LA NINA MAKES A RETURN ENGAGEMENT FOR THE WINTER OF 2010-11

ACTIVE STORM TRACK SHOULD MAKE FOR ONE INTERESTING WINTER

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NWS-WHITE LAKE /DTX/

Local Data Suggests:

Temperatures:

Expect temperatures during the 2010-2011 winter to be **more variable** than usual. This will be due to a rather strong and oscillating jet stream, guided by La Nina and the North Atlantic/Arctic Oscillation /NOA, AO/. In the final analysis, the southeast Lower Michigan winter will be somewhat colder than last winter with numerical temperature departures ranging from -2.0 to +1.0 degrees around the normal in Southeast Lower Michigan.

Expanding further on the concept of "normal", the 100 year winter mean temperature for Detroit is 26.7 degrees F with a standard deviation spread of 3.5 degrees F. Statistically speaking, the average winter temperature could be as low 23.2 degrees or as high as 30.2 and still be considered a "typical winter".

Snowfall and Rainfall:

Because of the temperature variability observed in many of the analogue winters, snowfall in those winters ranged widely from well above normal to well below. This would be expected since the variance of temperatures hint at the variability of the upper atmospheric patterns and storm tracks. Therefore, pinpointing the prevailing storm tracks and exact locations this winter will make a significant difference in regard to seasonal snowfall. However, using the expected dominant storm tracks for the upcoming winter, it is likely much of the region will experience normal to above normal precipitation and snowfall (see **storm tracks** for more information).

The official national winter/monthly outlooks from the Climate Prediction Center is updated regularly, and is available at: http://www.cpc.ncep.noaa.gov/index.html

Broad Scale Discussion

An interesting and another challenging winter is ahead with two main climate and weather drivers, La Nina and the NAO, working together to bring Southeast Lower Michigan a fairly busy winter.

1 - La Nina

Let's revisit what a "La Nina" episode is, since the current La Nina is one of the strongest on record. Water temperatures in Nino 1+2, 3 and 4 (Fig-1a, b, c) show the distinctive and fairly rapid cooling of the areas of the Pacific Ocean. For scientific purposes, temperature departures in Nino 3.4 are used to determine whether or not a La Nina is in effect. The temperature in Nino 3.4 has slipped to approximately 1.5C below normal in October which denotes a La Nina state. To officially be classified as a full-fledged La Nina, the temperature must average at/or below -0.5C for a period of at least 5 consecutive overlapping 3-month seasons. Looking at the graph of Fig 1b, monthly readings for all 4 regions continue to cool. Overall though, region 1+2 is still the coldest compared to normal. However, region 3.4 is nearly as cold with moderate to strong La Nina values. The Multivariable Enso Index (Fig-1d) shows the standard water temperature departures since 1950 and thus, denoting La Ninas and El Ninos.

Fig - 1a

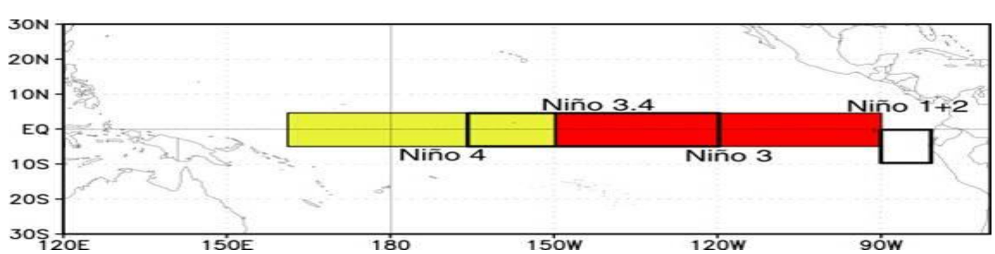


Fig - 1b

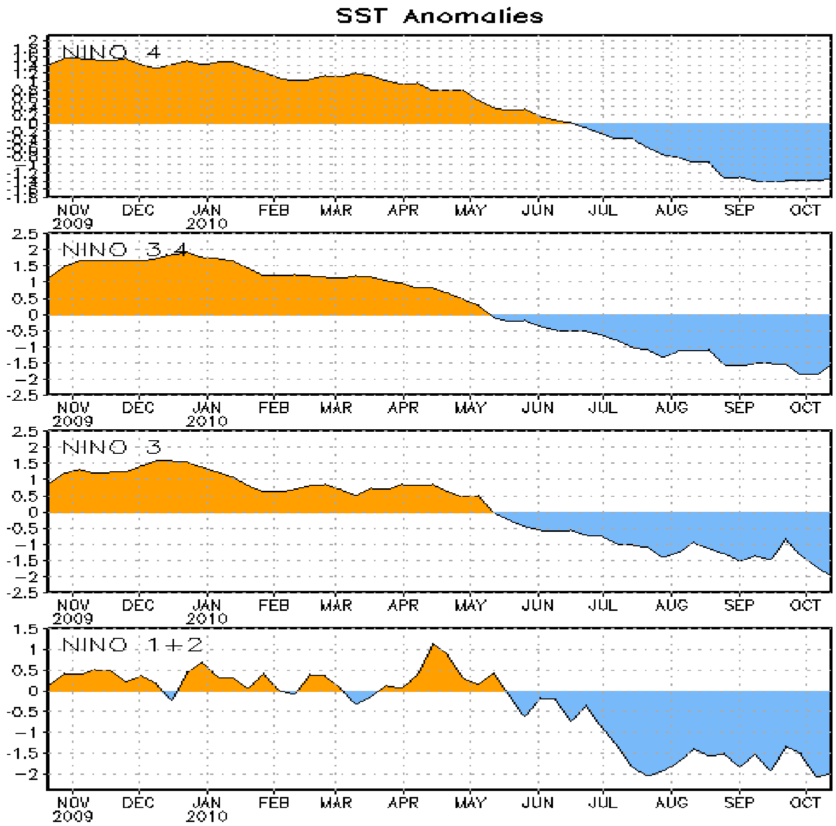

SST Anomalies
NINO 4
NINO 3.4
NINO 3
NINO 1+2
NOV 2009
DEC
JAN 2010
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT

Fig - 1c

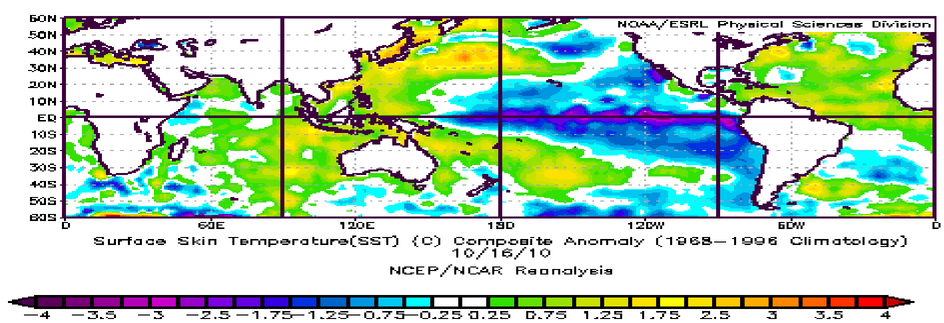
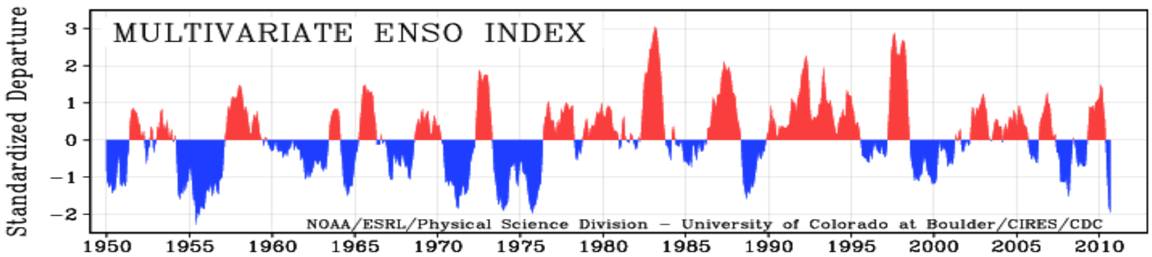
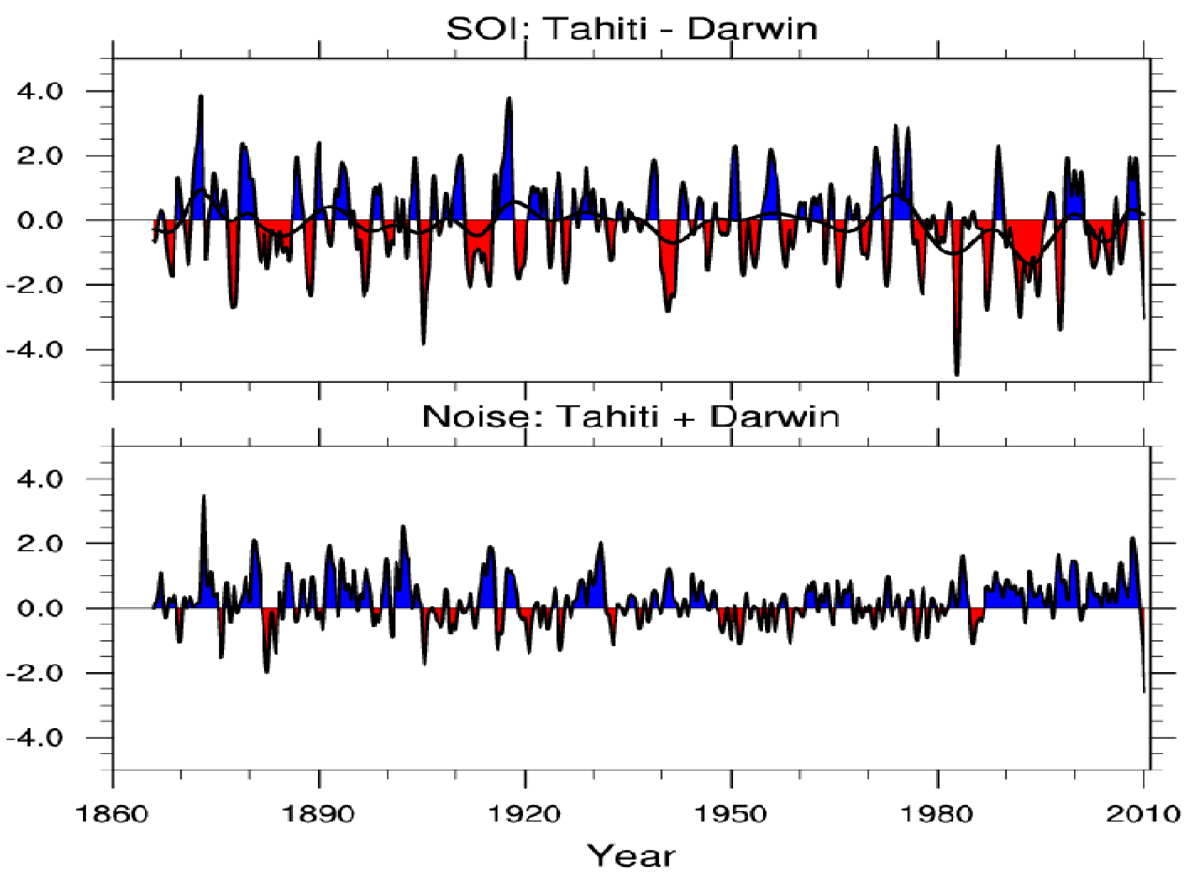

NOAA/ESRL Physical Sciences Division
Surface Skin Temperature(SST) (C) Composite Anomaly (1968–1996 Climatology)
10/16/10
NCEP/NCAR Reanalysis

Fig - 1d



A measure of the atmospheric signal is the Southern Oscillation Index (SOI) and is fully explained here. The SOI oscillating pattern is depicted well on Fig-2 since 1860. **Note, the chart it is updated through the last El Nino (2009-10) and thus, shows a sharp drop into negative territory /below -2.0/. It is important to remember, the SOI is <u>not the water departure</u>, it is the mean sea level pressure anomaly. Therefore, we are interested in the past stronger blue positive numerical data (SOI Tahiti – Darwin) for the upcoming winter.**

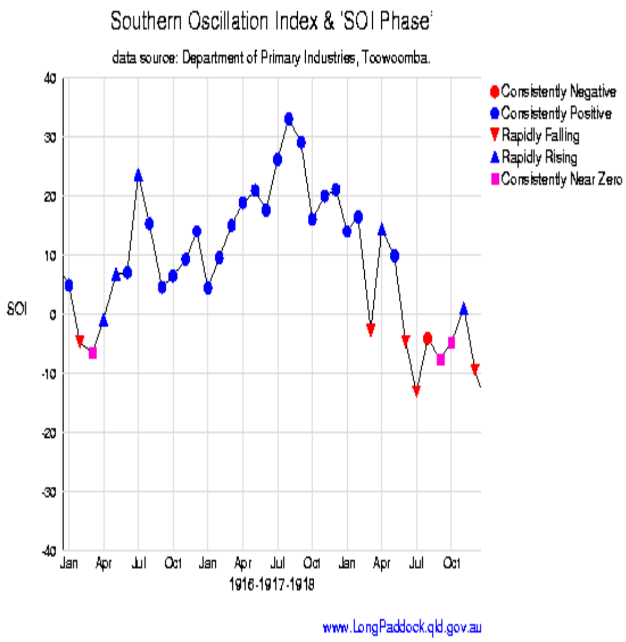
Fig - 2



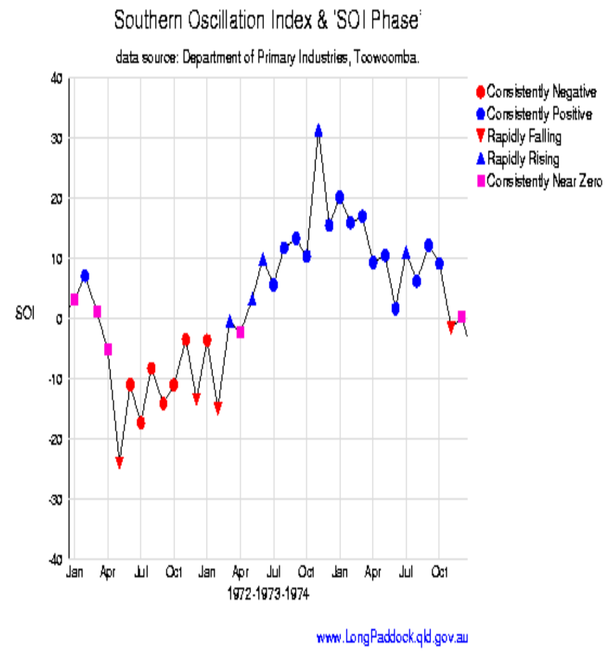
This year's La Nina strength should be a viable competitor for the one of the strongest La Nina episodes recorded. It appears the strongest La Nina in the analogue dataset was way back in 1916-17 / -2.4C/ with an estimated SOI of around +34.8! Another strong La Nina (Fig-3, SOI) in "relatively" recent years was the analogue winter of 1973-74 /-2.0C/ with the SOI peaking at approximately +31.6. In 1955-56 (not pictured), a strong ENSO departure dropped to -2.3C however the associated SOI peaked less, at just +19.2

Fig - 3

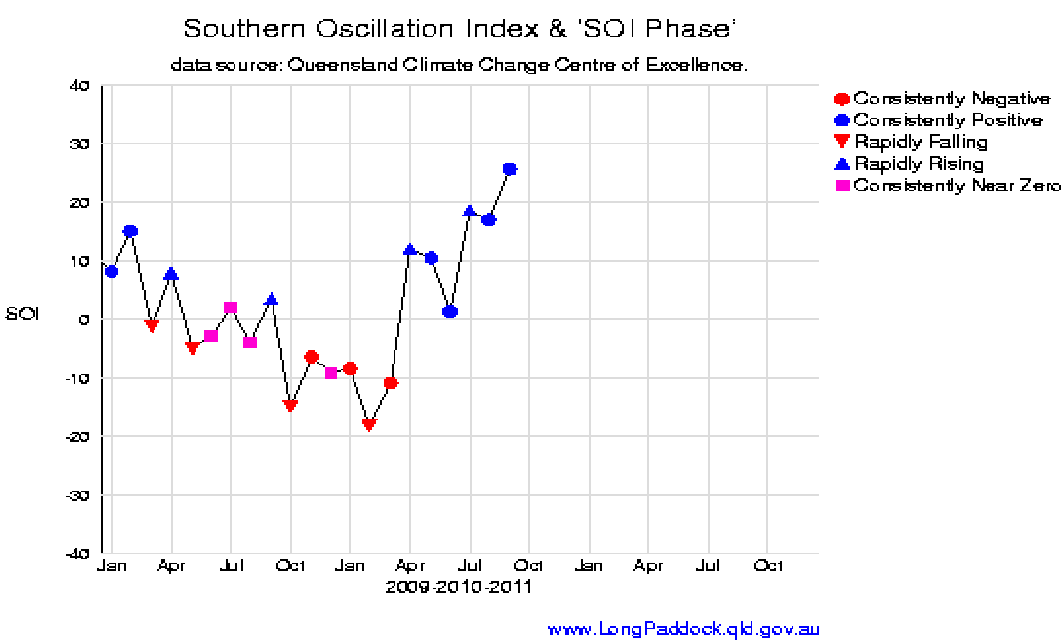
1916-17



1973-74



2009-2011



The latest computer projections show that La Nina is expected to max-out shortly in the November-December time frame. This latest projection gives La Nina a moderate to strong state off the coast of South America (Figs-4, 5).

Fig - 4

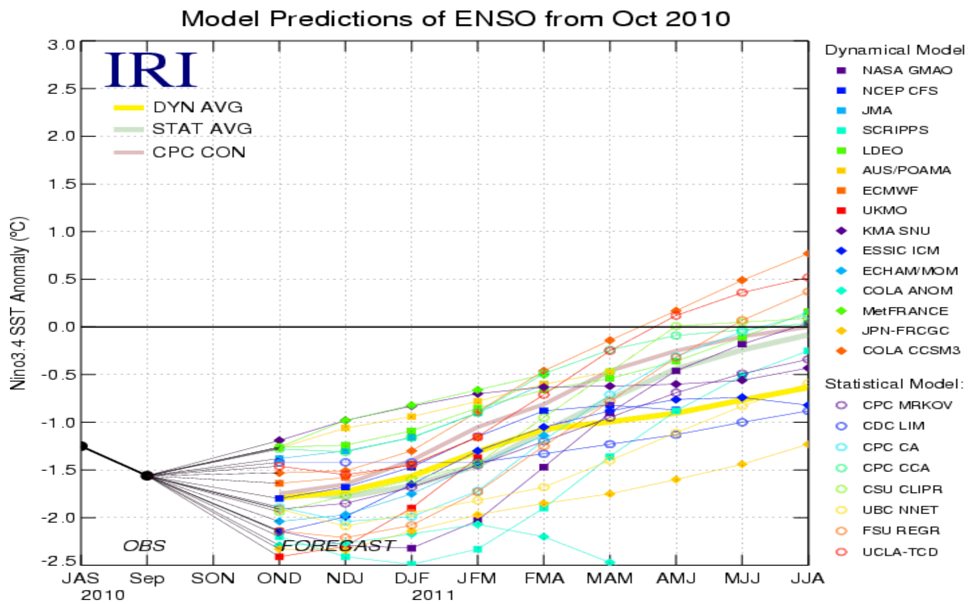
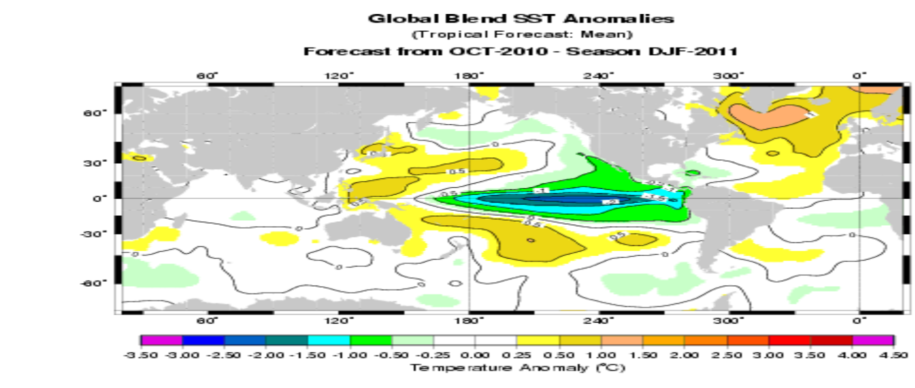


Fig - 5



NAO/AO

The other very important ingredient in this winter's weather is the trend of the North Atlantic Oscillation/Arctic Oscillation (NAO/AO). This is the biggest challenge to the forecast and potentially has the biggest bust potential. While trends with La Ninas and El Ninos are relatively stable, the NAO is highly elusive and trends are seen only a week or two in advance. Generally, colder winters in the study occurred with a predominately negative NAO. As an example, the winter of 1903-04 was a brutal winter with both cold and snow; and remains our coldest winter to date at Detroit. However, the winter of 1889-90 is by far the warmest La Nina winter, being the 3rd warmest winter on record at Detroit with a relatively balmy average of 35.1 degrees. The longer term trend of the NAO (Fig-4a) clearly shows the oscillations from negative to positive to neutral. A three month running average of the NAO since 1950 is displayed Fig-4b with a yellow highlight since 2005. Note the negative dominance and strong dip since mid 2008.

Fig - 4a

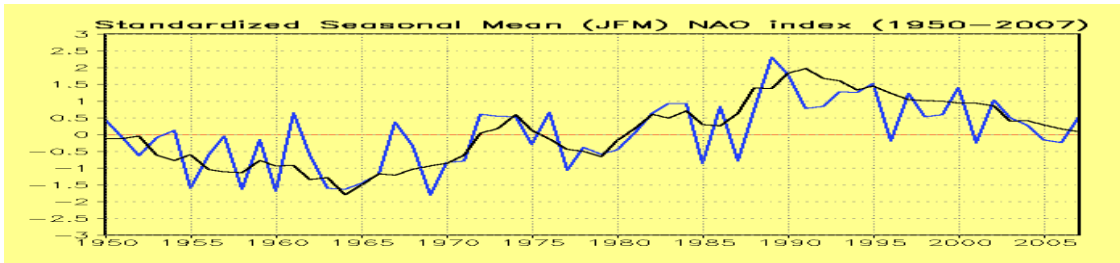
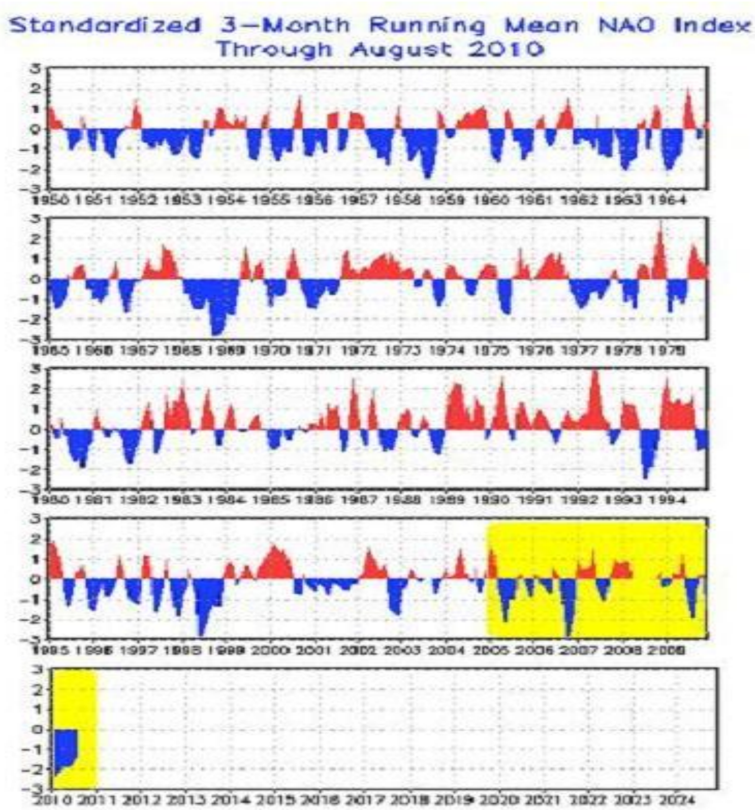


Fig - 4b



2010-11 ANALOGUE WINTERS FOR SOUTHEAST LOWER MICHIGAN

Examining La Nina episodes locally as far back as the late 1800s, 13 winters were chosen for analogues (see: Fig-5, Analogue Winters 2010-11 charts for Detroit, Flint and Saginaw. Most of the winters followed a similar sequence of events recently observed over the Eastern Pacific the past few seasons. A warmer El Nino prevailed during much of the previous winter, which quickly cooled to Neutral conditions by the spring and early summer. Then mainly a moderate or strong La Nina surfaced in the latter half of the year as Pacific water temperatures continued to cool. One of the most notable items in many of these analogues was how quick they transitioned from El Nino to La Nina.

Fig -5

DETROIT

	DETROIT	T	E	M	P	S		P	C	P	N
A	SEASON	DEC	JAN	FEB	WNT AVE	WINTER	WIN TOT	SEASON	DEC-FEB	WINTER	SEA CAT
N	1889-90	39.2	33.6	32.4	35.1	1		1889-90	7.80	1	
A	1898-99	26.9	24.0	19.8	23.6	1		1898-99	6.60	1	
L	1903-04	22.5	17.6	16.1	18.7	2		1903-04	7.72	2	
O	1916-17	26.9	24.0	19.5	23.5	3		1906-07	8.25	3	
G	1924-25	23.2	22.5	30.8	25.5	4		1924-25	6.72	2	
U	1942-43	25.6	21.7	28.0	25.1	5		1942-43	7.19	3	
E	1955-56	27.3	26.4	28.1	27.3	1		1955-56	4.79	1	
	1964-65	30.4	25.5	26.6	27.5	2		1964-65	8.42	4	
L	1970-71	29.0	20.7	27.4	25.7	6	6	1970-71	5.32	4	
A	1973-74	28.7	26.5	23.6	26.3	3		1973-74	9.14	5	
	1988-89	28.7	32.8	24.1	28.5	2		1988-89	4.02	2	2
N	1998-99	35.3	23.1	32.7	30.4	3	3	1998-99	6.14	5	5
I	2007-08	29.6	28.9	25.2	27.9	4	4	2007-08	9.22	6	6
N	Ave	28.7	25.2	25.7	26.5			Ave	6.85		
A	NORM 30Y	29.6	24.5	27.2	27.1	100YR -	26.7	Norm	6.30		
	Dep	-0.9	0.7	-1.5	-0.6		-0.2	Dep	0.55		

	DETROIT	S	N	O	W	F	A	L	L		
W	SEASON	OCT	NOV	DEC	JAN	FEB	MAR	APR	SEA TOT	SEASON	SEA CAT
I	1889-90	0.0	1.0	0.0	1.6	4.0	9.2	T	15.8	1	
N	1898-99	T	8.9	16.0	4.2	6.5	24.1	0.5	60.2	1	
T	1903-04	T	2.3	12.3	20.1	5.8	14.7	1.8	57.0	2	
E	1916-17	T	0.5	11.3	13.8	5.5	3.1	T	34.2	2	
R	1924-25	0.0	1.0	7.4	10.5	2.7	8.4	0.0	30.0	3	
S	1942-43	T	4.4	9.2	18.4	2.7	2.9	6.8	44.4	1	
	1955-56	T	4.8	4.8	11.0	10.6	13.3	0.7	45.2	2	2
2	1964-65	T	2.6	8.4	7.1	15.8	12.9	2.4	49.2	3	
0	1970-71	0.0	1.7	9.8	8.7	5.9	8.7	0.6	35.4	4	
1	1973-74	0.0	0.1	16.4	14.1	11.2	5.7	1.7	49.2	4	
0	1988-89	T	1.0	6.3	5.3	9.6	2.4	0.5	25.1	5	5
	1998-99	0.0	0.0	1.2	27.3	7.8	13.2	0.0	49.5	5	
I	2007-08	0.0	0.5	12.2	13.8	24.2	21.0	T	71.7	6	6
	Ave	T	2.2	8.9	12.0	8.6	10.7	1.5	43.6		
1	Norm	0.3	2.7	11.1	11.9	9.3	7.0	1.7	44.0		
1	Dep	-0.3	-0.5	-2.2	0.1	0.0	3.7	-0.2	-0.4		

Color	Temps	Degrees		Rain	Inches		Snow	Inches
Legend	Below	1.0>		Below	1.00>		Below	<5.0

FLINT

ANALOGUE LA NINA WINTERS 2010 I 11

FLINT	T	E	M	P	S		P	C	P	N
SEASON	DEC	JAN	FEB	WNT AVI	WINTER		SEASON	DEC-FEE	WINTER	WNT CAT
1903-04	20.7	13.1	11.4	15.1	1		1903-04	4.84	1	
1916-17	22.2	18.0	13.5	17.9	2		1916-17	2.92	1	
1924-25	23.6	19.2	28.0	23.6	3		1924-25	4.70	2	
1942-43	23.3	18.3	25.2	22.3	4	4	1942-43	6.20	1	
1955-56	24.5	22.1	23.2	23.3	1		1955-56	3.89	2	
1964-65	27.6	22.1	24.8	24.8	1		1964-65	6.18	2	
1970-71	26.8	19.6	26.3	24.2	2		1970-71	6.68	3	
1973-74	28.2	24.8	20.9	24.6	3	3	1973-74	7.55	4	
1988-89	27.3	30.9	20.8	26.3	4		1988-89	3.10	3	3
1998-99	32.3	20.6	31.0	28.0	5		1998-99	5.58	3	3
2007-08	27.6	26.9	23.7	26.1	4	4	2007-08	7.27	5	5
Ave	25.8	21.4	22.6	23.3			Ave	5.36		
Norm	26.7	21.3	23.8	23.9			Norm	5.10		
Dep	-0.9	0.1	-1.2	-0.6			Dep	0.26		

FLINT	S	N	O	W	F	A	L	L		
SEASON	OCT	NOV	DEC	JAN	FEB	MAR	APR	SEA TOT	SEASON	SEA CAT
1903-04	0.0	1.5	6.7	13.7	6.1	8.5	8.5	45.0	1	
1916-17	0.0	0.5	6.0	8.0	5.5	2.5	0.0	22.5	1	
1924-25	0.0	1.4	4.4	7.8	5.4	9.2	0.0	28.2	2	
1942-43	T	5.0	7.4	20.9	2.9	3.9	4.8	44.9	2	
1955-56	T	2.8	2.2	9.5	15.5	6.4	1.5	37.9	3	
1964-65	T	4.7	10.0	13.3	19.7	19.4	5.8	72.9	1	
1970-71	0.0	1.5	19.9	9.7	6.1	16.8	0.9	54.9	2	
1973-74	0.0	T	18.3	9.3	14.2	6.0	0.4	48.2	3	
1988-89	T	1.3	6.2	8.7	8.7	3.3	1.3	29.5	4	4
1998-99	0.0	0.2	3.4	24.9	6.0	14.4	T	48.9	4	4
2007-08	0	5.7	17.1	22.8	29.4	7.3	0.5	82.8	3	3
Ave	0.0	2.5	9.2	13.5	10.9	8.9	2.4	46.9		
Norm	0.3	3.5	11.6	13.2	9.4	7.7	2.6	48.3		
Dep	-0.3	-1	-2.4	-0.3	1.5	1.2	-0.2	-1.4		

Color	Temps	Degrees		Rain	Inches		Snow	Inches
Legend	Below	1.0>		Below	1.00>		BELOW	<5.0
	Normal	0.0-1.0		Normal	0.00-1.00		Normal	>-5.0<5.0
	Above	1.0>		Above	1.00>		Above	>5.0

SAGINAW

ANALOGUE LA WINTERS 2010 I 11

SAGINAW	T	E	M	P	S		P	C	P	N
SEASON	DEC	JAN	FEB	WNT AVE	WINTER	WNT TOT	SEASON	DEC-FEB	WINTER	WNT TOT
1898-99	26.1	21.9	18.9	22.3	1		1898-99	4.70	1	
1903-04	22.3	14.6	11.8	16.2	2		1903-04	5.33	2	
1916-17	22.9	19.8	14.4	19.0	3		1916-17	3.63	1	
1924-25	21.0	18.9	26.8	22.2	4		1924-25	4.08	2	
1942-43	22.5	17.8	24.3	21.5	5	4	1942-43	6.00	3	
1955-56	24.3	23.1	22.7	23.4	1		1955-56	4.07	3	
1964-65	25.7	20.7	22.8	23.1	2		1964-65	8.39	1	
1970-71	26.6	20.0	24.7	23.8	3		1970-71	4.85	4	
1973-74	26.1	24.6	19.8	23.5	4		1973-74	7.53	2	2
1988-89	26.9	29.0	19.7	25.2	1		1988-89	3.25	4	4
1998-99	32.0	19.4	30.5	27.3	2	2	1998-99	5.82	5	
2007-08	26.1	26.1	20.8	24.3	5	5	2007-08	4.51	6	5
Ave	25.1	21.3	21.7	22.7			Ave	5.22		
NORM 30Y	27.0	21.4	23.8	24.1			Norm	5.45		
Dep	-1.9	0.1	-2.1	-1.4			Dep	-0.23		

SAGINAW	S	N	O	W	F	A	L	L		
SEASON	OCT	NOV	DEC	JAN	FEB	MAR	APR	SEA TOT	SEASON	SEA TOT
1898-99	0	11.0	8.0	5.2	2.8	36.0	0.0	63.0	1	
1903-04	0.0	1.8	12.5	15.8	16.3	14.5	14.0	74.9	2	
1916-17	0.0	1.3	7.5	9.5	3.7	1.3	0.6	23.9	1	
1924-25	0.2	0.0	2.7	7.2	17.7	2.8	1.3	31.9	2	
1942-43	0.0	4.7	7.8	19.7	4.9	11.0	3.3	51.4	3	
1955-56	0.0	4.9	4.9	5.9	17.1	7.3	0.6	40.7	1	
1964-65	0.0	1.9	10.5	10.6	20.3	11.8	6.0	61.1	4	
1970-71	0.0	0.1	11.5	8.2	7.8	27.5	0.4	55.5	5	
1973-74	0.0	0.0	11.6	8.3	10.1	12.3	0.0	42.3	2	2
1988-89	0.0	0.0	14.0	5.1	15.2	1.8	0.0	36.1	3	3
1998-99	0.0	T	4.8	29.0	6.0	14.2	T	54.0	6	
2007-08	0.0	2.8	22.6	18.9	34.2	1.5	T	80.0	7	6
AVE	0.0	2.6	9.9	12.0	13.0	11.8	2.6	51.2		
NORM 30Y	0.2	3.8	10.2	11.8	8.3	8.0	2.2	44.5		
Dep	-0.2	-1.2	-0.3	0.2	5.6	3.8	0.4	6.7		

Color	Temps	Degrees		Rain	Inches		Snow	Inches
Legend	Below	1.0>		Below	1.00>		BELOW	<5.0
	Normal	0.0-1.0		Normal	0.00-1.00		Normal	>-5.0<5.0
	Above	1.0>		Above	1.00>		Above	>5.0

Temperatures:

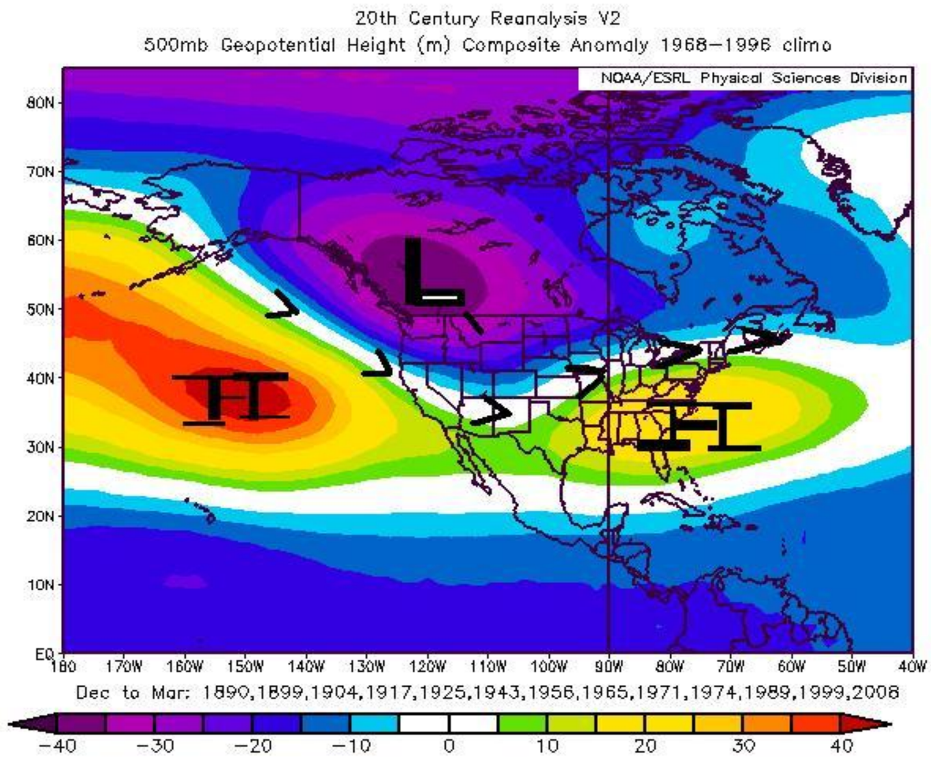
Variability was the name of the game with a decided preference toward a bit colder and stormier winter. While there were few warm winters with well above normal temperatures, they were in the minority. Using Detroit with the largest data set, three quarters /77%/ of all the winters were in the average to below average temperature regime. Out of that sample /10 winters/, 60% averaged below average. However, since 1950, the winter temperature trend has been an average to above average. Is the "short term" trend /60 years/ more pertinent this time or is the entire trend more pertinent? Actually, both should have their say and are important. While the shorter term trend is milder, there are also changes happening in the last decade. The NAO discussed earlier has been showing a more neutral trend over the past decade, the Pacific Decadal Oscillation /PDO/ appears to be on the cusp of a more negative trend. If so, this should aid the development of more La Ninas. Lastly the warm trend seen this year is getting pretty long in the tooth (since March). All these would at least hint to a colder than average temperature trend possible this winter. Therefore, using the analogue departures, the lower side of the average range seems suitable for the winter temperature projection (-2.0F to +1.0F around the normal for Southeast Lower Michigan). The pattern of the temperatures in the analogues suggests normal to below normal readings dominating the beginning to the winter. On the flip side however, there is also a strong likelihood of a mild period in or around January ("January Thaw"). Then the likelihood of normal to below normal temperatures is expected to resume later in the winter and/or early spring.

Precipitation:

Jet Stream and resultant Storm Tracks: Jet axis holds the key to this winter

The interaction between the La Nina-influenced Pacific jet stream and the North Atlantic Oscillation will hold the key to this winter's storm tracks. The interaction of the two, whether it is by phasing or split flow will, to a large extent, establishes a dominant pattern. Figure 6 shows the mean 500 MB flow for nearly the entire analogue set of La Ninas back to 1889-90. Though 500 MB maps were not available for the earlier years, a re-analysis of all the data that **is** available helps in estimating the upper wind pattern for the early years (1943 and before). The 500 MB composite anomaly shows much lower heights than typical over west and central Canada and closer to normal over eastern Canada. At the same time, strong ridging is shown by the much higher than average heights over the central Pacific which stretch out across the southern US. Between the two, a vigorous storm track is likely to set up. **The resultant energetic storm track (white with arrows) should extend from the northern Pacific, southeast into the Texas Panhandle then northeast into the southern Great Lakes. How far south the Polar/Arctic jet interacts with the subtropical jet will help dictate the amount of precipitation and snow Southeast Michigan receives. If the Polar/Arctic jet is more aggressive, then colder weather with less precipitation and snow is likely - with the dominant storm tracks further south and east. However, winter analogues show us that the best chance of above normal snow will lie across the north and central portions of Southeast Lower Michigan with closer to normal snowfall further south. In addition with the storm track expected to be near or over the region this winter, the risk of mixed precipitation looks higher than average.**

Fig - 6



Specific Storm Tracks:

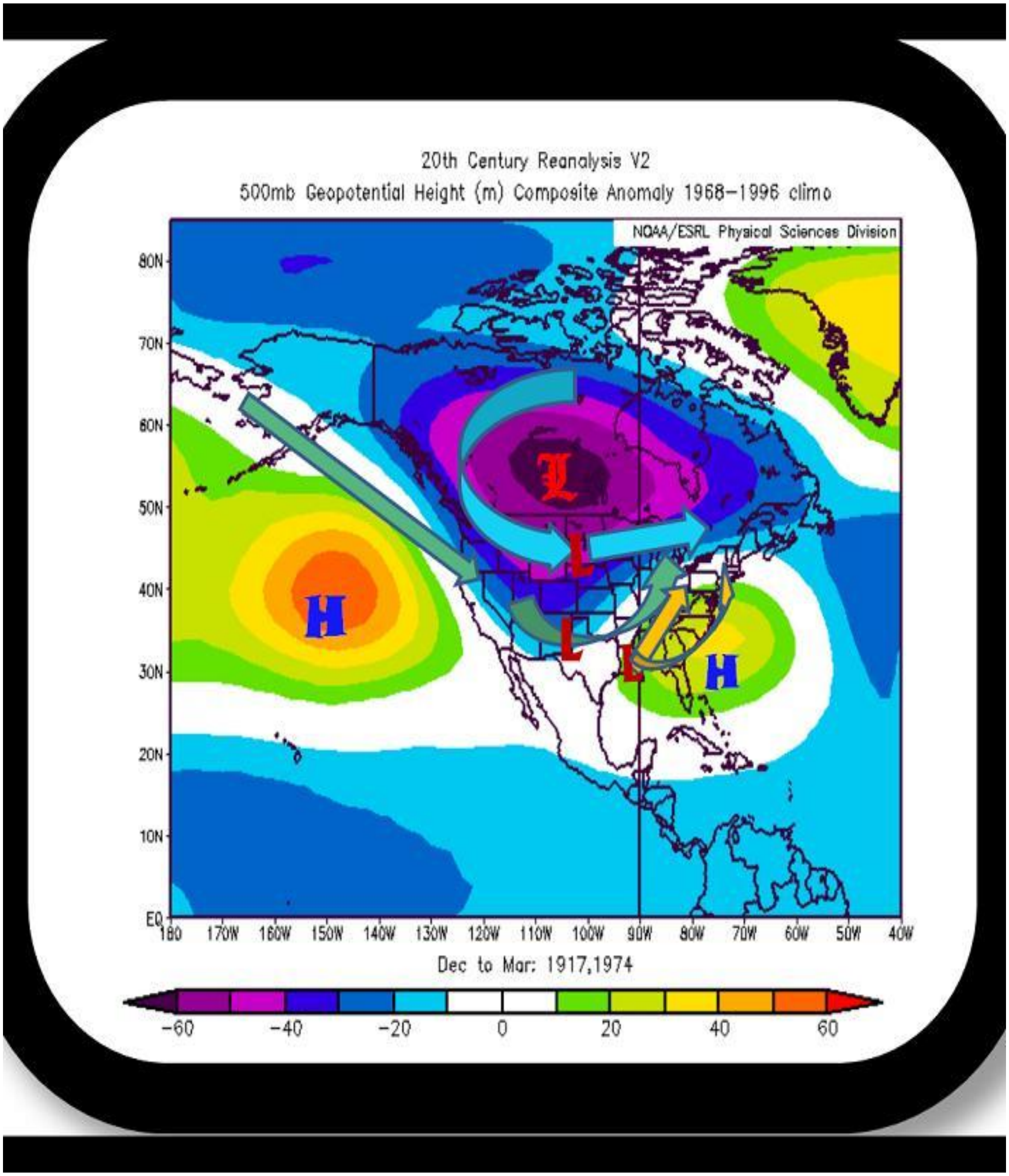
The resultant storm tracks (Fig-7) could be quite interesting, especially when phasing occurs. Note the most likely storm tracks over the country and Great Lakes are the polar jet circulation and attendant (1) clipper storm track (light blue arrows), the (2) Texas Panhandle/Oklahoma storm track (green arrows) and the (3) Gulf Area Low (tan colored storm track). The map composite anomalies were taken from two of our strongest La Ninas, 1916-17 and 1973-74. Note the placement of the upper low those years was further east and south in Canada with a somewhat sharper storm track from Texas/Oklahoma area and the Gulf region as compared to all analogue La Ninas (Fig-6)

1-**Clippers** (blue track) are expected to be quite active this year due to a large, oscillating and active upper low in Canada. While all clippers will push east southeast out of Canada, what path they take toward the Great Lakes could be quite variable. Expect the clippers to track anywhere from across the northern Great Lakes to as far south as the Ohio Valley. Generally, light to moderate snows or rain are triggered by these systems.

2-A common track in La Nina winters is associated with the **Texas Low** (green track). The heaviest precipitation typically occurs to the northeast and north of the clipper system. The Oklahoma/Texas Panhandle Low can produce moderate to heavy precipitation in the form of snow, sleet and freezing rain. The expected upper pattern this winter, with the warm ridge over the Southeast US, also suggests that higher risk of mixed precipitation.

3- The third track, the "**Gulf Low**" is a general term used for systems developing from Eastern Texas into the Gulf of Mexico and/or northward to Arkansas. These systems typically produce our heaviest precipitation by clobbering the region with snow or mixed precipitation. These systems typically push northward up through the Ohio Valley and Great Lakes. At times, a second low track will veer farther east, up the East Coast. With the expected ridging along the SE Coast, more storms should track farther west of this track.

Fig - 7


20th Century Reanalysis V2
500mb Geopotential Height (m) Composite Anomaly 1968–1996 climo
NOAA/ESRL Physical Sciences Division
80N
70N
60N
50N
40N
30N
20N
10N
EQ
180
170W
160W
150W
140W
130W
120W
110W
100W
90W
80W
70W
60W
50W
40W
L
L
L
L
H
H
Dec to Mar: 1917,1974
-60
-40
-20
0
20
40
60

COMPOSITE MAPS OF ANALOGUE WINTER YEARS

Below are the composite maps (Fig 8a.b) for the analogue years in the local study. Remember these maps average **what happened** over the region and do not take into account any recent trend observed over the region and therefore, are not a prediction. They are only a "guidance tool" to past similar type La Nina winters. While they do show slightly below average temperatures and average to above rain/snow (over and vicinity of SE Michigan), the average winter category this year was truly, more often than not, an average of the extremes with few "average" or "typical" winters.

Fig - 8a

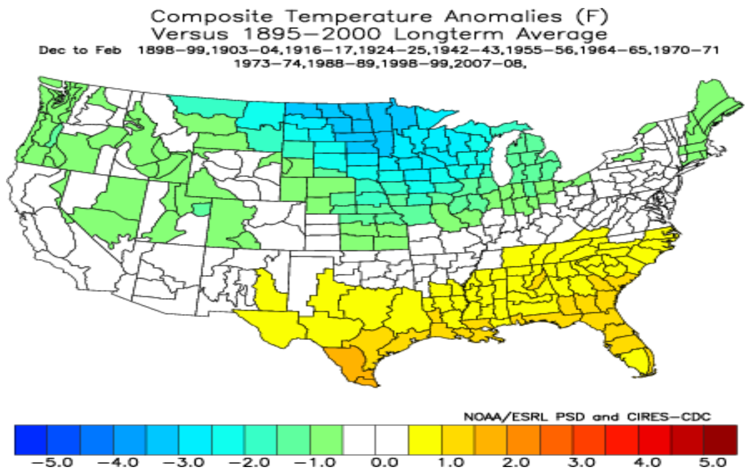
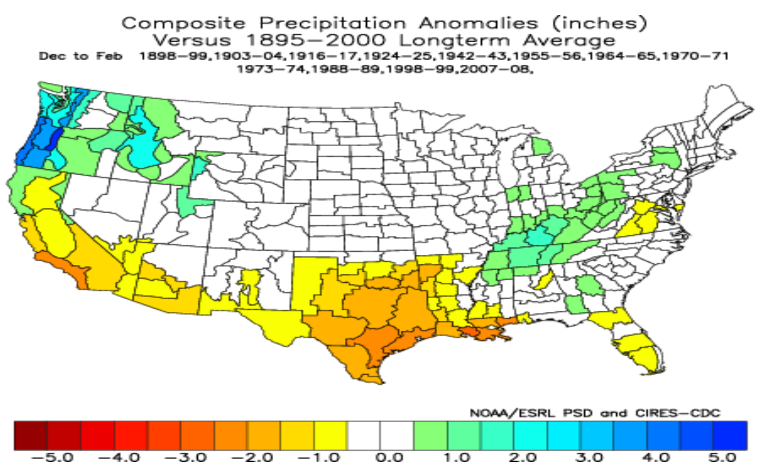


Fig - 8b



Some Notable Winter Dates:

Winter Begins: **December 21st 2010 at 638 PM EST**
Holiday Full Moon: Monday December 21st 2010 at 313 AM EST
Christmas: Saturday December 25th 2010
New Years: Saturday January 1st 2010