Analysis of extreme drought and record heat – USA

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Content

1 Summary

After a record-breaking hot spring, the heat persisted in the USA and North America through summer 2012. July 2012 was the hottest July on record in the USA. Extreme drought above all occurred in the Great Plains. The Canadian-Arctic Archipelago and Greenland saw massive ice shrinkage.

2 Temperature

2.1 Evolution of the Heat Wave in the USA

The extraordinary warm weather continued through July and August 2012. This is mainly due to the persistent large-scale flow pattern above North America and in the Northern hemisphere. It resulted in very long lasting and stable general weather situations that made very warm air masses of southern origin advance to and stay in the USA. Frequently, a long wave mid and upper troposphere ridge filled with very warm air developed above the North American continent. It brought much sunshine, few clouds, hardly any precipitation, and very high temperatures. Long waves in the upper level tend to hardly move east or west and, hence, remain quasi-stationarily at the same position. The planetary frontal zone appeared to be pushed back very far into the north of North America. This planetary frontal zone is mainly responsible for low pressure activity and large-scale precipitation. Due to these conditions, dry and very hot air of subtropical origin remained over the USA for a very long time, with a few short interruptions only.

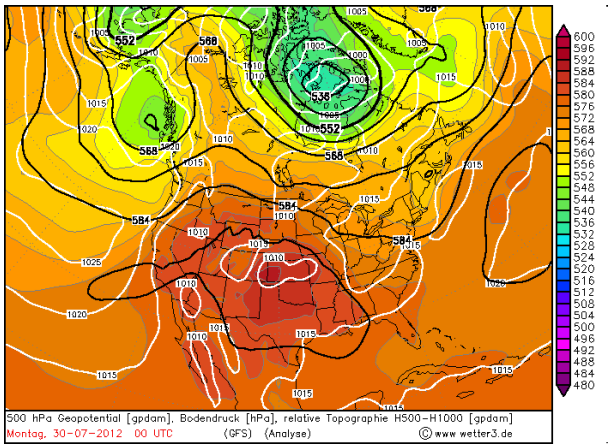

Figure 1:
Synoptic weather pattern over North America, July 30, 2012, 00 UTC: 500 hPa geopotential height and sea level pressure analysis
Image Credit: wetter3.de

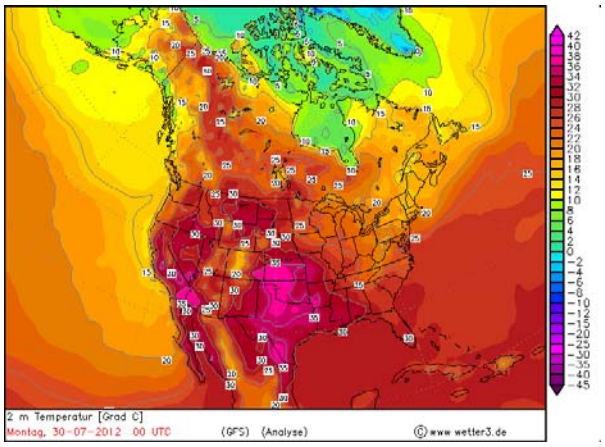

Figure 2:
Synoptic weather pattern over North America, July 30, 2012, 00 UTC: 2 meter temperature analysis
Image Credit: wetter3.de

2.2 Extreme Temperature Anomalies, many new Temperature Records

Extreme and extraordinarily high temperatures are present in North America and in particular in the USA in 2012. After an already record-breaking spring (see our article Record heat in March 2012), the extreme heat is now continuing over the summer without any noteworthy interruption (see also our article Heat in June/July 2012).

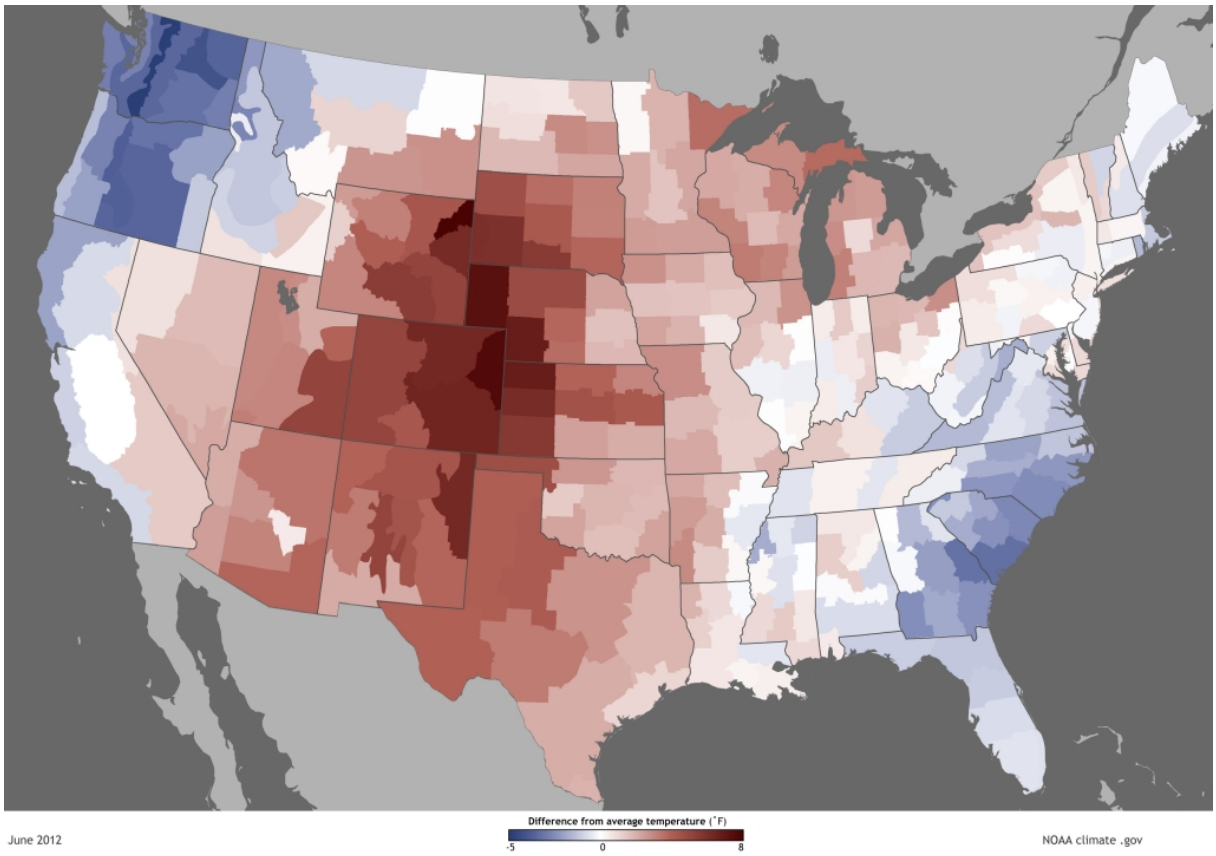

Figure 3:
Temperature anomaly [°F], USA, June 2012
Image Credit: NOAA ClimateWatch

As obvious from Figure 3, June 2012 also was too hot like many other months. Temperatures in June exceeded the US-wide average by about 2°F (about 1.2K). While temperature deviations along the coasts tended to be negative, high positive anomalies occurred especially in the Great Plains and the Midwest. The state of Colorado saw the hottest June on record with a deviation of +6°F (about +3K). In seven other states, June 2012 was listed under the top ten of the hottest June months. All over the USA, 170 old records of daily high temperature were tied or broken.

2.3 Hottest July on Record, Heat Waves and Record Heat in 2012

Figures 4 and 5 show the mean July temperature recorded and its significant positive deviation by up to 8°F (about 4.5K). The state of Virginia recorded the hottest July since the beginning of observations. In 32 states, July 2012 was listed under the top ten of hottest months of July. Averaged over the USA, July 2012 is the hottest July since the beginning of recording in 1895.

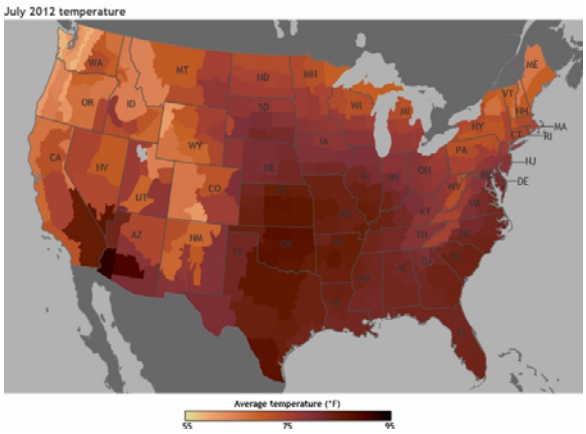

Figure 4:
Mean temperature [°F] USA, July 2012
Image Credit: NOAA ClimateWatch

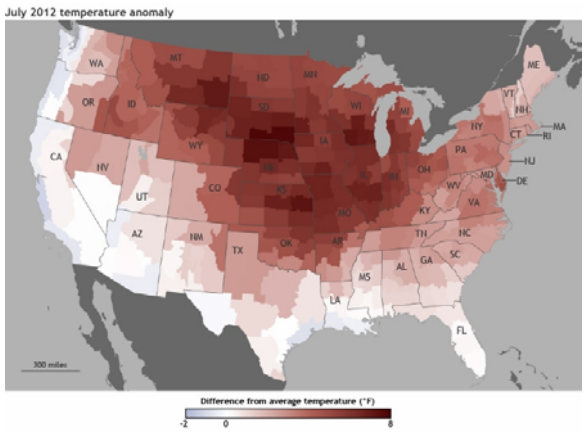

Figure 5:
Temperature anomaly [°F] USA, July 2012
Image Credit: NOAA ClimateWatch

Full-blown heat waves occurred in parts of the USA, also in the state of Oklahoma. In Oklahoma City, the old record temperature of 45°C of observations made since 1891 was tied. On 19 successive days, the thermometer measured above 100°F (corresponding to 37.8°C). This value was exceeded only once in the climate recordings of Oklahoma. This was during the "Great Dust Bowl Summer" in 1936 when such high temperatures were reached or exceeded on 22 successive days.

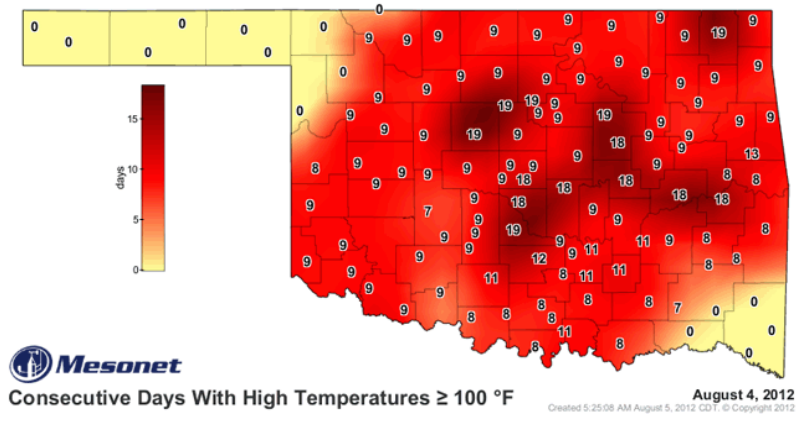

Figure 6:
Consecutive Days With Hight Temperatures >100°F
Image Credit: Mesonet OK

Regarding days with a temperature in excess of 110°F (corresponding to 43.3°C), the heat wave of summer 2012 has already drawn level with the record summer of 1936. In both cases, such a high temperature was observed on three days. Records were also tied for the highest minimum temperatures, for example at Tulsa (OK), where the lowest daily temperature was not below 31°C.

The United States are experiencing the hottest year on record. After the hottest March, the third-hottest April, and the second-hottest May, the hottest July of 2012 even outshines the record July of the dust-bowl year 1936. Together with the past and extraordinarily hot year 2011 (with the second-hottest summer at that time), the temperature statistics exhibits a heat episode that has never been observed before in the USA.

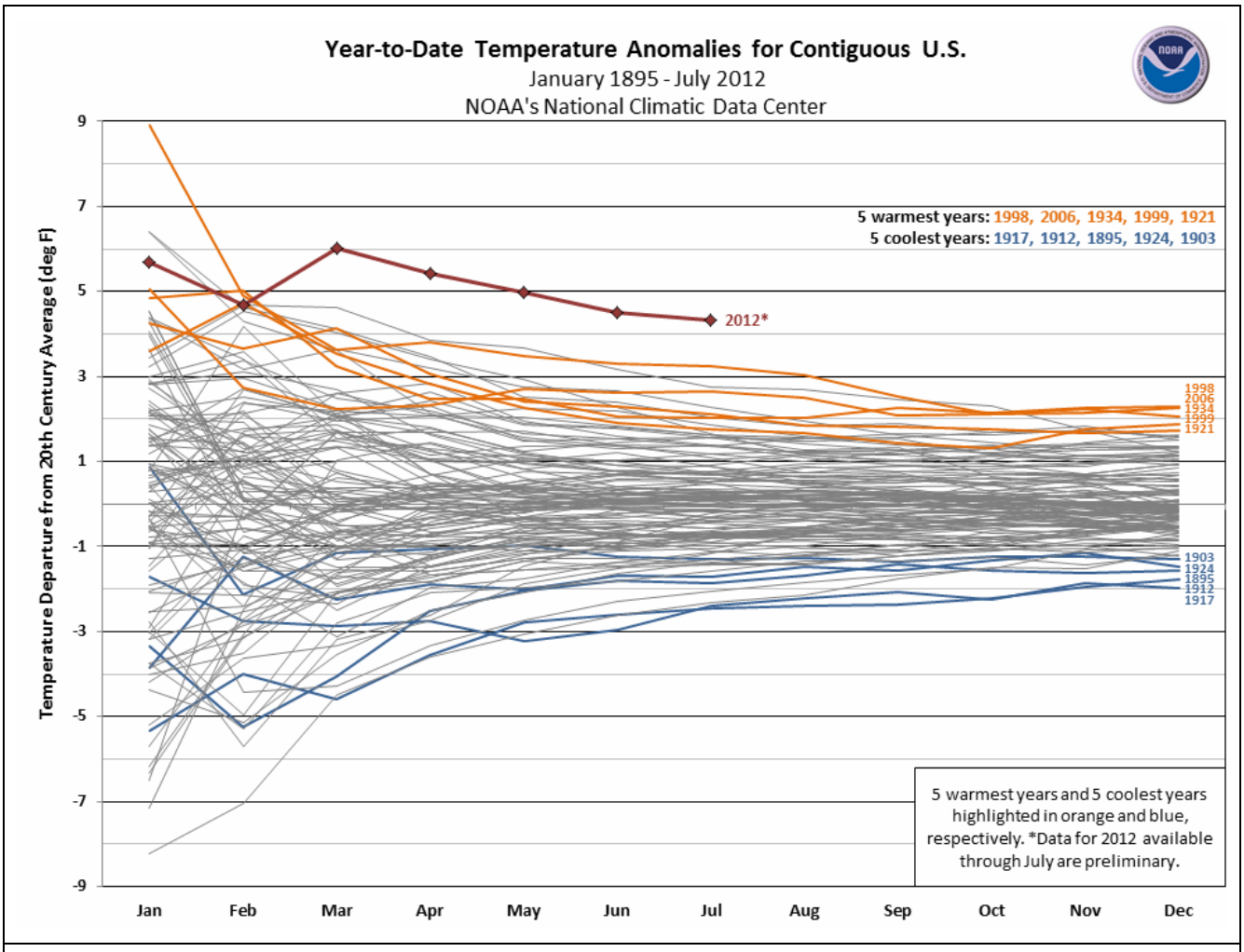

Figure 7:
Preliminary Year-to-Date Temperature Anomaly for Contiguous U.S.
Image Credit: NOAA NESDIS / NCDC

The twelve-months' period from August 2011 to July 2012 saw record heats in 24 states. All over the USA, this was the hottest twelve-months' period ever measured. Analysis of temperature deviations from the start of this year to July produces a curve which is beyond all observations made so far (see also images). About 132 million inhabitants were directly affected by the heat. They were informed about the current weather situation by the American Weather Agency NOAA.

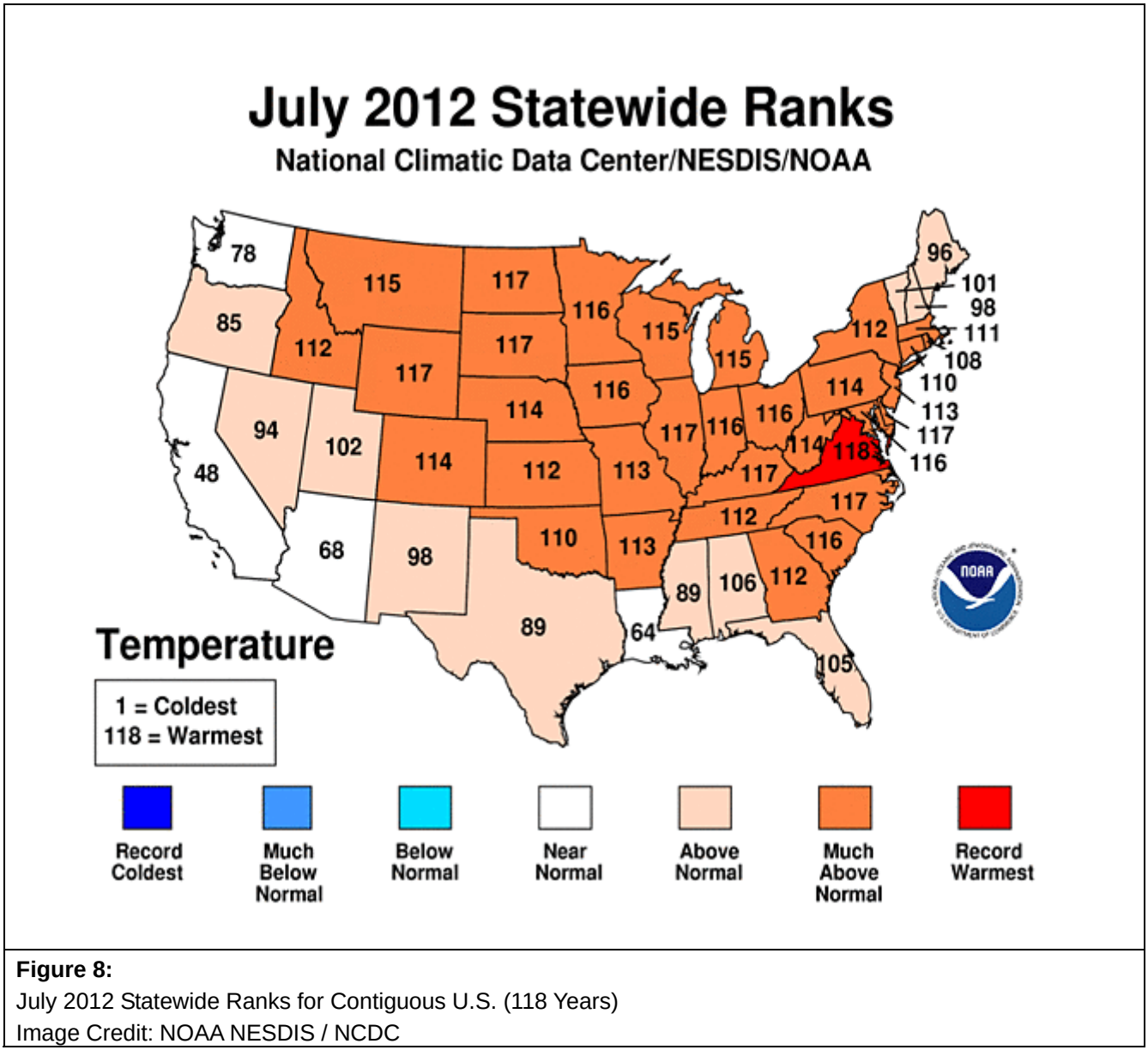

Figure 8:
July 2012 Statewide Ranks for Contiguous U.S. (118 Years)
Image Credit: NOAA NESDIS / NCDC

2.4 71 New All-time Records of Highest Temperature in July 2012

After 170 all-time records had been tied or even surpassed in June, highest temperature records again were surpassed in July, mainly in the eastern part of the USA. 102 stations tied their previous records. At 71 places, a new all-time record was measured.

Springview (NE)	45 °C	43 °C	2006
Poplar Bluff (MO)	45 °C	44 °C	1930
Ralston (OK)	45 °C	44 °C	1996
Lewisburg (TN)	44 °C	43 °C	1930
Siloam (GA)	43 °C	42 °C	1983
Bremo Bluff (VA)	43 °C	42 °C	2007
Burlington (IA)	42 °C	40 °C	1983
Covington (MI)	40 °C	39 °C	1988
Battle Creek (MI)	39 °C	38 °C	1971
Hesperia (MI)	38 °C	37 °C	1953

Table 1:
Selection of new all-time records of highest temperatures in July 2012
Image Credit: NOAA/NCDC Records

Figure 9:
High temperature all-time records reached or surpassed in July 2012
Image Credit: NOAA/NCDC Records

3 Precipitation

3.1 High Precipitation Deficit and Extreme Drought

Due to the persistent general weather situation, extreme heat in many parts of the USA was accompanied by longer-term sparse or lacking precipitation. Passing troughs with large-scale precipitation brought relief to some regions only. Sunshine, dry and hot air, and wind stimulated evaporation and resulted in a high precipitation deficit that is still growing at many places. At Joplin (MO), no drop of rain was measured in July. The last time, this happened in the year 1946. At Springfield (MO), 8.3 mm monthly precipitation was measured, the driest July since 1953. Also at Sioux Falls (SD), precipitation was measured to be 6.1 mm only. Normally, precipitation in July would amount to about 78 mm.

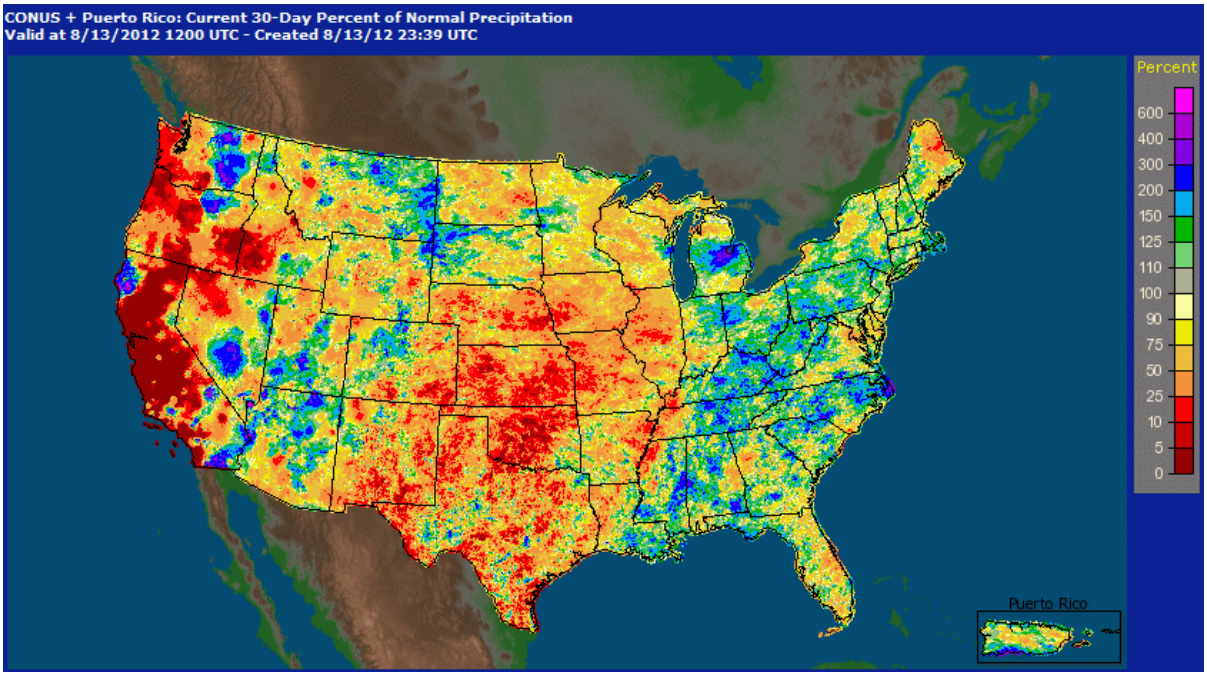

Figure 10:
Precipitation deviations in the USA in summer 2012 - 30 days period (July 14 – August 13, 2012)
Image Credit: NOAA AHPS, NOAA CPC

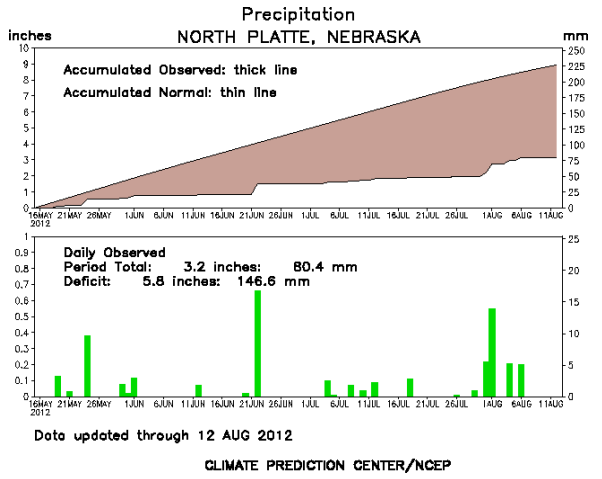

Figure 11:
Precipitation (May 16 –August 13, 2012) at North Platte, Nebraska, and deviation from normal
Image Credit: NOAA CPC

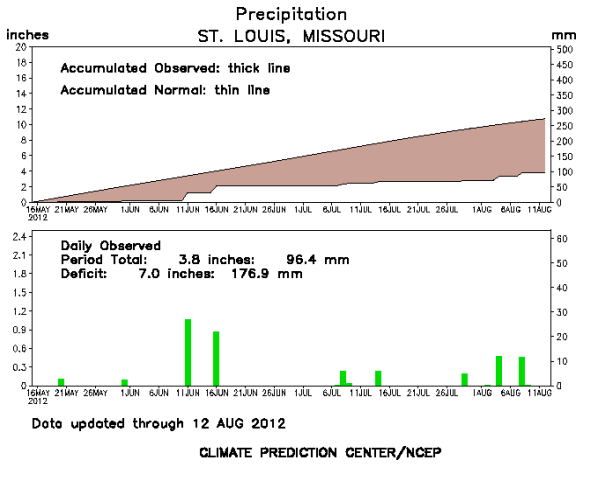

Figure 12:
Precipitation (May 16 –August 13, 2012) at St. Louis, Missouri, and deviation from normal
Image Credit: NOAA CPC

3.2 Fifth Largest Drought Since 1895

The percentage of areas that are at least moderately affected by the drought increased to 75% in July according to the Palmer Drought Severity Index. This is the fifth largest drought on record reaching back to the early 20th century. The area affected by extreme drought increased to more than twice the value from June to July. The state of Maine experienced the fifth-driest July since the beginning of observations. Judging from the three-months' precipitation amount, the months from May to July have to be considered record-dry in Nebraska, Kansas, and Arkansas. The last great drought occurred more than 50 years ago in December 1956.

07/1934	80 %
12/1939	60 %
07/1954	60 %
12/1956	58 %
07/2012	**57 %**

Table 2:
Largest droughts since 1895 in the USA (percentage of area that is at least moderately affected by the drought) according to the Palmer Drought Severity Index
Image Credit: NOAA NCDC

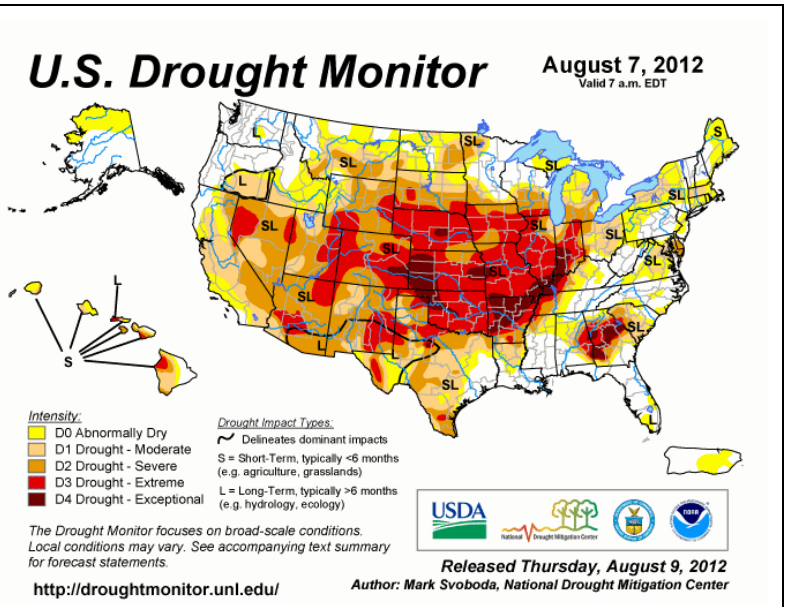

Figure 13:
Drought intensity at August 7,2012
Image Credit: U.S. Drought Monitor

4 Consequences of Heat and Drought

4.1 Forest Fires and Crop Failures

The parts west of the Appalachian Mountains including the Great Plains, most of the West and even some areas in the Pacific Northwest as well as Northern Mexico are most seriously affected by the drought. The situation in the Great Plains is highly critical. Due to the excessive production of corn, the Great Plains are referred to as the "corn belt" of the USA. Now, as a result of lacking precipitation, all grainfields and farms are completely dry. Significant decrease in cattle and crop failures of up to 50%

are expected. By mid of August 2012, 85% of the total US crop area and 71% of the cattle ranges suffered from drought. In the medium term, food prices are expected to increase. The price of grain has already increased by about 25%. Many US insurance companies fear enormous damage due to the bad harvest. Last year, the amount insured already amounted to about 11 billion dollars. It is expected that this sum will not be sufficient this year.

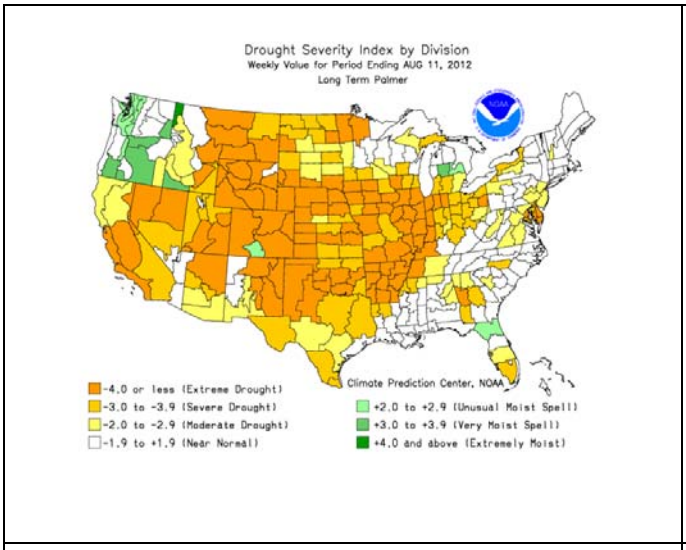

Figure 14:
Drought Intensity until August 11, 2012
Image Credit: NOAA CPC

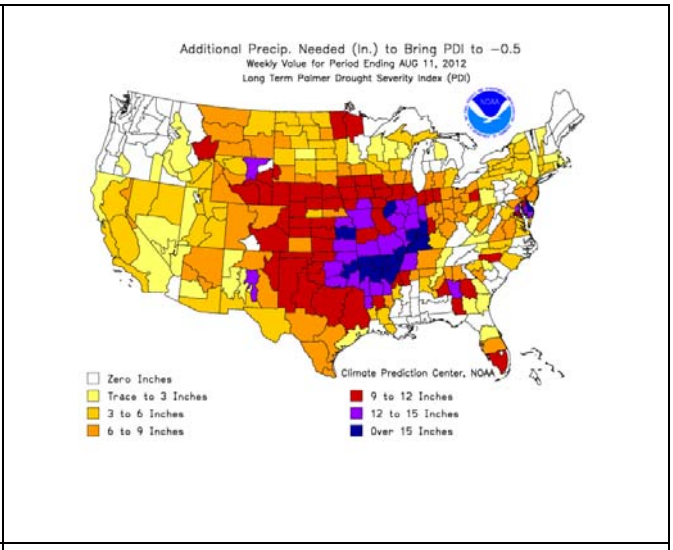

Figure 15:
Precipitation needed until August 11, 2012
Image Credit: NOAA CPC

In more than every second US county, emergency has been declared. More than 1500 counties in 32 federal states are on the list of the Department of Agriculture for rapid help by the state, with increasing tendency. In large parts, drinking water was rationed, as reservoirs and lakes are presently using all water they have.

The dry heat with lacking precipitation promotes forest fires fanned by wind gusts or lightning, mainly in the north and northwest of the country.

Figure 16:
Dry corn, Noblesville, IN
Image Credit: wunderground.com

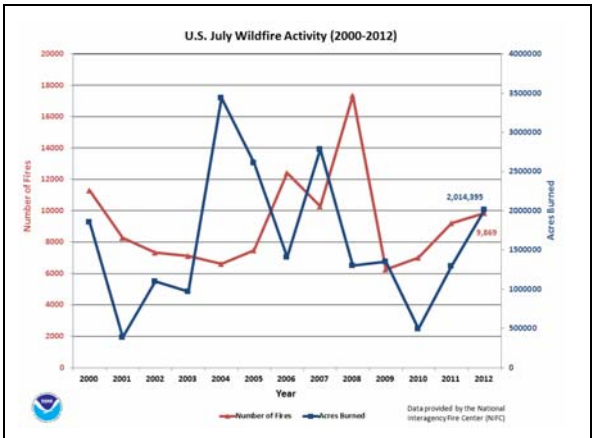

Figure 17:
U.S.Wildfire Activity 2012
Image Credit: wunderground.com

4.2 Rapid Ice Melting in the North West Passage and on Greenland

The extreme heat surplus on the North American continent did not only result in a record heat wave in the USA, but also affected the Canadian-Arctic Archipelago and Greenland. This is reflected by two temperature values:

- Alert, Nunavut, Canada, 82°N: Tmax 19.6°C on July 18, 2012 (old record being only marginally higher with 20.0°C on July 18, 1956)
- Summit on the ice shield of Greenland (3300 m above sea level): Tmax +3.6°C on July 16, 2012 (first positive temperature since the start of measurements)

For the first time, 97% of the Greenland inland ice showed signs of melting, a consequence of extraordinarily high temperatures up to the positive range.

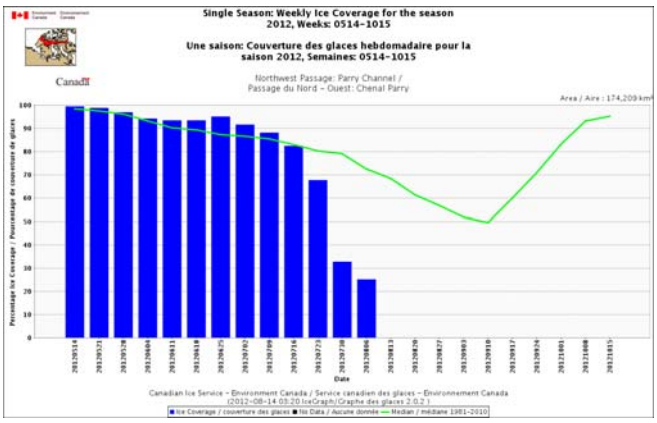

Figure 18:
Ice Coverage Northwest Passage / Parry Channel [%]
Image Credit: Canadian Ice Service

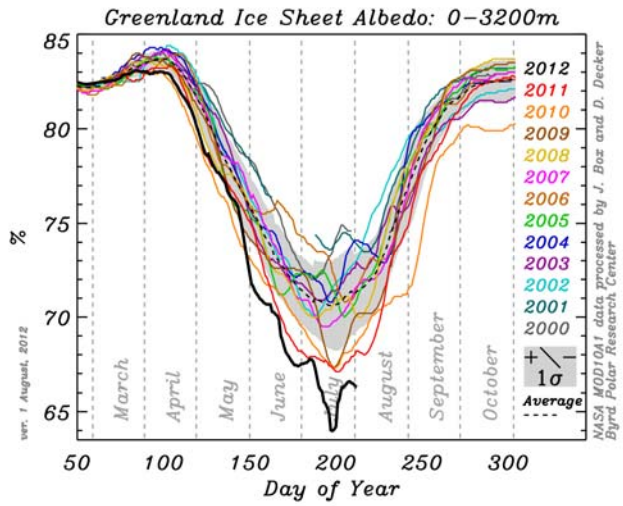

Figure 19:
Albedo of Greenland 2012
Image Credit: Byrd Polar Research Center

Since 2000, there has never been so little ice on Greenland in a July than this summer. The North West Passage known as an important sea route experienced an unequal shrinkage of sea ice during the second half of July. In early August, only 25% of the sea surface was covered by ice. According to the 30-year-mean (1981-2010), more than two thirds of the passage are normally covered by ice at this time of the year. And according to climate.gov, on August 26, 2012, the arctic sea ice extent broke the 2007 record low.

5 Outlook and Hurricane "Isaac"

An overall end of heat and drought is not expected during the next 7-10 days for most of the affected areas. But hurricane "Isaac", which made landfall by Wednesday morning (August 29, 2012) near the mouth of the Mississippi river, will bring much rain not only to New Orleans. During the next days "Isaac" might cause heavy precipitation and even flooding all along its path towards the Great Lakes area. At least for some areas in parts of the Mid West the drought might come to an end.

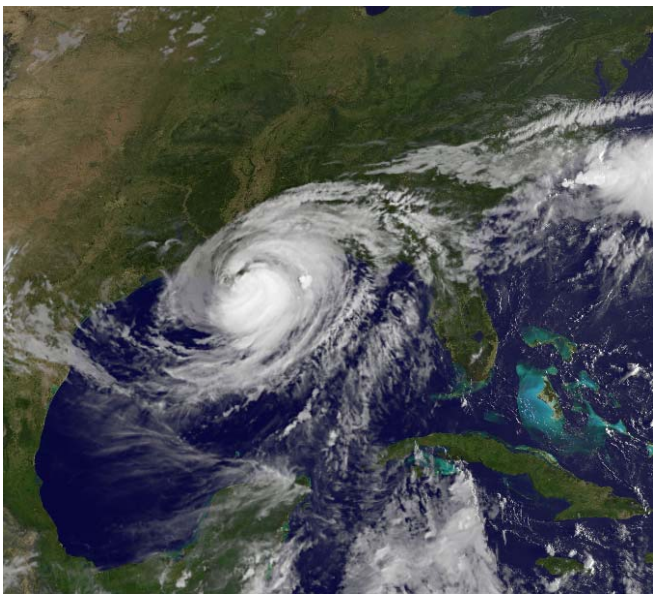

Figure 20:
Satellite image, GOES13, August 29, 2012, 11:31 UTC
Image Credit: NASA GSFC GOES Project

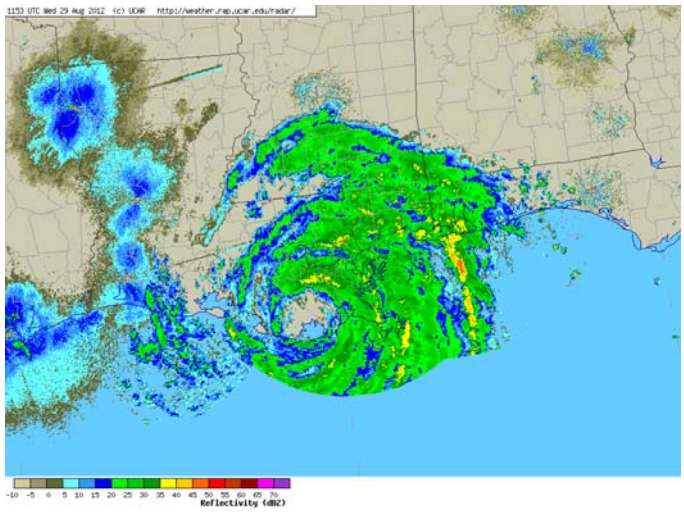

Figure 21:
Radar image (New Orleans) with "Isaac" making landfall, August 29, 2012, 11:56 UTC
Image Credit: NCAR

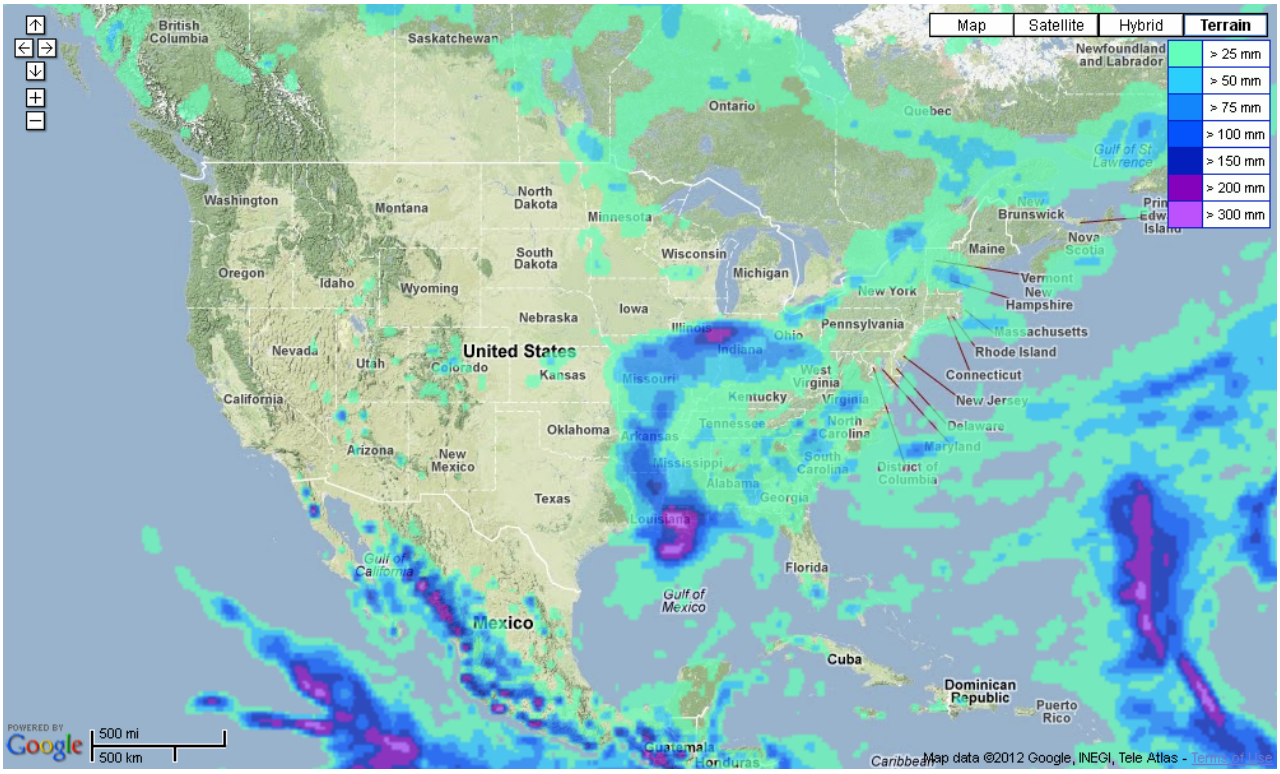

Figure 22:
Precipitation amount until September 6, 2012 – forecast issued August 29, 2012
Image Credit: Wettergefahren-Frühwarnung

6 References

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