What a Winter!

Incredible Stormy Winter Brings Widespread Record Territory Snowfalls

Winter 2007-08 Final Review

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With storm after storm pushing northeast into the southern Great Lakes this past winter, a surplus of snow and rain was seen throughout the Winter of 2007-08 which continued into the spring. Temperatures fluctuated energetically up and down throughout the winter. When all was said and done (and partly because of those wide temperature fluctuations), the Winter of 2007-08 will go down statistically as just slightly above normal temperature-wise but well above normal for both rain and snow.

Using the three main locations (Detroit, Flint and Saginaw) the average temperature for Southeast Lower Michigan averaged around 26.0 degrees, or a degree /+1.0/ above normal. And strictly speaking, a degree above normal is still comfortably within the "normal" or average range. In the Winter Outlook, temperatures were forecast to swing above and below frequently and sometime widely but in the end, average between 1.0 degree below normal and 1.5 degrees above. If the NWS site is also added to represent the northern suburbs of Detroit, the average falls to 25.6, or about a half degree /+0.6/ above the normal of 25.0 degrees (see bottom of chart, lower right).

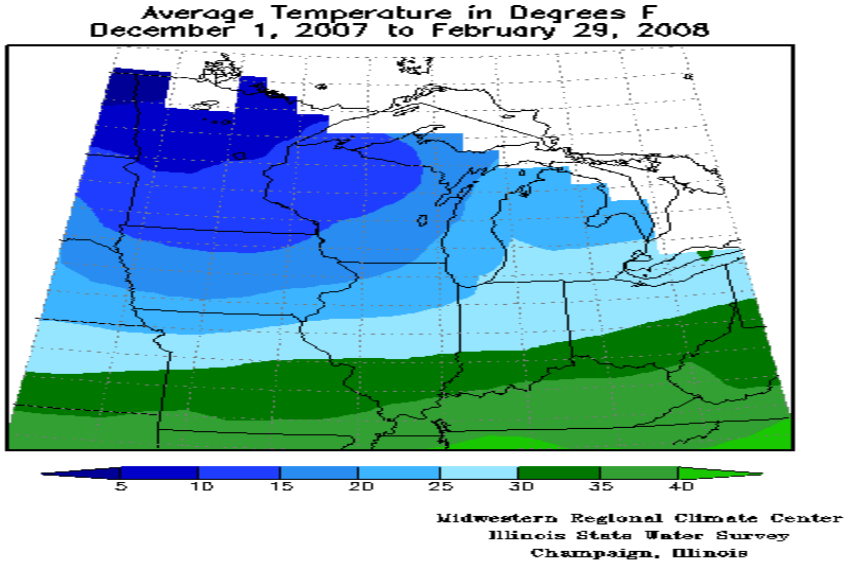
SOUTHEAST LOWER MICHIGAN

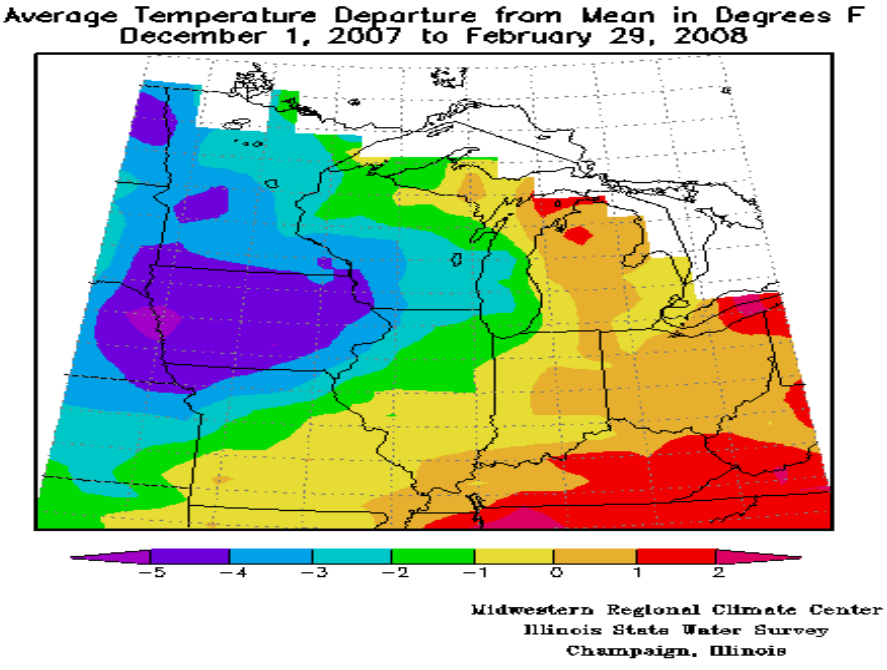
WINTER 2007-08 TEMPERATURES

SITE	DEC	JAN	FEB	WINTER TEMP AVE DEP
DETROIT	29.6	28.9	25.2	27.9 / +0.8
FLINT	27.6	26.9	23.7	26.0 / +2.1
SAGINAW	26.1	26.1	20.8	24.3 / +0.2
NWS WHITE LAKE	25.9	25.9	20.6	24.1
DEPART FROM NORM	N	A	B	25.0 / 26.0 / +1.0 25.0 / 25.6 / +0.6

Actual 2007-08 winter temperature maps

Below are the actual temperature maps along with departures from the Midwest Climate Center for the winter /Dec-Feb/. In these maps, all the Southeast Lower Michigan sites are used and averaged and thus, the temp averages and departures may be slightly different (in this case, near normal temperatures rather than above).





Below are the actual precipitation tables for the stations in Southeast Lower Michigan, including NWS White Lake /Dec-Feb/.

WINTER 2007-08 PRECIPITATION

SITE	DEC	JAN	FEB	WINTER TOTAL PRECIP/DEPART
DETROIT	3.48	2.13	3.61	9.22 / +2.92
FLINT	2.43	2.49	2.35	7.27 / +2.17
SAGINAW	2.09	2.02	3.13	7.24 / +1.79
NWS WHITE LK	2.66	4.18	3.74	10.58
DEPART FROM NORM	A	A	A	A

S N O - O H!

WINTER 2007-08 SNOWFALL

SITE	OCT	NOV	DEC	JAN	FEB	MAR	APR	SEASON/DEP	LAST ENTIRE SEASON
DETROIT	0.0	0.5	12.2	13.8	24.2	21.0	T	71.7/+27.7	30.3
FLINT	0.0	5.7	17.1	22.8	29.4	7.3	0.5	82.8/+34.5	41.0
SAGINAW	0.0	2.8	22.6	18.9	34.2	1.5	T	80.0/+29.1	29.1
NWS - WHITELK	0.0	6.5	16.4	27.4	28.6	12.3	0.5	91.7/+36.7	46.6
	B	N	A	A	A	A	B	A	B

Note: Estimated average snowfall for White Lake is around 55.0''

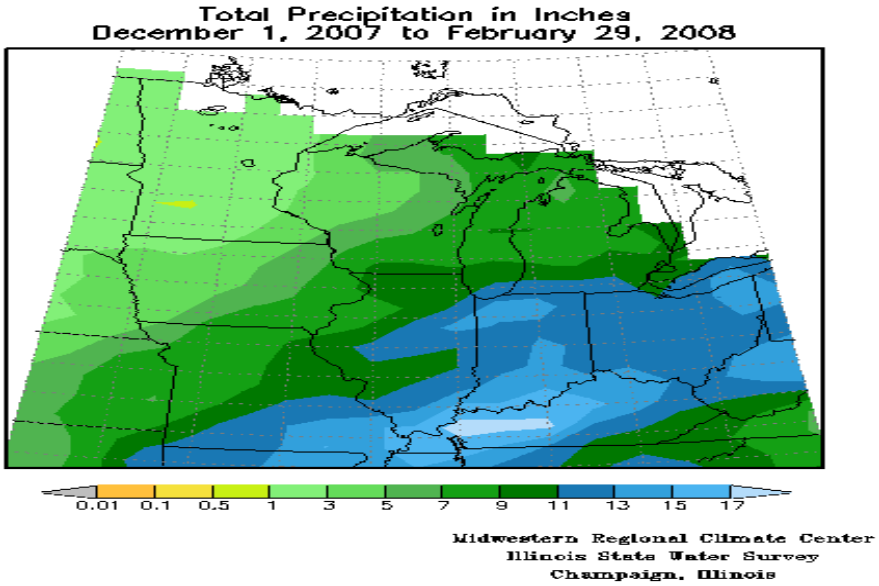
Top 20 Snowless/Snowiest Seasons in Southeast Lower Michigan

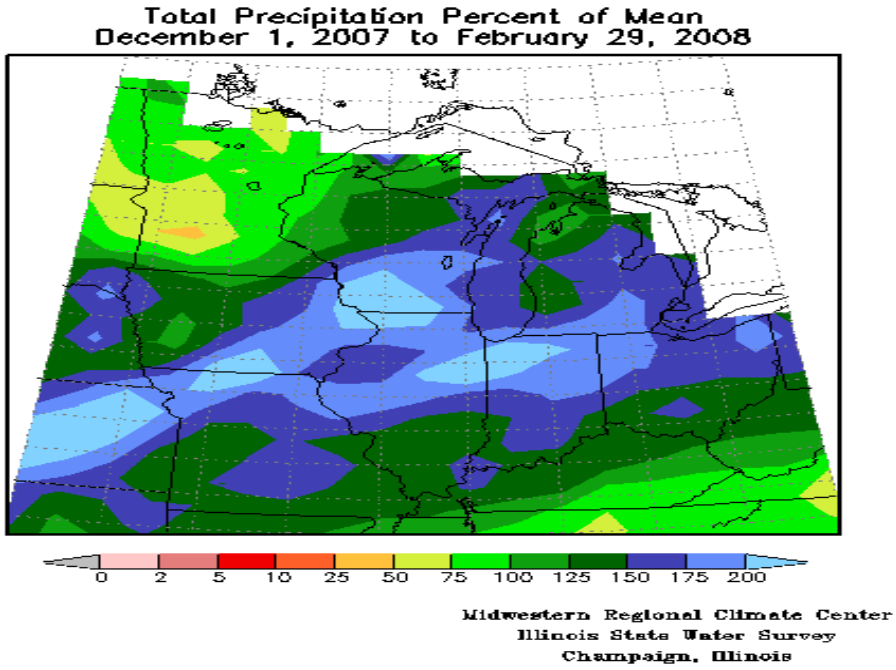
Rank	Detroit Area*				Flint Bishop**				Saginaw Area***			
	Snowless		Snowiest		Snowless		Snowiest		Snowless		Snowiest	
	Total	Year	Total	Year	Total	Year	Total	Year	Total	Year	Total	Year
1	12.9	1936-37	93.6	1880-81	17.6	1948-49	82.9	1974-75	7.8	1941-42	87.2	1966-67
2	13.2	1881-82	78.0	1925-26	17.6	1944-45	**82.8**	**2007-08**	18.5	1976-77	83.5	1951-52
3	13.7	1948-49	74.0	1981-82	21.7	1943-44	78.6	1966-67	20.0	1952-53	**80.0**	**2007-08**
4	15.2	1918-19	**71.7**	**2007-08**	23.4	1952-53	76.6	1975-76	21.0	1920-21	75.5	2004-05
5	15.4	1965-66	69.1	1899-00	24.2	1957-58	75.3	1951-52	21.4	1901-02	75.4	1996-97
6	15.8	1889-90	67.2	1907-08	26.9	1941-42	73.0	2004-05	21.9	1963-64	74.9	1903-04
7	16.6	1952-53	66.5	1929-30	28.3	1997-98	72.9	1964-65	22.7	1948-49	72.4	1908-09
8	17.1	1968-69	63.8	2004-05	28.6	1968-69	62.9	1972-73	23.6	1918-19	68.4	1995-96
9	18.0	1960-61	63.1	1974-75	29.5	1999-00	62.2	1981-82	23.8	1982-83	67.8	**2000-01**
10	18.0	1957-58	61.7	1977-78	29.5	1988-89	61.5	1958-59	23.9	1916-17	65.8	1972-73
11	20.0	1982-83	60.9	**2002-03**	31.3	1956-57	60.1	1959-60	24.3	1943-44	63.0	1971-72
12	22.0	1945-46	60.8	1884-85	33.1	1954-55	55.9	**2005-06**	24.5	1932-33	62.2	1984-85
13	22.5	1997-98	60.2	1898-99	33.6	1982-83	55.4	1989-90	25.0	1986-87	61.7	1989-90
14	22.6	1937-38	59.9	1892-93	33.6	1965-66	55.0	1969-70	25.1	1944-45	61.3	1907-08
15	22.8	1943-44	58.6	1951-52	33.9	1945-46	54.9	1970-71	25.3	1927-28	61.1	1964-65
16	23.2	1888-89	58.0	1911-12	34.2	1990-91	54.4	1991-92	25.4	1990-91	60.6	1947-48
17	23.4	1941-42	57.0	1903-04	34.5	1998-99	53.4	**2000-01**	25.6	1983-84	59.3	1911-12
18	23.7	1999-00	56.9	1922-23	34.7	1960-61	53.3	1985-86	26.1	1921-22	58.1	1904-05
19	24.1	2003-04	56.7	1885-86	36.3	1950-51	53.2	1992-93	26.9	1993-94	57.0	1929-30
20	25.1	1988-89	55.9	1975-76	36.4	1980-81	52.1	1971-72	27.5	1979-80	56.3	1975-76

The 2007-08 season snowfalls are not only notable because of the snow amounts but also because of the extent (or coverage) of high amounts of snowfall, (all three stations placed in the top four snowiest winters). Interestingly (and to a slightly lesser extent), this happened just a few winters ago /2004-05/ when all three stations placed in the top eight highest snowfall seasons! Therefore, the winter of 2007-08 not only exceeded the winter of 2004-05 for amounts (ranks) but also for the extent of snowfall cover. In 2004-05 with ranking of 8-6-4, the average is 6 for extent. However in 2007-08, with rankings of 4-3-2, the average is 3 for extent. Therefore, this is the most snowfall ever seen by all three stations at the same time (and this isn't even including the ninety some inches /91.7"/ here at the NWS in White Lake)!

Actual 2007-08 winter precipitation maps

Below are the actual precipitation maps along with departures from the Midwest Climate Center for the winter /Dec-Feb/.



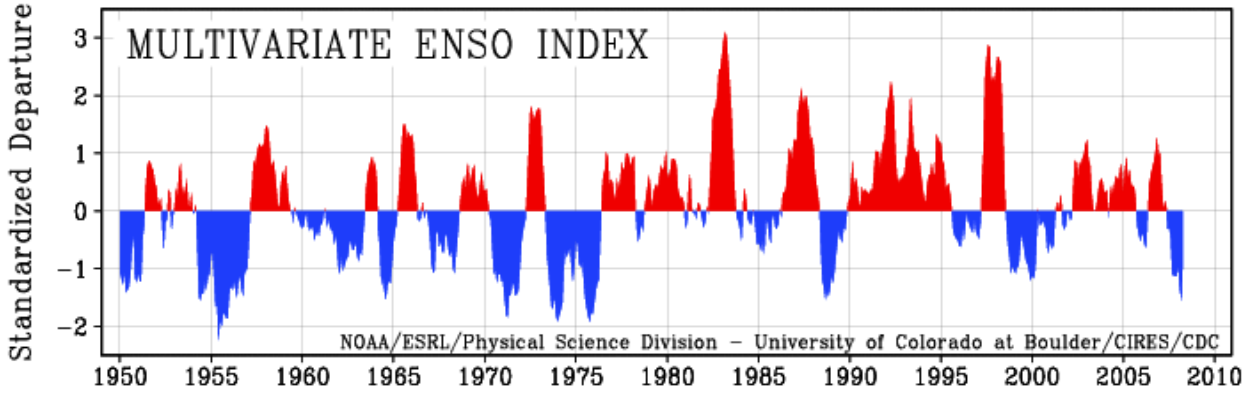


Recent Winter Trends:

Winter trends continue to show stormier and snowier winters (a similar pattern last seen in the 1970s). Note that three or four of the past winters since 2000 show up in the top 20 snowiest for each city. As mentioned in past outlooks and reviews, some other similarities show up from back in that time period and now. These hemispheric patterns (below), among others, affect surface patterns and trends across the country and Great Lakes.

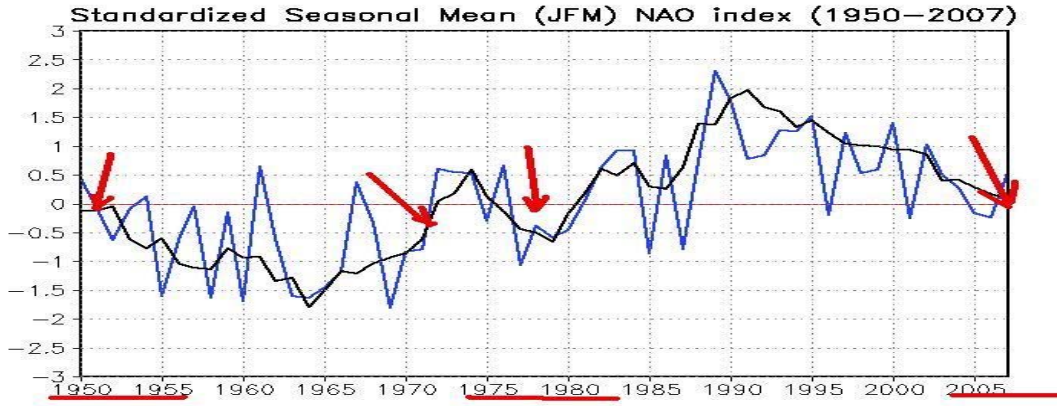
La Nina's versus El Nino's

As seen by this ENSO Index trace, La Nina's (colder SST's temperatures off the coast of South America) were more dominant from 1950s through much of the 1970s with a switch to El Nino's (warmer waters) being more dominant from the early 1980s through the early 2000's Is this trend in the midst of changing back to the dominant cooler SST's (similar to what was seen in the early 1950s)?

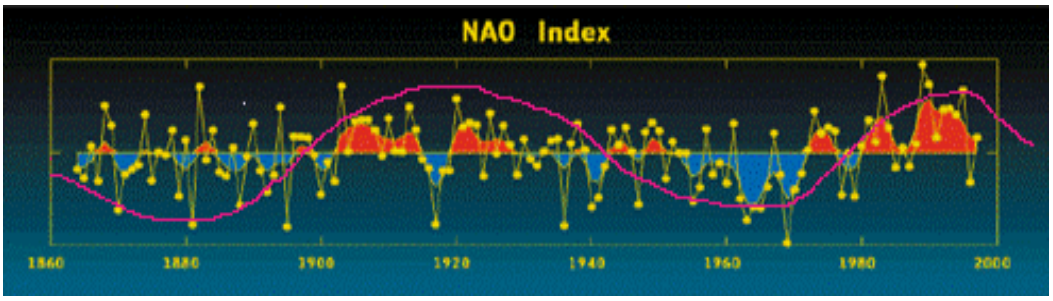


North Atlantic Oscillation /NAO/:

This trace of the NAO (below, since the 1950's), shows the oscillation during the winter months /JFM/ from negative to positive and recently back toward negative (in 2007, similar phase timing to that of 1950). Other times the NAO was hovering in the same weakly negative phase was from the late 60s into the early 80s (however, at this time the trend channel was at the end of the negative cycle rather than trending into or toward it). Generally, a predominantly negatively phased /NAO-/ brings colder or below normal temperatures to the region.



NAO 1860-2000 AND DOMINANT DRAWN ESTIMATED CYCLE

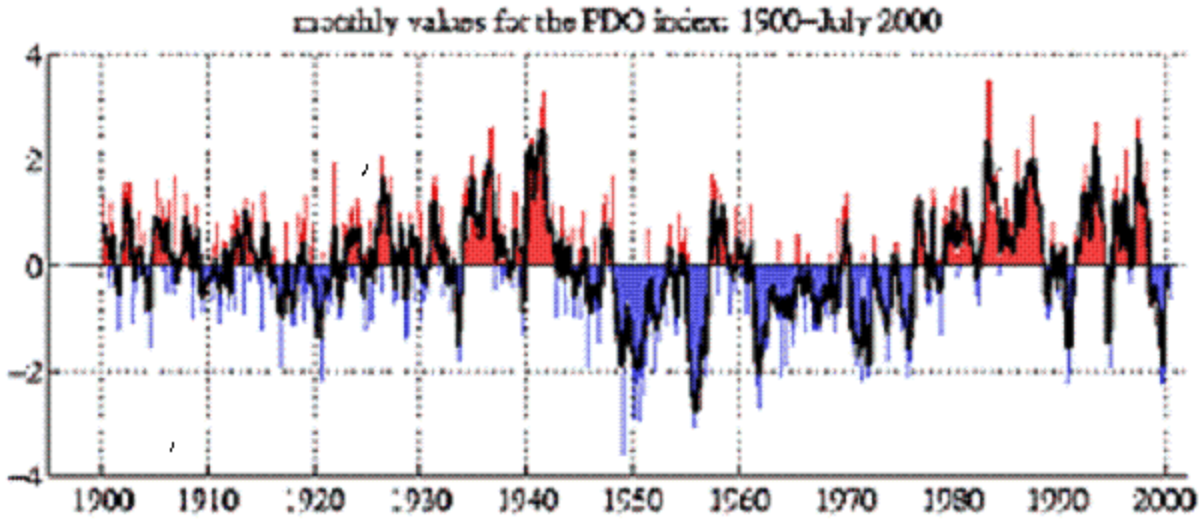


<u>Pacific Decadal Oscillation</u> /PDO/:

Another Ocean cycle believed to affect the upper wind patterns across the northern hemisphere is the <u>Pacific Decadal Oscillation</u> /PDO/ also mentioned in past articles.

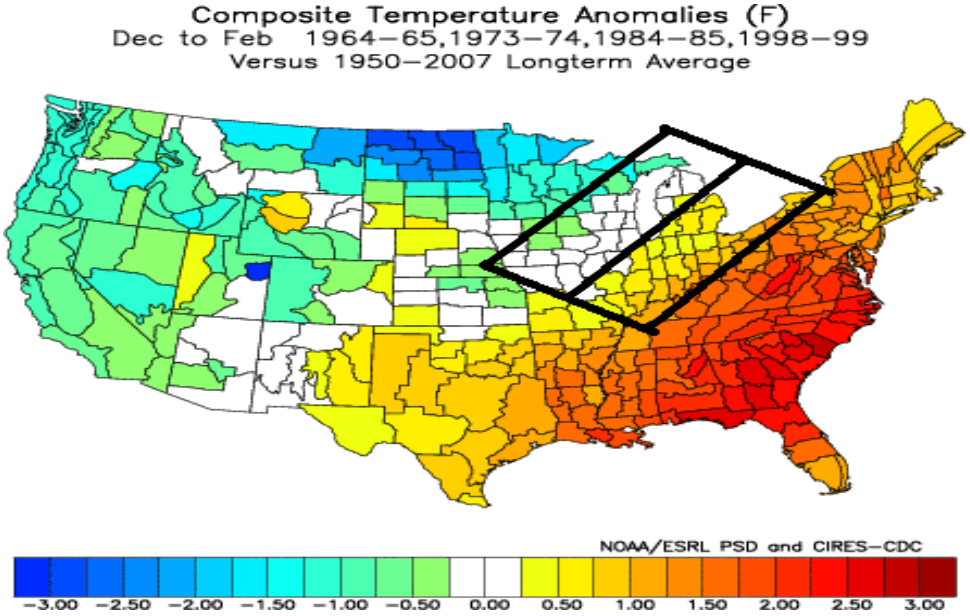
The Pacific Decadal Oscillation (PDO) is a pattern of the Pacific climate variability that shifts phases on at least inter-decadal time scale, usually about 20 to 30 years. The PDO is detected as warm or cool surface waters in the Pacific Ocean north of 20° N. During a "warm", or "positive", phase, the west Pacific becomes cool and part of the eastern ocean warms; during a "cool" or "negative" phase, the opposite pattern occurs (Wikipedia).

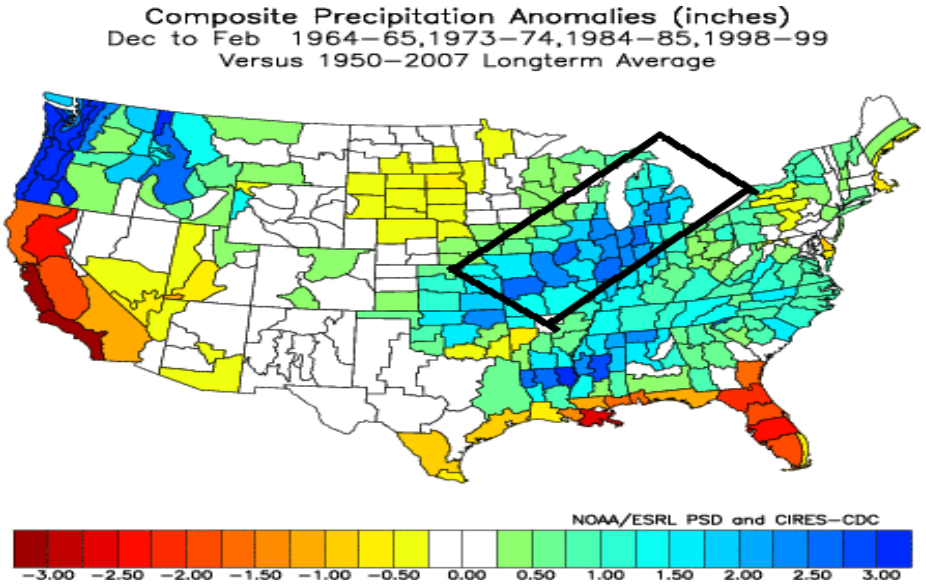
The past warm cycle began in the late 1970s, it may be now just beginning to fade toward the cooler cycle, last seen in the mid 70s (which began in the mid-late 1940s).



THE BEST ANALOGUE WINTERS FOR TEMPERATURES /PRECIPITATION TRENDS

The following are the composite temperatures and precipitation anomalies from the analogue winters in the original Winter Outlook that most resemble the temperatures and/or snow for the current winter. Note the northeast to southeast "dividing area" that shows up nicely in the temperatures, normal (white) to slightly above normal (yellow) over the Great Lakes and Ohio Valley Below to much below normal temperatures were also seen west of the Lakes in the upper Midwest. The second map relays the precipitation trends (resulting from the storm tracks across the same region). Temperature departures, like this past winter, on average hovered around normal to slightly above. Check out the composite precipitation departures in these winters and like this past winter, they averaged about 2.0"–3.0" above normal.





Performance of the 2007-08 Winter Outlook

The performance of the Winter Outlook (and subsequent preferred analogue winters) was one of the strongest to date (past ten years). In the original Outlook issued mid October, the following trends were forecast:

From the Outlook (in blue)

TEMPERATURES

ACTIVE STORM TRACK SHOULD MAKE FOR ONE CHANGEABLE WINTER

Look for temperatures during the winter to be quite variable (more than usual) due to a rather strong and oscillating southwest to northwest jet stream, guided by La Nina in conjunction with the North Atlantic/Arctic Oscillation /NOA, AO/.
In the final analysis, look for temperatures to average around normal /-1.0 to +1.5/ of the 30 year normal.

As stated above, the actual outcome:

Using the three main locations (Detroit, Flint and Saginaw) the average temperature for Southeast Lower Michigan averaged around 26.0 degrees, or a degree /+1.0/ above normal. If the NWS site is also added to represent the northern suburbs of Detroit, the average falls to 25.6, or about a half degree /+0.6/ above the normal of 25.0 (also, see Midwest Climate Center Map above, which takes all reporting locations into account and gives the region about normal).

PRECIPITATION (including snowfall)

The best chance for above snow obviously will lie just north of the main storm tracks in the colder air. Therefore, above normal precipitation (rain and melted snow) is forecast across the entire region.

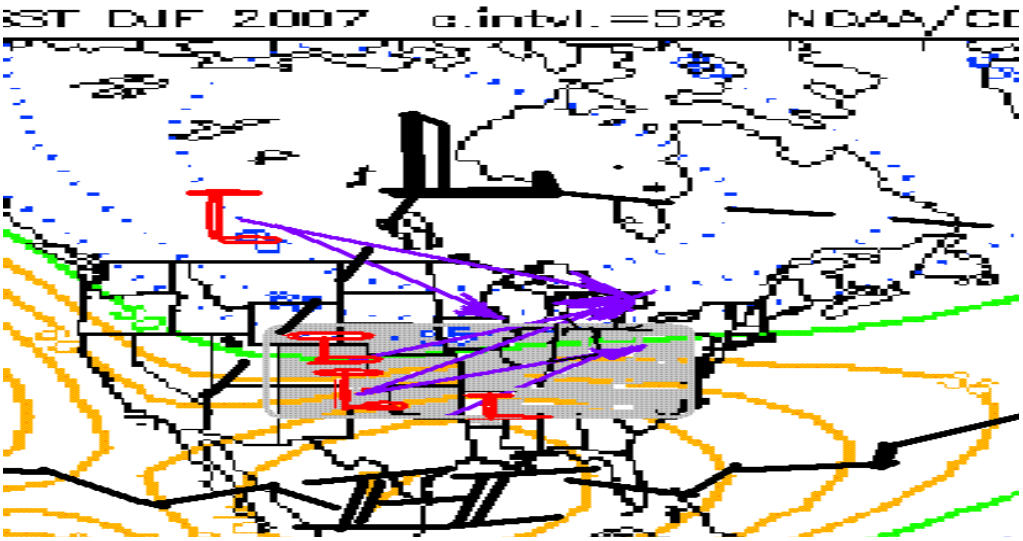
PROJECTED STORM TRACKS:

Jet axis holds the one of the keys to this winter

The interaction between La Nina influenced Pacific jet stream and the North Atlantic Oscillation will hold the key to this winter's storm tracks and what type of storms develop over the country. The interaction of the two, whether it be by phasing or split flow will, to a large extent, layout a pattern. The estimated storm tracks I have drawn (Fig-10) could be quite interesting, especially when phasing occurs. Note the most likely storm tracks over the country and Great Lakes. Storm tracks are in purple, while the main convergence between the two jets is shown in gray-scale along with the mean 500 MB pattern in black.

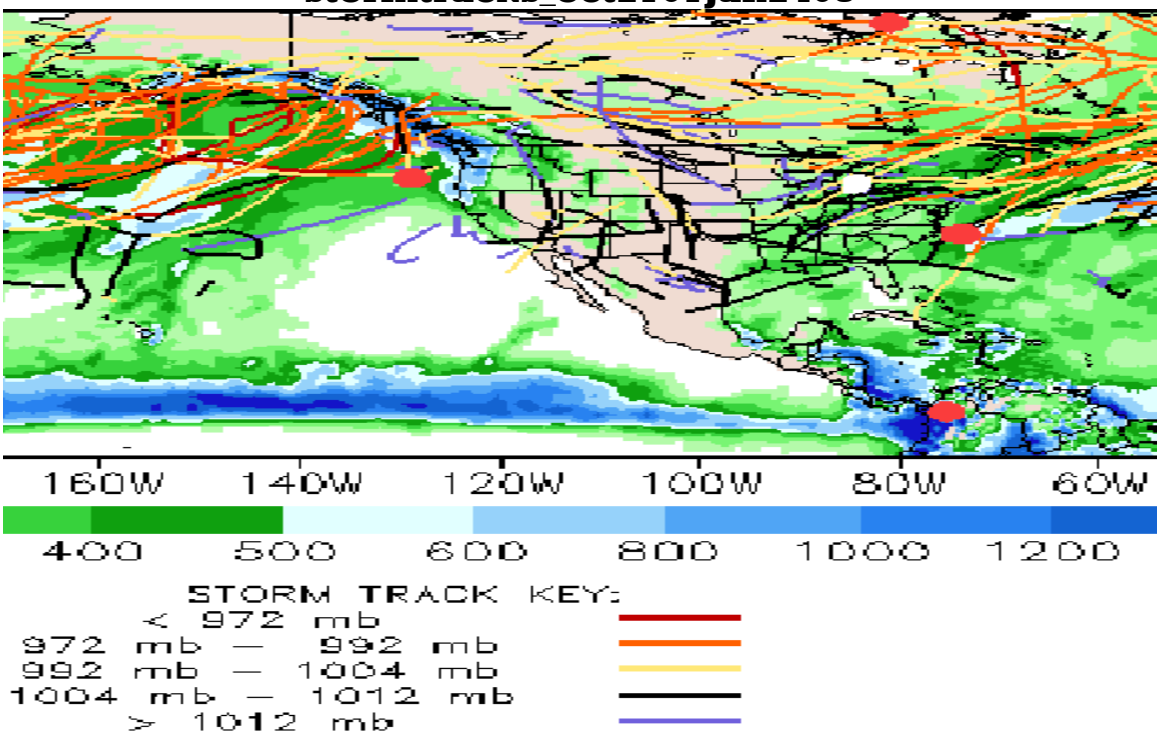
FIG-10

PROJECTED WINTER STORM TRACKS



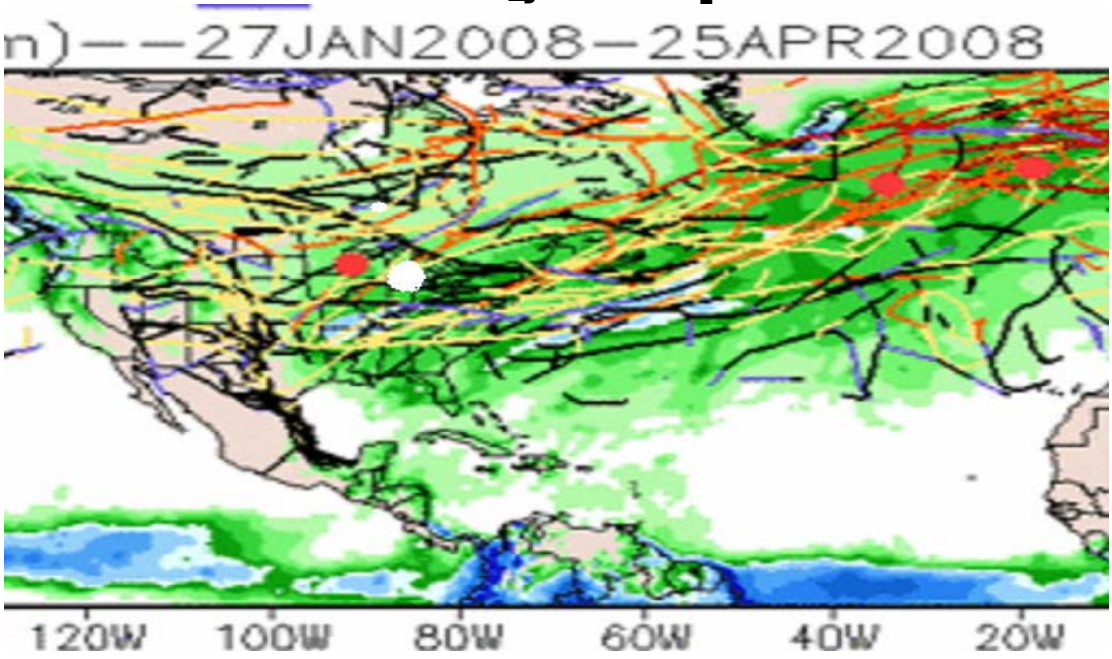
ACTUAL MAIN STORM TRACKS FIRST HALF (LATE AUTUMN-MID WINTER)
(white spot represents Michigan)

stormtracks_oct2707jan2408



ACTUAL MAIN STORM TRACKS SECOND HALF (MID WINTER-EARLY SPRING)

stormtracks_jan2707apr2508



The winter storm track outcome:

The busyness of the winter storm tracks is quite apparent on these maps (and especially from our winter snowfall/rainfall amounts) with the main tracks surging from the Southern Plains into the Great Lakes. For our relevance, the active storm tracks ran from Texas or Arkansas, northeast into the southern and eastern Great Lakes this past winter. Three of the main cyclogenesis regions depicted in the Winter Outlook. Several times during the winter, a cold air mass moved out of Canada, pushed through the Lakes and stalled (draping in a east northeast to west southwest fashion caught up in the projected *convergence band*) as a developing storm moved from the Texas or Arkansas region northeast into the southern Great Lakes (a snow-lover's dream scenario).

Look for the Summer Outlook in the late May-early June timeframe.