



## 2009-2010 WINTER FORECAST

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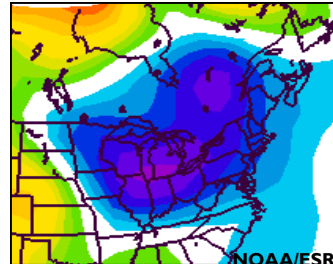
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### 2008-2009 Winter Recap

The winter of 2008 - 2009 was a winter influenced by La Niña, with most locations north of the Mid-Atlantic region receiving near to above average snowfall. As is typically the case during La Niña winters, average temperatures were below normal in most areas, especially during the extremely cold month of January as the map to the right shows.



**January Temp Anomaly**  
Blues/Purples: Below Normal  
Greens/Yellows: Above Normal

Without question, the New England States and much of NY had plenty of snow last season. Accumulations were quite high, in some cases 20-30" above normal. Looking south to much of NJ and PA, as expected, snow accumulations came in very near the seasonal averages. Below the Mason-Dixon Line, however, it was another lackluster snow season. On average, snow totals were 5-10" less than normal. Particularly low totals (10-15" below normal) were observed in the Hagerstown to Frederick corridor which escaped much of the moisture from coastal lows.

Higher snow totals at northern latitudes are generally expected, but in some areas, most notably in Eastern MA, coastal influences had a hand in strongly augmenting seasonal snow totals. Superfluous coastal moisture aided in the production of numerous snow showers, and ocean effect

snows that extended the duration of several regular storms. Boston had an exceptionally snowy winter, final snow totals came in more than two feet greater than seasonal averages.

Last winter got off to an unusually early start in some locations, as a powerful low pressure system brought accumulating snow to portions of NJ and PA on October 28th! Totals were widely variable with up to 2" of snow along the southern extent (Central NJ), and upwards of 12" in high spots of NJ & E. PA. Despite the early start, November was fairly quiet with just a few light events before the winter weather really got into full swing beginning in the month of December.

December and January were very active, with several periods featuring back to back snow and ice events. January had the coldest temperatures of the season, with average temperatures for the month well below normal in most locations. December was the snowiest month, with both snow and liquid precipitation totals above average. Although liquid precipitation in January was below average across the board, the aforementioned very cold temperatures allowed relatively small amounts of moisture to

produce a fluffy dry snow. This put the month in a close second place finish behind December for monthly snowfall totals.

February began with a long duration storm which produced up to 12" of snow beneath heavy bands that set up in Southeast PA, but the rest of the month was much less eventful. There were mainly just a few light snow and mixed events in the second half of the month. Although it seemed like winter was winding down, the atmosphere had other plans.



**View from Space 3/3/09:**  
Snow Blankets East Coast from Virginia to Maine

On March 1st and 2nd, a powerful coastal storm brought accumulating snow to the entire I-95 corridor, from Northern Virginia into New England. For the Mid-Atlantic states, this storm brought the biggest snowfall of the season. Coastal locations which had the most moisture, received the most snow; many areas measured between 6 and 12 inches. Fresh snow on the ground kept temperatures below freezing for two days after the storm. There were two more snow events before winter weather ceased entirely in April, but both events were very light, and had little impact.

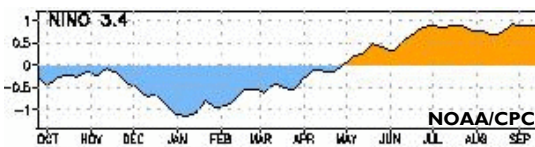


**Winter began early: Snow in Washington Twp, NJ (10/28/08)**

## El Niño Making a Comeback

The winter of 2008-2009 featured weak La Niña conditions or slightly cooler than normal ocean temperatures in the Equatorial Pacific Ocean. In fact, based on official NOAA guidelines, last year's La Niña did not even qualify as a "La Niña Episode" as it did not last long enough. As the graph below shows, ocean temperatures trended towards normal during this past spring, and since mid-May have been classified as above normal. This means a weak El Niño is currently in place for the first time following a nearly 2.5 year absence.

Unlike last winter's non-

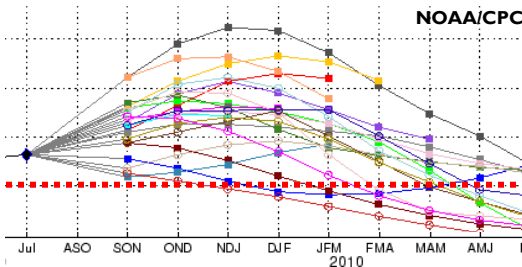


Pacific Ocean Sea Surface Temp Anomalies

October 2008-Present  
Blue: Cooler than Normal  
Orange: Warmer than Normal

descript La Niña, most forecast guidance indicates a moderately strong El Niño will be in place by December. As the chart to the right depicts, a few models even show the development of a rather strong El Niño. However, this does not appear to be likely. In recent weeks, ocean temperatures in the Pacific have stabilized. For a strong El Niño to materialize, sea temperatures would have

to warm up unrealistically rapidly. However, trends will still need to be monitored in the coming weeks



September 2009 El Niño Model Forecast Thru June 2010  
(Red Dashed Line: El Niño Threshold)

and months, as any change will impact the upcoming winter.

If the forecast guidance holds, this El Niño will coincide nearly perfectly with the dead of winter. Except for some outliers, nearly all model forecast guidance points to El Niño peaking in intensity in the December to January time frame, before weakening during Spring 2010. This means that El Niño's impact on winter 2009-10 should be maximized.

## El Niño's Forecast Implications

In the United States, one of the areas that El Niño tends to have the greatest impact on is the Midwest and Great Lakes Region. This area tends to see milder winters with less than normal snowfall. Fortunately for snow lovers, this relationship begins to break-down towards the east coast.

In a thorough examination of the 17 winter seasons that have featured an El Niño since 1949, snowfall totals from Virginia northward into New England averaged out above normal. This was especially true in New England, where snowfall totals were about 8-12 inches above

### Snow Accumulations During El Niño Patterns

City	1972-1973	1977-1978	1986-1987	2004-2005	Niño Avg.*	30 Yr. Avg.**
Baltimore, MD	1.2	34.3	35.2	11.0	23.4	18.2
Philadelphia, PA	Trace	54.9	25.7	30.4	23.2	20.5
New York, NY	2.8	50.7	23.1	41.0	25.9	22.5
Boston, MA	36.9	27.5	52.6	86.6	49.8	41.0

\*El Niño Average is the average snowfall during the 17 El Niño Winters  
\*\* 30 Year Average is the average snowfall from 1970/1971 thru 2000/2001

normal levels. The big winner in El Niño winters is apparently the Hartford, CT area which has seen about 14 inches more snow than the 30 year average.

Despite more snow than average, the data above also shows the inconsistencies that El Niño can bring about, particularly the 1972-73 season when the totals were very low. In the midst of the swings in snowfall, is the winter of 1986-87. That season,

which saw near to well above normal snowfall, is of particular interest as the strength of that El Niño is fairly close to the forecast model consensus for the upcoming winter. Other factors aside, given the overall above average tendency of snow during El Niños, and the prospects for a El Niño like the one in 1986-87, it would appear that the winter ahead should feature near to above normal snowfall.

## El Niño/La Niña By the Numbers (Since 1949-1950)

- 24 Neutral Winters
- 19 La Niña Winters
- 17 El Niño Winters
- 97-98 Strongest El Niño
- 88-89 Strongest La Niña

## Featured Website

[www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/enso.shtml](http://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/enso.shtml)



Track the progress and development of El Niño through the fall and winter along with the Climate Prediction Center. Maps and discussions are updated on a weekly basis with the latest observations and forecast model guidance.

**NAO**  
**By the Numbers**  
**(Since 1949-1950)**

**21** Neutral Winters

**22** Positive Winters

**17** Neg. Winters

**83-84** Strongest Pos. Phase

**62-63** Strongest Neg. Phase

**Decadal Snowfall**  
**Averages:**

**What can they tell us**  
**about this winter?**

As we go into the last Winter of the current decade, average decadal snowfall could give us a hint about what to expect this season.

In Philadelphia, the average decadal snowfall has been 221.5" for each 10 year period since 1890. There has been 186.6" of snow measured in Philadelphia since 2000, which means the area needs another 34.9" this winter to reach the decadal average. Average Philadelphia snowfall is 21.2" each winter, so above average snowfall would be required this winter in order to have near normal snow totals for the decade.

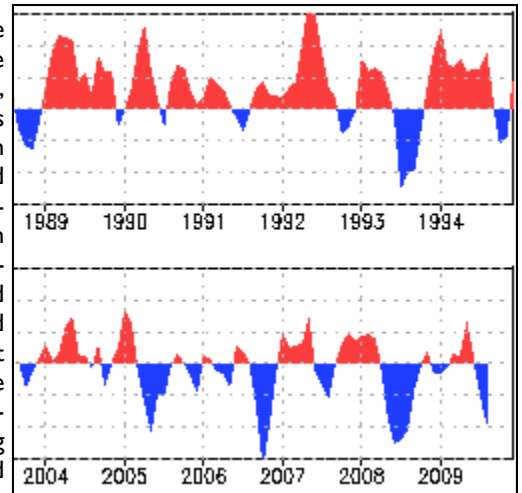
**More Forecast Predictors: The NAO**

Of all the elements that comprise a winter forecast, the North Atlantic Oscillation (NAO) in many respects can be the most useful as it can quantify pressure and temperature patterns along the Atlantic Seaboard. Unfortunately, unlike other atmospheric indicators that are relatively stable over the course of a season, the NAO can have significant and abrupt changes over the course of a week or so. The intra-seasonal shifts make it nearly impossible to forecast the NAO index more than a few weeks into the future.

The good news, however, is that over the span of several years to a decade, overarching patterns in the NAO are often visible. The chart to the right shows that the early 1990's were a great example of a period that exhibited a long period of a positive NAO, which is supportive of below normal snowfall. On the other hand,

despite some minor positive cycles mixed in, the last 7 years have featured an overall trend towards a negative NAO, which is a definite positive sign for cold weather and snow storms. At present, there are no suggestions indicating that this should change, and over the next 1-3 years there is a decent chance

that the NAO will average out negative. This prospect adds to the notion that snowfall up and down the East Coast should at least be normal, perhaps once again above normal levels in typically snowier New England. In the meantime, the NAO is currently slightly negative. In



**NAO Status**  
**1988 -1995 (top) & 2003 - Present (bottom)**  
**Red: Positive/Blue Negative**

the coming weeks most guidance indicates that the NAO stays negative, before reaching a neutral state. This lends support to the idea of cooler than normal temperatures for the first several weeks of fall, which is currently being forecasted by medium range forecast models.

**What to expect: Typical Winter Storm Tracks**

Although every winter storm is unique, storms tend to originate in many of the same areas and follow similar tracks. Two of the most frequently observed storm types in the Mid-Atlantic and Northeast are discussed in detail: Alberta Clippers, and the more widely known Nor'easter.

**Nor'easter**

Named for the northeasterly winds these storms produce as they track northward along the coast, Nor'easters are capable of bringing significant snow accumulations along the Atlantic Coast. Snow totals heavily depend on the exact track the storm takes; A far inland track will bring warmer air and a mix of precipitation, while a track too far off the coast may miss an area altogether. When a Nor'easter takes a perfect track, though, the snow can really pile up. Those in the snow & ice industry saw this firsthand March 1-2, 2009 when a powerful storm brought accumulating snow from Virginia northward to New England.

**Alberta Clipper**

Common throughout the winter, these storms originate east of the Canadian Rockies and get caught up in the jet stream when they dive down south into the US. They move quickly and don't contain much moisture, so snow totals are usually light. These systems can be associated with powerful cold fronts, with gusty winds and significant temperature drops. Some variations of the Alberta Clipper are Manitoba Maulers and Saskatchewan Screamers, which are named for their respective Canadian provinces of origin.



**Typical Nor'easter Track**



**Typical Alberta Clipper Track**

## A Quiet Hurricane Season's Influence on Winter

**E**l Niño's arrival along with more wind shear than normal across the Atlantic Ocean has made for a tranquil hurricane season to date, with no signs of a significant increase over the last 2 months of the season. One of the more impressive facts about this past season was that there were no named storms that formed prior to August 1st. Since 1950, this has happened 11 other times, and only twice in the last two decades.



International Space Station view of Hurricane Bill (8/18/2009)

### Snow Accumulations after a Hurricane Season With no storms before August 1st

City	2000-2001	1987-1988	1967-1968	11 Yr. Avg*	30 Yr. Avg.
Atlantic City, NJ	26.1	7.3	18.5	13.8	13.6
Hartford, CT	50.1	14.9	61.7	47.2	41.2
Newark, NJ	39.3	22.8	13.9	28.0	27.9
Baltimore, MD	8.7	24.4	51.8	20.0	18.2

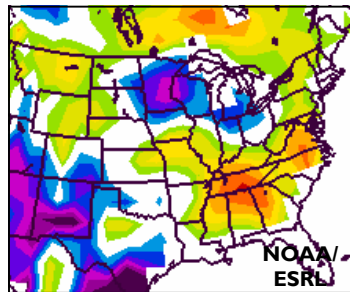
\*11 Year Average is the average snowfall in the winters following the 11 Hurricane Seasons with no storms prior to August 1st

Across the region, when a tropical storm fails to form by the end of July, often times the following snow season ends up with normal snowfall. Unfortunately, this correlation is not a perfect one. While the average snowfall for most locations studied comes within a few inches of climatology, usually 7 of the 11 seasons examined featured less snow than normal.

Despite not being a flawless correlation, the quiet 2009 Atlantic Hurricane Season should provide optimism for those south of the Mason-Dixon Line looking for the streak of snow seasons with disappointingly low accumulations to come to an end. For instance, in Baltimore, about 10% more snow than usual fell in the winter following a late start to the tropical season.

## A Wet Summer's Potential Impact on Winter

**W**ithout a doubt, the latter half of Spring and much of the Summer featured a plethora of rain across most of the region. As would be expected, there was variability from place to place since much of the rainfall in the summer is based on localized thunderstorms. However, thanks to the persistent trough that was in place, rainfall amounts were almost uniformly at least 3-7" above normal between May and August. Totals



Soil Moisture Anomaly May 1 - August 31, 2009  
(Warm colors: wetter than normal)

### Snow Totals in Winters Following Wet Summers (3"+ above norm)

City	Wet Summer Average	30 Year
Providence, RI	26.9	31.3
New York, NY	23.3	22.5
Philadelphia, PA	19.5	20.5
Washington, DC	14.5	15.2

were locally higher in some places, like Hartford, CT where the month of July alone saw 7.50" more rain than normal.

Looking into winters following significantly wetter than normal summers, it appears near normal amounts of snow can be expected roughly from the New York Metro Area and points to the south. Further to the north, snowfall amounts tended to be a couple of inches below seasonal averages in

most places. However, the tendency for below normal snowfall should be tempered in the New England States, as the summer months were not quite as wet there as they were in the Mid-Atlantic. The soil moisture map to the left demonstrates this clearly. Much of the region from VA to NY had wetter than normal soils this past summer. On the other hand, much of New England had soil moisture content close to normal levels.

## Tropical Storm & Hurricane Activity (Season thru Sept. 25)

Year	Named Storms	Hurricanes
2009	6	2
1987	5	3
1983	3	3
1977	3	3
Normal	7	4

## Recent Snowfall Totals/Departures From Normal MD, VA & DC

Location	07-08	08-09
Aberdeen, MD	9.0 (-8.1)	9.4 (-7.7)
Annapolis, MD	9.6 (-8.5)	12.3 (-5.8)
Baltimore, MD	8.5 (-10.0)	12.0 (-6.5)
Dulles, VA	6.5 (-14.6)	10.3 (-10.8)
Frederick, MD	13.5 (-12.1)	10.7 (-14.9)
Hagerstown, MD	13.6 (-14.6)	8.5 (-19.7)
Laurel, MD	8.8 (-12.6)	10.7 (-10.7)
Washington, DC	4.9 (-10.5)	11.0 (-4.4)
Westminster, MD	16.2 (-15.6)	14.1 (17.7)

### 2009-2010 Winter Season Calendar

Dec. 1	Meteorological Winter Begins
Dec. 21	Astronomical Winter Begins
Jan. 18-23	Avg. Temperatures Begin Rising
Feb. 2	Ground Hog Day
Feb. 15	President's Day
Feb. 28	Meteorological Winter Ends
Mar. 20	Astronomical Spring Begins

### Recent Snowfall Totals/Departures From Normal PA & DE

Location	07-08	08-09
Allentown, PA	21.2 (-12.2)	26.0 (-7.4)
Doylestown, PA	10.9 (-16.9)	23.8 (-4.0)
Exton, PA	10.0 (-17.0)	26.7 (-0.3)
Harrisburg, PA	14.0 (-21.0)	15.5 (-19.5)
Philadelphia, PA	6.3 (-14.9)	22.9 (-1.7)
Scranton, PA	38.3 (+7.6)	31.4 (+0.7)
Wilmington, DE	9.2 (-11.9)	16.1 (-5.0)
York, PA	17.6 (-2.7)	18.7 (-1.6)

## Winter Forecast 2009-2010 Overview

The prior pages of this Winter Forecast have looked at some of the more important factors that will play a role in this winter's weather. Putting the different pieces together implies a decent probability of a winter with near normal snowfall for a good portion of the East Coast. While there are some exceptions to the rule, most of the forecast elements ranging from El Niño to wet summers point to the following winter seeing approximately normal snow accumulations.

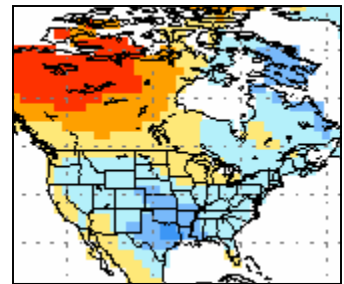
As was noted several times, even within the same forecast element there was some degree of variability in the eventual outcome of the winters studied. These subtle differences were not only season to season but also region to region. This is not all that surprising given that individual winter storm events have to deal with smaller scale features, on which global scale

patterns will have limited effect. However, from a forecast perspective, these modest inconsistencies point to an increased likelihood of a near normal snow season. Furthermore, there were no seasons that had all of the forecast parameters that were studied in the preceding pages present. So there was no reason to trend towards the outcome of one particular winter over another.

Pattern-wise, the interaction that occurs between warmer than normal temperatures across much of the Upper Plains and Midwest and the cooler than temperatures expected across the southern tier of the U.S. will be of great interest. Given this setup, there likely will not be a whole lot of clipper type lows, meaning a lot of the precipitation will come from ordinary frontal boundaries and coastal lows, which could be steered towards the

Northeastern United States.

As for temperatures, expect readings overall to be near or perhaps a bit above average. Normally, this would suggest lower than normal probabilities of seeing an early snow event. However, that may not be the case in 2009. There are indications of cold air in October and November, which may lead to an early season surprise, harkening back to last year's storm on October 28th.



**CFS Model Temperature Departure from Normal November 2009**  
(Reds: Warmer than Normal  
Blues: Cooler than Normal)

## Month by Month Forecasts

### OCT-NOVEMBER 2009

Temps	Slightly Below Normal
Snow	Near to Above Normal

Current forecast guidance shows several shots of cool air poised to move across the northern half of the country during October. Longer term data suggests an above normal probability that this trend may in fact continue into November.

The early arrival of cool air will lead to an above normal threat for an early snowfall this season. In most cases, accumulations should be held to normal levels. However, since normals are so low for these months, just an hour or two of moderate snow could allow for the

averages to be exceeded.

### DECEMBER 2009

As average temperatures approach the coldest values of the year, the threat for snow and ice storms will increase markedly. Actually, temperatures in December may wind up once again coming in below seasonal averages, perhaps for the third straight month in some areas.

Temps	Near/Slightly Below Normal
Snow	Near Normal

However, snow lovers may be mildly disappointed as precipitation could come in slightly below normal, limiting the chance of a snowier than normal December. As mentioned above,

El Niño will act to keep much of the Northern Plains States warmer than normal. Lacking a source region for cold air, Alberta Clippers and to a lesser extent Lake Effect Snow showers likely struggle to add to December's snowfall totals.

### JANUARY 2010

As the new year begins, changes in the overall pattern look to be subtle. Temperatures may not cool appreciably compared to December's readings, keeping temperatures slightly above seasonal averages. This may be the case particularly in western areas which may see some "bleeding" of warmer than normal temperatures associated with anticipated warmth in the

## Winter Forecast Continued

Great Lakes and Midwest.

<b>Temps</b>	<b>Slightly Above Normal</b>
<b>Snow</b>	<b>Near to Above Normal</b>

January, however, is still a very cold month and will likely see at least normal snow amounts. Connecticut, Massachusetts and places further to the north and east will have the greatest opportunity of receiving more snowfall than normal. Not only are monthly precipitation amounts healthy in January, the effects of El Niño probably are going to be maximized, and that combination suggests a moderate probability of above normal snow for much of New England.

### FEBRUARY 2010

Despite being the shortest month of the year and in many areas the driest month of the year, February certainly has a history of being snowy. This February's forecast is more

challenging than usual. Even though by this time El Niño's strength should be waning, its influence will still be felt. Just how much is the question. Some long range climate forecast models are insistent that the overall pattern may not shift significantly, if at all.

<b>Temps</b>	<b>Near Normal</b>
<b>Snow</b>	<b>Near Normal</b>

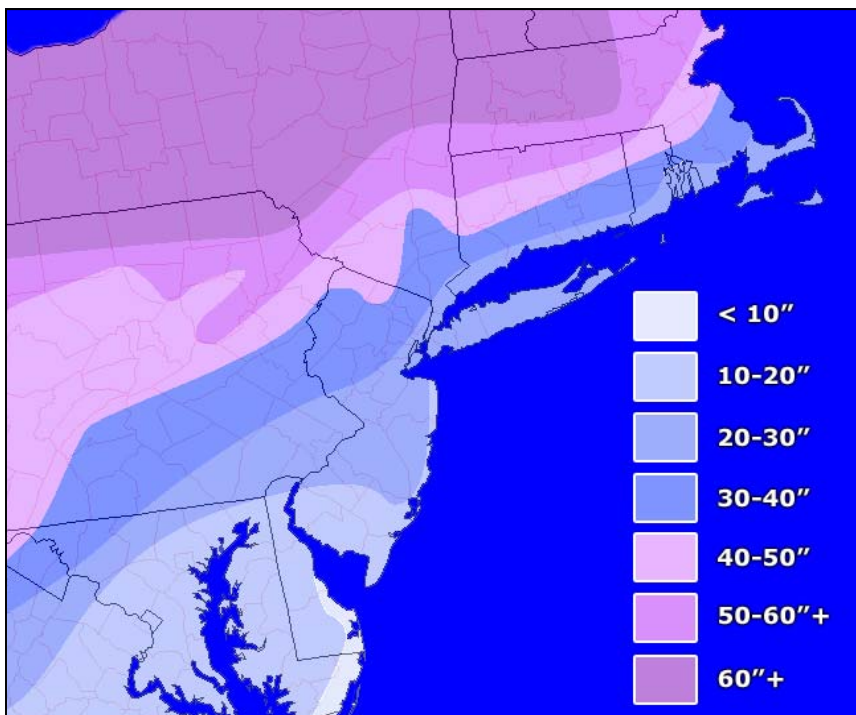
Keeping this in mind, with slightly lower confidence than the prior months, February's temperature and snowfall trends should be near normal. Whether or not there will be a strong coastal storm during the month obviously remains to be seen. But indicators point to cool and wet weather in the Gulf Coast States, the source region for Nor'easters, which would certainly be supportive of a big east coast storm.

### MARCH-APRIL 2010

This year's snow season may close much the way the 2008-2009 did: without much fanfare. If it were not for the storm of March 1st and 2nd, March's snowfall totals would have been quite anemic. While this season's finish may not be as quiet, do not expect a prolific 6 weeks either. Even though precipitation amounts come in near seasonally expected values, region-wide temperatures look to be at least slightly above normal levels. Surprisingly, the New England States have the greater likelihood of seeing a warmer than normal March/April time period compared to the Mid-Atlantic States.

<b>Temps</b>	<b>Above Normal</b>
<b>Snow</b>	<b>Below Normal</b>

## 30 Year Average Regional Snowfall



## Recent Snowfall Totals/Departures From Normal NY & NJ

Location	07-08	08-09
Atlantic City, NJ	8.8 (-8.3)	17.1 (0.0)
Islip, NY	8.0 (-13.1)	36.2 (+15.1)
Middletown, NY	50.1 (+13)	45.5 (+8.4)
Mt. Holly, NJ	7.2 (-12.8)	17.2 (-2.8)
New Brunswick, NJ	13.6 (-13.2)	29.5 (+2.7)
Hackensack, NJ	16.7 (-10.9)	29.8 (+2.2)
Queens, NY (LGA)	11.8 (-12.2)	28.3 (+4.3)
Trenton, NJ	10.5 (-15.0)	18.3
Vernon, NJ	49.8 (+8.8)	42.7 (+1.7)
White Plains, NY	26.5 (-8.2)	43.2 (+8.5)

## Recent Snowfall Totals/Departures From Normal CT, MA & RI

Location	07-08	08-09
Boston, MA	52.0 (+12.6)	68.1 (+28.7)
Bridgeport, CT	20.2 (-5.5)	48.3 (+22.6)
Framingham, MA	64.2 (+14.3)	76.5 (+26.6)
Hartford, CT	39.1 (-2.1)	50.5 (+9.3)
Providence, RI	29.5 (-1.8)	51.0 (+19.7)
Worcester, MA	69.7 (+8.3)	76.7 (+15.3)