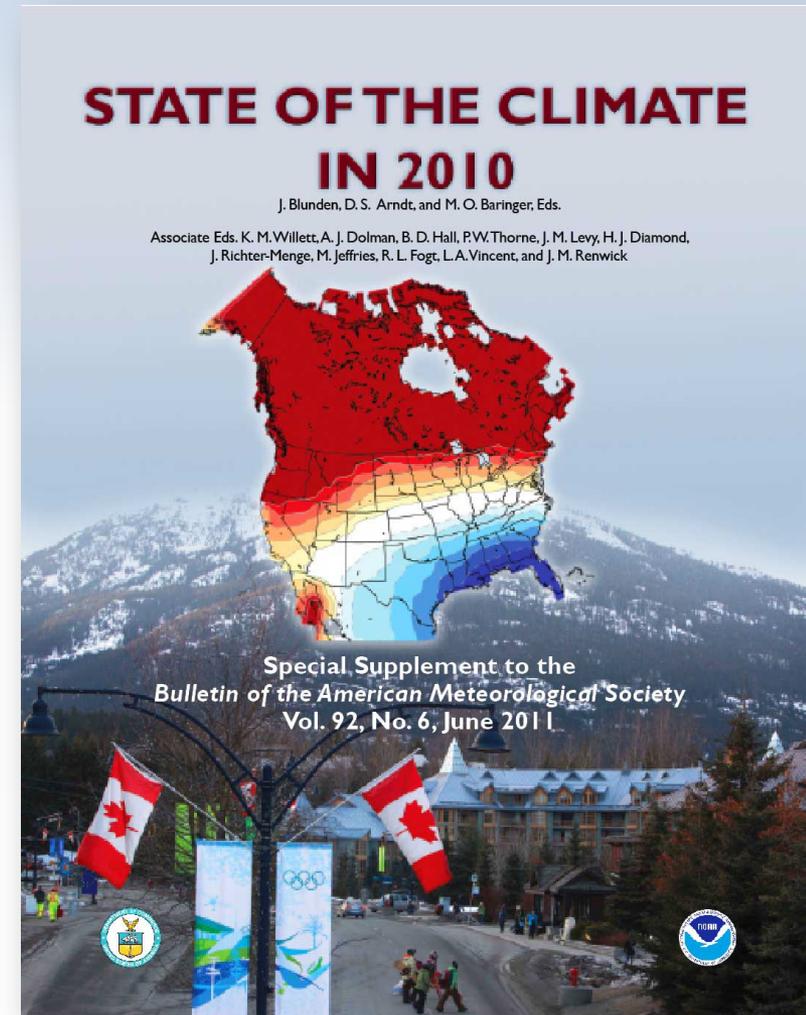
July 12, 2011



Thomas R. Karl, L.H.D., Director, NOAA's National Climatic Data Center, and Chair of the Subcommittee on Global Change Research

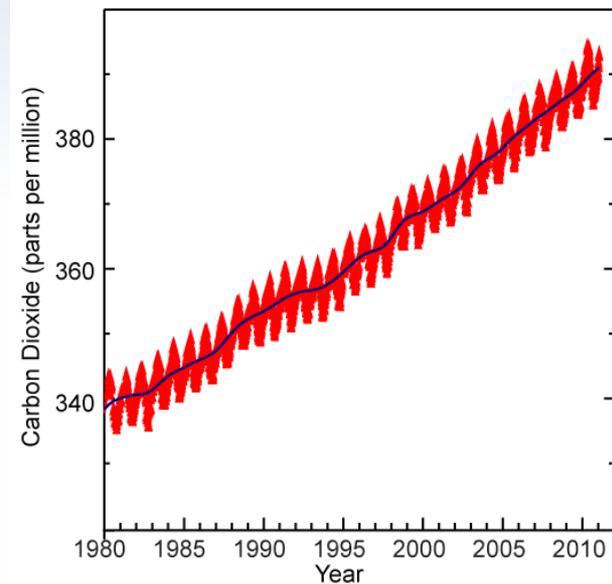
21st Annual *State of the Climate* Report

- Surveys the changing state and the behavior of the physical climate system
- Now tracks 41 global-scale climate indicators
- Peer reviewed report has 368 authors from 45 countries

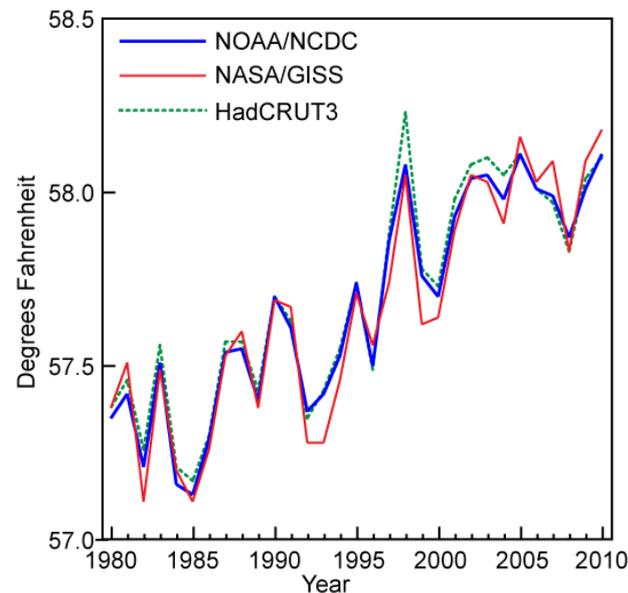


2010: Long-term Trends Continue

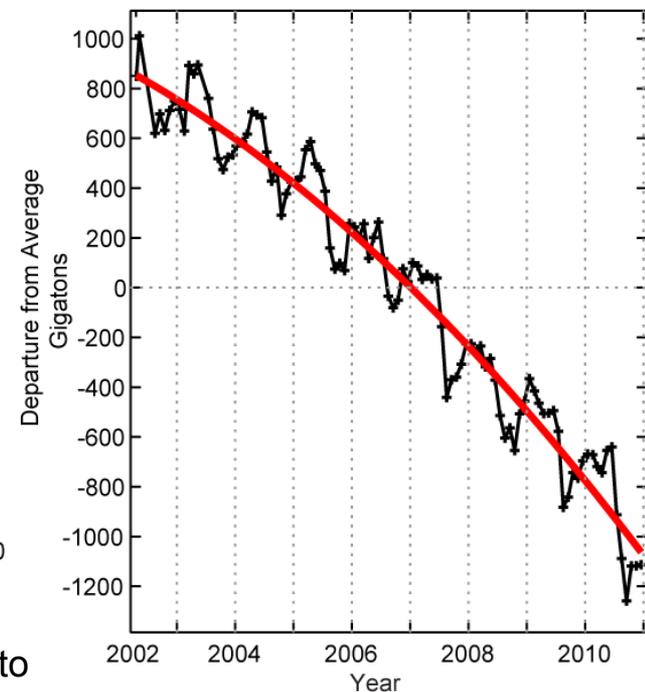
Global average surface temperature among the two warmest of the instrumental record



Air samples collected weekly at NOAA's Mauna Loa observatory continue to show a rise in the concentration of carbon dioxide.



Three data sets show global surface temperatures continue to rise; 2010 was one of the two warmest years on record.

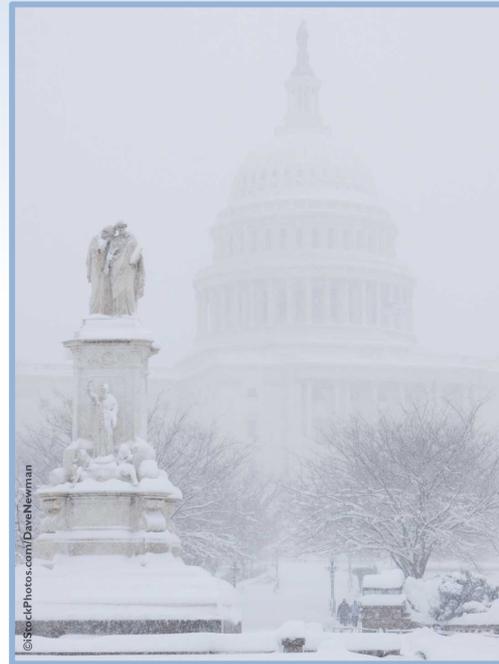


Greenland's ice sheet lost more mass in 2010 than at any time in the past ten years.

2010: Climate Variability Played a Major Role

Two recurrent climate patterns had major impacts on 2010 weather:

- El Niño / La Niña
- Arctic Oscillation



Washington D.C.,
Feb. 2010

“Climate is what you expect, weather is what you get.” --
Robert A. Heinlein



Vancouver, British Columbia February 2010

CLIMATE INDICATORS 2010

More than 800 weather balloons are launched around the world every day to collect upper atmospheric data.

STRATOSPHERIC TEMPERATURE: Air in the upper layers of the atmosphere continued to be colder than average.

SNOW COVER during February was high over the Northern Hemisphere, but by May warm surface temperatures reduced it to the lowest area ever recorded by satellites. The decrease in snow cover from December to May was the largest in more than 40 years.

GLACIERS lost mass for the 20th consecutive year. Greenland glaciers lost more mass in 2010 than any other year on record.

GREENHOUSE GASES in the atmosphere continued to rise. Carbon dioxide levels increased at a faster rate in 2010 than in 2009 and also faster than the average rate over the past 30 years.

AIR TEMPERATURE above land was the second warmest on record. The Arctic continued to warm at about twice the rate of lower latitudes.

ANTARCTIC SEA ICE grew to record levels during the South Pole's winter, affected by an air circulation pattern that locked in the cold.

CLIMATE INDICATORS 2010

ARCTIC SEA ICE shrank to its third smallest area on record. The area was so small in September that for the first time in modern history, both the Northwest Passage and the Northern Sea Route were open for navigation.

SEA LEVEL continued to rise across the world's oceans on average.

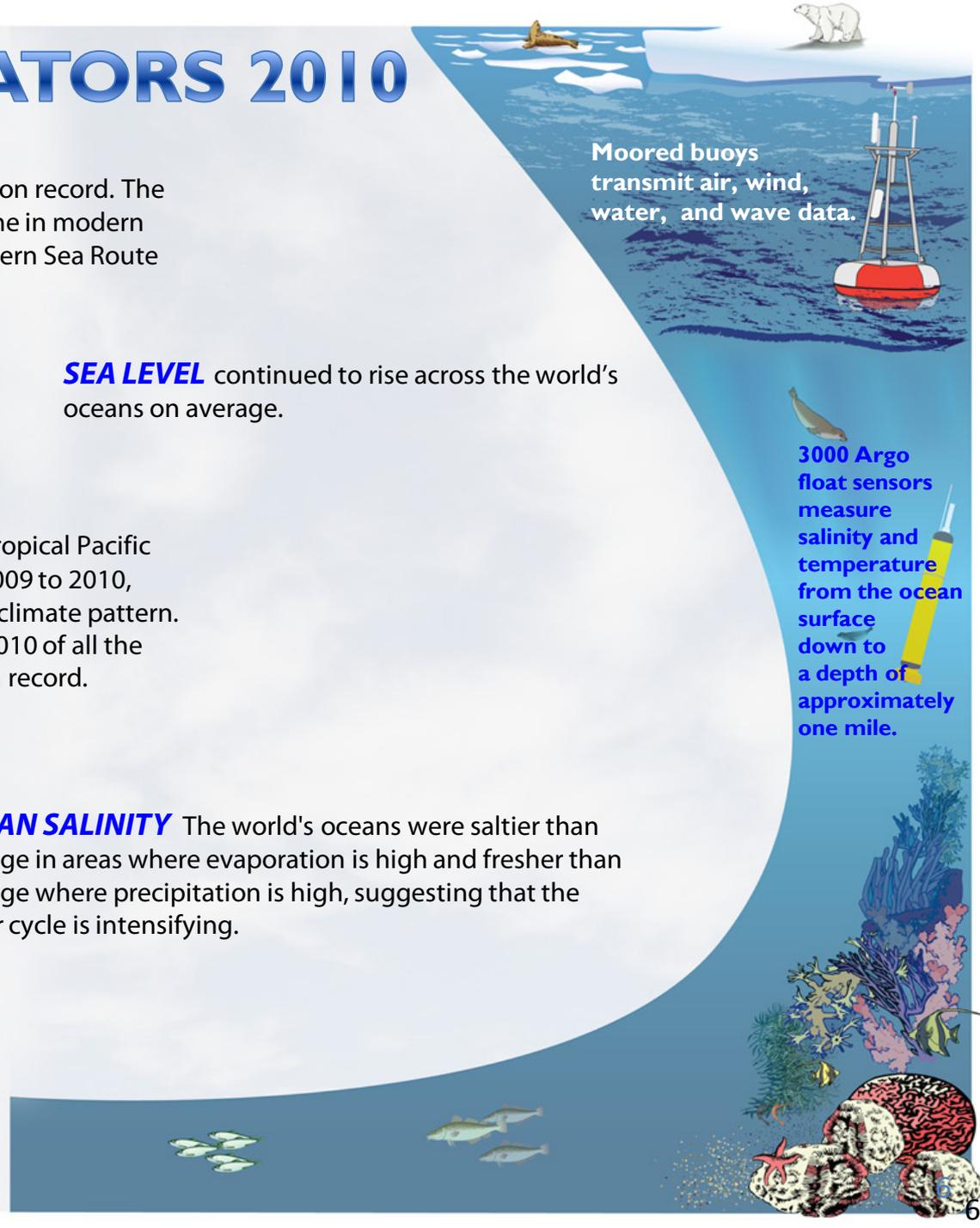
SEA SURFACE TEMPERATURE in the eastern tropical Pacific Ocean cooled almost 2 degrees Fahrenheit from 2009 to 2010, reflecting the transition from an El Niño to La Niña climate pattern. Even so, the average sea surface temperature for 2010 of all the oceans around the world was the third warmest on record.

OCEAN SALINITY The world's oceans were saltier than average in areas where evaporation is high and fresher than average where precipitation is high, suggesting that the water cycle is intensifying.

OCEAN HEAT CONTENT in 2010 was similar to 2009 and was among the highest values in the record. Oceans store a large portion of the heat that is trapped by increasing greenhouse gases.

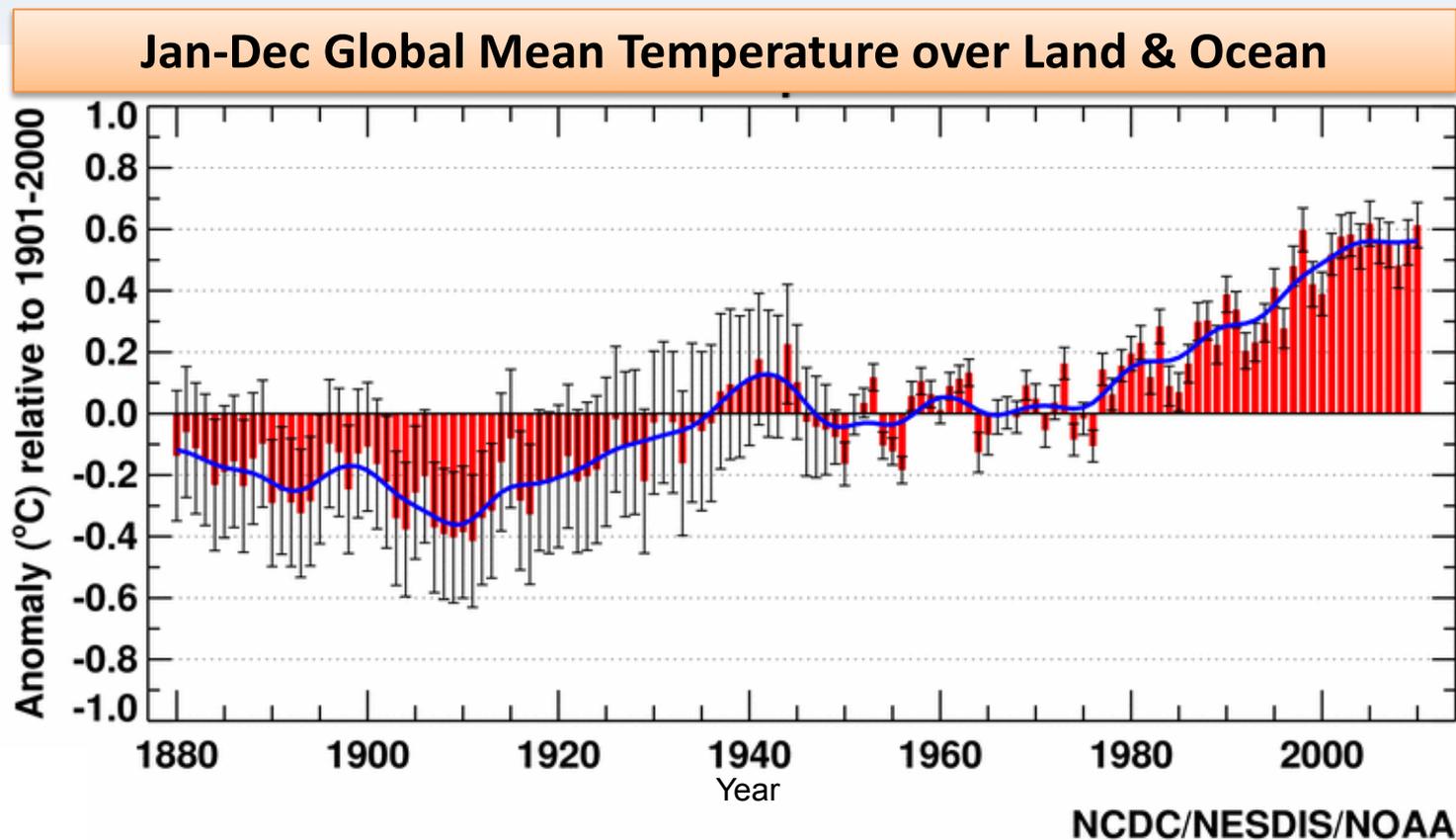
Moored buoys transmit air, wind, water, and wave data.

3000 Argo float sensors measure salinity and temperature from the ocean surface down to a depth of approximately one mile.



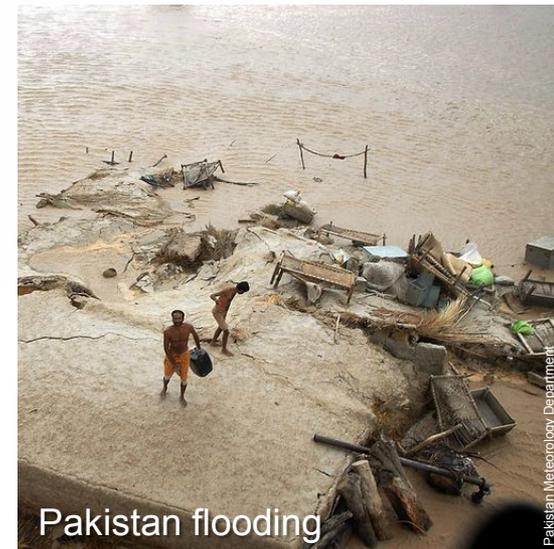
The World Continues to Warm

- Multiple indicators, same bottom line conclusion
 - Consistent and unmistakable signal from the top of the atmosphere to the bottom of the oceans



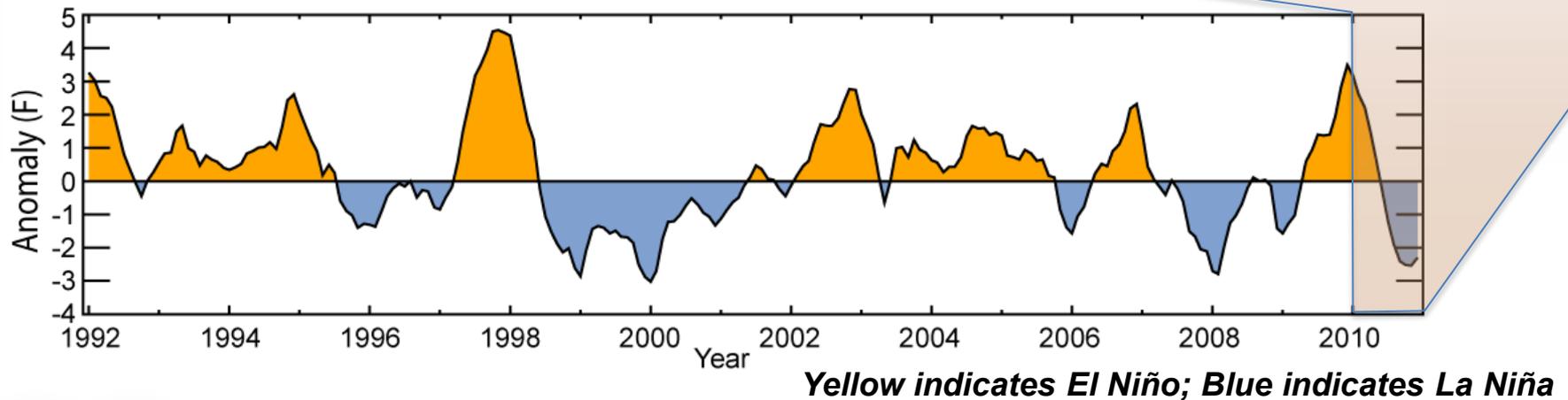
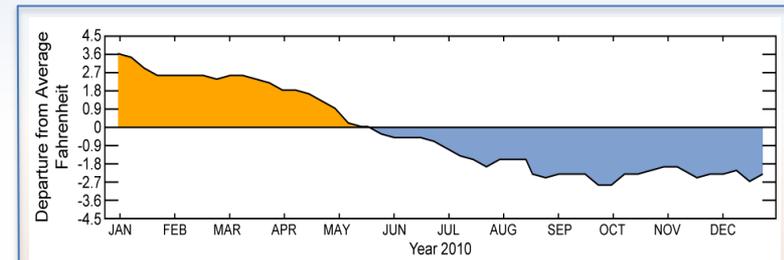
Weather and Climate Events

- Many extreme events at regional and local levels
 - 2009/10 coldest European winter since 1978/79
 - February 2010 – a month of extremes in North America:
 - Several U.S. cities had snowiest months on record
 - Warm, dry, with limited snow for 2010 Winter Olympics in Vancouver, British Columbia
 - Summer:
 - Russia: Deadly summer heat wave
 - Pakistan: Floods displaced over 20 million people
 - Most of the world (except the Atlantic) had a very *inactive* tropical cyclone year
 - Catastrophic flooding in Australia
 - Drought in Brazil



Major Event: El Niño to La Niña Transition

- Lingering effects of El Niño were responsible, in part, for 2010 being one of two warmest years on record
- Relationship between emerging La Niña and very slow tropical cyclone season in the Pacific
- La Niña also associated with Australia flooding

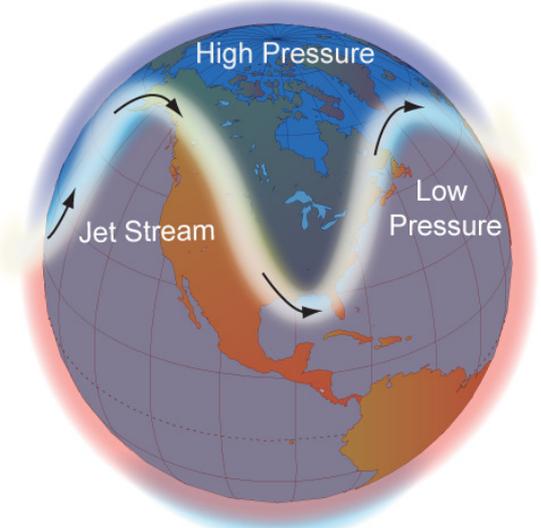


Major Events: Arctic Oscillation

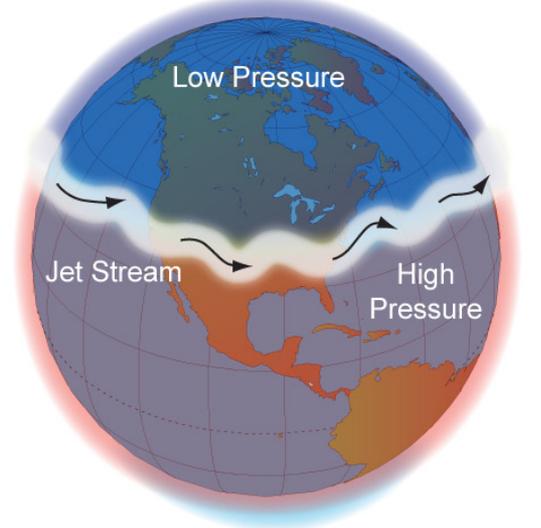
- Record negative values in Feb 2010
- Impacts to the Northern Hemisphere
 - U.S. and Western Europe endured record or near-record cold during winter 2009/10 and winter 2010/11
 - Parts of northern North America, Greenland, and Asia experienced profound warmth at the same time

Arctic Oscillation

Negative Phase

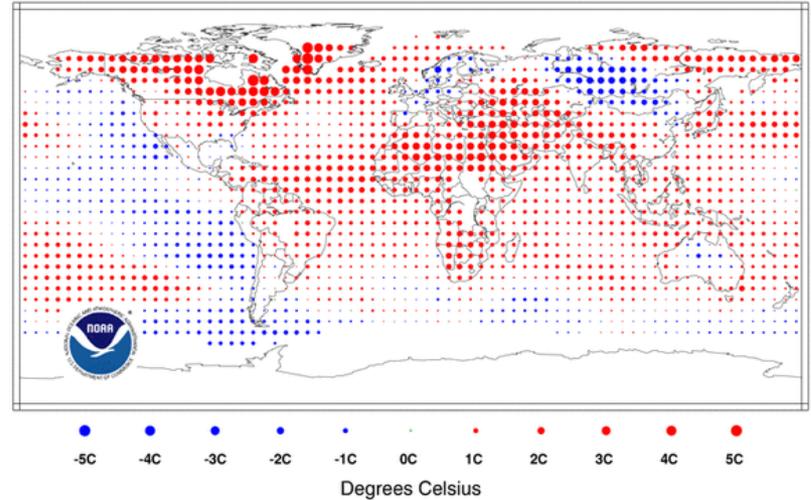


Positive Phase



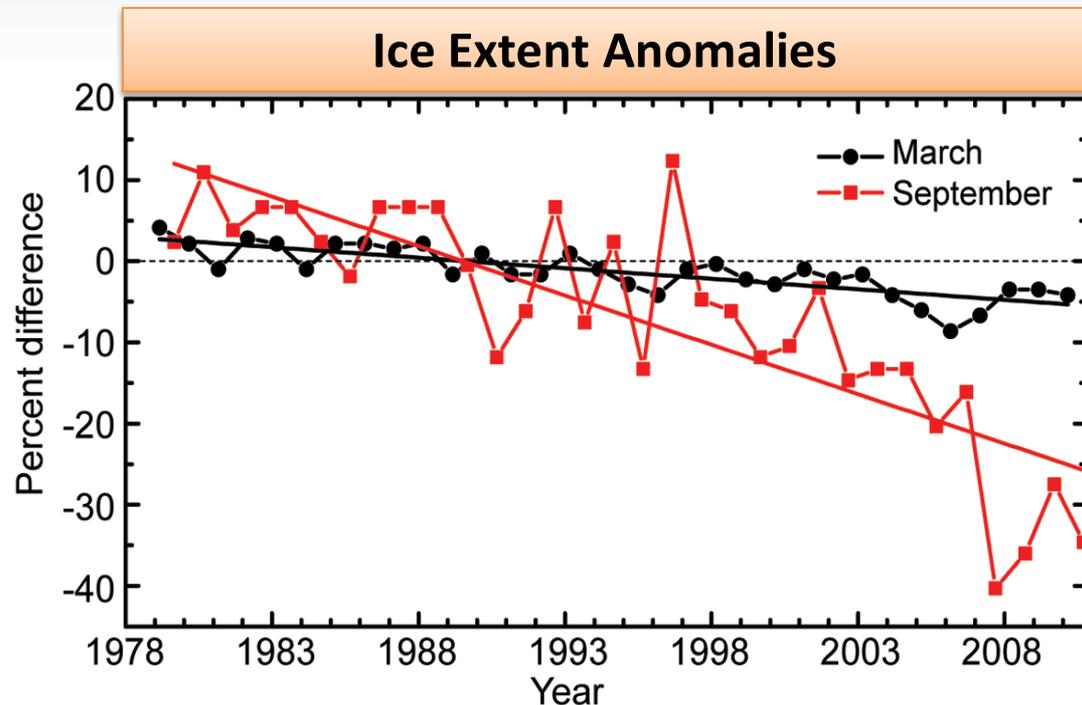
Temperature Anomalies Jan-Dec 2010

With respect to a 1971-2000 base period



The Arctic

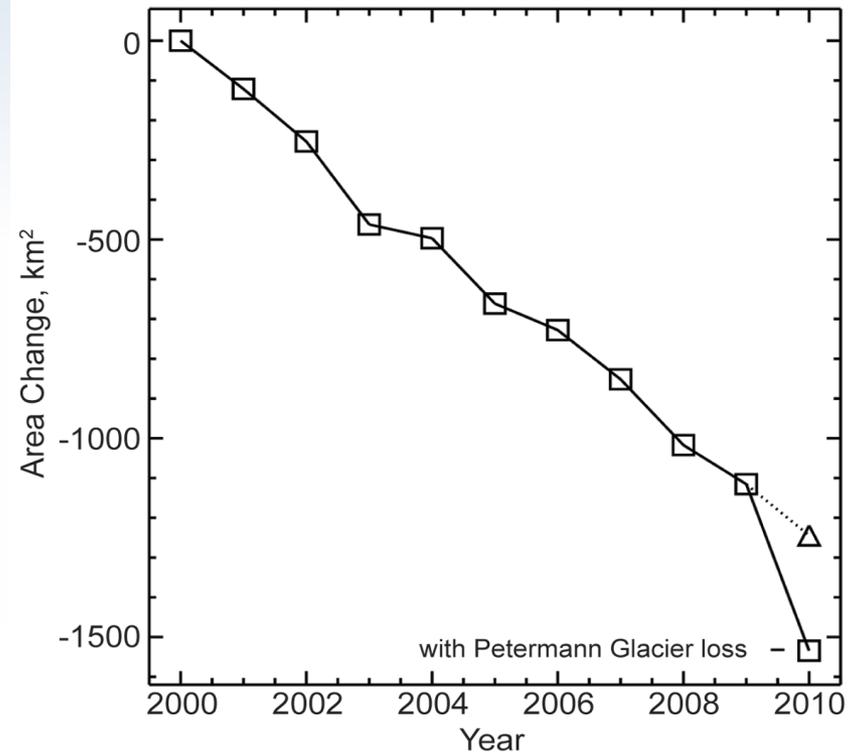
- Changes occurring faster than in most of the rest of the world
- 2010 maximum sea ice extent was latest in 30 years- March 31
- September sea ice extent was third smallest of the past 30 years
- Trends in snow cover duration, permafrost, and vegetation continued or accelerated



Greenland: changes continue to accelerate

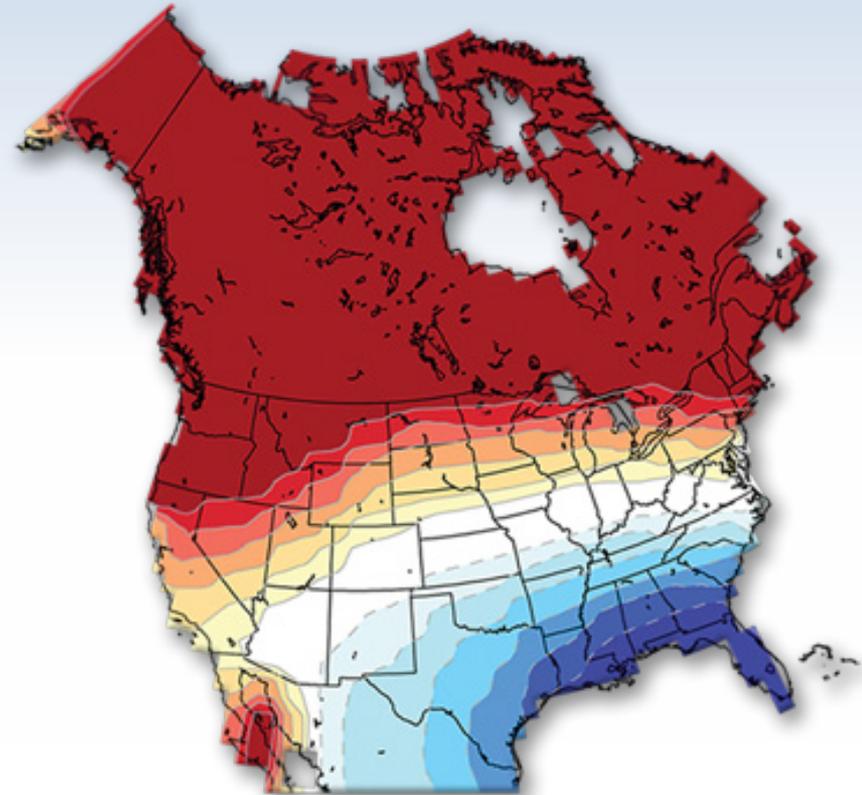
- Record-setting temperatures along entire western Greenland, both near the ground and higher in the atmosphere
- The high temperatures contributed to greater ice sheet melting
 - April–September 2010 melt was about 8 percent more than the previous record set in 2007

Cumulative Area Changes for 35 Major Glaciers of Greenland's Ice Sheet



State of the Climate Summary

- 2010 global average surface temperature among the two warmest on record
- Two recurrent climate patterns – El Niño / La Niña and Arctic Oscillation - had major impacts on 2010 weather
- 2010 report tracks 41 climate indicators. Long-term trends continue to show the world is warming



30-Year Climate Normals

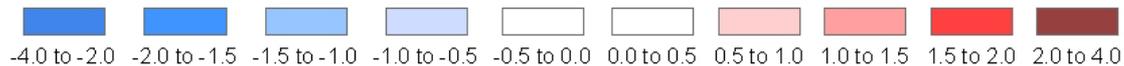
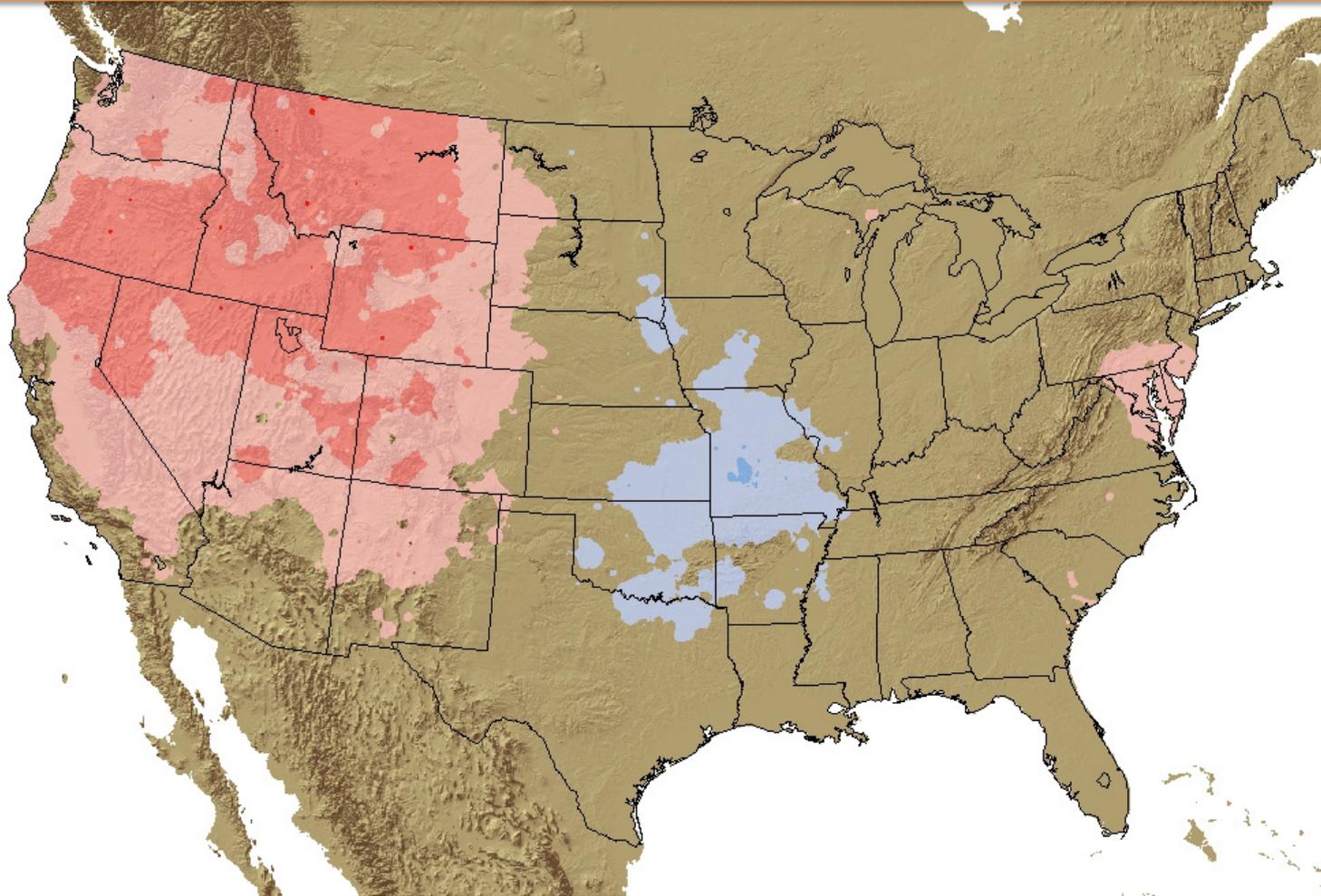
- Used to understand typical climate conditions for thousands of locations across the United States
 - Data from 7500 weather stations for temperature; 9300 stations for precipitation
- The "normal" of a particular variable, such as temperature, is defined as the 30-year average
 - NCDC uses robust standardization and quality control methodology
- Widely used by broadcast meteorologists, energy industry and agricultural/gardening sector

Normals Include:

- Maximum and Minimum Temperatures
- Precipitation, Snowfall, and Snow Depth
- Heating and Cooling Degree Days

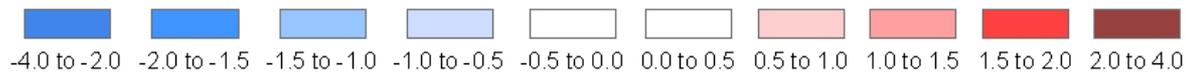
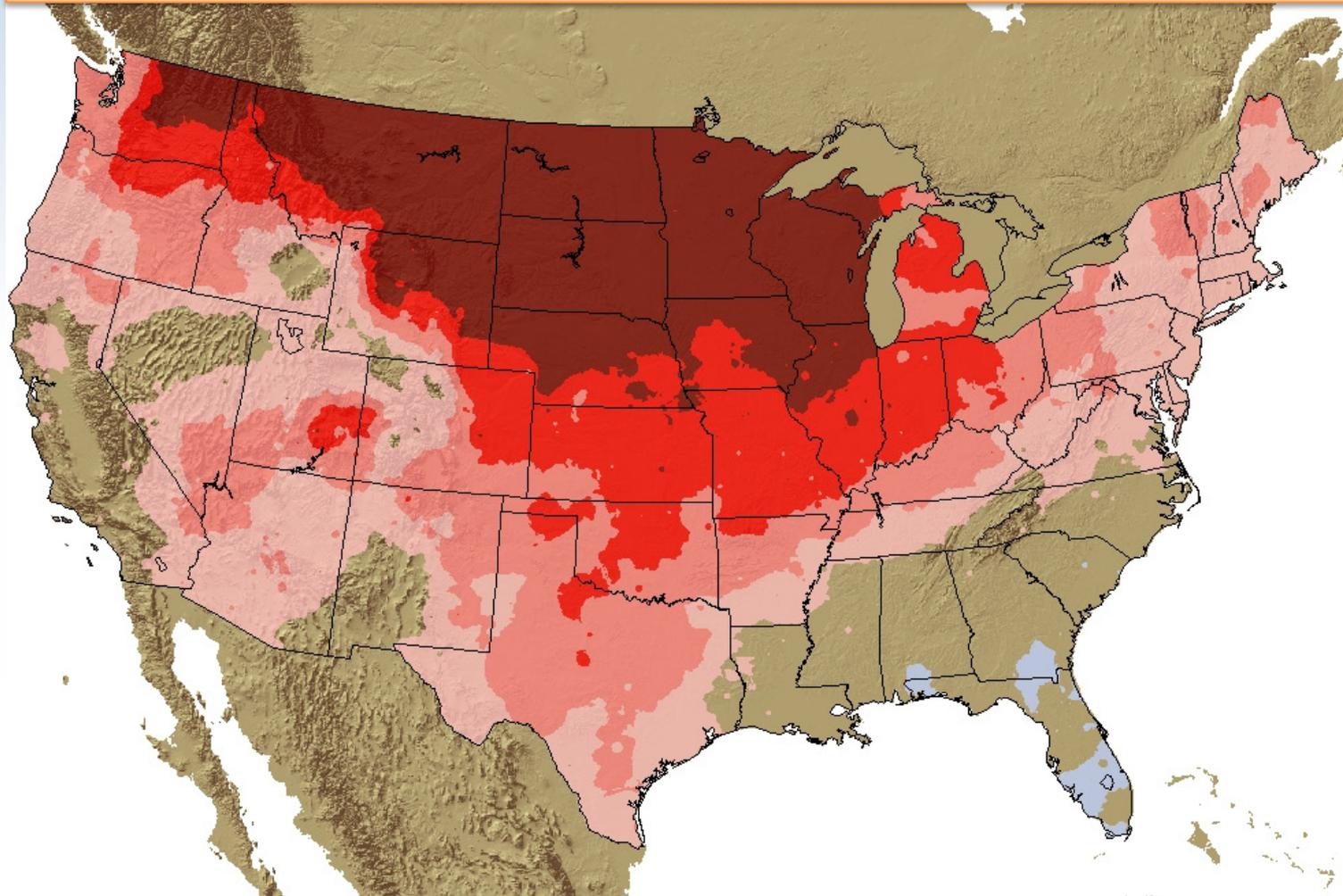
Normals Change in Temperature

July Maximum Temperature (F): 1981-2010 Minus 1971-2000



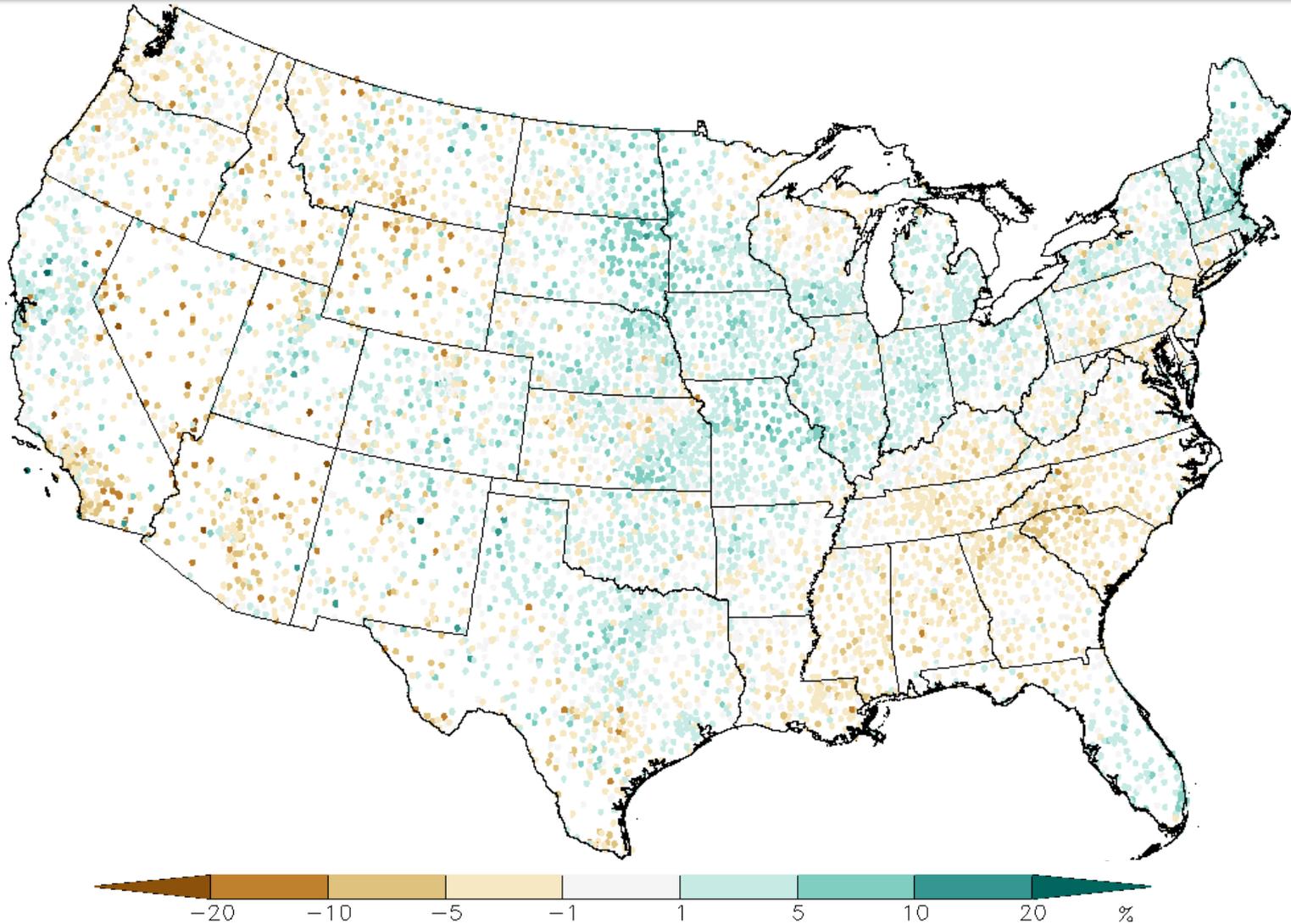
Normals Change in Temperature

January Minimum Temperature (F): 1981-2010 Minus 1971-2000



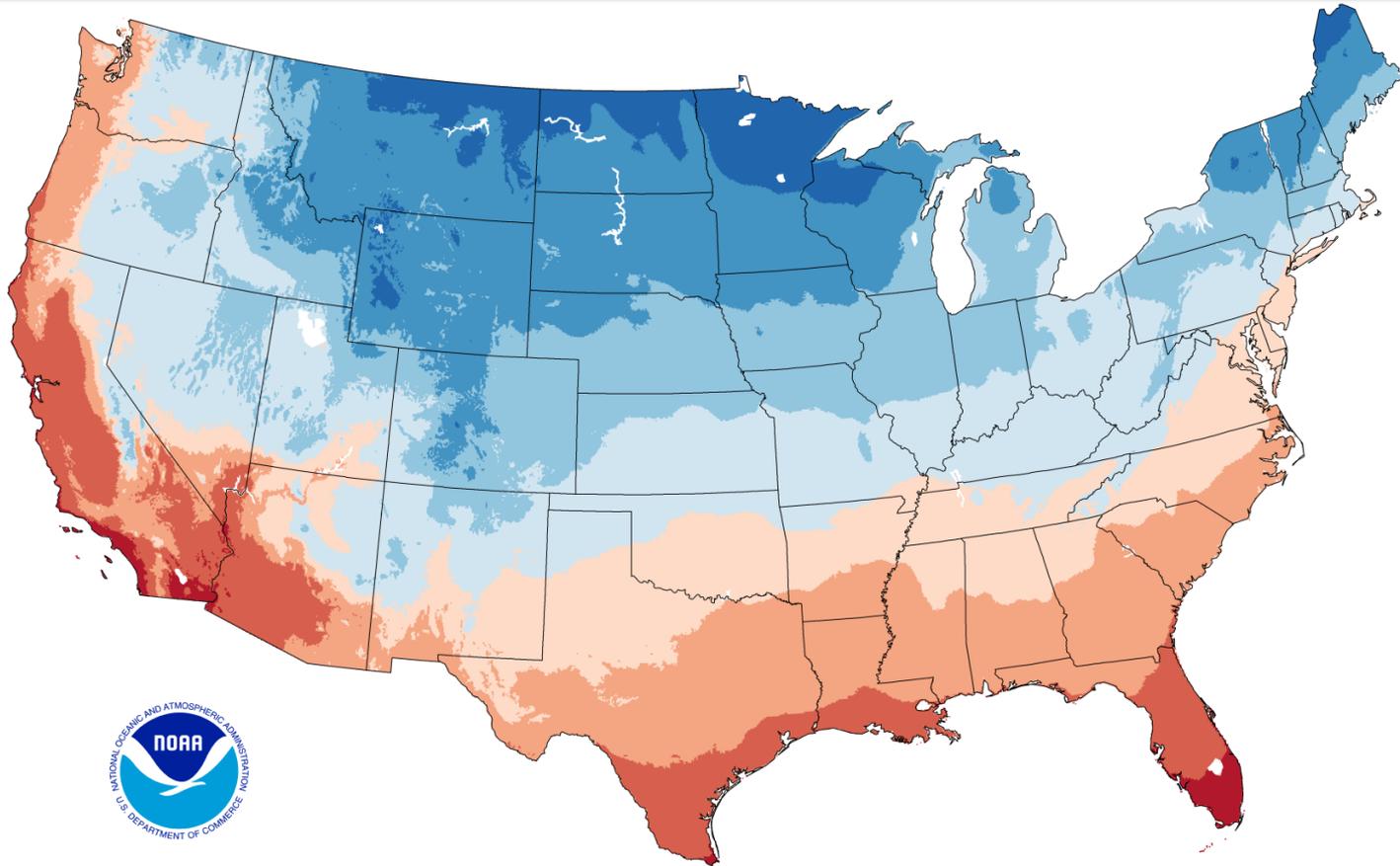
Changes in Precipitation

Percent Changes in Annual Normal Precipitation



Climate-Related Planting Zones

Based on 1971-2000 Climate Normals



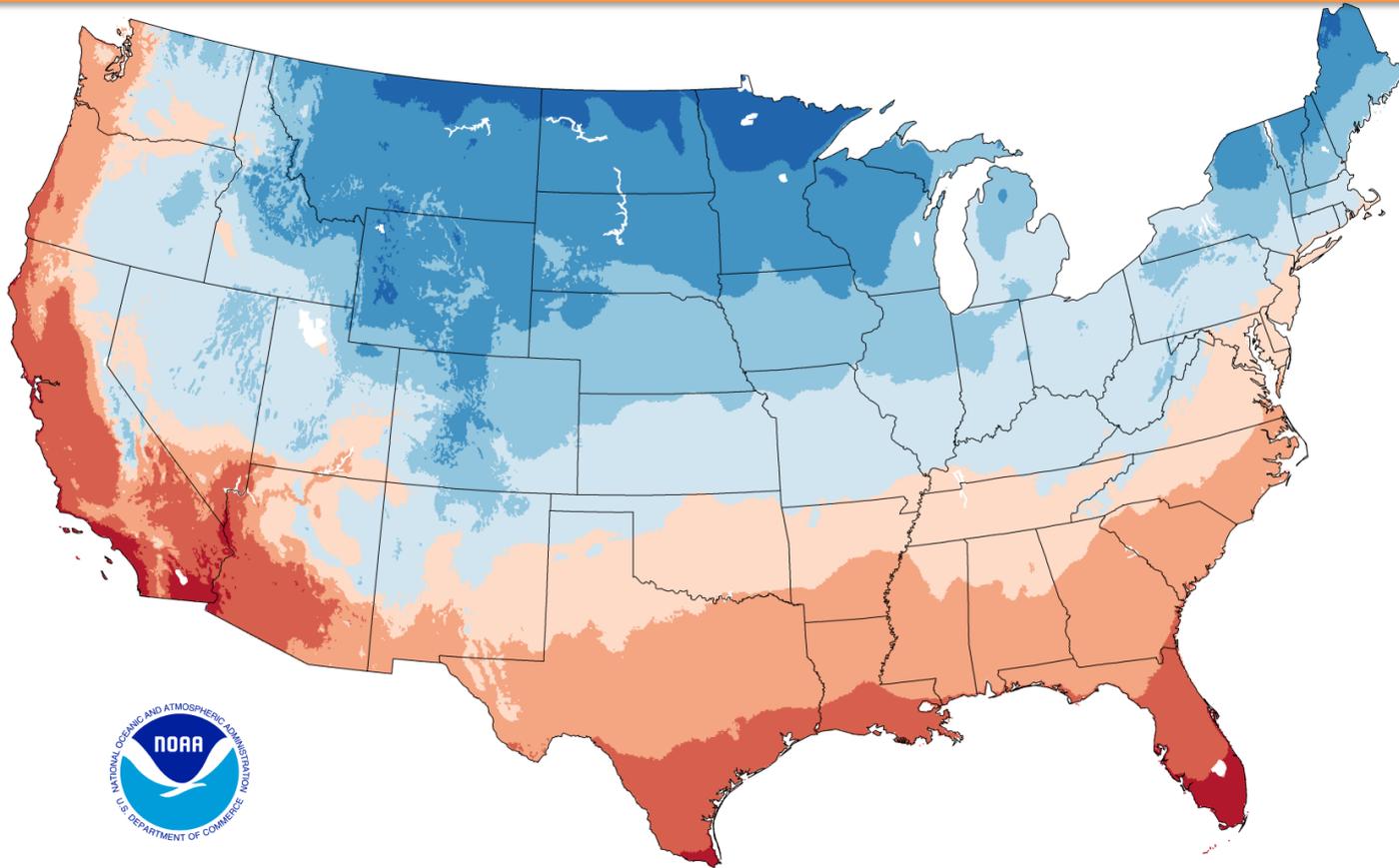
Average Annual Minimum Temperature by Climate-Related Planting Zone



Disclaimer: This illustration of nationwide patterns and changes in climate-related planting zones for gardeners was created as a special service to the American Public Gardens Association by the National Oceanic and Atmospheric Administration (NOAA). The official Plant Hardiness Zone map was prepared by the U.S. Department of Agriculture (USDA) in 1990 using data collected and distributed by NOAA. USDA is currently updating its official map, which will soon be available via the Internet.

Climate-Related Planting Zones

Based on New 1981-2010 Climate Normals



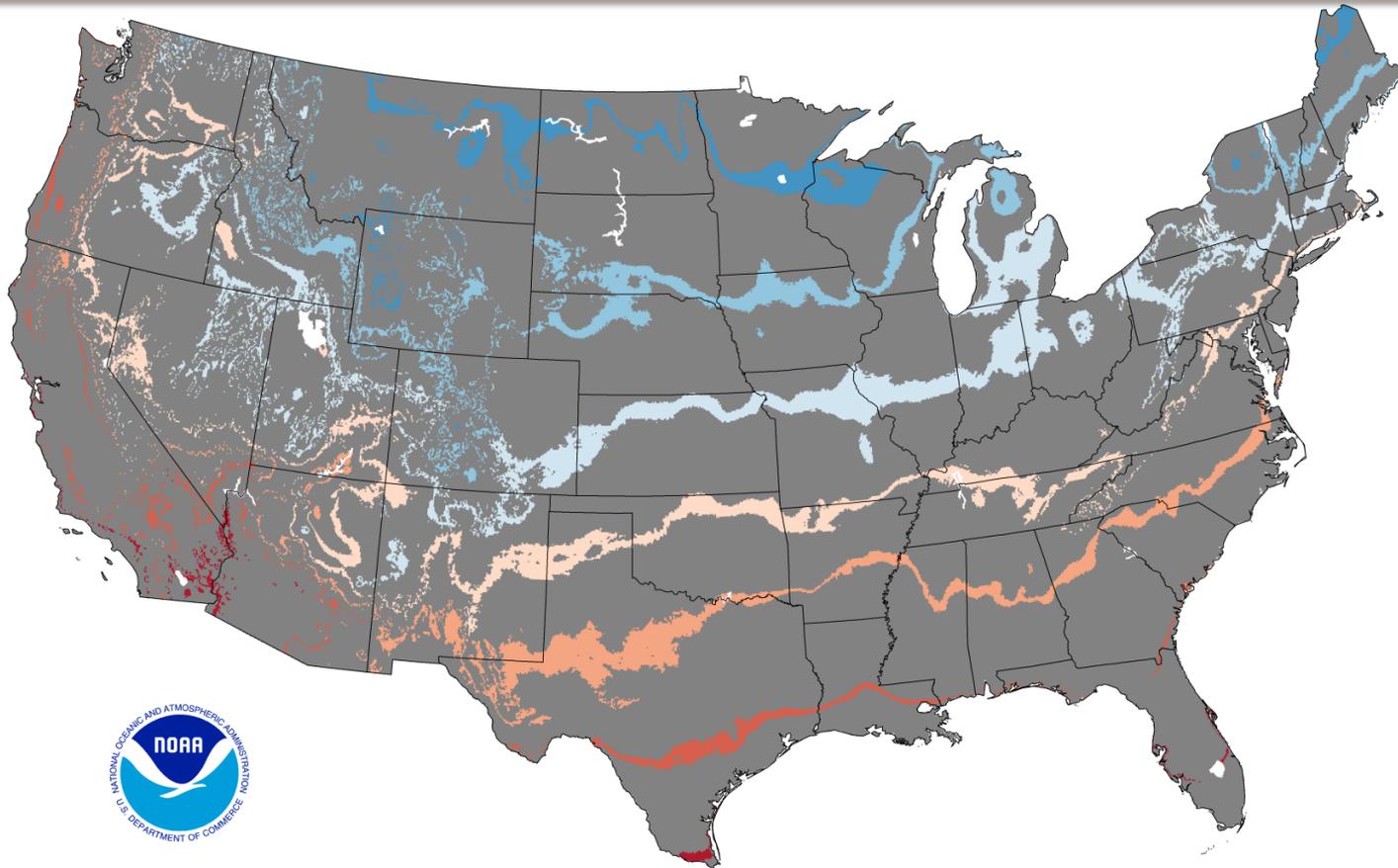
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Zone Changes in Past 10 Years

In Color of New Planting Zone



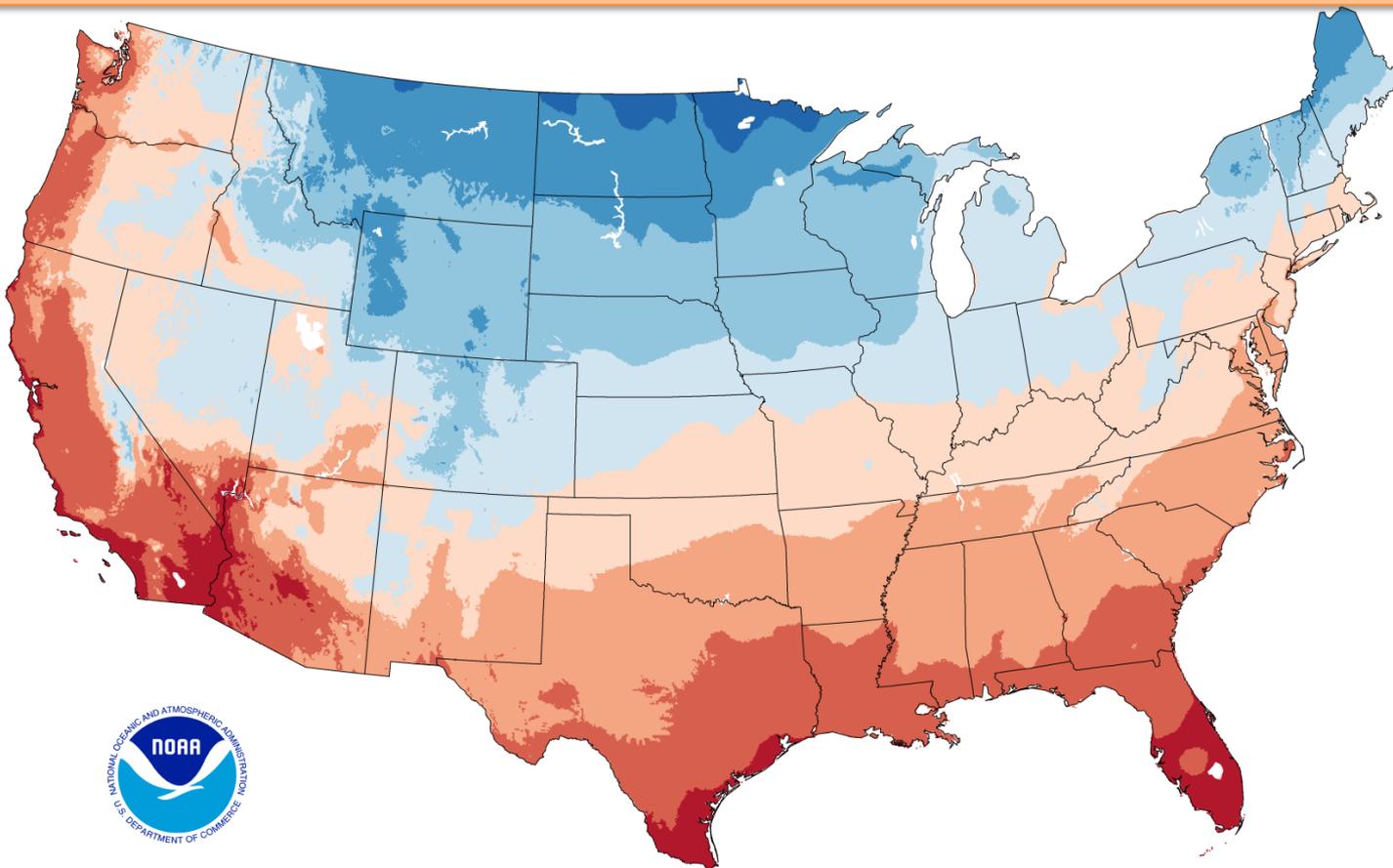
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Projected Climate-Related Planting Zones: 2011-2040

Based on 1971-2010 Trends



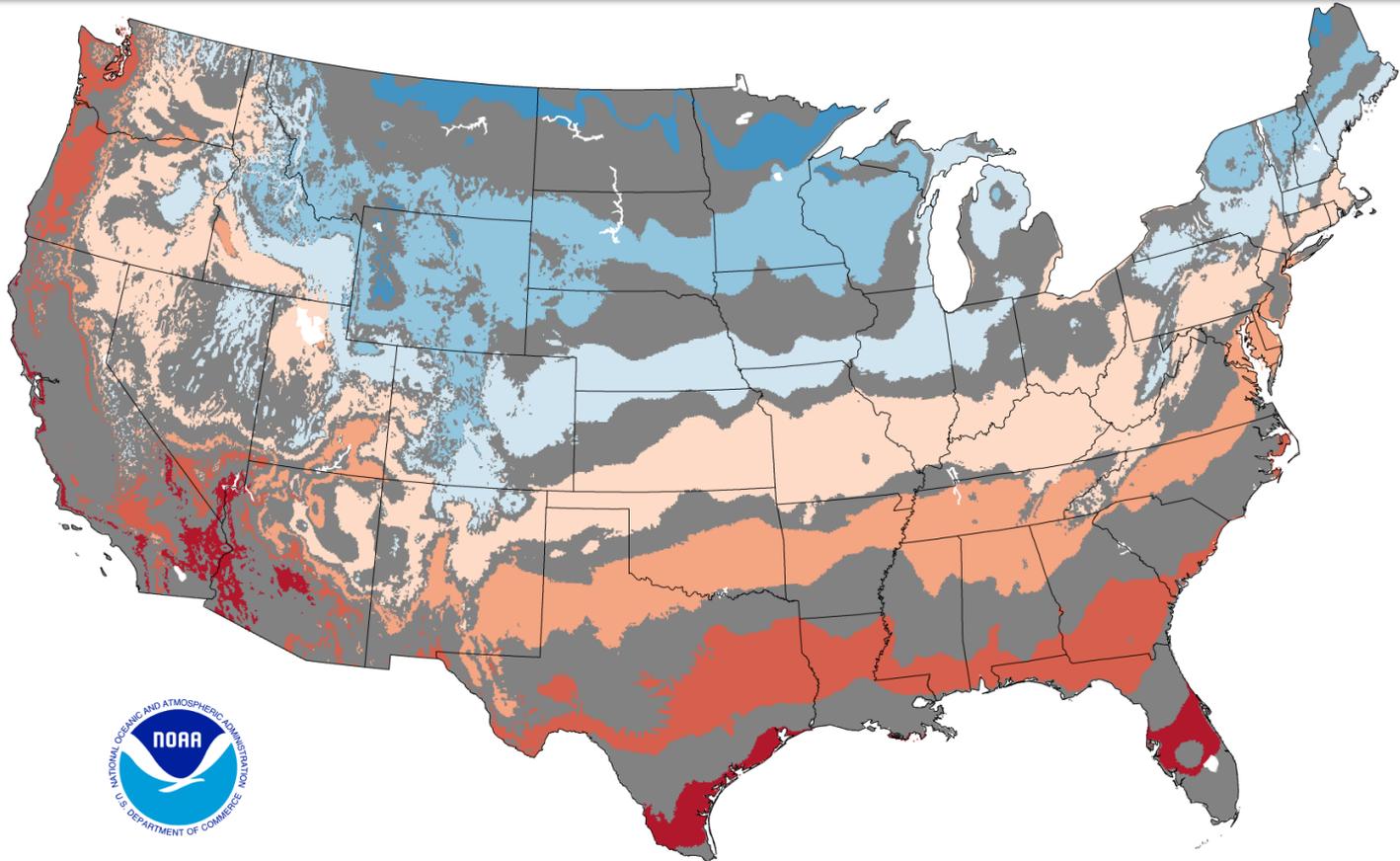
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Projected Zone Changes: 2011-2040

In Color of New Planting Zone



Average Annual Minimum Temperature by Climate-Related Planting Zone



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STATE OF THE CLIMATE IN 2010

J. Blunden, D.S. Arndt, and M. O. Barringer, Eds.

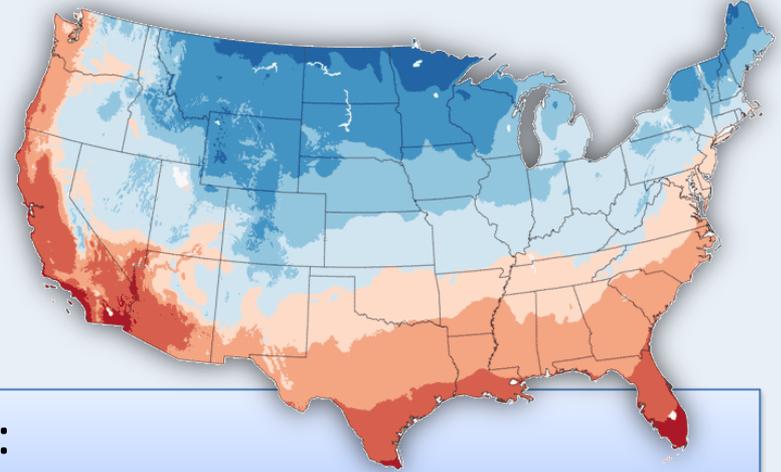
Associate Eds. K. M. Willett, A. J. Dolan, B. D. Hall, P. W. Thorne, J. M. Loy, H. J. Diamond,
J. Richter-Menge, M. Jeffries, R. L. Fogg, L. A. Vincent, and J. M. Renwick



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Bulletin of the American Meteorological Society
Vol. 92, No. 6, June 2011

**State of the Climate in 2010 full report and Highlights
available online**

<http://www.ncdc.noaa.gov/bams-state-of-the-climate>



Information on 1981-2010 Climate Normals:

<http://www.ncdc.noaa.gov/oa/climate/normals/newnormals.html>

