

## **The Long Hot Summer of 2010**

### **A Bountiful Summer of Heat, Humidity and Storms**

### **Warmest Spring-Summer Period on Record**

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### **Summary**

The 2010 summer stats are in for Southeast Lower Michigan. It was a very warm, humid and stormy, but at the same time wet and dry summer. Over half the area saw average to above average rainfall. The wettest extending from the Ann Arbor area, east across the southern portions of Metro Detroit and Downriver communities and points south to near the Ohio border. This area also saw the majority of the severe weather. Another wet area could be found over the tip of the Thumb Region /Huron County/. Notably dry conditions were sandwiched in between the above areas from the far northern suburbs of Detroit, north into the base of the Thumb (or over the mid-portion of the Southeast Michigan).

**Fourth Warmest Summer on Record at Detroit  
Seventh Warmest Summer at Flint and Saginaw**

While the past couple of summers across Southeast Lower Michigan have been relatively cool, the Summer of 2010 reversed that cool trend and contained an abundance of heat, humidity and storms (in most areas). Officially, the Summer of 2010 (Table-1) will go down in weather history as the **4<sup>th</sup> warmest summer on record for the Detroit Metropolitan Area with an average temperature of 74.4**. It should be stated, however, once again the urban heat island in Metro Detroit did help influence the mean temperature by mainly modifying the overnight lows and thus, raised the overall average temperature. The daytime highs are less influenced by the urban heat island. At Flint, it was the **7<sup>th</sup> hottest summer on record with an average temperature of 72.3**. In sharp contrast, it was just last year in the Summer of 2009 that Flint landed in 2<sup>nd</sup> place for the coldest summer with an average temperature of just 66.1! Further north across the Saginaw Valley and Thumb Region, **Saginaw placed in 7<sup>th</sup> position for hottest summer with an average temperature of 72.0**. This is after placing in 8<sup>th</sup> place for coldest summer last year with 66.4.

**Table – 1**

2010 SUMMER STATISTICS-SOUTHEAST LOWER MICHIGAN						
TEMPS	JUN	JUL	AUG	2010	2010	2010
				SUMMER AVERAGE	SUMMER NORM	WARMEST SUMMER RANK
DETROIT	71.4	76.6	75.2	74.4	71.4	4TH
DEPART	2.4	3.1	3.4	3.0		
Normal	69.0	73.5	71.8	71.4		
FLINT	68.7	74.2	73.7	72.3	68.4	7TH
DEPART	2.5	3.6	5.2	3.9		
Normal	66.2	70.6	68.5	68.4		
SAGINAW	68.2	74.3	73.3	72.0	68.9	7TH
DEPART	1.4	3.1	4.6	3.1		
Normal	66.8	71.2	68.7	68.9		
SE MI AV	69.4	75.0	74.1	72.9	69.5	6TH
				3.4		(EST)
WHITE LK	67.3	72.3	71.4	70.3		
RAIN	JUN	JUL	AUG	SUMMER TOTAL	SUMMER NORM	WET/DRY RANK
DETROIT	5.42	5.96	0.59	11.97		25TH
DEPART	1.87	2.80	-2.51	2.16		
Normal	3.55	3.16	3.10	9.81	9.81	
FLINT	3.12	2.49	0.32	5.93		10TH
DEPART	0.05	-0.68	-2.78	-3.74		
Normal	3.07	3.17	3.43	9.67	9.67	
SAGINAW	4.49	2.09	2.63	9.21		
DEPART	1.43	-0.41	-0.75	0.27		
Normal	3.06	2.50	3.83	8.94	8.94	
SE MICH	4.34	3.51	1.18	9.03		
					9.47	
WHITE LK	3.62	6.52	0.16	10.30		
<b>Color Legend:</b>	<b>Temps</b>	<b>Degrees</b>		<b>Rain</b>	<b>Inches</b>	
	Below	1.0>		Below	1.00>	
	Normal	0.0-1.0		Normal	0.00-1.00	
	Above	1.0>		Above	1.00>	

## Spring into Summer Warmth

While the warmth has been impressive for the summer period it has been even more impressive when the previous spring period is added. **The six month period /Mar-Aug/ average temperature at Detroit, Flint and Saginaw all show the warmest average ever.**

In fact, just looking at Table-2 below shows how this year ranked against the previous warmest six-month periods!

**Table - 2**

				<i>Spring - Summer Period</i>							
				<i>March 1st - August 31st</i>							
	Rank	Ave Temp	Year		Rank	Ave Temp	Year		Rank	Ave Temp	Year
<b>Detroit</b>	1	63.8	2010	<b>Flint</b>	1	61.2	2010	<b>Saginaw</b>	1	61.4	2010
	2	63.2	1991		2	61.0	1987		2	61.1	1921
	3	63.1	1921		3	60.6	1991		3	60.5	1998
	4	62.6	1955		4	60.2	1955		4	59.8	1991
	5	62.1	1987		5	59.4	1977/88		5	59.5	1987

### HOW THE REAL HEAT ADDS UP AND COMPARES IN DETROIT'S HOTTEST SUMMERS

A closer examination is needed to tell the whole story how hot a summer actually feels. A comparison of the five top hottest summers in Detroit reflects this point nicely (Table - 3). The summer daytime highs are where a closer examination is needed to tell the whole story.

While the Summer of 2010 will go down as the 4<sup>th</sup> hottest summer on record in Detroit, a more pertinent comparison of summer heat would be seen if one examines the **average high** in the hottest of summers at Detroit.

**Table - 3**

	1	2	3	4	5
	2005	1995	1955	2010	1988
	Ave High	Ave High	Ave High	Ave High	Ave High
<b>JUN</b>	84.1	82.0	78.5	79.9	83.9
<b>JUL</b>	84.9	84.5	89.6	86.2	89.3
<b>AUG</b>	84.1	85.3	85.2	84.5	85.3
<b>Summer</b>	<b>84.4</b>	<b>83.9</b>	<b>84.5</b>	<b>83.5</b>	<b>86.2</b>
	Ave Low	Ave Low	Ave Low	Ave Low	Ave Low
<b>JUN</b>	64.0	61.1	58.5	62.9	56.9
<b>JUL</b>	65.9	65.0	68.5	67.0	64.9
<b>AUG</b>	65.6	69.0	66.2	66.0	64.8
<b>Summer</b>	<b>65.2</b>	<b>65.0</b>	<b>64.4</b>	<b>65.3</b>	<b>62.2</b>
<b>Summer</b>					
<b>Ave</b>	<b>74.8</b>	<b>74.5</b>	<b>74.5</b>	<b>74.4</b>	<b>74.2</b>
<b>Annual</b>					
<b>90+</b>	<b>20</b>	<b>20</b>	<b>32</b>	<b>16*</b>	<b>39</b>
<b>Days</b>					
	* denotes through 9/15				

The above statistics (Table - 3) gives a better comparison of daytime heat (highs) during our hottest of summers in metropolitan Detroit while addressing the question that may arise about this summer, “How can the Summer of 2010 be hotter and rank higher than 1988? That was a miserable summer with all its 90’s and 100’s?” As one can see when comparing the **two summer’s average highs**, this is a legitimate question. However, while the average high in the Summer of ’88 was nearly three degrees hotter / 2.7/ than the Summer of ’10, the average low in the Summer of 88’ was a full 3 degrees /3.1/ cooler than this past summer. Thus, the minimum departure in 1988 cancelled out the maximum departure and then some by +0.4 on the cooler side. Truly the daytime heat was much worse in 1988 than in 2010 (or 2005 for that matter). While on the subject of daytime heat, the number of 90 degree days during the summer is discussed next.

## **PERSISTENCE WAS THE NAME OF THE GAME IN THE SUMMER OF 2010**

### **Number of 90 Degree Days: Slightly Above Average**

While the amount of days where the high temperature reached 90 or above were generally above the typical average, they were nowhere near the records. Detroit totaled up 15 days during the summer (16 for the year thus far) where the high temperature hit 90 or above. The record for a year was in the hot summer of 1988 with an extraordinary 39 days. In Flint, the temperature reached 90+ on 12 days during the summer (13 for the year thus far), also a far cry from their record of 36 also back in 1988. Saginaw totaled up seven days in which the mercury hit 90 or above so far this year. The record for Saginaw is also 39 days but it came in back in 1931 (in 1988 there were 37 days). Typically, in any given year, the average number of days it reaches 90 degrees or better is 8 to 12. The Summer of 2002 is a case that had a surplus of 90+ days with 24 at Detroit, yet failed to crack the top ten hottest summers list /12<sup>th</sup>/. Flint had one more 90+ degree day with 25 but came in at 14<sup>th</sup> hottest (Saginaw was quite a bit lower with only 10).

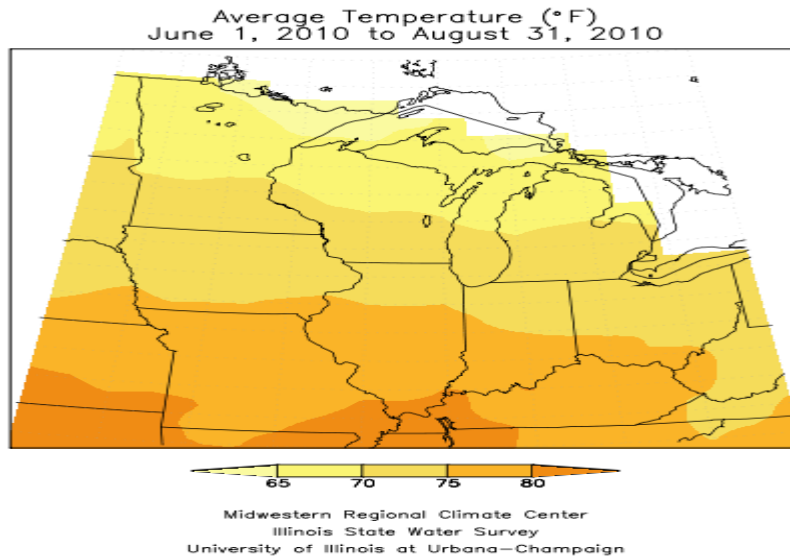
### **Number of 80 degree days**

The more outstanding warm feature of the summer was the amount and persistence of 80 degree days or better. While not record heat, there were a high number of warm to very warm days. In Detroit, there were **70 days** (out of the possible 92) in this past summer /Jun-Aug/ where the mercury rose to 80 degrees or above. Generally, the Detroit area has an average of 53 days of 80 degrees or better in the summer period. The most 80(+) days in a summer happened back in 1991 (10<sup>th</sup> warmest summer) and again in 2005 (warmest summer), both containing **74 days**. This also helps explain why the Summer of 2010 (like 2005) ranked high in average high temperature yet there were no record highs (nor temperatures at or above 95 at Detroit, Flint or Saginaw). The three other hot summers at Detroit, 1995, 1988, 1955 all listed temperatures in the 100s. At Flint this past summer, **71 days** the temperature rose to 80 or above, a new record since 1942 with the previous records occurring in two years, 1983 and 1995 with 69 days. Typically, Flint experiences about 51 days in the summer where the temperature rises to 80 or better. Saginaw recorded **65 days** where the high temperature rose to 80 or above. On average, Saginaw has 49 days of 80 or better in a summer. The record number of 80+ days at Saginaw was established way back in 1933, when 73 days in the summer saw an 80 or better.

The following maps (Fig's -1, 2) show the average temperatures and departures across the Midwest and Great Lakes Region for the Summer of '10

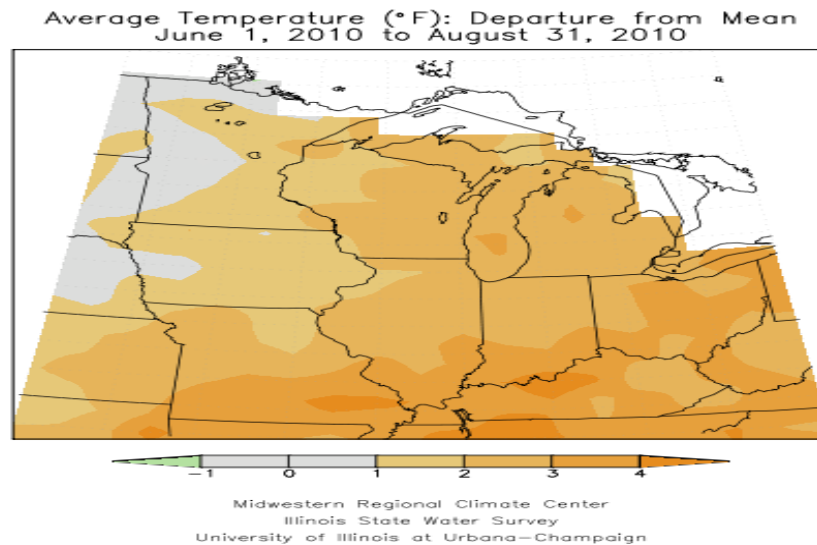
**Fig - 1**

**Temps**



**Fig - 2**

**Departures**



## **BUSY SEVERE WEATHER SEASON LEADS TO 12 TORNADOES**

The severe weather season for 2010 has been busy with numerous severe weather outbreaks producing 12 tornadoes. On average, we have about seven tornadoes in a severe weather season. The 12 tornadoes places 2010 tied for 6th place (Table - 4) for the number of tornadoes in Southeast Michigan for any year (back to 1950).

<b>Table - 4</b>	<b>YEAR</b>	<b>Number of TORs</b>
	<b>1973</b>	<b>20</b>
	<b>1974</b>	<b>19</b>
	<b>2004</b>	<b>16</b>
	<b>1997</b>	<b>14</b>
	<b>1988</b>	<b>13</b>
	<b>1984, 1986, 2010</b>	<b>12</b>
	<b>1975, 1990</b>	<b>11</b>
	<b>1976, 1977, 2001, 2007</b>	<b>10</b>

June was the most active month for tornadoes across Southeast Lower Michigan with eight tornadoes. We can see June 2010 (Table - 5, 6) flirted with some tornado records in Southeast Michigan.

<b>Table - 5</b>		Most Tornadoes in June for Southeast Lower Michigan	
<b>No.</b>		<b>Year</b>	
17		1973	
9		1953	
8		2010	

**Table – 6****Most Tornadoes in Any Month for Southeast Michigan**

<b>No.</b>	<b>Year</b>
17	June 1973
14	May 2004
13	July 1997*
9	June 1953
8	May 1956**, July 1974, and June 2010

\*The 13 tornadoes in July 1997 all occurred on a single day, July 2, 1997

\*\*The 8 tornadoes in May 1956 all occurred on a single day, May 12, 1956

As stated above, there were many severe weather episodes and a listing can be found on our [news archive](#) page on the web and also highlights are always included in the [monthly climate summaries](#).

Of course, along with the severe weather events, the thunderstorms were plentiful, especially in the south. June and July recorded the most thunderstorms with a sharp drop-off in August in all areas. Detroit recorded 19 days with thunderstorms in just June and July alone (on average we see 12). Add May to that list, and the number of thunderstorm days jumps to 27 (on average we see around 16 days). However, the thunderstorm switch was shut off in August and not one storm was recorded at either Detroit or Saginaw and Flint recorded just two. In a whole year's time, the average amount of thunderstorm days in Southeast Lower Michigan is around 32.

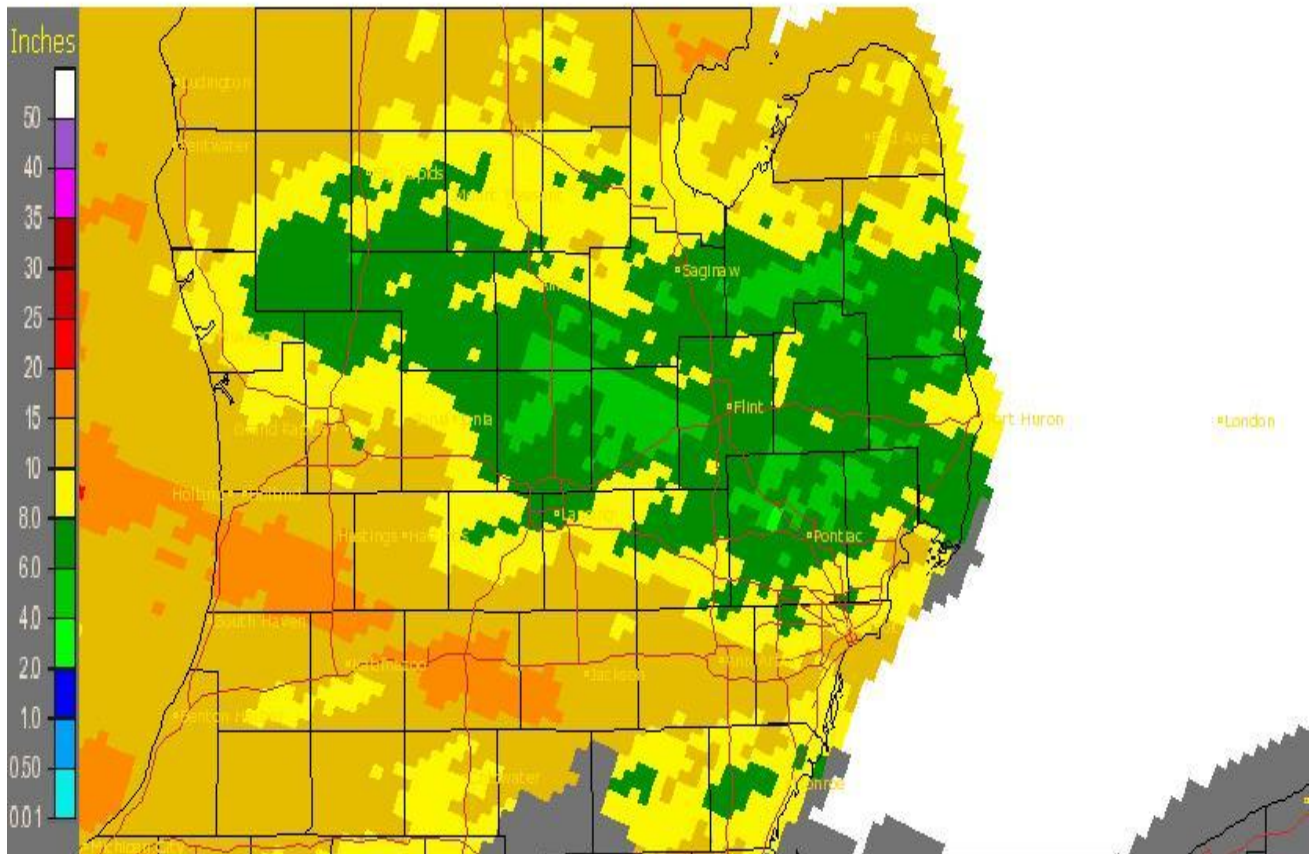


## Extreme Variances in Summer Rainfall across Southeast Lower Michigan

### A Truly Feast or Famine Scenario This Summer

**Fig - 3**

Detroit/Pontiac, MI (DTX): Current 90-Day Observed Precipitation  
Valid at 9/2/2010 1200 UTC- Created 9/2/10 15:29 UTC

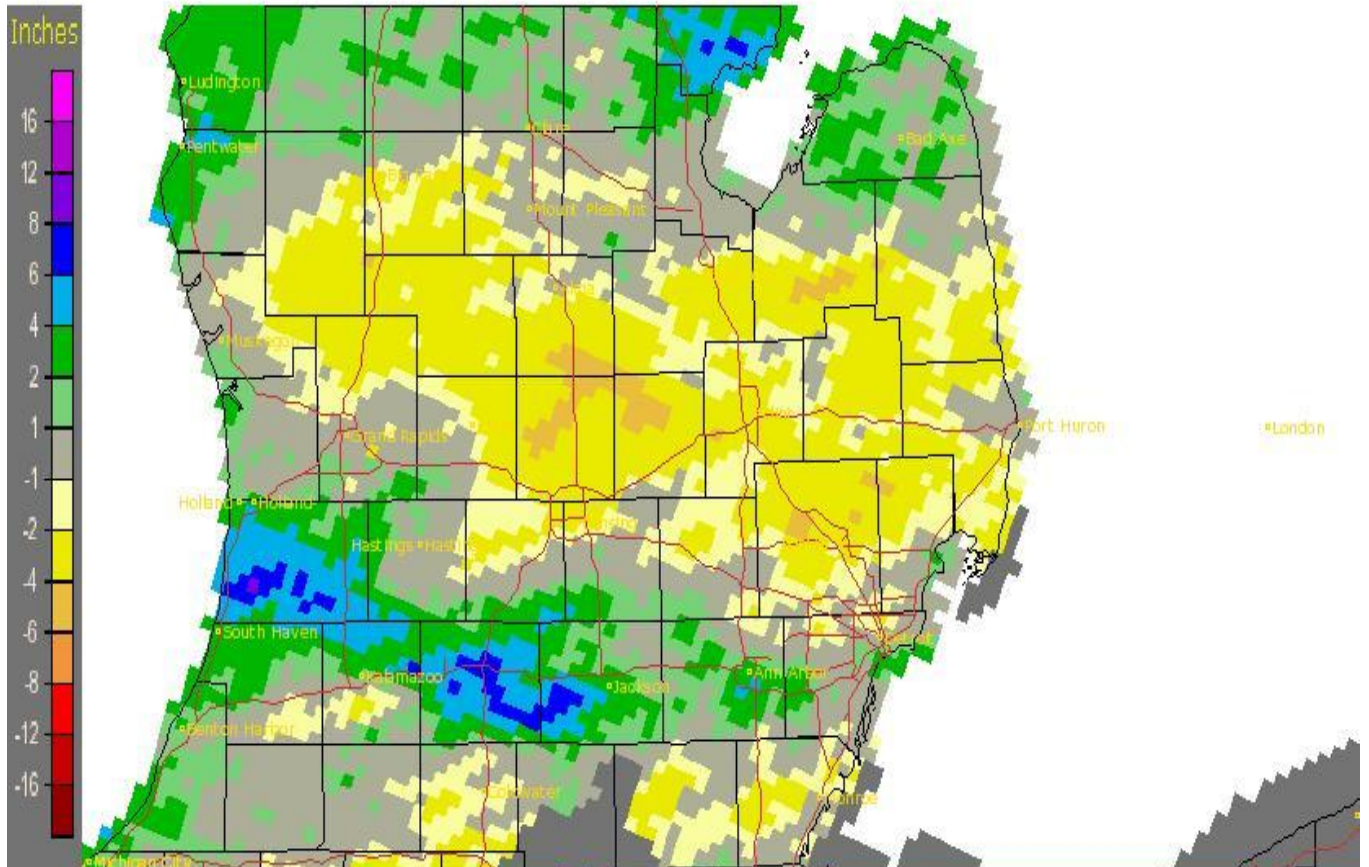


The summer rainfall /Jun-Aug/ across all of Southern Lower Michigan is shown in Fig - 3. Note the lower totals (dark and light green) sandwiched between much greater amounts over much of Southern Lower Michigan and Thumb Region. Rainfall amounts ranged generally from 4.0 - 6.0" in the "famine" areas to 10.0 to 15.0" in the "feast" locations

## Rainfall Departures for the Summer of 2010

Fig - 4

Detroit/Pontiac, MI (DTX): Current 90-Day Departure from Normal Precipitation  
Valid at 9/2/2010 1200 UTC- Created 9/2/10 15:32 UTC

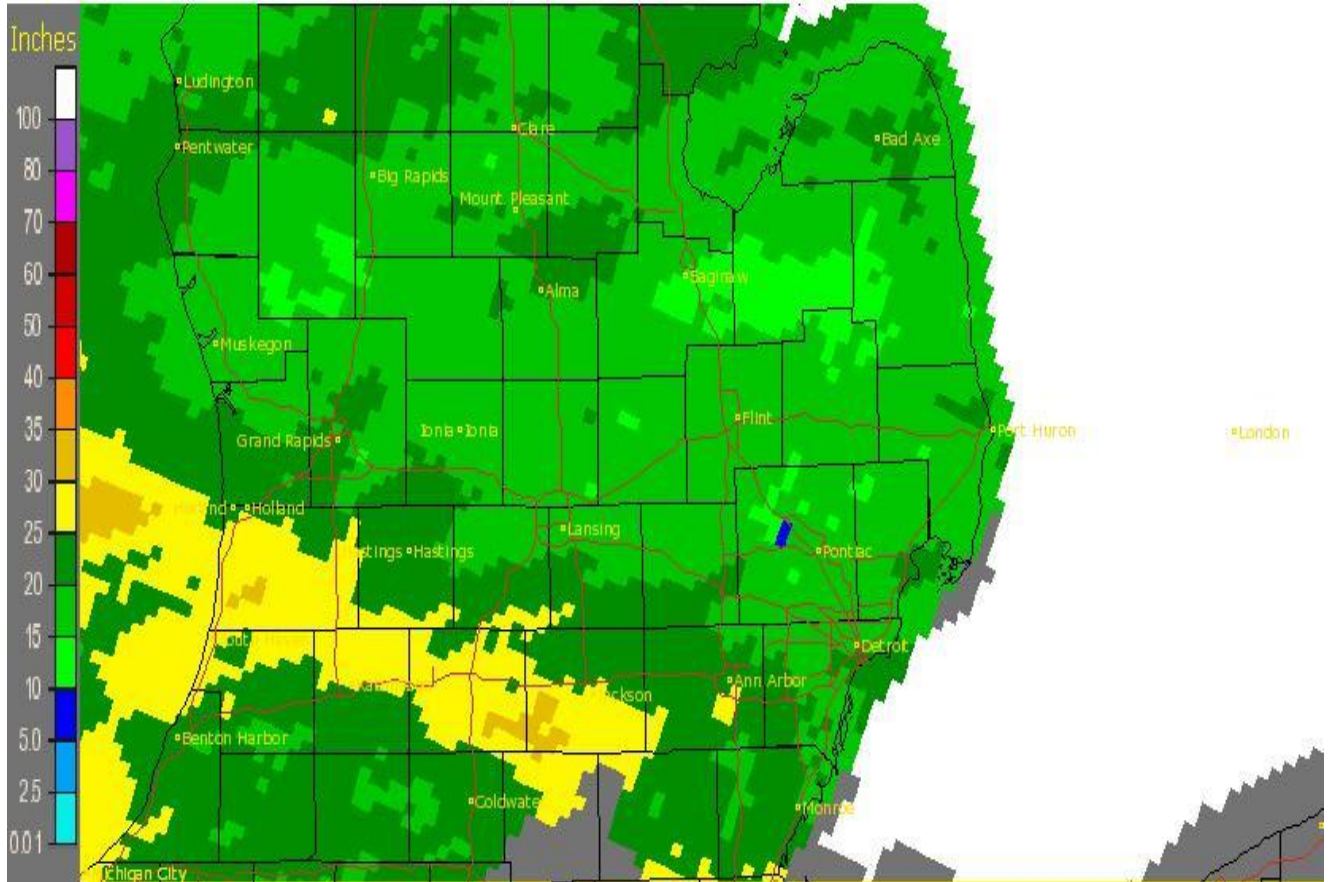


Departures from normal (Fig -4) range from roughly 4.0 - 5.0" below average (parts of northern Oakland and southern Tuscola counties) to as much as 4.0 - 5.0" above average near the I-94 corridor (southern of the Ann Arbor area, in Washtenaw county).

## Spring-Summer 2010 Rainfall

**Fig - 5**

Detroit/Pontiac, MI (DTX): Current 180-Day Observed Precipitation  
Valid at 9/2/2010 1200 UTC- Created 9/2/10 15:35 UTC

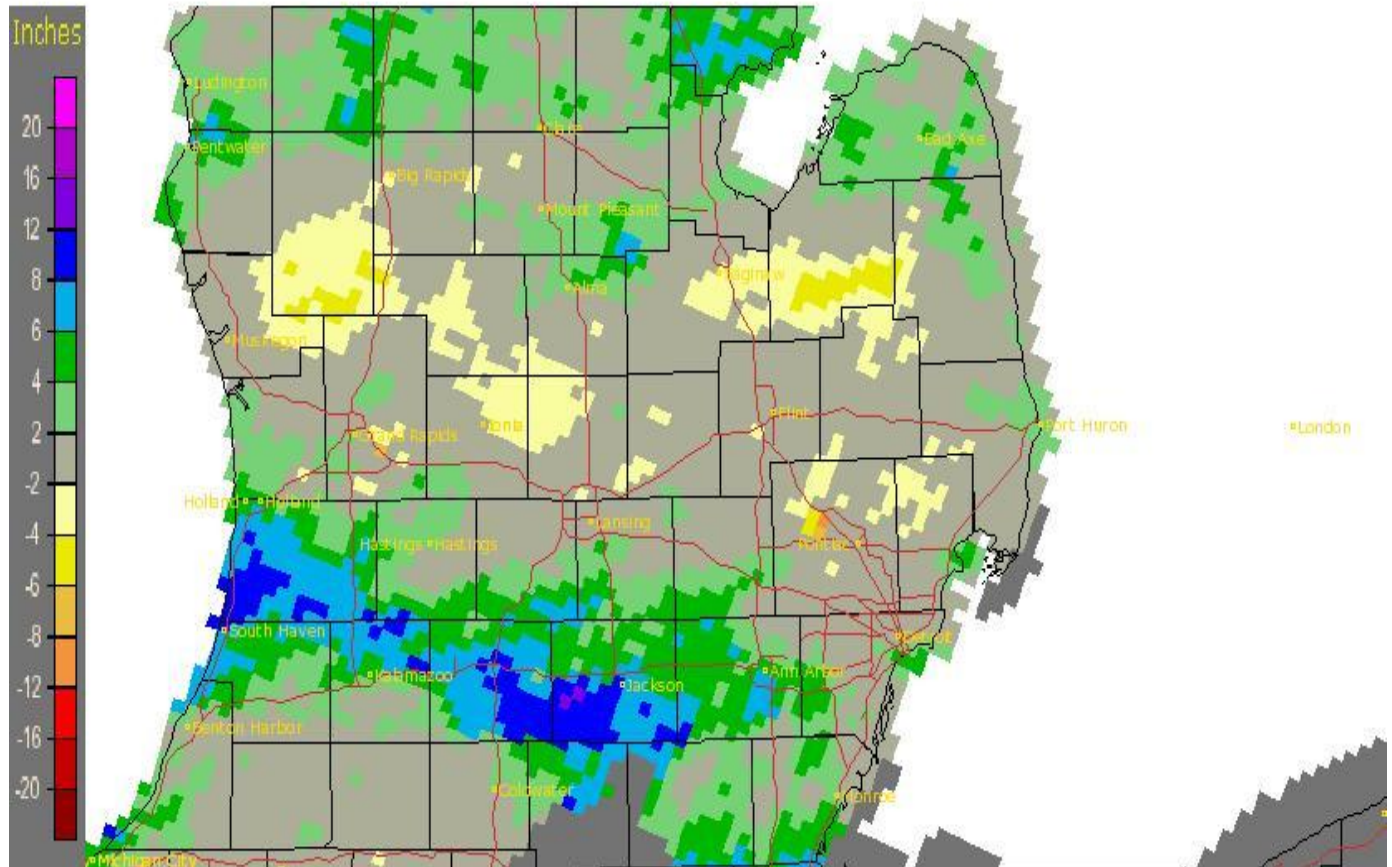


Rainfall amounts and variances only grow wider in the spring-summer timeframe (180 day period) or roughly, the 2010 growing season (Fig – 5). Rainfall amounts ranged generally from 10.0 –15.0” in the “famine” areas to 25.0-30.0” in the “feast” locations. Keep in mind, Southeast Michigan’s typical annual rainfall averages 30.0” - 34.0”

## Spring-Summer Rainfall Departures

Fig - 6

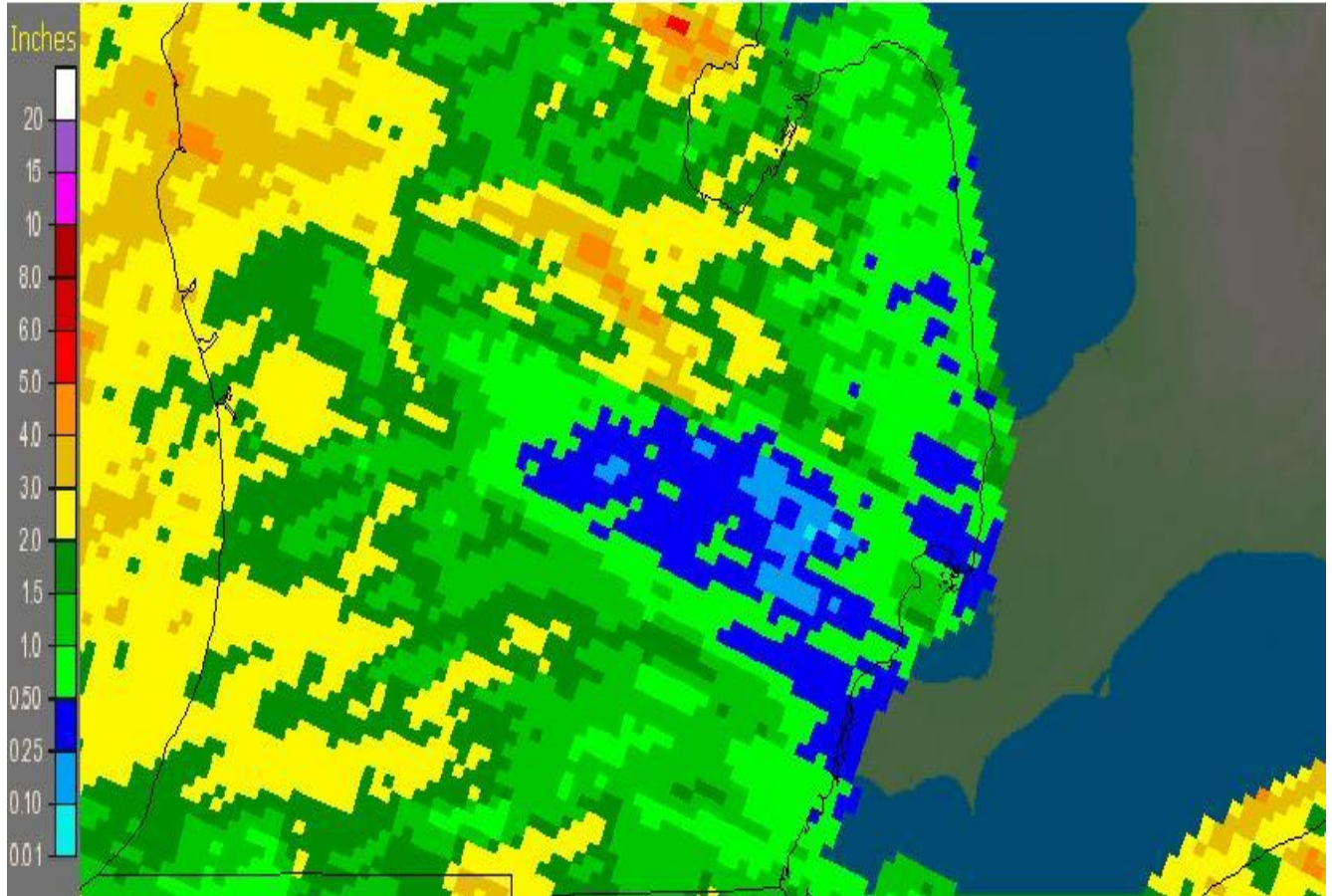
Detroit/Pontiac, MI (DTX): Current 180-Day Departure from Normal Precipitation  
Valid at 9/2/2010 1200 UTC- Created 9/2/10 15:38 UTC



The growing season rainfall deficits are still impressive even when adding three more months (Fig - 6). The deficits still show up at 4.0 - 6.0" below normal to a surplus as high as 8.0" - 10.0".

**Fig - 7**

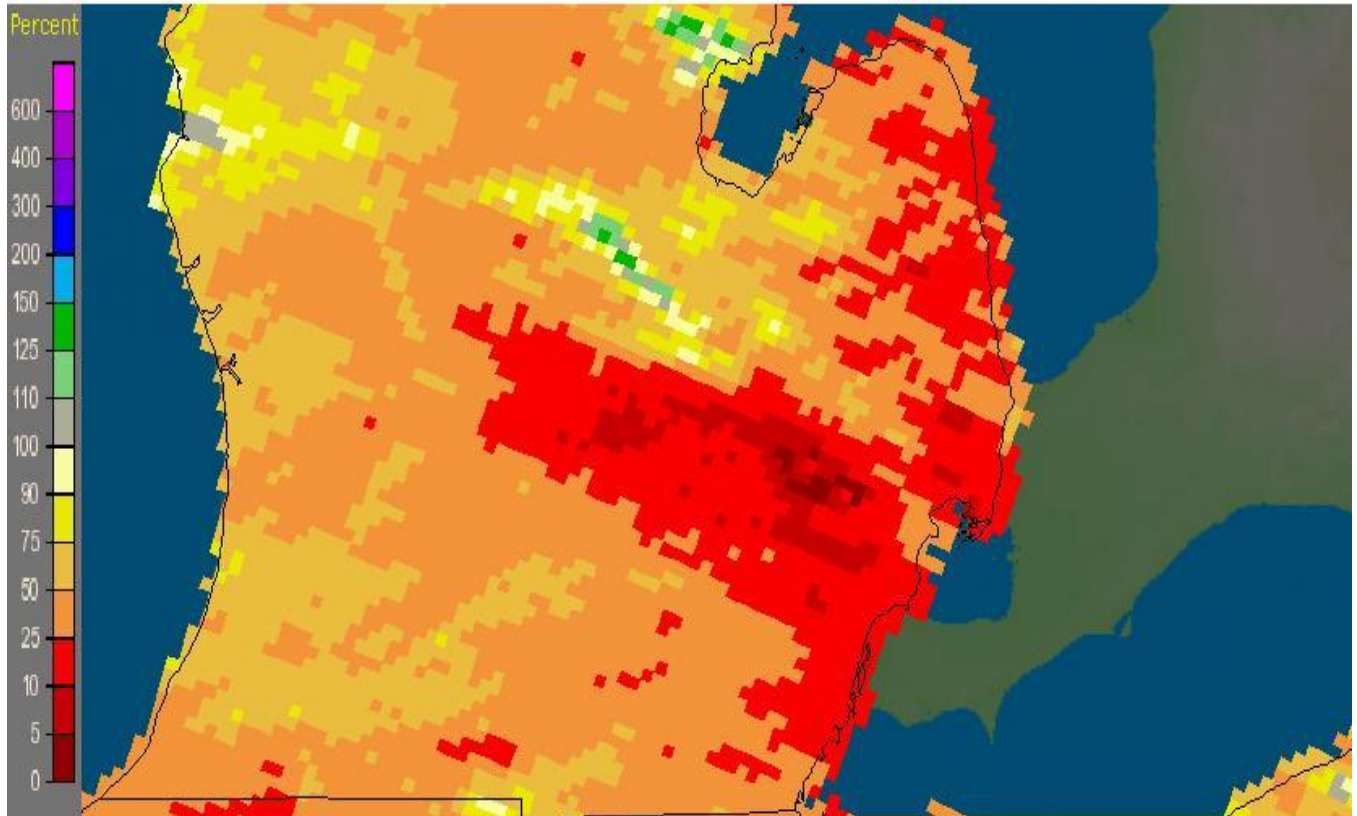
Detroit/Pontiac, MI (DTX): August, 2010 Monthly Observed Precipitation  
Valid at 9/1/2010 1200 UTC- Created 9/3/10 21:40 UTC



The driest part of the summer and growing season surfaced late in the season in August (Fig - 7). Nearly all but a small portion of the Saginaw Valley saw less than an inch or rain. Over much of the area this translates to less than 25% of the normal rainfall (Fig - 8), not good for farmers or gardeners alike.

**Fig - 8**

Detroit/Pontiac, MI (DTX): August, 2010 Monthly Percent of Normal Precipitation  
Valid at 9/1/2010 1200 UTC- Created 9/3/10 21:44 UTC



## **How Did the Analogues Project the Summer?**

### **Temperatures**

Overall, the analogue projection of summer worked out fairly well for a warm, above average summer but the magnitude fell short. Any cooler than average weather projections or guidance was discounted and a departure up to 1.5 above the summer average was the consensus. Ironically at this point, the Summer of '88 was thought to be too extreme for heat with its surplus of 90s and 100s (and it was) but at the same time, as far as its **average temperature** it turned out to be the best predictor.

**With a warmer start to the summer seen and analogues pointed to the warmest part of the summer was yet to come, an update was issued mid July headlined, [“Warm Summer to Continue the Remainder of the Season”](#) for departures up to 2.2 above the 30 year normal. At this point, a call for a top 20 warm summer was indicated by these forecasted departures. Alas, even this turned out to be too cool with the summer temperatures averaging nearly 3 ½ degrees /+3.4/ above normal.**

Though there were a few top 20 warmest summers in the analogues (1988 being the most noteworthy) and a warm summer was forecast, an average temperature of nearly 3 ½ degrees above normal for the entire region was surprising and not expected. **This shows (and this has been occasionally seen in the past) that while the majority of analogues have frequently pointed us in the right direction for temperature; they can fail on departure magnitude because their overall departure can be diluted (or weakened) by the contrary minority analogues.**

### **Rainfall**

Rainfall projection worked the best in this outlook, even to point of pegging areas where the heaviest and lightest rains would fall (not bad for a **convective** summer season). The composite map for Southeast Michigan showed the general trend. The exception was the tip of the Thumb, which received a few heavy thunderstorms during the summer leaving that area wetter. The following was taken from the initial **outlook**.

**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. In the analogues, 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.**

The busier severe weather season was also projected in the **Outlook**

### **Severe weather projections**

**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.**

The following 500 MB composite mean flow from the more recent analogue years was used in depicting the expected upper winds pattern along with in-house pressure pattern annotations (Fig – 9)

**Fig- 9**

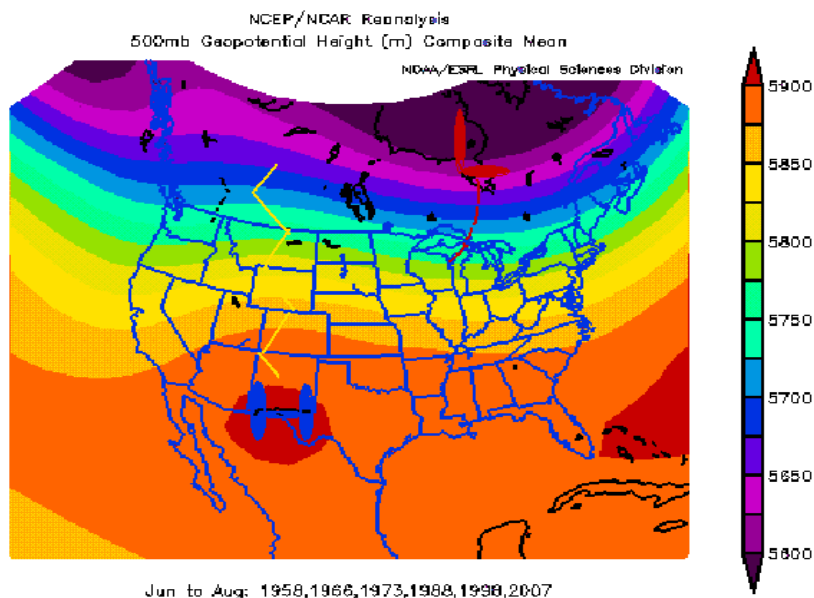


Fig-10 below, shows that the mean 500 MB flow this past summer was similar to the mean flow of the other summers (Fig -9) but with a broader ridge in the Midwest and Great Lakes and less troughing. This was one of the main reasons this past summer was warmer than most of the other analogue summers.

**Fig - 10**

