National Weather Service Summer 2008 Outlook

For Southwest Lower Michigan

By William Marino

Summary

The National Weather Service forecast for June through August of 2008 for Southwest Lower Michigan calls for equal chances (EC) for above, below, or near normal temperatures and precipitation.

Normals

Normal's (Table 1) are calculated averages from a 30-year period of record (in this case, 1971 to 2000). Table 1 lists normal values of temperature and precipitation for the summer months of June through August for Grand Rapids, Lansing, and Muskegon.

TABLE 1. The list below shows what is normal for June through August and are based on the years 1971 to 2000. All temperatures are in degrees Fahrenheit.

	Grand Rapids	Muskegon	Lansing
Average High Temperature	80°	78°	80°
Average Low Temperature	58°	58°	57°
Mean Temperature	69°	68°	68°
# of days with High above 89 F	9.5	2.2	9.2
Precipitation (inches)	11.01	7.86	8.76

FORECASTER'S REASONING ON TEMPEATURE.

This summer's forecast was based on five factors that influence seasonal climate patterns over the United States. Those factors are: the influence of both the Pacific and Atlantic Ocean sea surface temperatures on the position of the polar jet stream, recent trends in the climate pattern, short term atmospheric oscillations such as the North Atlantic Oscillation (NAO), soil moisture, and to some extent snow and ice cover over northern Canada, Asia and the North Pole.

Given the significance of sea surface temperatures on the position of the polar jet stream and in turn the temperature trends for Southwest Lower Michigan, we will look at three significant oscillations that impact the weather over Southwest Lower Michigan and determine which is the most significant. The El Niño Southern Oscillation (ENSO) is the one most used by the Climate Prediction Center (CPC) since that oscillation has the most reliable forecasts for its future state. The Pacific Decadal Oscillation (PDO) is based on the temperature pattern over the entire Pacific Ocean, not just the tropical Pacific as is ENSO. In fact, the PDO modulates ENSO. In the positive phase of the PDO, El Niño is more prevalent. During the negative phase, La Niña is more prevalent. The Atlantic Multi-decadal Oscillation (AMO) is like the PDO but in the Atlantic Ocean. Both the PDO and AMO oscillate over a period of decades. This means once they are in a given state they tend to stay in that state for a long period of time. (See references at the end of this for more details on these oscillations)

Of the three most significant oscillations that impact the weather over Southwest Lower Michigan, one may ask, which is the most significant? Figure 1 through Figure 3 show these three oceans temperature based oscillations used by most long range forecasters. Figure 1is ENSO, Figure 2 the PDO and Figure 3 is the AMO. An index value of .3 or higher is considered statistically significant. Given that, and looking at the Figure 1 through Figure 3, it is quite clear the AMO has the highest correlation to Southwest Lower Michigan's summer temperatures.

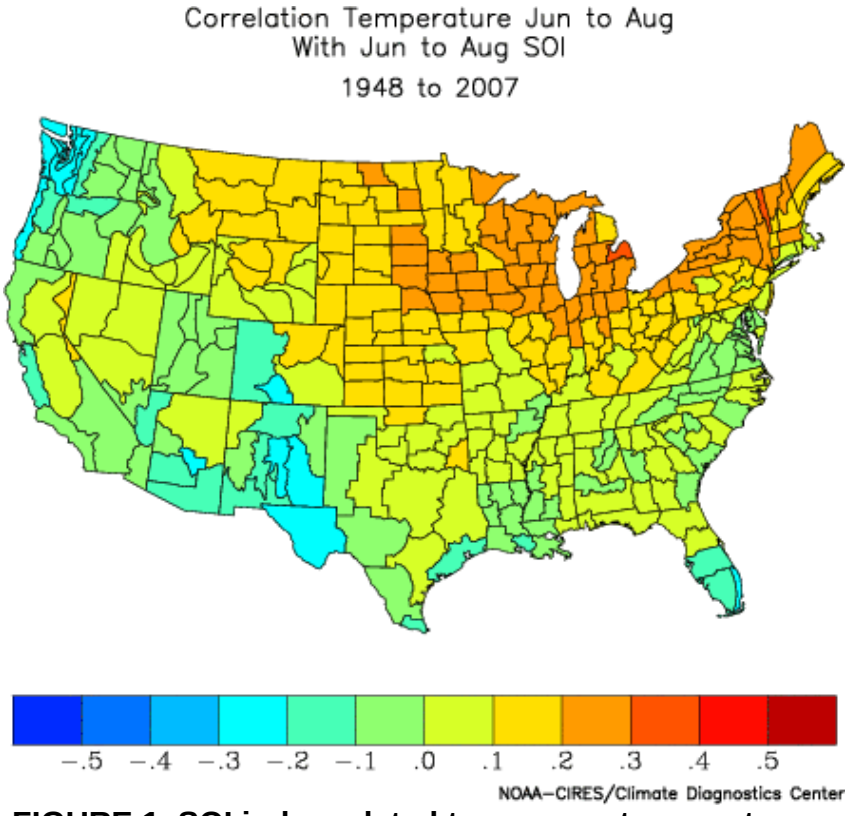

FIGURE 1. SOI index related to summer temperatures.

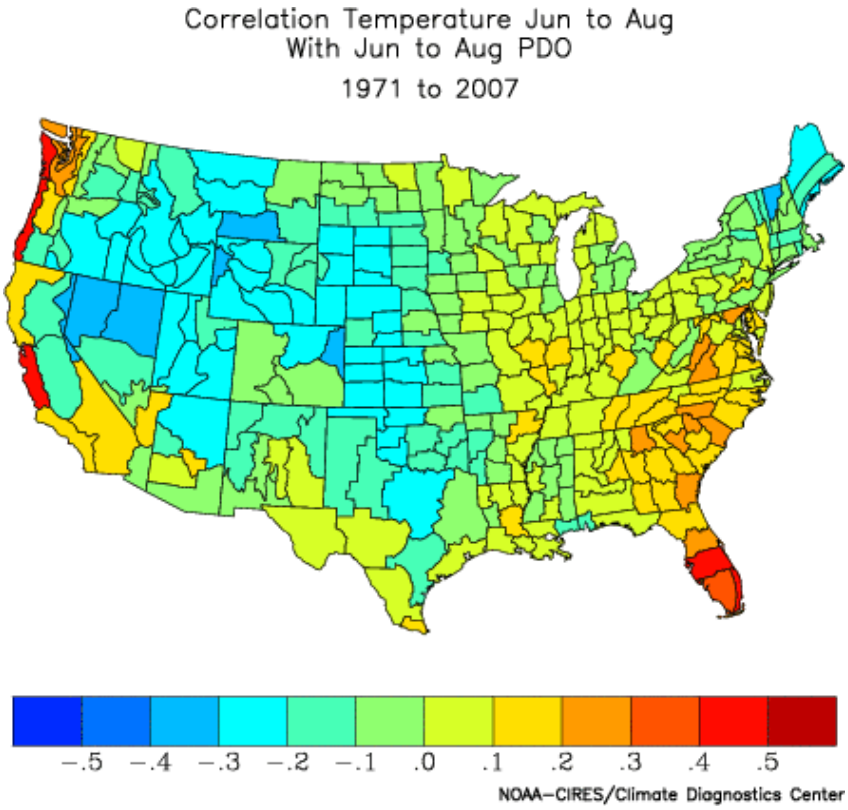

FIGURE 2. PDO index related to summer temperatures

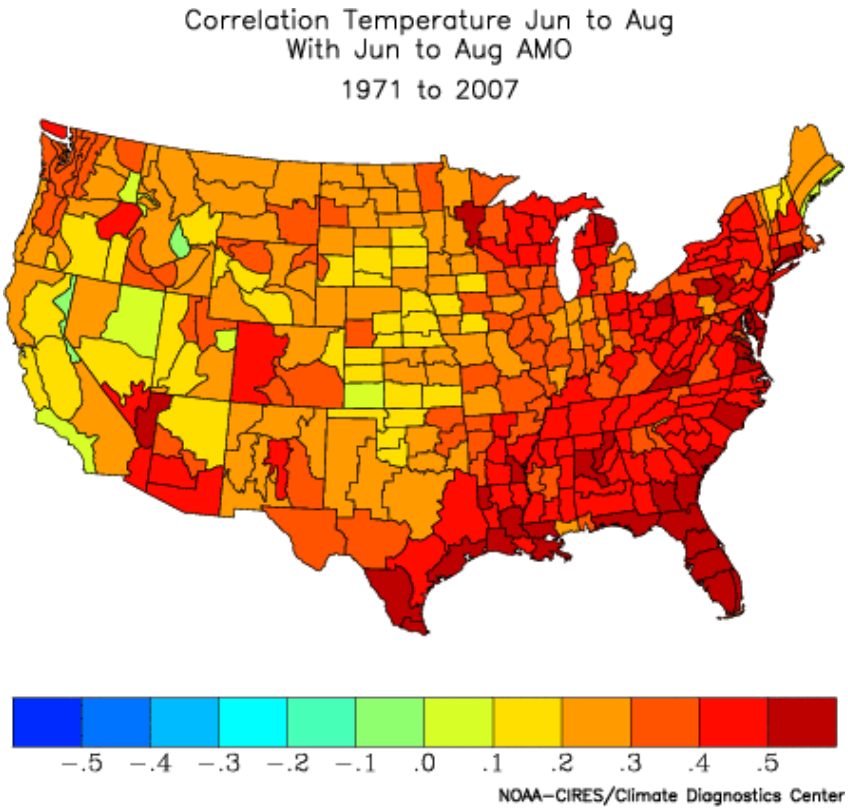

FIGURE 3. AMO index related to summer temperature

While the AMO (Figure 3) clearly has the highest correlation to Southwest Lower Michigan's summer temperatures, ENSO (Figure 1), also shows some correlation to the summer temperature anomalies. Figure 4 shows the impact of the phases of the AMO on Southwest Lower Michigan's summer temperatures. Curiously, during the positive phase, warm summers outnumber cold summers nearly 2 to 1. However for the negative phase, the ratio of warm to cold summers is closer to 1 to 1. Looking at Figure 5, the impact of ENSO on Southwest Lower Michigan's summer temperatures, it can be seen there is not a 2 to 1 advantage for warm or cold summers under any scenario that is possible this coming summer. Figures. 4 and 5 confirm what Figure 1 through Figure 3 suggest, that is, the AMO is more significant in terms of modulating Southwest Lower Michigan's summer temperatures than is ENSO.

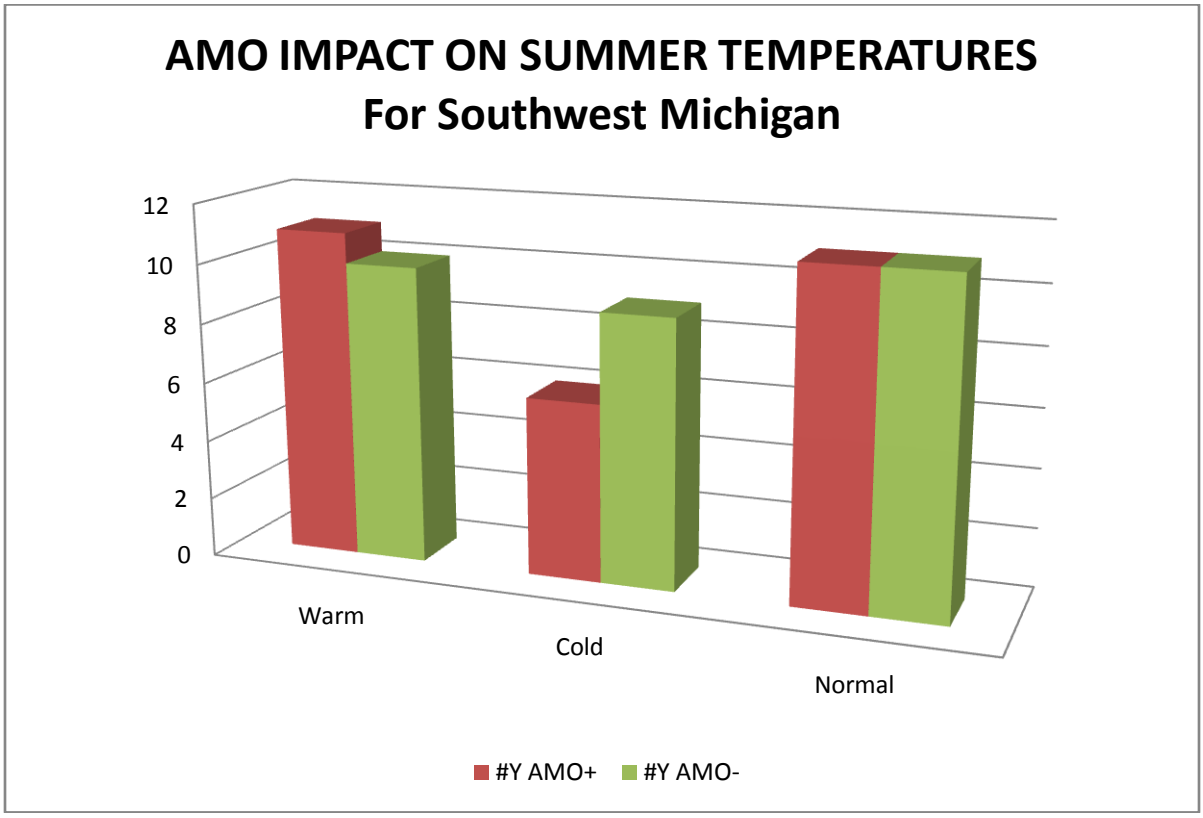

FIGURE 4. The AMO and Southwest Michigan summer temperatures

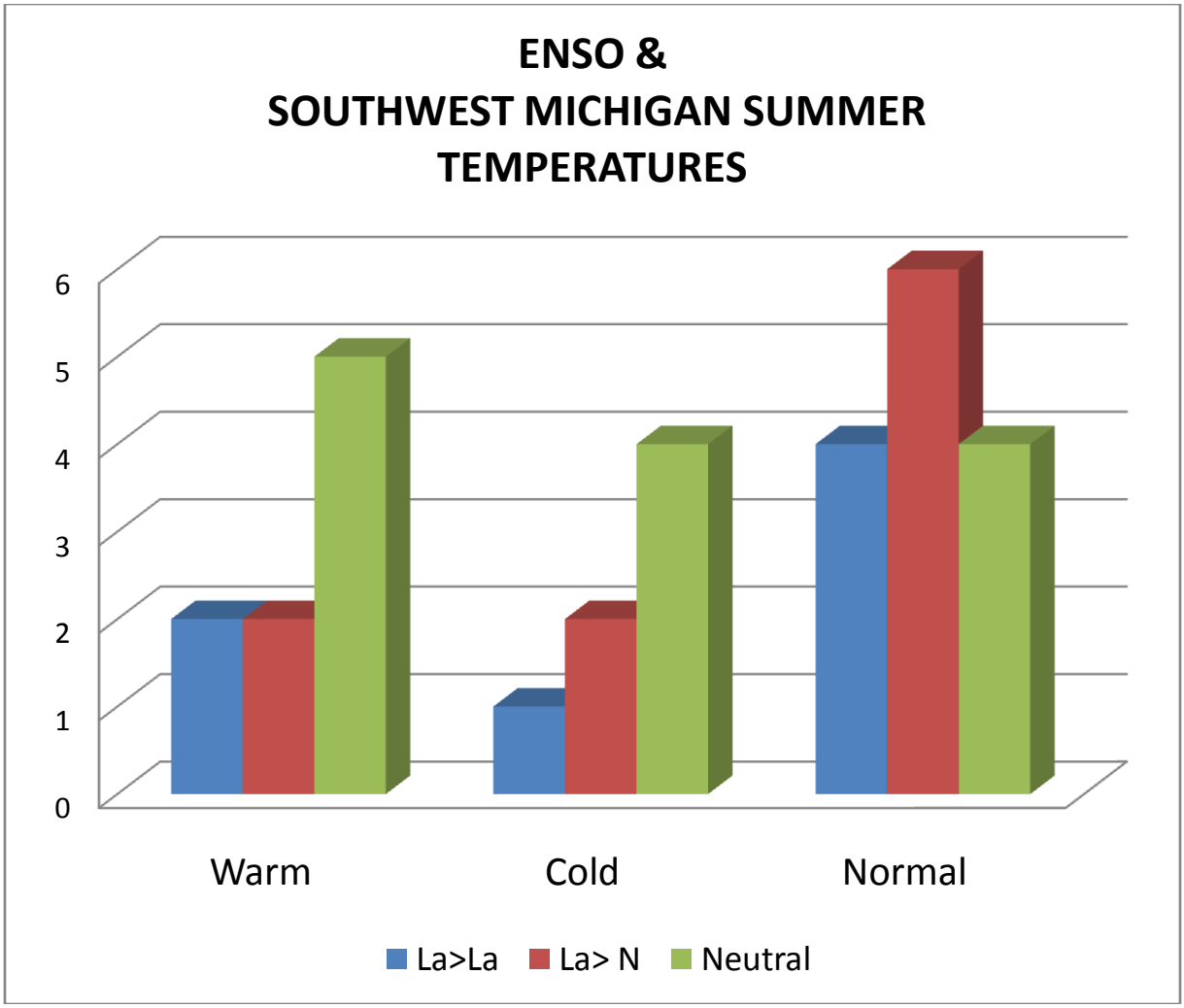

FIGURE 5. ENSO and Southwest Lower Michigan summer temperatures

Currently (ENSO state now), we have a La Niña in the Pacific Ocean and the AMO(AMO state now) is in the positive phase as it has been since the late 1990s. The trend for both is a fade to neutral. The latest (IRI current ENSO forecast)forecast for the ENSO state this summer is for La Niña to fade to neutral. There is still some question about this however. The AMO phase will more than likely stay on the positive side as it has over the past several summers. Given a La Niña fading to neutral summer, while the AMO is for the most part positive, Figure 4 would suggest a cool summer is the most unlikely while either normal to warmer than normal is preferred. Figure 5 suggests that given the La Niña fading to neutral scenario is correct, there is an equal chance of a warm or cold summer but near normal summer temperature occur three times more frequently than either a warm or cold summer. This leads me to believe near normal is the most favored category. However there is no clear winner, which brings us back to the equal chance scenario.

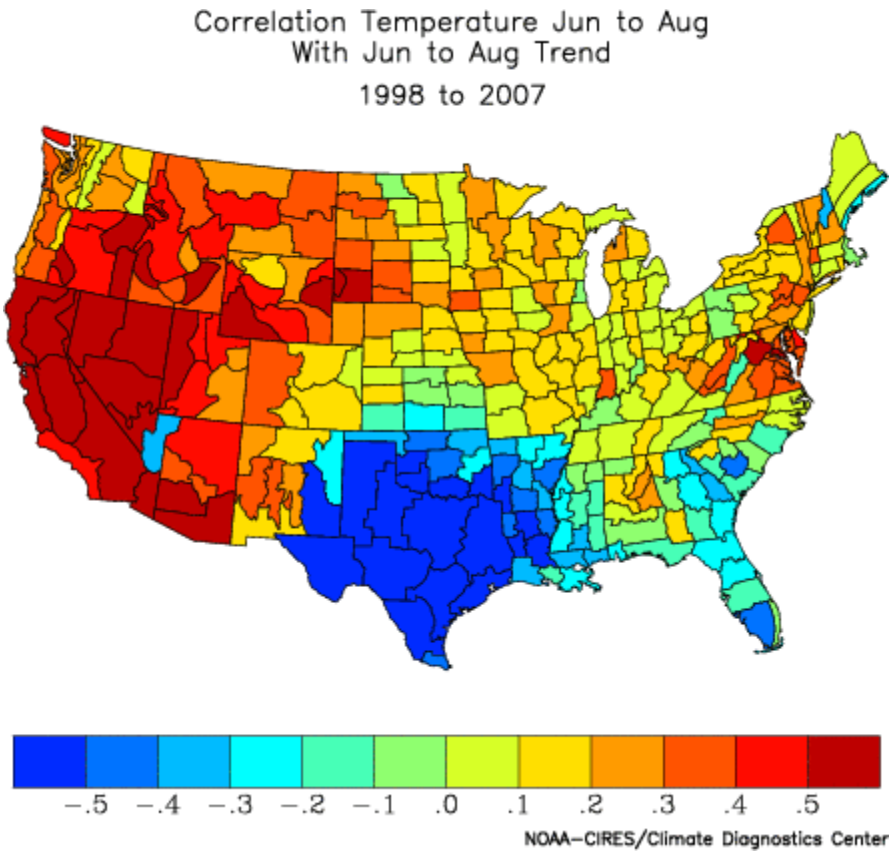

FIGURE 6. Trend in the summer temperature from 1998 through 2007 across the contiguous United States

Now let us consider the trend of the summer temperatures to see if that will push the summer temperature anomaly forecast one way or the other. Figure 6 shows the overall trend across the contiguous United States between 1998 and 2007. This does suggest a trend toward warmer summer temperatures, but with a correlation between 0.2 and 0.3 the correlation is not strong. Figure 7, which is the summer temperature trend for all of Southwest Lower Michigan since 1895, with the Grand Rapids curve superimposed over it, clearly shows a trend toward warmer summers that began in the late 1980s and seems to be currently peaking, if not trending downward.

While the Grand Rapids curve is very similar to the area wide curve for the period of record, it is more than curious to note that during warm periods the Grand Rapids curve is significantly higher than the overall area curve is. During cooler periods, it is nearly identical. This suggests something happens during warmer summers to cause the city of Grand Rapids to warm more than surrounding areas do. Then once it cools back off, it cools to what the rest of the area's temperature is. That happened twice for both the warming aspect and the cooling aspect. More investigation is needed to understand what is going on there.

Since the temperatures for 2008 seems to be on the beginning of the down side of the curve in Figure 7 and Figure 6 does not show the summer warning to be significant, the summer temperature trend will be given little influence on the overall summer forecast. I therefore will continue the equal chance scenario for the summer temperature anomaly over Southwest Lower Michigan. This will also not change our preference for normal to below normal temperatures over warmer than normal given the weakness of the trend.

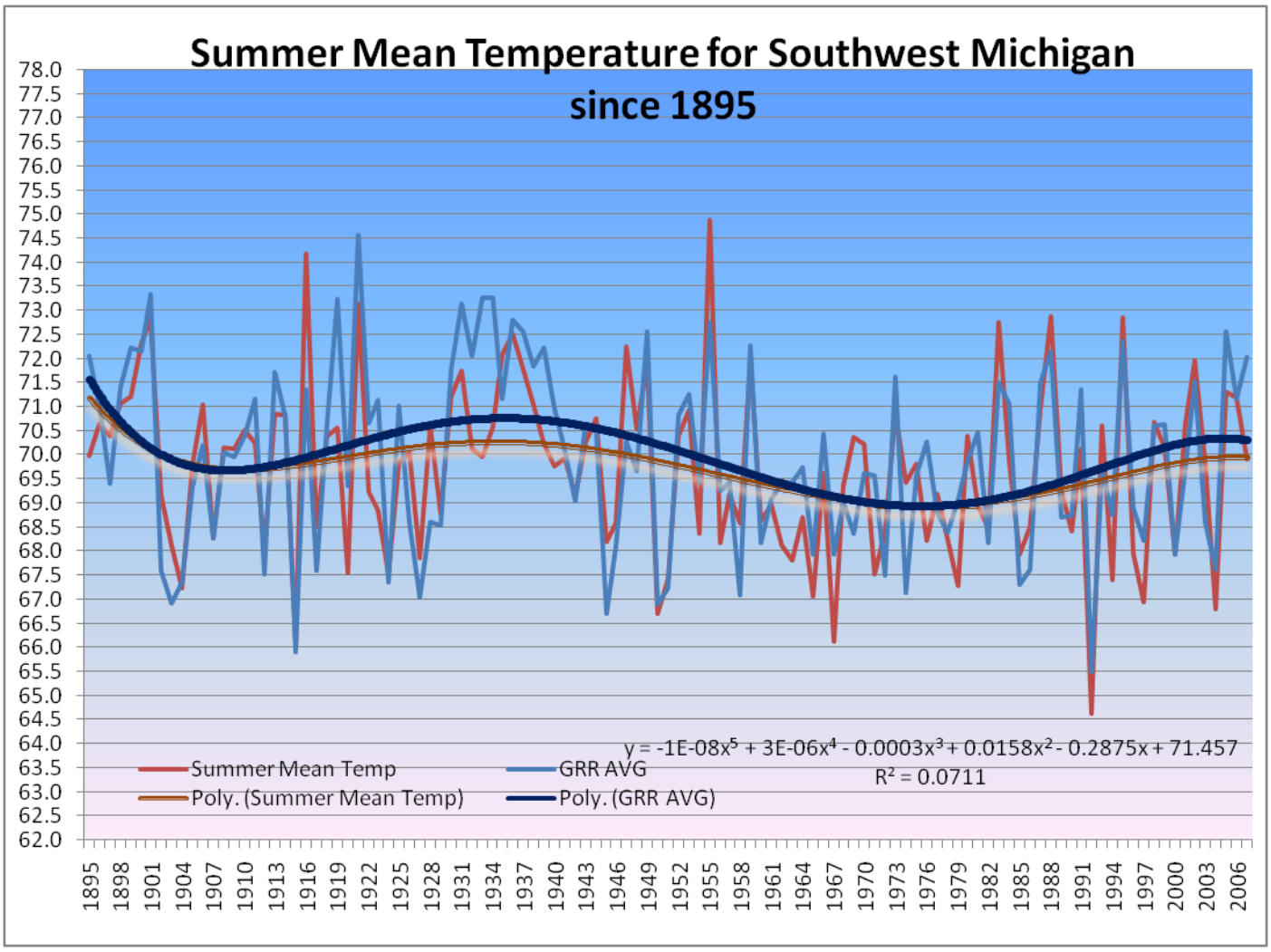

FIGURE 7. The summer temperature trend for all of Southwest Lower Michigan from 1895 to 2007. Grand Rapids summer temperature trend is superimposed on the chart to show how its trend compares to the overall area's trend. The "summer mean temp" line on this chart uses all of the climate stations in Southwest Lower Michigan each year from 1895 to 2007.

Finally we will consider the last aspects of the summer forecast. These are: the shorter term oscillations and the summer snow and ice cover. Figure 8 shows that the Arctic Oscillation (AO) has a weak correlation in the .1 to .2 range. Figure 9 shows the North Atlantic Oscillation (NAO). The NAO shows nearly no correlation at all. The best correlation is shown by the Pacific North America (PNA) oscillation with a range of .2 to .3 over Southwest Lower Michigan. Even at that level, it is not a significant correlation. The ice and snow cover (Figure 11) have been at record low levels (Current Snow and Ice)over the past few summers over northern Canada, the Arctic and northern Asia. Given the warmth of the past few summers, one could suggest some impact. Figure 11 clearly shows a very significant negative correlation between snow cover extent and summer temperatures, that is increased northern hemisphere snow cover means cooler summers. This would increase the odds of a warm summer. It too may partly explain the recent increase in warm summers over the United States.

Considering all of the above factors, I have to conclude as CPC did that there is no preferred outcome. The equal chance of warmer than normal, near normal or below normal seems the best possible forecast. I would still suggest, considering the snow cover extent, and the La Niña to neutral suggesting near normal as the most likely outcome and that a cooler than normal summer is the least

likely outcome. Based on CPC's downscaled forecast probabilities I would say there is a 34 percent chance of a warm summer, 34 percent chance of normal summer and a 32 percent chance of cold summer. [(CPC downscaled forecast for Grand Rapids for this summer)]

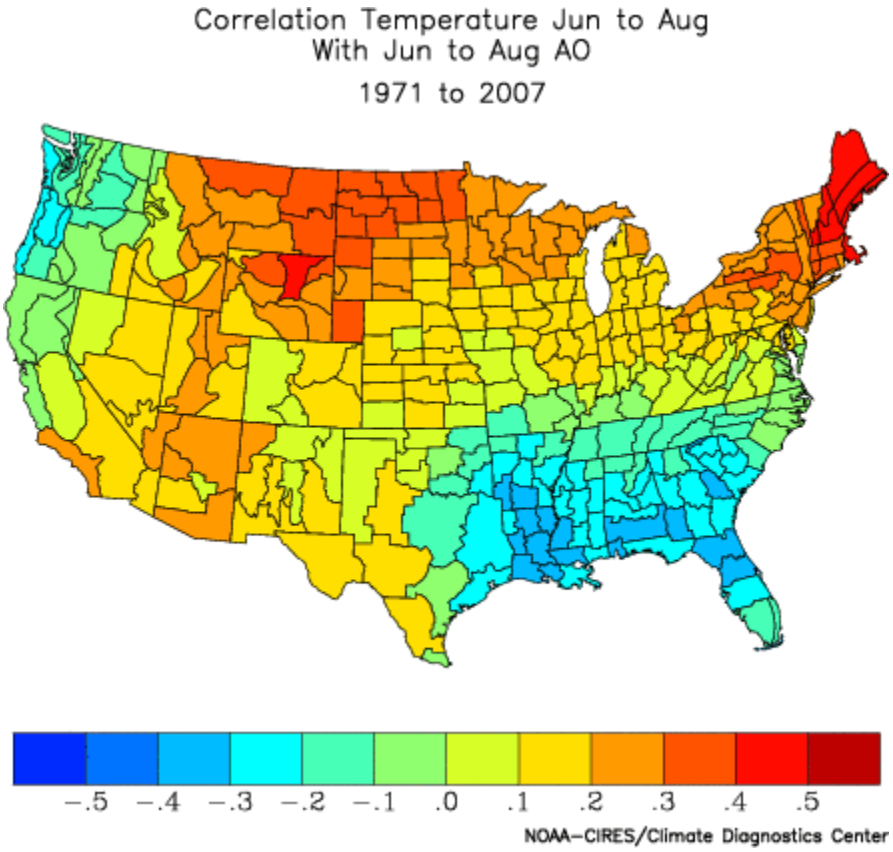

FIGURE 8. AO index related to summer temperatures

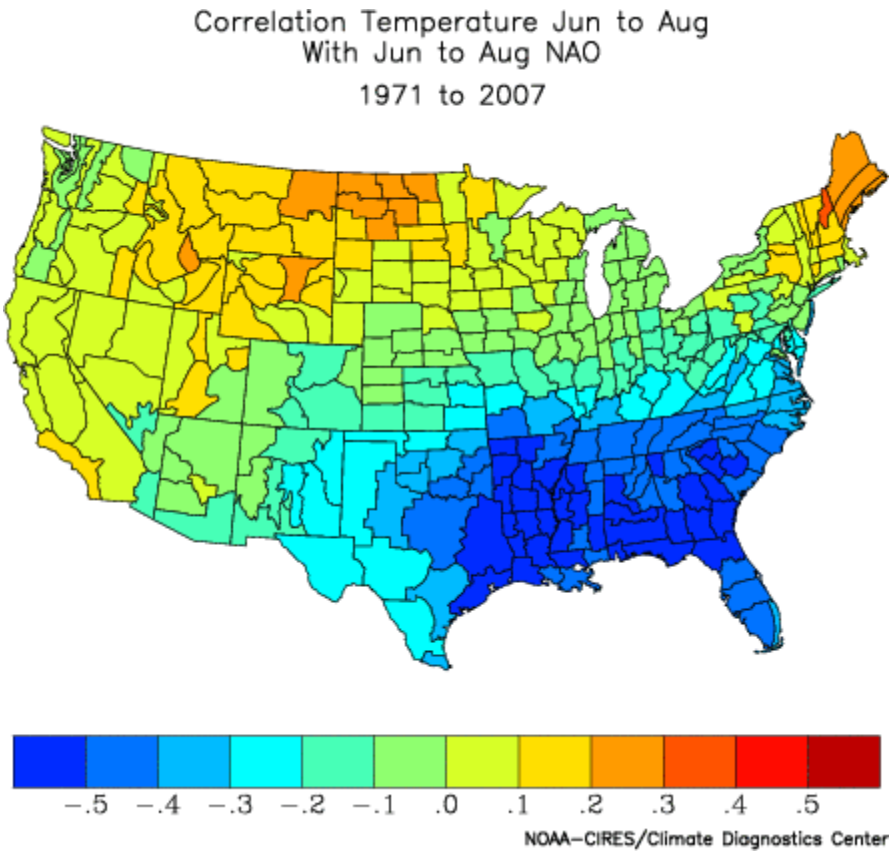

FIGURE 9. NAO index related to summer temperatures

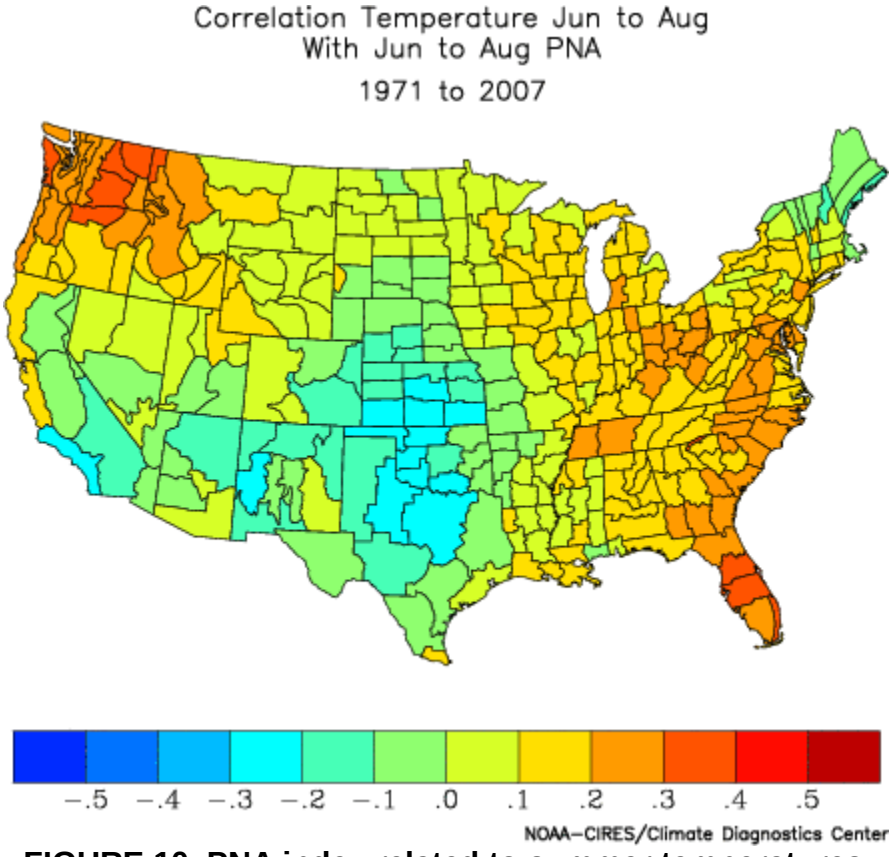

FIGURE 10. PNA index related to summer temperatures

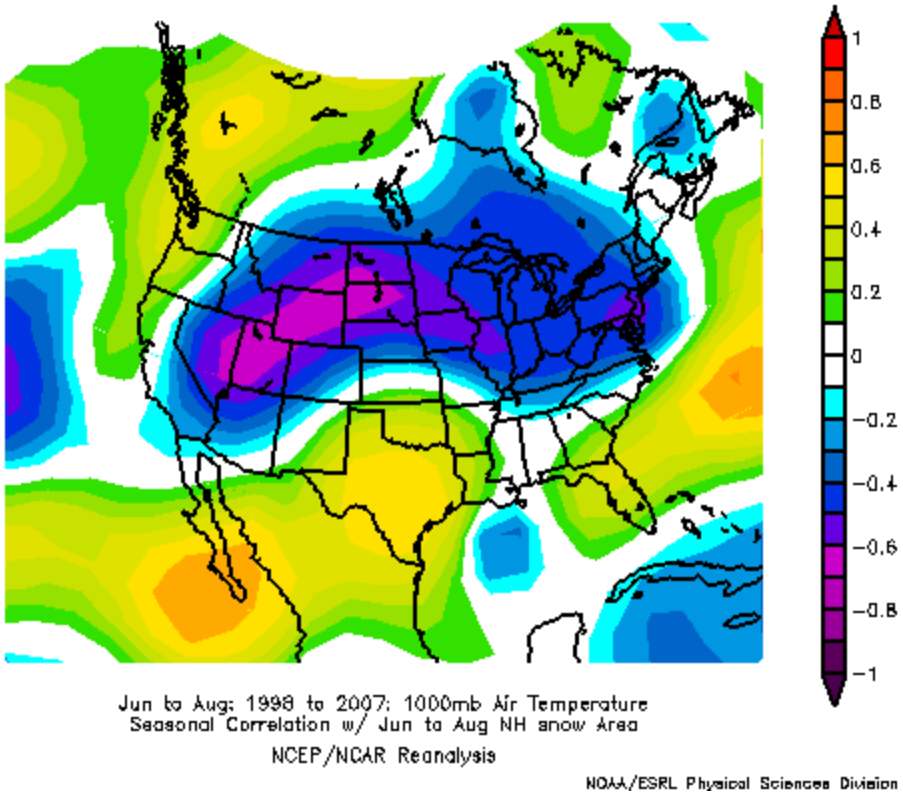

FIGURE 11. The correlation of summer temperature with Northern Hemisphere Snow Cover Extent

FORECASTER'S REASONING ON PRECIPITATION.

We will consider the precipitation forecast for the summer of 2008 in a similar way to the temperature forecast. Since we have a positive AMO with a weak La Niña fading to neutral during this coming summer, I will consider that as my primary forecast scenario. Figure 12 would suggest the current above normal rainfall pattern that has been occurring all year just south of Lower Michigan will continue this summer. The extreme southern counties on the Grand Rapids county warning area (CWA) would be on the north edge of this area.

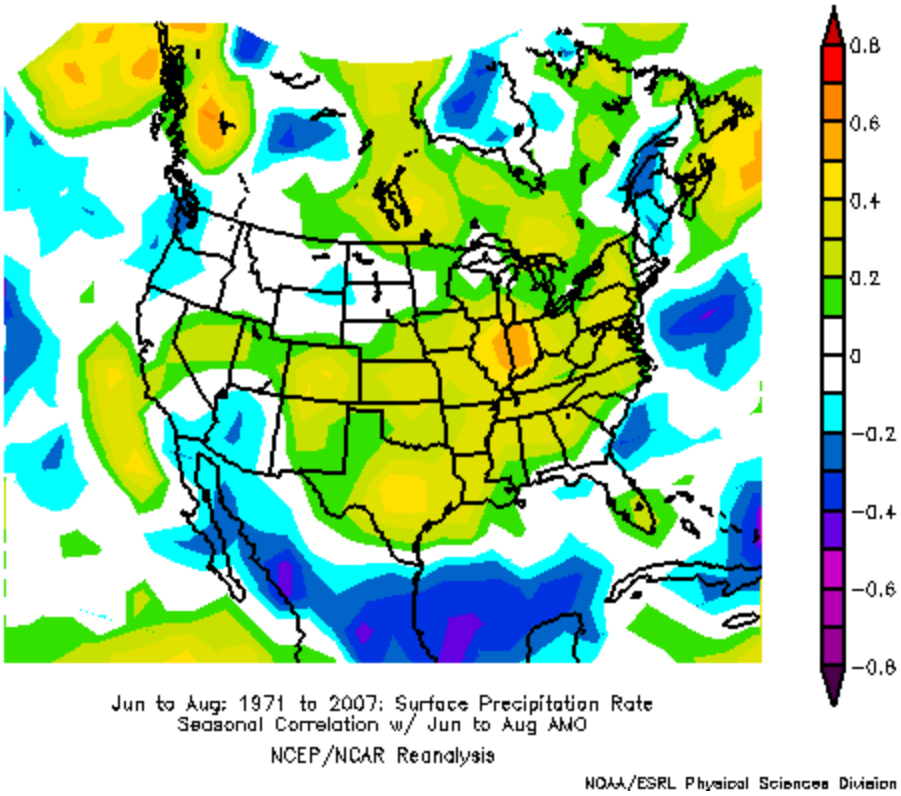

FIGURE 12. AMO correlation to summer precipitation

The ENSO correlation is weak. Note that in Figure 13, given that we expect an overall neutral ENSO summer, the middle panel is what we should look at and that suggests no significant anomaly. In Figure 14, the trend shows only a weak increase toward wetter summers in recent years.

While the chart has not been included in this forecast, recent data suggests La Niña's tend to create a precipitation void near the Lake Michigan shore south of Muskegon. That would suggest lakeshore areas south of Muskegon would have a slightly enhanced probability of below normal precipitation.

All of this leads me to believe that once again, equal chance is our best possible forecast. That is there is 33 percent chance of above normal precipitation, a 33 percent chance of near normal precipitation and a 33 percent chance of below normal precipitation.

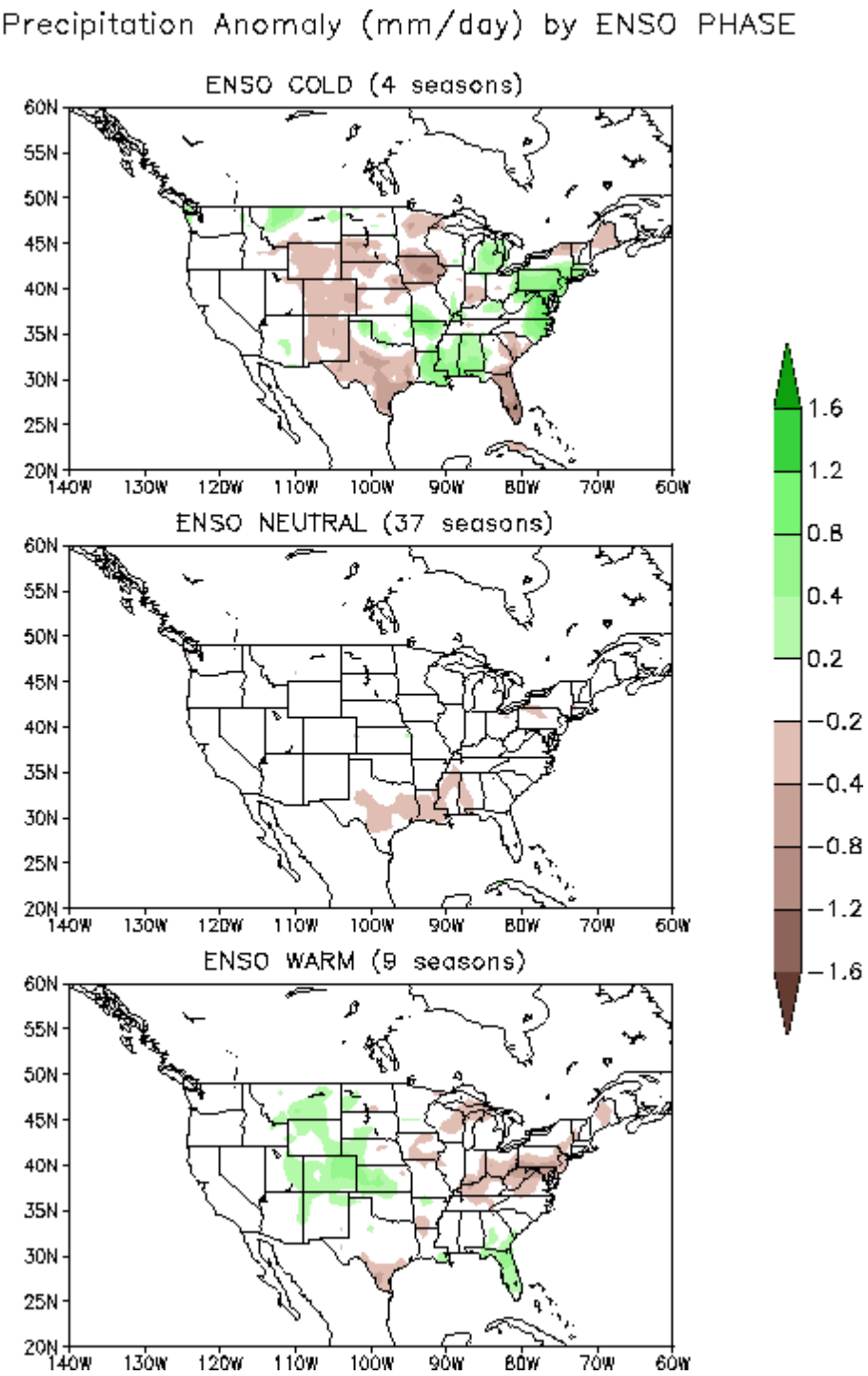

FIGURE 13. CPC calculated precipitation anomaly correlation for all ENSO states for the summer months

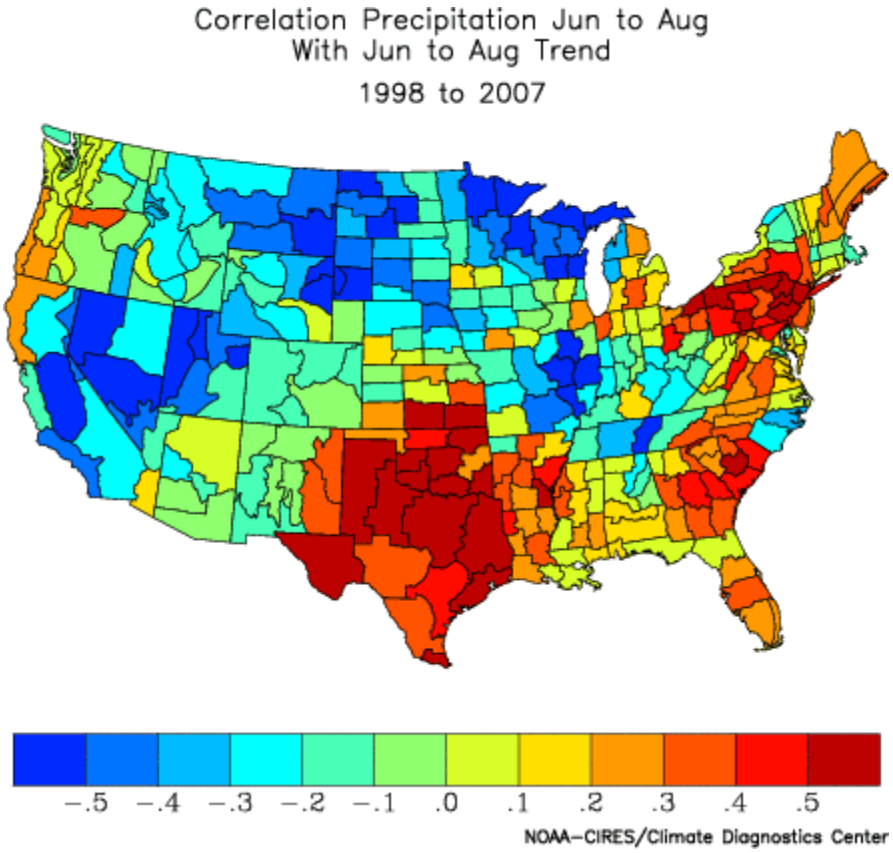

FIGURE 14. Precipitation Correlation with the trend from 1998 through 2007

SUMMARY:

When all of these influences are considered together for temperatures in Southwest Lower Michigan, the result is equal probabilities of temperatures above, below, or near normal.

The result for precipitation forecasts is also equal probabilities above, below, or near normal. However, based on previous La Niña summers, there is a greater probability for a dry summer close to the Lake Michigan shore.

USEFUL WEB LINKS ON LONG RANGE FORECASTING:

Three month downscaled outlooks for selected cities in Southwest Lower Michigan:
http://www.weather.gov/climate/calendar_outlook.php?wfo=grr

For additional details, please visit the Climate Prediction Center's forecast at:
http://www.cpc.ncep.noaa.gov/products/predictions/90day/

To learn more about ENSO, please visit:
http://www.cpc.ncep.noaa.gov/products/analysis_monitoring/enso_advisory/

All the other Climate Prediction Center Forecasts
http://www.cpc.ncep.noaa.gov/products/predictions/

Numerous aspects of the past and current climate conditions:
http://www.cpc.ncep.noaa.gov/products/predictions/90day/tools/briefing/

Information on the PDO:
http://www.wrh.noaa.gov/fgz/science/pdo.php

Information on what ENSO is:
http://www.pmel.noaa.gov/tao/elnino/nino-home.html

Information on what the AMO:
http://www.aoml.noaa.gov/phod/amo_faq.php

Persistent Patterns that Shape Weather and Climate Variability- a glossary for them:
http://www.ucar.edu/news/backgrounders/patterns.shtml