***Summer of 2010: Will We Have a Warmer Summer?***

## ***Summer 2010 Outlook For Southeast Lower Michigan***

**(Also Includes Brief Spring 2010 Review)**

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**June 1st, 2010**

### Temperatures:

Last summer was a cool one across Southeast Lower Michigan with temperatures 2-3 degrees below average, while the Summer of 2008 was an average (normal) summer. The last warmer summer was in 2007 when temperatures averaged around a degree above the average in Southeast Lower Michigan. I look for a warmer summer this year compared to the last two. Strictly speaking, this latest set of summer analogues are mixed and really have something for everyone. This makes perfect sense since they reflect a neutral influence from the Pacific as El Nino departs and just before a new La Nina revs up. That being said, if the intermediate time frame from the analogues (1960s on) and recent short term (spring) is our friend, then a warmer summer is on tap. However, when the analogue data years before the 1960s are included, then a slightly cooler and more comfortable summer is likely, (could we possibly get three comfortable summers in a row)? Weighing the intermediate and short term data a bit more heavily, **look for our summer temperatures to average numerically / 0.0 to +1.5 degrees/ which seems suitable given the data.**

Analogue 500 MB mean wind patterns suggest a general broad ridging west and south in the US with occasional troughing in the Upper Midwest east through the Great Lakes and East Coast (more below). Last summer, this cool trough was rather persistent over the region bringing the cool summer. While Detroit just missed placing in the top 20 coldest last summer, it was Flint's second coldest summer and Saginaw's eighth. The trough that was so persistent last summer is expected to be more intermittent this summer, and thus, a warmer summer than last summer. Indications from past analogue Neutral summer data and upper wind projections suggest a summer similar to that of 2007. The Summer of 2007 was on the high side of normal and was also wet (more about that below). The Summer of 2007 also contained many contrasting air masses and patterns which were mainly due to a rather amplified and at times, changeable upper wind pattern.

**Number of 90 degree days**

If the past is any predictor for the number of 90 degree days, then look for the number of 90 degree days for the summer to be in the normal /8 – 12 days/ range across Southeast Lower Michigan. The summer of 1988, one of our analogue years, was an extreme outlier in the study for heat and 90 degree days, when 39 days reached 90 or better (the most ever on record). I don't foresee anything near that number nor a summer with a 74.2 average (like attained in1988).

## Rainfall:

This is a tough call (and even more so than usual this summer) with the summer convective rains. Keeping one eye on our analogue summers and the other on recent late spring developments (rain events picking up, especially across the southern Great Lakes and the upper Ohio Valley) strongly intimates above normal rains for at least the southern third of Southeast Lower Michigan (around the same general area that has recently seen the pick-up in rainfall). At the same time, many of the analogue years showed decidedly drier conditions prevailed just to the north of the wet area across much of the Northern Lakes. **It is my belief this pattern in the Southern Lakes has already begun and will continue but oscillate somewhat during the summer. The best chance for above normal rainfall this summer lies across much of the region around and south of a line from Flint to Port Huron with normal to below further north in the Saginaw Valley and Thumb region.**

Heaviest rainfalls varied not only by year but timing within the summer with a slight edge toward mid to late summer but each summer month (especially Detroit) contained some heavy rain years in the 12 analogues. With rainfalls in the summer, it is important to look at the overall **rainfall trend** (as done in our monthly write-ups) of the summer and not just the rainfall amount (as gardeners and farmers will attest). The Summer of 2007 was an excellent example of this rainfall **trend** versus rainfall **amount.** Even though the statistics said it was a generally wet summer with ample rainfall (all stations were above normal) **one of the most notable items of the summer was in fact, its dry spell.** And, the main period of dry weather hit at one of the worst times for agriculture and garden interests, in mid June to mid-late July (only to be followed by a wet and stormy August).

**Severe Weather Season:**

Look for a pick-up in severe weather (unlike last summer) this summer as periodic battles fire-up along the surface systems generated by the cold upper low in Eastern Canada and high pressure ridging transiting the country. Analogue severe weather **seasons** were average to above for events.

***National Outlook***

The national outlook from the Climate Prediction Center (CPC) shows a greater chance for below normal temperatures here and west and equal chances just south and east. Therefore, extreme Southeast Lower Michigan is basically on the edge of below and equal chances of below, normal or above (mixed signals – not unlike our local data and composite maps of the past in the Great Lakes; see analogue maps).

**Broad Scale Discussion**

Our cyclical Pacific sea surface temperature /SST/ pattern evolved from below to above average last year and is now in the process of falling fairly quickly through Neutral territory during summer. Many models continue this drop of the SST's and project the likelihood of a new La Nina commencing by late summer or autumn. This is similar to the last Neutral to La Nina pattern established during the Summer of 2007.

As one can see with Figs 1a and 1b (location of Nino 3.4 and the projected sea surface temperatures /SST/ for the summer), latest May guidance members do persist in dropping sea surface temperatures /SSTs/ in area Nino 3.4. Under these basically Neutral conditions little, if any, significant effects are slated for the Great Lakes.

**Fig 1a**

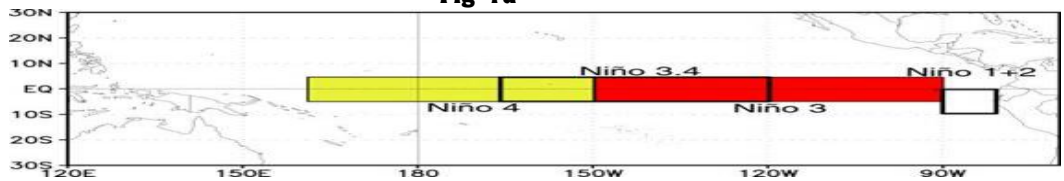
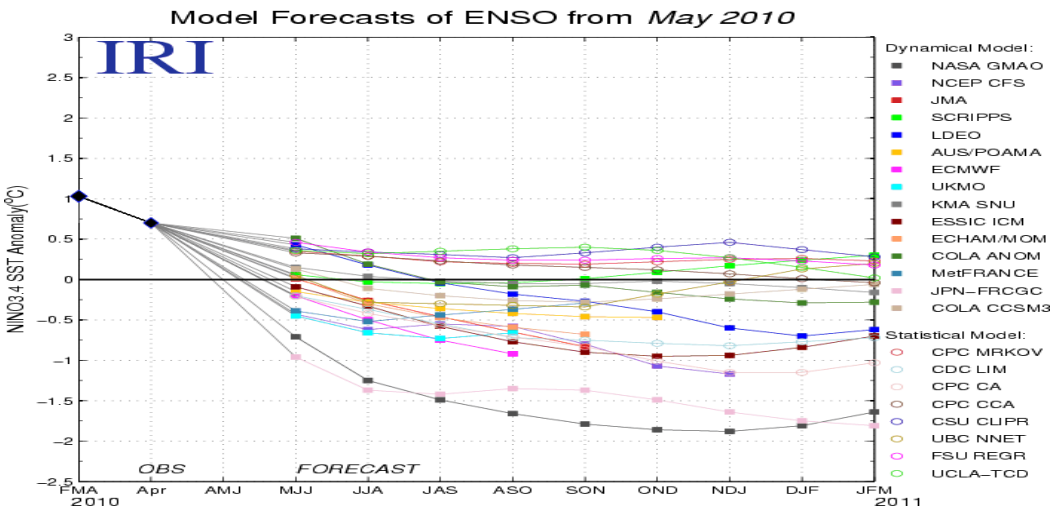



**Fig 1b**
**Model SST projections**



## ***Brief Review of Spring 2010***

Before we dive into the analogues for this summer, let's discuss that warm spring…

Warmest Spring on Record at Detroit!
Fifth Warmest at Flint and Second Warmest at Saginaw

It was a beautiful and exceptionally warm (see stats, Fig-2 and 3) spring across the Great Lakes and Southeast Lower Michigan. While the spring as a whole was extraordinarily warm, the most noteworthy part was really early to mid spring when temperatures were well above average and precipitation was below. This certainly made for an easy transition from winter to spring for the inhabitants of Southeast Lower Michigan. It was the warmest spring since 1991 across the region. Most areas saw below to well below normal rainfall up until May (a spring month when it's most needed for gardeners and farmers). Speaking of May, though it too was above average, it really was the only month that had an anomalously cold period. (see Frost/Freeze). Both March and April comfortably reached the top 20 warmest lists with April being the most impressive (see monthly write-ups). The first week of April was the most notable, as it ended-up being the warmest first week of April in climate history at all three sites (Detroit with a mean temperature of 62.4 degree average, Flint 60.5 and Saginaw 59.0). These temperatures were nearly 20 degrees above the norms. It should be mentioned, however, if one shifted the dates by just one day (2nd - 8th) back in April 1921, the average was exactly the same in Detroit with 62.4. At Saginaw, April 2nd-8th, 1921actually was even warmer than this April 1st-7th period with 61.0 degrees.

### In Spite of the Warmth, the Spring was Not Without Its Frost/Freezes

Though it was an exceptionally warm spring, some impressive frost and freezes visited the second half of April and the first half of May. The last cold snap came when the coldest weather (relative to average) occurred from May 7th – 13th. Temperatures averaged around 10 degrees below normal with the mornings of the 9th and 10th the bottom, when temperatures fell down into the mid 20s to mid 30s (away from the Great Lakes). Widespread Frosts and freezes were observed over much of the area with Detroit falling to 33 degrees, Flint 27 and Saginaw 31.

### Spring Starts Out Dry, Ends Up Wet

The drier than normal weather that dominated in the winter, held on the first half of the spring at many locations. Detroit, in fact, was 3.37" below normal for precipitation through the end April for the year and two and a quarter below -2.24"/ for the spring. The deficit in the spring was all made up for in May with the heavy rains that fell (see table below) bringing both and Flint up to normal for the spring season. This wasn't the case further north around Saginaw and most of the Thumb region as less rain fell in those areas, leaving the spring drier than normal.

***Fig-2***

*SPRING 2010 STATISTICS*

| DETROIT | | | | SPRING |
|---|---|---|---|---|
| 2010 | March | April | MAY | AVE |
| Actual | 42.4 | 54.2 | 62.7 | 53.1 |
| NORM 30Y | 36.9 | 48.1 | 59.8 | 48.3 |
| Depart | +5.5 | +6.1 | +2.9 | +4.8 |
| | | | | TOTAL |
| Actual | 1.07 | 2.26 | 5.31 | 8.64 |
| Norm 30Y | 2.52 | 3.05 | 3.05 | 8.62 |
| Depart | -1.05 | -0.79 | +2.26 | +0.02 |

| FLINT | | | | SPRING |
|---|---|---|---|---|
| 2010 | March | April | MAY | AVE |
| Actual | 38.6 | 51.6 | 60.3 | 50.1 |
| NORM 30Y | 33.7 | 45.4 | 57.1 | 45.4 |
| Depart | +4.9 | +6.2 | +3.2 | +4.7 |
| | | | | TOTAL |
| Actual | 0.65 | 3.34 | 4.23 | 8.22 |
| Norm 30Y | 2.22 | 3.13 | 2.74 | 8.09 |
| Depart | -1.57 | +0.21 | +1.49 | +0.13 |

| SAGINAW | | | | SPRING |
|---|---|---|---|---|
| 2010 | March | April | MAY | AVE |
| Actual | 39.4 | 51.7 | 61.3 | 50.8 |
| NORM 30Y | 33.5 | 45.5 | 57.6 | 45.5 |
| Depart | +5.9 | +6.2 | +3.7 | +5.3 |
| | | | | TOTAL |
| Actual | 0.72 | 2.16 | 3.45 | 6.33 |
| Norm 30Y | 2.42 | 2.82 | 2.89 | 8.13 |
| Depart | -1.70 | -0.66 | +0.56 | -1.80 |

**Fig-3**

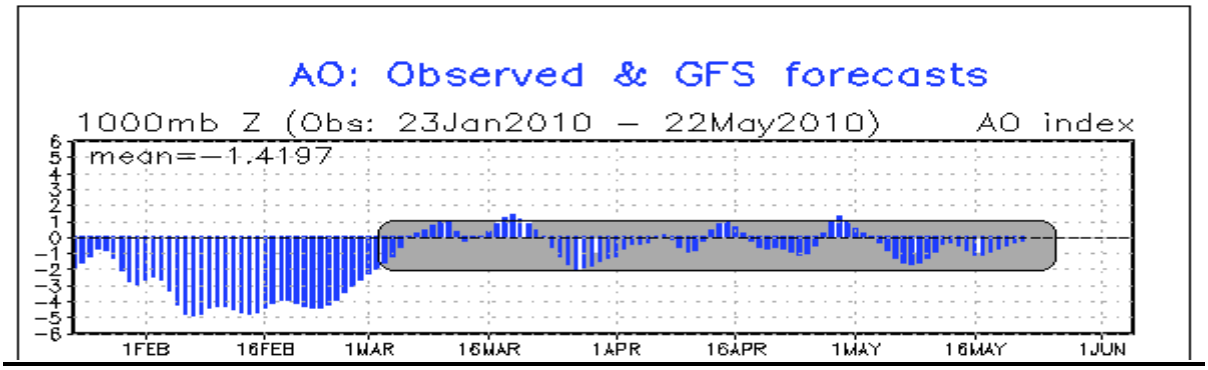
**Top 20 Coldest/Warmest Springs in Southeast Lower Michigan**

| Rank | Detroit Area* | | | | Flint Bishop** | | | | Saginaw Area*** | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Coldest | | Warmest | | Coldest | | Warmest | | Coldest | | Warmest | |
| | Temp | Year | Temp | Year | Temp | Year | Temp | Year | Temp | Year | Temp | Year |
| 1 | 41.7 | 1875 | 53.1 | 2010 | 40.8 | 1947 | 51.2 | 1921 | 39.8 | 1950 | 52.1 | 1977 |
| 2 | 42.0 | 1888 | 52.9 | 1991 | 41.1 | 1984 | 50.7 | 1991 | 40.1 | 1926 | 50.8 | 2010 |
| 3 | 42.4 | 1940 | 52.7 | 1977 | 41.5 | 1960 | 50.5 | 1977 | 40.4 | 1940 | 50.2 | 1938 |
| 4 | 42.5 | 1877 | 52.5 | 1921 | 41.6 | 1950 | 50.3 | 1987 | 40.6 | 1947 | 50.1 | 1985 |
| 5 | 42.6 | 1926 | 51.8 | 1998 | 41.7 | 1996 | 50.1 | 2010 | 40.9 | 1923 | 50.1 | 1921 |
| 6 | 42.9 | 1885 | 51.3 | 2000 | 41.9 | 1997 | 49.6 | 2004 | 41.0 | 1956 | 49.4 | 1998 |
| 7 | 43.1 | 1947 | 51.3 | 1987 | 42.3 | 1956 | 49.6 | 1936 | 41.1 | 1943 | 49.4 | 1991 |
| 8 | 43.2 | 1907 | 50.7 | 2004 | 42.4 | 1943 | 49.4 | 1985 | 41.2 | 1924 | 49.2 | 1903 |
| 9 | 43.3 | 1883 | 50.6 | 1955 | 42.5 | 1971 | 48.9 | 1998 | 41.3 | 1978 | 48.8 | 1910 |
| 10 | 43.3 | 1876 | 50.3 | 2006 | 42.5 | 1940 | 48.9 | 1946 | 41.7 | 1996 | 48.5 | 2000 |

## ***Dominant Upper Air Patterns This Spring***

The Arctic Oscillation has been aggressively negative at times during the past year (February, as a good example). A notable change occurred this spring when it became less negative with just minor oscillations (Fig-4).

**Fig-4**




This moderation in the AO since March along with an active blocking pattern in the high latitudes aided the El Nino, the jet stream was alive and active across the country this spring. With as storm track further south, our spring was very mild and up until May, relatively dry. It's this same storm track, however, that brought several rounds of severe weather to the Southern Plains and flooding rains across the Lower Ohio and Tennessee Valleys. The pattern has been gradually shifting north and bringing more rain to the northern Ohio Valley and extreme Southeast Lower Michigan, as of late. Below are the spring maps for temperature (Fig-5) and precipitation (Fig-6), courtesy of the Midwest Climate Center

**Fig-5**
**Temps**

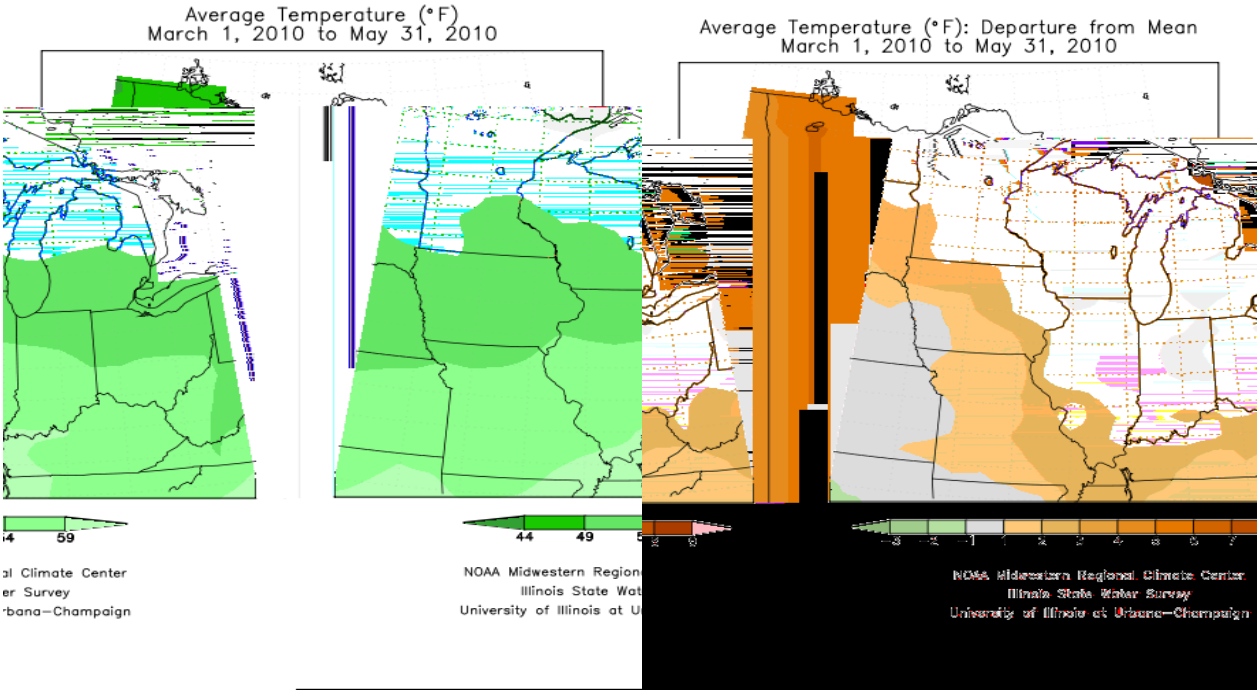
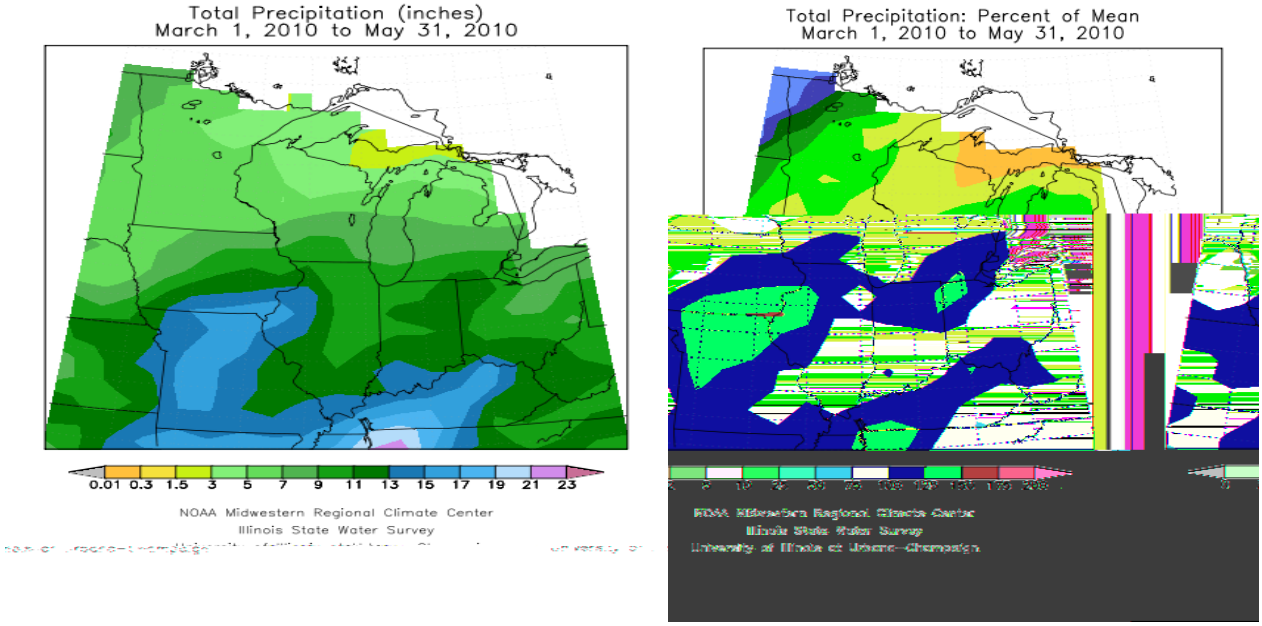


**Fig-6**
**Precipitation**




**Performance of Spring Outlook**

**Temperatures:**

This was not the time to go with the dominant trend shown by the spring analogues. **Straight up, the majority were too cold for the spring.** This was noted and adjusted for (but not enough) in the Outlook write up when near normal (rather than below) was forecast:

*Look for temperatures to average around normal (or within 1 ½ degrees below or above the normal mean). Even though below normal temperatures dominated, some of our better winter analogue years were more mixed in the spring with some considerable monthly variances.*

*While I thought the majority of analogues were too cold, I went with around average because of trends seen (1973 in particular which was on the high side of normal for spring).* ***What materialized, ironically, from this set of analogues, is that the two springs that were above normal in the study: were in top warmest spring records! The Spring of 1987 was the 7th warmest at Detroit and 5th at Flint, while the Spring of 1977 was the 3rd warmest at Detroit and Flint and the warmest ever at Saginaw. Sound familiar? This time it was the minority from the past that ruled (which hasn't happened often).***

**Precipitation:**

*Precipitation: Look for precipitation to average normal to below*

*Nearly all the springtime precipitation averaged normal to below with just two above normal. Basically, this dominant normal to below normal pattern follows very favorably from our winter pattern. And, since El Nino influenced upper air pattern is slated to only slowly weaken, this too looks reasonable.*

The precipitation outlook and trend worked much better than temperatures as many areas saw below normal rainfall up until late April (when El Nino weakened quickly and the storm track began shifting north with normal seasonal adjustments). It is only because of May's above normal rainfall that Detroit and Flint even attained normal seasonal rainfall status. Drier weather further north in the Saginaw Valley and Thumb precluded that region from making normal rainfall with Saginaw still 1.80" below at the end of May. Therefore, below normal to normal worked not only for the regions but for the trend of the spring as beneficial rains came later to many areas.

## Now On To Summer

***Researching as far back as the 1880s, 12 summers were chosen for our analogue summers this go-around (see Analogue Summers; El Nino to Neutral Summers 2010, Table-1 below). These analogue summers were chosen based on similar broad-scale conditions. Of course, these summer stats are a result of what happened in the past and no two summers are ever exactly alike. We focus on past local trends which have generally offered some guidance for the future. These selected summers followed a similar sequence of events seen recently over the Eastern Pacific the past few seasons. El Nino was in full swing the previous winter which then faded (or cooled) to Neutral conditions during the summer months, with La Nina conditions surfacing in most of them by autumn.***

***Table-1***
***Analogue Summers***

| DETROIT Summer | JUN | JUL | AUG | SUM AVE | FNT AVL YRS COMP | SUMMERS | FLINT Summer | JUN | JUL | AUG | SUM AVE | SUMMERS | SAGINAW Summer | JUN | JUL | AUG | SUM AVE | FNT AVL YRS COMP | SUMMERS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1889 | 63.8 | 71.3 | 69.9 | 68.3 | | 1 | | | | | | | | | | | | | |
| 1897 | 64.6 | 74.8 | 67.8 | 69.1 | | 2 | | | | | | | | | | | | | |
| 1906 | 67.9 | 71.5 | 74.5 | 71.3 | | 1 | | | | | | | 1906 | 67.6 | 70.0 | 72.9 | 70.2 | | 1 |
| 1915 | 63.1 | 70.4 | 66.0 | 66.5 | | 3 | | | | | | | 1915 | 61.5 | 68.8 | 64.1 | 64.8 | | 1 |
| 1926 | 63.4 | 72.4 | 72.0 | 69.3 | 69.3 | 4 | 1926 | 62.2 | 72.1 | 71.7 | 68.7 | 1 | 1926 | 61.0 | 70.6 | 69.3 | 67.0 | 69.0 | 2 |
| 1942 | 69.0 | 73.6 | 70.6 | 71.1 | 71.1 | 2 | 1942 | 67.7 | 70.6 | 68.5 | 68.9 | 2 | 1942 | 65.8 | 70.0 | 68.1 | 68.0 | 68.7 | 1 |
| 1958 | 63.9 | 72.4 | 71.0 | 69.1 | 69.1 | 5 | 1958 | 61.0 | 69.5 | 68.1 | 66.2 | 1 | 1958 | 61.8 | 70.0 | 69.3 | 67.0 | 67.0 | 3 |
| 1966 | 68.4 | 73.5 | 69.1 | 70.3 | 70.3 | 3 | 1966 | 66.5 | 70.5 | 66.3 | 67.8 | 3 | 1966 | 69.2 | 73.4 | 68.3 | 70.3 | 70.7 | 2 |
| 1973 | 69.9 | 72.6 | 72.9 | 71.8 | 71.8 | 4 | 1973 | 67.4 | 70.4 | 71.0 | 69.6 | 1 | 1973 | 69.2 | 72.4 | 72.0 | 71.2 | 71.9 | 3 |
| 1988 | 70.4 | 77.1 | 75.1 | 74.2 | 74.2 | 1 | 1988 | 67.7 | 75.2 | 72.6 | 71.8 | 2 | 1988 | 68.0 | 75.8 | 72.3 | 72.0 | 73.4 | 4 |
| 1998 | 69.1 | 73.4 | 73.2 | 71.9 | 71.9 | 2 | 1998 | 66.8 | 70.4 | 71.1 | 69.4 | 4 | 1998 | 69.3 | 73.4 | 72.4 | 71.7 | 72.5 | 5 |
| 2007 | 71.3 | 72.8 | 73.8 | 72.6 | 72.6 | 3 | 2007 | 68.8 | 69.7 | 71.0 | 69.8 | 3 | 2007 | 69.9 | 69.6 | 69.7 | 69.7 | 69.7 | 2 |
| Ave | 67.1 | 73.0 | 71.4 | 70.5 | 71.3 | 70.9 | Ave | 66.0 | 71.1 | 70.0 | 69.0 | 69.0 | Ave | 66.3 | 71.4 | 69.8 | 69.2 | 70.3 | 69.8 |
| Norm | 69 | 73.5 | 71.8 | 71.4 | 71.4 | -0.6 | Norm | 66.2 | 70.6 | 68.5 | 68.4 | -0.6 | Norm | 66.8 | 71.2 | 68.7 | 68.9 | 68.9 | 0.9 |
| Summer | | | | | FNT AVL YRS COMP | | Summer | | | | | | Summer | | | | | FNT AVL YRS COMP | |
| 1889 | 3.28 | 1.54 | 0.19 | 5.01 | | 1 | | | | | | | | | | | | | |
| 1897 | 3.52 | 1.70 | 3.10 | 8.32 | | 2 | | | | | | | | | | | | | |
| 1906 | 5.24 | 4.24 | 3.25 | 12.73 | | 1 | | | | | | | 1906 | 2.66 | 3.01 | 4.15 | 9.82 | | 1 |
| 1915 | 3.71 | 6.99 | 4.63 | 15.33 | | 2 | | | | | | | 1915 | 4.75 | 2.38 | 5.28 | 12.41 | | 1 |
| 1926 | 2.81 | 1.24 | 8.33 | 12.38 | 12.38 | 3 | 1926 | 2.18 | 1.47 | 4.94 | 8.59 | 1 | 1926 | 2.58 | 3.06 | 5.34 | 10.98 | 10.98 | 2 |
| 1942 | 2.31 | 3.35 | 4.12 | 9.78 | 9.78 | 1 | 1942 | 2.30 | 3.13 | 5.29 | 10.72 | 1 | 1942 | 3.88 | 3.36 | 2.67 | 9.91 | 9.91 | 2 |
| 1958 | 2.98 | 3.01 | 2.25 | 8.24 | 8.24 | 3 | 1958 | 4.18 | 2.61 | 3.46 | 10.25 | 1 | 1958 | 3.32 | 3.34 | 2.63 | 9.29 | 9.29 | 3 |
| 1966 | 4.16 | 5.24 | 5.03 | 14.43 | 14.43 | 4 | 1966 | 2.31 | 1.51 | 2.44 | 6.26 | 2 | 1966 | 1.73 | 2.08 | 4.33 | 8.14 | 8.14 | 4 |
| 1973 | 4.86 | 4.66 | 1.67 | 11.19 | 11.19 | 5 | 1973 | 3.24 | 1.78 | 1.76 | 6.78 | 3 | 1973 | 3.41 | 1.70 | 2.86 | 7.97 | 7.97 | 5 |
| 1988 | 0.97 | 2.43 | 3.13 | 6.53 | 6.53 | 4 | 1988 | 0.63 | 3.74 | 4.00 | 8.37 | 4 | 1988 | 0.61 | 2.53 | 2.75 | 5.89 | 5.89 | 1 |
| 1998 | 2.69 | 5.72 | 4.19 | 12.60 | 12.60 | 6 | 1998 | 1.25 | 1.13 | 2.62 | 5.00 | 5 | 1998 | 1.81 | 1.30 | 1.51 | 4.62 | 4.62 | 2 |
| 2007 | 3.10 | 2.10 | 6.61 | 11.81 | 11.81 | 7 | 2007 | 3.48 | 1.83 | 5.09 | 10.40 | 2 | 2007 | 2.06 | 2.90 | 6.73 | 11.69 | 11.69 | 3 |
| AVE | 3.33 | 3.52 | 3.88 | 10.72 | 10.87 | 10.80 | AVE | 2.45 | 2.15 | 3.70 | 8.30 | 8.30 | Ave | 2.68 | 2.57 | 3.83 | 9.07 | 8.22 | 8.65 |
| Norm | 3.55 | 3.16 | 3.10 | 9.81 | 9.81 | 0.99 | Norm | 3.07 | 3.17 | 3.43 | 9.67 | -1.37 | Norm | 3.06 | 2.50 | 3.38 | 8.94 | 8.94 | -0.29 |

| Color: | Temps | Degrees | | Rain | Inches |
|---|---|---|---|---|---|
| Legend: | Below | 1.0> | | Below | 1.00> |
| | Normal | 0.0-1.0 | | Normal | 0.00-1.00 |
| | Above | 1.0> | | Above | 1.00> |

| Color | Temps | Degrees | | Rain | Inches |
|---|---|---|---|---|---|
| Legend: | Below | 1.0> | | Below | 1.00> |
| | Normal | 0.0-1.0 | | Normal | 0.00-1.00 |
| | Above | 1.0> | | Above | 1.00> |

| Color | Temps | Degrees | | Rain | Inches |
|---|---|---|---|---|---|
| Legend: | Below | 1.0> | | Below | 1.00> |
| | Normal | 0.0-1.0 | | Normal | 0.00-1.00 |
| | Above | 1.0> | | Above | 1.00> |

## ***Trends Seen in the Past***

### ***Temperatures***

The Neutral analogue summers are really quite mixed on the temperature front this time. And talk about variability, data from Detroit contains one of our coldest summers and one of the hottest (also have seen this wide variance in the winter time under Neutral conditions). Even though Detroit's summer data favors normal to below normal temperatures (like last year), one must closely compare this to Flint and Saginaw. The reason being, the averages at Detroit were increased in the 1971-2000 set (mainly an effect of the local heat island) whereas Flint and Saginaw saw little change.. Therefore, this would logically skew Detroit's temperature departures data down a bit. Just looking at the color code tells one that Flint and Saginaw's summers were more mixed with a slight lean toward warmer than normal. I made up a second set of analogues using data from 1926 on (under; FNT AVL YRS COMP) to underscore this so that all three sites could be compared, equally from1926 to 2007. When doing so, average temperatures rise (being that mainly colder summers before 1926 are dropped).

Now, there is certainly no difficulty in pegging our previous season's trend (spring 2010) with it being one of the warmest springs on record at all three sites. That being said, there are other trends to watch for in the analogues in projecting out this summer's weather;

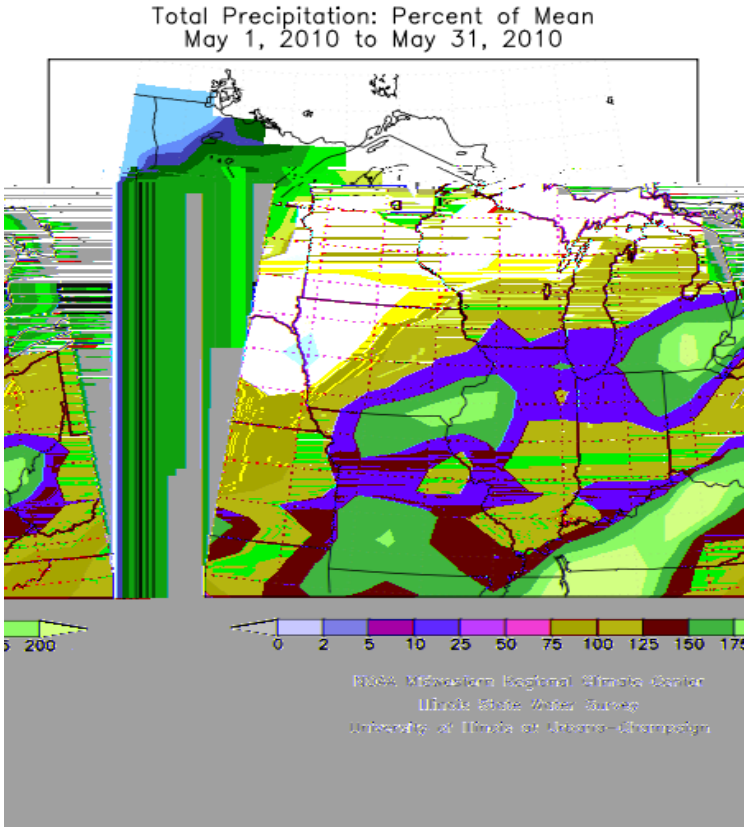
The warmest weather relative to average in many of the analogues usually came mid to late summer (July and/or August). The stubbornness of the trough in eastern Canada along with some of the cooler June's found gives more credence for normal to below normal temperatures possible early to mid season. While early to mid summer had the best chance for average normal to below, mid to late summer chances were better for normal to above temperatures. **Again, for summer overall, temperature are expected to fall within the normal range (+/-) but with a lean toward the higher side of normal.**

### ***Rainfall***

Rainfall data was more dependent on location rather than the particular year. There was a notable difference between Detroit (or southern half of Southeast Michigan) and the northern half. Several of the years (7 out of 12) saw more rain around the Detroit metro area while drier conditions showed up (sometimes in the same summer) at Flint and/or Saginaw. From the data, Detroit and points south have the best chance for the most rain and Flint northward, the least. But when dealing with convective rains, one or two heavy storms in an otherwise dry summer can goof it all up and that is why **trend** is considered along with **amount.**

Larger scale maps (see summer analogue composite maps below) definitely show in the past on average that heavier rains occurred in an arc shape from the Mississippi Valley, northeast through the Midwest into the northern Ohio Valley and Southern Lakes Region. Some years it oscillated further north, others, further south. This pattern has actually evolved set up in May across the same region, note May's rainfall map (Fig-7) below.

**Fig-7**




***<u>Summer Analogue Maps (Fig-8 and 9)</u>***
***(based on the 1895-2000 average)***

**Fig -8**

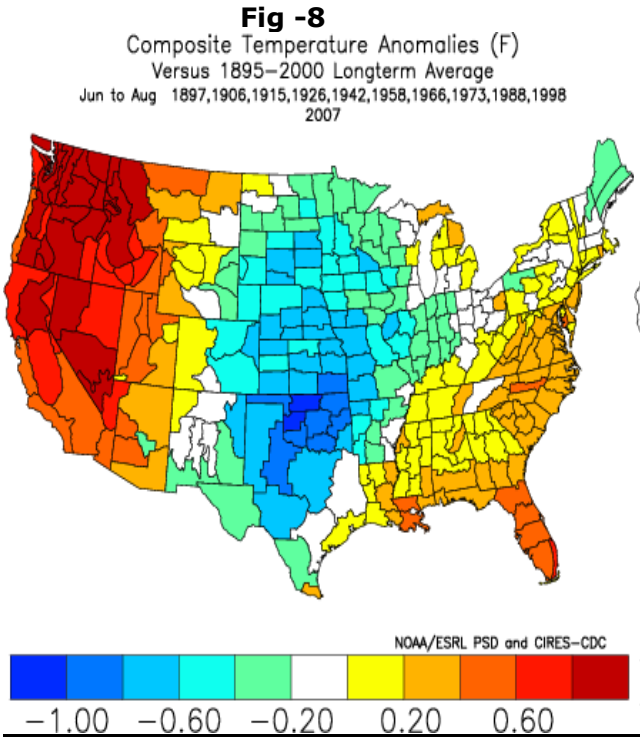
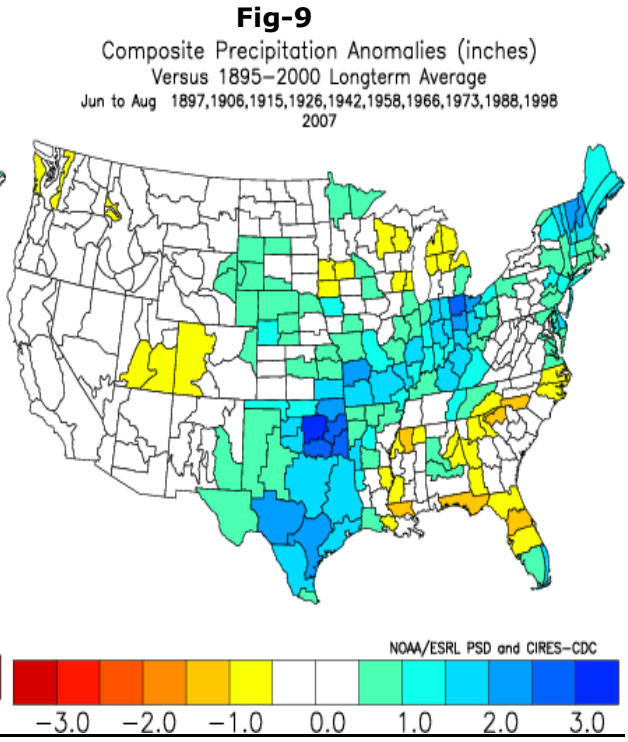


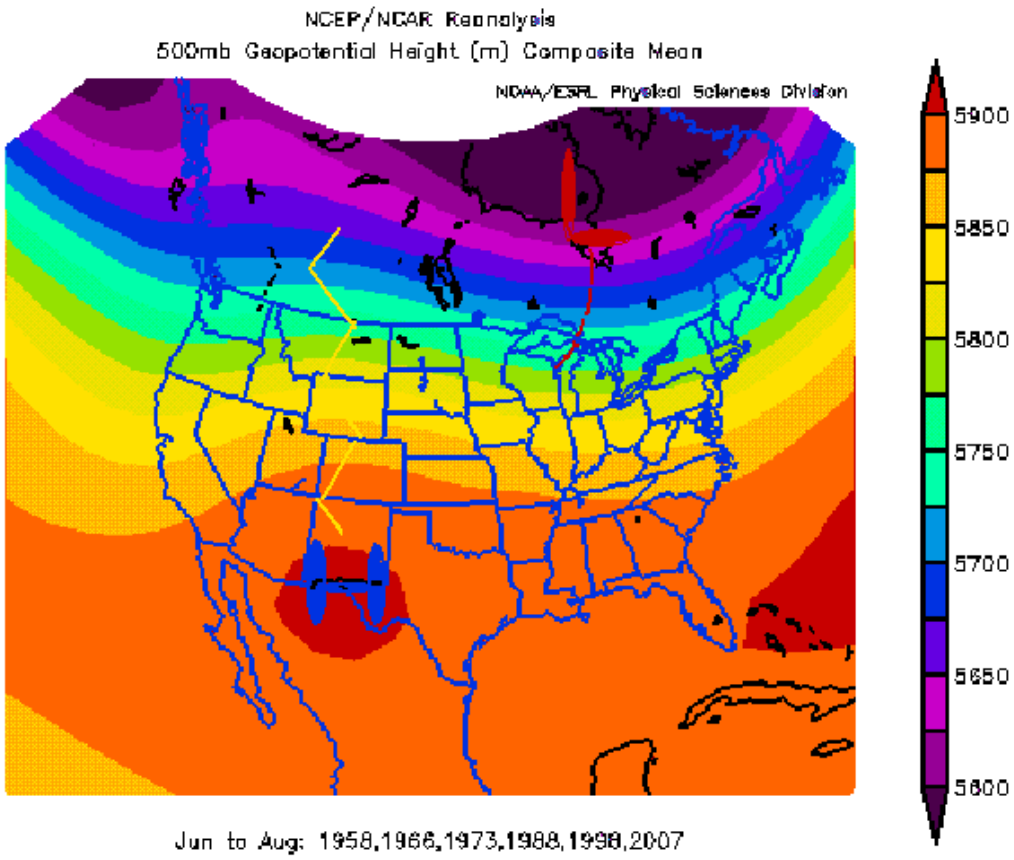

**Fig-9**



***Upper wind data from previous analogue summers (Average)***

The map below (Fig-10 is an average of the 500 MB heights from the later years (earlier years are not available) of our summer analogues. The upper air pattern reflects a broad ridge across the west and central portions of the US with a zonal flow across the northern quarter of the US, aided by the upper low in eastern Canada. How much that ridge visits Southeast Lower Michigan this summer will be the deciding factor on how warm we get. In the Summer of 2009, the troughing over the Great Lakes was more dominant than any ridge, keeping us in a primarily northwesterly cool flow. The map also shows the best jet to lift up in southern Canada and the northern tier states of the US. This is typical of the summer, but as of late May it still has a ways to head north.

***Fig-10***



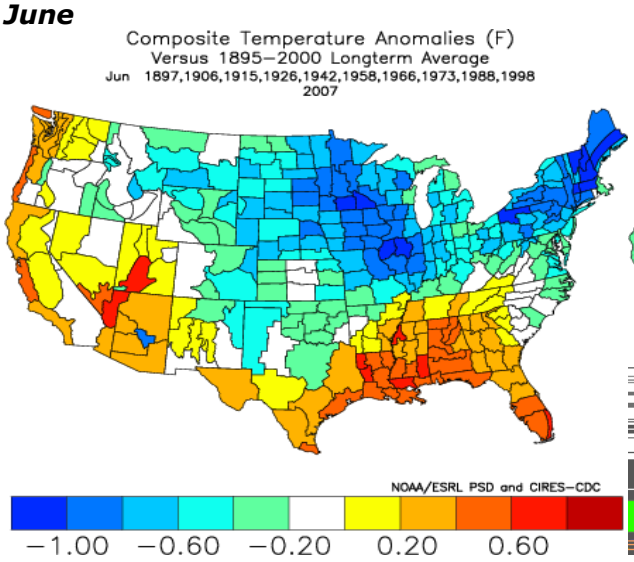

**A note on the following monthly composites:**

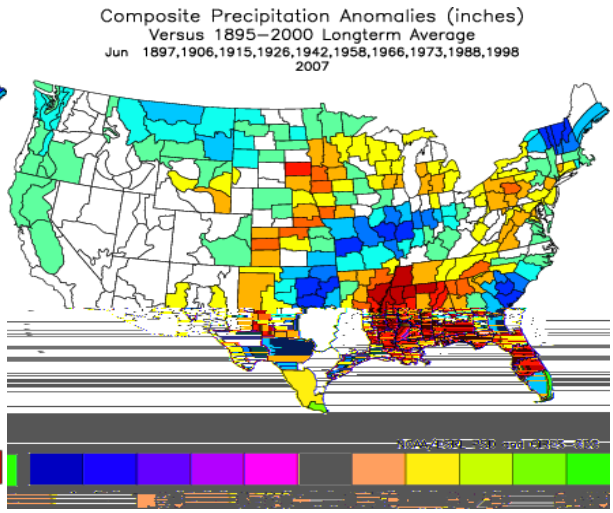
1) It's best to look at the trend of the temperatures or precipitation for an entire season when looking at the monthly projections. In other words, warm or cool periods don't always come neatly wrapped up in one month. Many times a trend is seen overlapping from one month into another. As an example, one month's data may be above normal, while the next is above to below and the third below. The whole season may indeed start out above normal but toward the middle or end, temperature departures average below.

***COMPOSITE SUMMERS MONTHS 2010***
***(based on the 1895-2000 average)***
**Fig - 11**

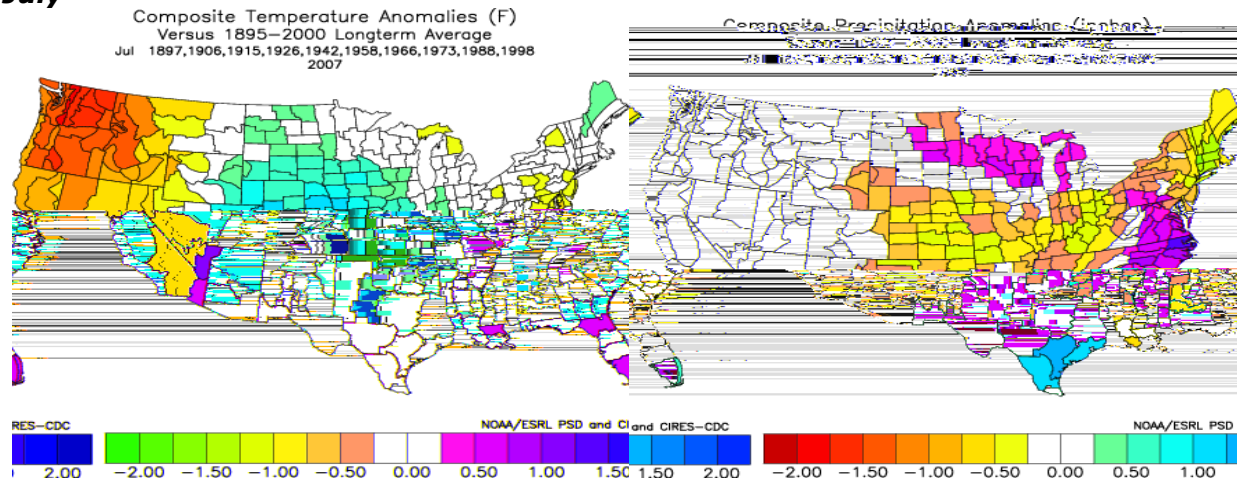
***Temperature*** ***Precipitation***

***June***

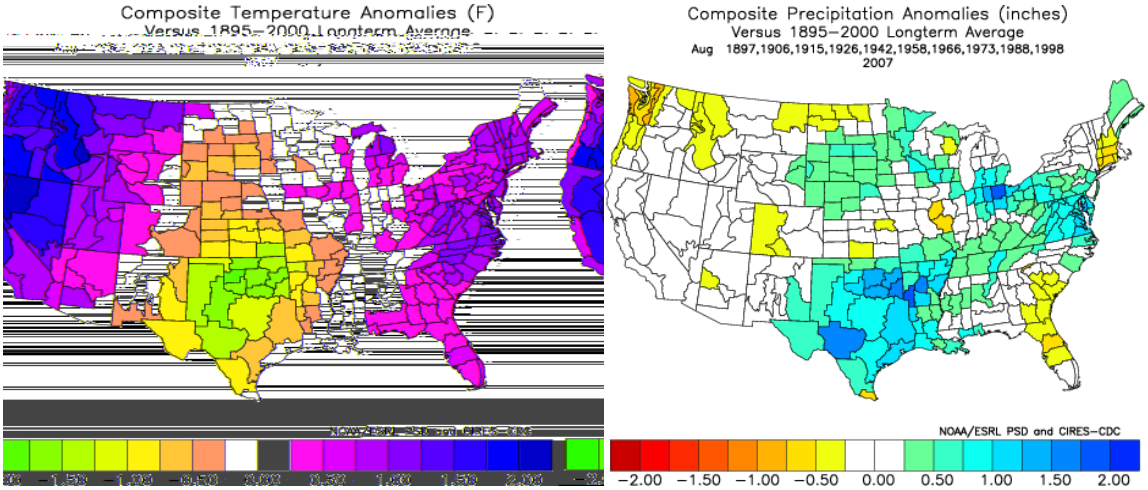



***July***




***AUG***



If conditions warrant, an updated Summer Outlook will be sent.

Have a good summer, enjoy any time off and may good weather be your traveling companion.

**SUMMER BEGINS: MONDAY JUNE 21st @ 728AM EDT**

**JULY 4TH IS ON A SUNDAY THIS SUMMER**

**LABOR DAY FALLS ON MONDAY SEPT 6TH**