Winter Final Review Southeast Lower Michigan Including Snowfall

Written by: William R. Deedler, Weather Historian NWS White Lake

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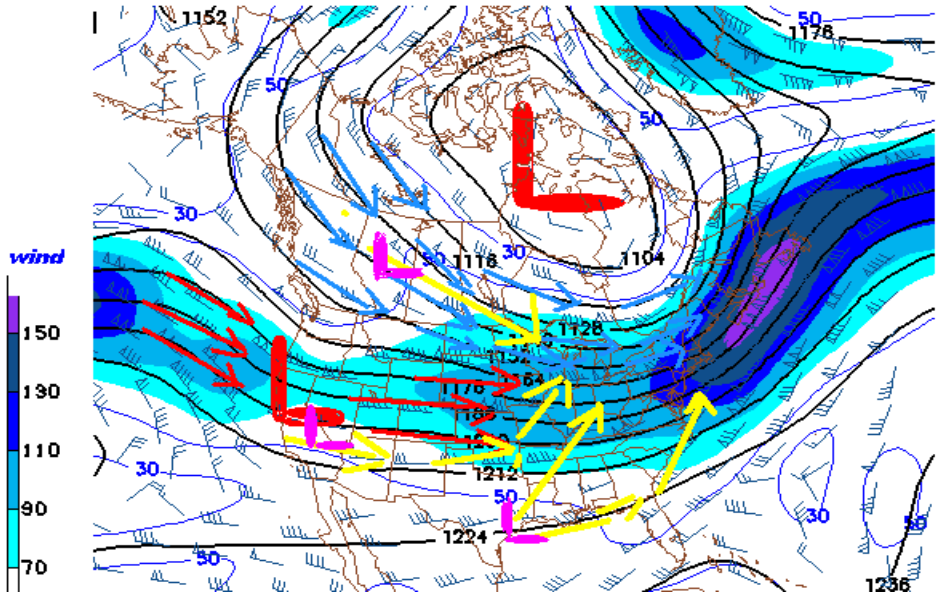
The two main weather influences on for the Winter 2009-10, almost exclusively, have been and continue to be the key players this spring though abating with the season change. The potent El Nino and an ever aggressive negative North Atlantic Oscillation /NAO/ certainly left their marks on this winter's weather across the country. Our readers of the Winter Outlook might remember the discussion about these two important features and how they were expected to play a role in this past winter.

From the **Outlook**:

"There are definitely a few wild cards in this season's outlook and just how strong El Nino becomes is one of the most important features of the winter and will have a marked influence on our winter weather. The other important wild card this winter is the trend of the North Atlantic Oscillation/Arctic Oscillation throughout the winter."

"This model projected 200 MB height/jet from a recent computer run I think demonstrates nicely the key upper air players I discussed about above for the upcoming winter."

Fig-1a



As it turned out, the above (Fig-1a) 500 MB height simulation (from a computer run in the autumn) that I thought demonstrated what we were up against for the winter, verified well. I indicated on the map the expected vibrant El Nino/subtropical flow off the Pacific along with a strongly negative NAO. A negative NAO encourages a large upper low in eastern Canada and associated dominant troughing over the eastern half of the country. The El Nino charged-up into the moderate category and thus, strongly influenced the southern jet stream across the country. Both of these northern hemispherical patterns worked in conjunction to create suppressed 500 MB heights across the country. The suppressed heights were responsible for the below normal temperatures in the Deep South and near normal here in Southeast Lower Michigan (since the cold was tempered by the El Nino).

Looking Back

The official winter season (Dec-Feb) temperatures (Fig -2) across Southeast Lower Michigan. All temperature data indicates the Winter of 2009-10 was a normal (or typical) winter in regards to the cold weather experienced. In fact, temperatures across all of Southeast Lower Michigan during the winter months were “unusually normal” and varied less than in a typical winter. Perusing the temperature data chart below shows just how normal it was. Temperature patterns, did ride their typical roller-coaster track at times, especially in January, but the pattern settled down remarkably in February and hung around normal much of the month.

Fig-2

WINTER 2009-2010 TEMPERATURES

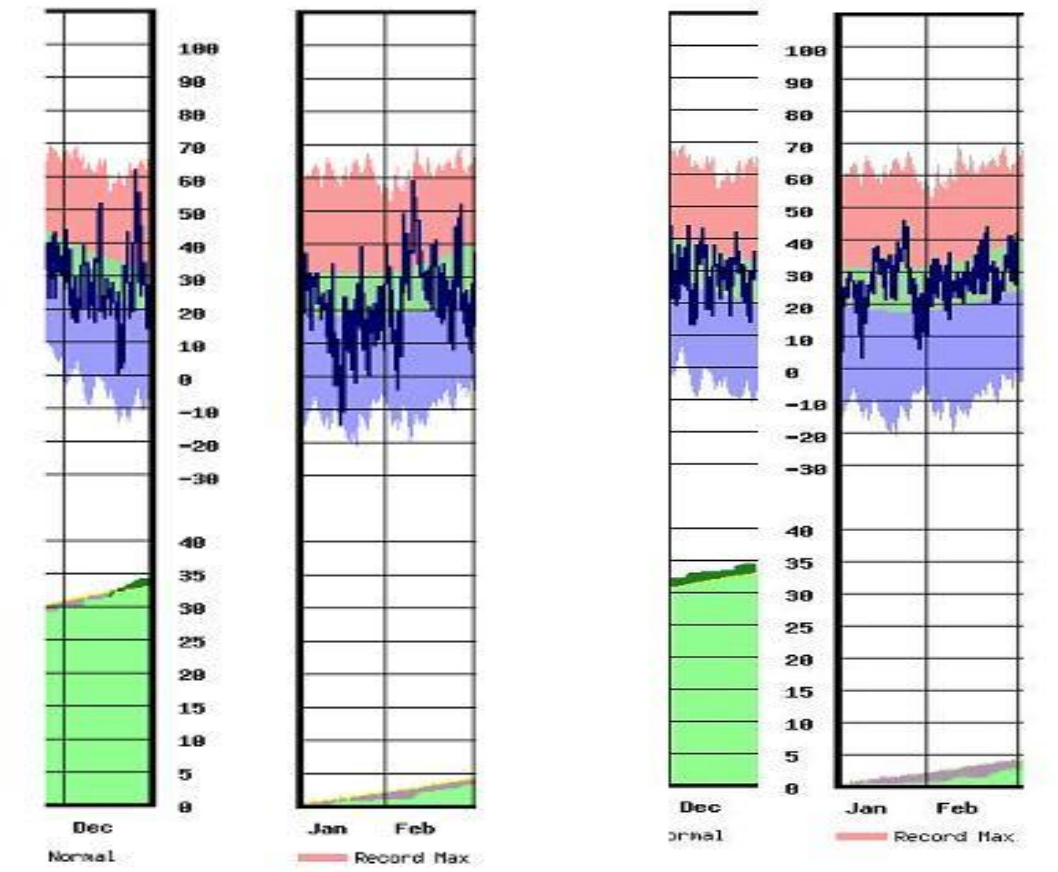
SITE	DEC	JAN	FEB	WINTER TEMP AVE DEP
DETROIT	**29.3**	**25.1**	**27.8**	**27.4/ +0.3**
FLINT	**26.8**	**22.0**	**23.9**	**24.2/ +0.3**
SAGINAW	**26.9**	**22.5**	**25.2**	**24.9/+0.8**
NWS WHITE LAKE	**25.5**	**21.6**	**23.7**	**23.6**
DEPART FROM NORM	***N***	***N-A***	***N***	***SE Michigan Winter Ave 25.5 / +0.5 Including DTX 25.0 / 0.0***

MA= Much Above A=Above N=Normal **B=Below MB=Much Below**

Examining this winter’s lack of variability a little closer

When comparing the temperature trace of this winter (on the right (Fig -3, **navy blue trace)** to last winter (on the left (Fig-3, **navy blue trace**), we see that last winter’s temperature trace was more classic of a typical winter’s temperature pattern (quite variable). Now look at **this winter’s trace**, the lack of variability is quite noticeable.

Fig –3



WINTER 2008-09 **WINTER 2009-10**

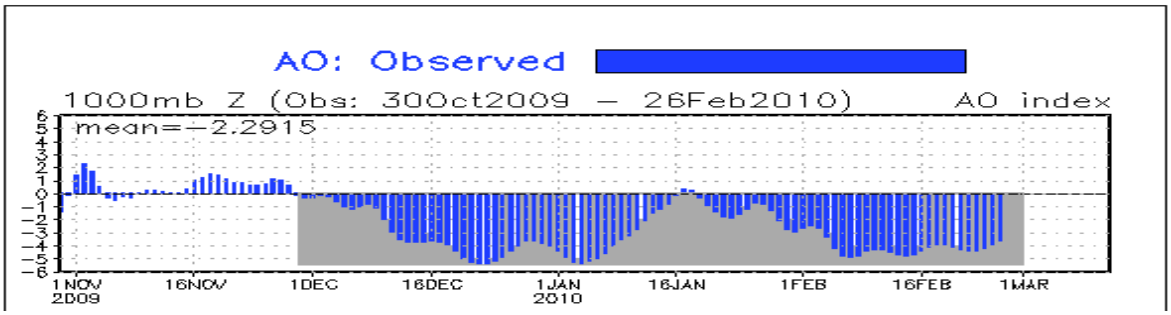
The predominant temperature projection of our analogue winters in the **Outlook** was very helpful at showing the resultant mean (or average) temperature of the winter.

What was interesting in this year's analogue winters was that the overall final winter temperature mainly hugged near the normal mean (within a few degrees). Look for temperatures to average -1.5 to +1.5 degrees of normal in the end for Winter 2009-10. The major challenge with this winter's outlook is how do we get to the near normal averages?

The El Nino with its energizing effect on the Pacific Jet Stream usually leads to a moderating effect on our temperatures but unfortunately, this was offset by a strongly negative NAO/AO (which was our major concern in the Outlook). Thus, these two patterns combined, led to a rather stable temperature regime for the most part. As mentioned above, the heights across the US were pushed well south of their normal position as an end result of these two climate patterns.

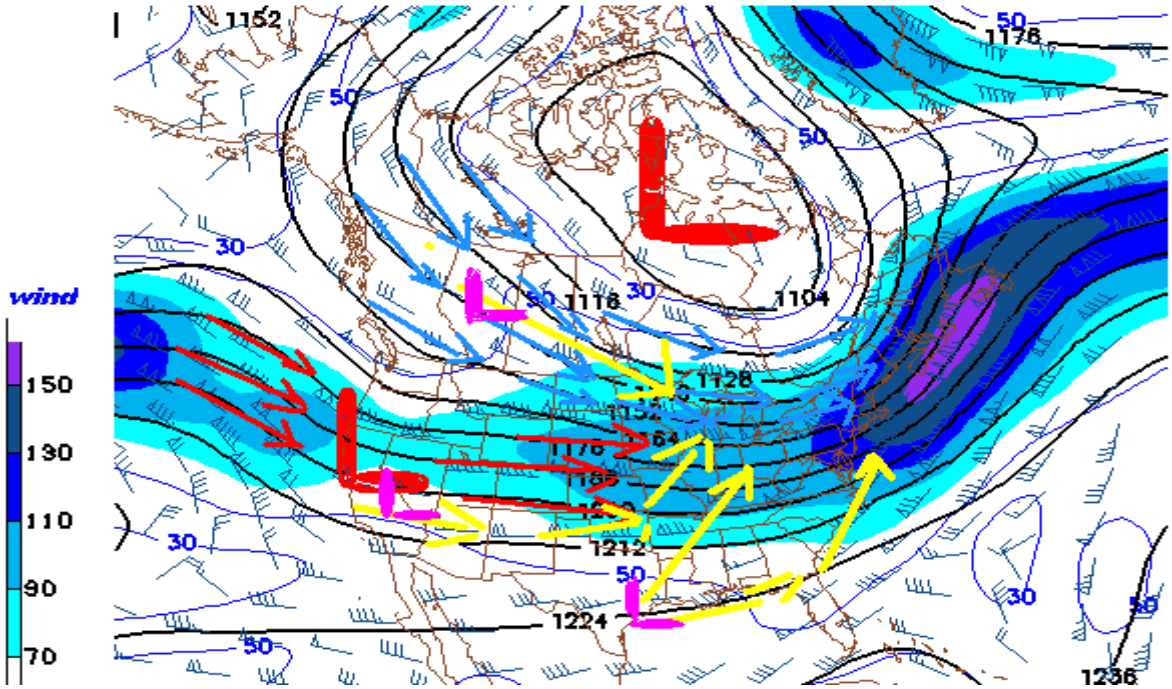
Since the Arctic Oscillation /AO/ (basically, a subset of the North Atlantic Oscillation) was almost exclusively negative much of the winter (not unlike last summer), any moderating effects of the El Nino were quite limited. Note (Fig-4), the mid-late January period of the AO where it was much less negative (or even neutral) which corresponded well with our January Thaw this winter.

Fig-4



Checking back on earlier map from the Outlook, note the storm tracks (denoted in yellow).

(Fig-1b)



Projected storm tracks forecast in the Winter Outlook

One of the main storm tracks expected for this winter was the East Coast storm track, either originating as a weak low which crossed the Upper Midwest, moved southeast across the Great Lakes to fully develop along the Mid Atlantic States, **or** a Gulf of Mexico Low, that rode up along the East Coast with explosive deepening. Both tracks have meant trouble for that region (from the Outlook, below)

"The Gulf of Mexico Low, which moves north northeast through the Ohio Valley and into the eastern Great Lakes...and/or develops along the East Coast. This storm track up the East Coast was noted more in El Nino patterns (especially in the 1970s) with a negative NAO and troughing was more prevalent in the eastern half of the county. It will be interesting to see whether or not more Gulf Lows make their appearance this season."

Mentioning storm tracks, how did we fare as far as precipitation and snowfall (Fig-5) from these tracks? Precipitation for the winter months did come in below normal, while snowfall was normal, in fact within a few inches or so!

WINTER 2009-10 PRECIPITATION

SITE	DEC	JAN	FEB	WINTER TOTAL PRECIP/DEPART
DETROIT	2.90	0.76	1.90	5.56/-0.74
FLINT	1.41	0.83	1.37	3.61/-1.49
SAGINAW	1.47	1.00	1.21	3.68/-1.77
NWS WHITE LK	2.77	0.97	1.40	5.14/ B
DEPART FROM NORM	N	B	N -B	B

WINTER 2009-10 SNOWFALL

SITE	OCT	NOV	DEC	JAN	FEB	MAR	APR	SEASON/DEP	LAST SEASON
DETROIT	0.0	0.0	7.8	8.9	27.0	T		43.7"/-0.3" ave proj: 40.5"	65.7"
FLINT	0.0	T	12.5	10.7	21.2	0.7		45.1"/+1.1" ave proj: 46.2"	72.8"
SAGINAW	0.0	T	11.9	14.4	18.3	1.0		45.6"/-2.9" ave proj: 42.9"	79.4"
NWS - WHITE LK	T	T	15.1	9.8	21.8	T		46.7	88.8"
DEPART FROM NORM	B	B	N	N	MA			N	MA

Storm Tracks across our neck of the woods were dominated by the southern paths (displayed in the projected storm tracks) mainly due to an active El Nino. The busiest and most storm aggressive part of our winter was during the second half, February. So plentiful were the storms and snow in February that both Detroit's and Flint's snow total landed them in top 5 snowiest Februaries (Saginaw placed a respectable 11th). Also included in the above table were the analogues snowfall projections for comparisons. Given these analogues are done from past winters and issued in late October (well ahead of the main snow season) the general timing of the "worst of the winter" was considered the most helpful part of the snow forecast . Normal snowfalls were expected with the worst coming during the second half of the winter, which verified well.

Top 11 Snowiest Februaries

Rank	Detroit Area*				Flint Bishop**				Saginaw Area***			
	Snowiest		Snowless		Snowiest		Snowless		Snowiest		Snowless	
	Total	Year	Total	Year	Total	Year	Total	Year	Total	Year	Total	Year
1	38.4	1908	0.0	1998	29.4	2008	0.4	1998	34.2	2008	0.0	1987
2	28.4	1881	0.0	1880	**21.2**	**2010**	1.4	1992	26.0	1908	0.1	1984
3	28.0	1900	0.7	1953	20.8	1990	2.2	1987	23.4	1935	0.6	1998
4	27.6	1926	0.9	2004	20.6	1986	2.4	1953	20.3	1965	1.4	1983
5	**27.0**	**2010**	1.5	1895	20.1	1994	2.4	1937	20.0	1912	1.9	1977
6	24.2	2008	1.6	1906	19.7	1965	2.9	1969	19.8	1985	2.0	1932
7	20.8	1986	2.0	1987	19.6	1988	2.9	1943	19.6	1988	2.1	1980
8	19.6	1898	2.1	1882	18.3	1946	3.0	1979	18.9	1903	2.2	1947
9	19.2	2003	2.2	1915	17.2	1960	3.0	1934	18.4	1990	2.2	1928
10	19.2	1988	2.3	1969	17.0	1924	3.5	1945	18.4	1926	2.4	1942
11	18.0	1893	2.4	1992	16.7	1973	3.6	1984	**18.3**	**2010**	2.5	1969

Even more impressive, February 2010 was Detroit's **tenth snowiest month** ever**.** When you consider that there are generally four months during a snow season that could place /Dec, Jan, Feb, Mar and a few in Nov or Apr/ each year back to 1874 (close to 550 months in contention) yes, impressive. February 2010's snowfall was at the top 2% of all the possible snow months. Just back in January of 2009 we also made the list at Detroit for 13th snowiest, while February 2008 placed 15th. Flint's data goes back to 1921 and February 2010 placed 16th for snowiest mainly because less snow fell in the area. The year of 2008 was very popular for snowy months at Flint with January, February and December all making the grade. Almost the same could be said for Saginaw's 2008 snow data with February and December 2008 also very high on the list!

Top 16 Snowiest/Snowless Months in Southeast Lower Michigan

Rank	Detroit Area*				Flint Bishop**				Saginaw Area***			
	Snowiest		Snowless		Snowiest		Snowless		Snowiest		Snowless	
	Total	Year	Total	Year	Total	Year	Total	Year	Total	Year	Total	Year
1	38.4	Feb-1908			35.3	Dec-2000			39.3	Dec-2000		
2	34.9	Dec-1974			**29.4**	**Feb-2008**			**39.1**	**Dec-2008**		
3	30.2	Mar-1900			**29.1**	**Dec-2008**			**34.2**	**Feb-2008**		
4	29.6	Jan-1978			28.5	Jan-1976			30.9	Jan-1967		
5	28.4	Feb-1881			27.7	Dec-1929			30.3	Jan-1978		
6	28.0	Feb-1900			27.6	Jan-1967			27.5	Mar-1971		
7	27.6	Feb-1926			26.1	Jan-1979			26.7	Dec-1929		
8	27.4	Dec-1929			26.0	Jan-1959			26.1	Jan-1979		
9	27.3	Jan-1999			24.9	Jan-1999			26.0	Feb-1908		
10	**27.0**	**Feb-2010**			24.9	Dec-1951			26.0	Jan-1997		
11	26.9	Jan-2005			24.2	Jan-2004			25.9	Dec-1989		
12	25.7	Apr-1886			23.6	Jan-1978			24.4	Jan-2004		
13	**25.2**	**Jan-2009**			**22.8**	**Jan-2008**			24.0	Dec-1951		
14	25.1	Dec-2000			22.2	Dec-2005			23.4	Feb-1935		
15	**24.2**	**Feb-2008**			21.3	Dec-1974			23.0	Nov-1995		
16	24.1	Mar-1899			**21.2**	**Feb-2010**			22.6	Jan-1914		

From the Outlook

While I'm calling for less snow than the last few winters, I still expect snowfalls to range within a half of foot of the average or normal rather than below each area's perspective mean).

The snowfalls seen across the region were surprisingly close to their respective norms (or averages) at all three climate sites, **varying only by a few inches**. The seasonal snow *norms (averages) for Southeast Lower Michigan are calculated from* a wide array of snowfall seasons with totals encompassing snowfalls as low as the teens to as high as the 90s.

One pattern that did show up was that the majority of the winters contained their best snows mid-late season and therefore, tended to be back-end loaded. Best snows were found February and March (especially if we weren't hit January). March was a snowy month, seven out of the 12 analogue years.

The winter was indeed back-end loaded with snow as many areas saw half or more of the winter total during February, alone. As stated in the analogues, the best snows were found in February and March. February 2010 now ranks the second highest snow for Detroit (including the analogue group) with February 1926 having just an inch more at 28.0". In past Outlooks, I have explained that I look for the overall or general trend from the analogues, not necessarily each individual month. Frequently, weather patterns develop mid month to mid month (or the first half or last half of a season). Timing is always an issue and some sort of flexibility has to be exercised when mentioning a time period. The Outlook performed remarkably well for the **overall winter trend, including the actual snowfall amounts and temperatures averages versus projected snow amounts and temperature averages. While no measurable snow fell in March, February's double to nearly triple the normal amounts more than took care of the "back-end loaded" snowy part of the winter forecasted.**

Learned from this set of analogues?

Studying and researching prevailing patterns of the past and relating it to the present continues to prove beneficial for the local season outlooks. It may be more beneficial to make more use of the phases "late winter", "second half of the winter" etc instead of pegging a particular month especially when data suggests back to back months containing similar traits (example, our projected snowy February and March scenarios**) Finally, to quote a dearly departed weatherman who I worked with during my student days (and it has proven itself, time and time again), "It's generally not the weather forecast that's turns out wrong…it's the timing. ;-)"**

After last summer's cool weather, what do our summer analogues and research suggest for this summer? Check back in late May for the Summer Outlook for Southeast Lower Michigan.