Developing a Climatology of Snowfall Events in Oneonta, NY

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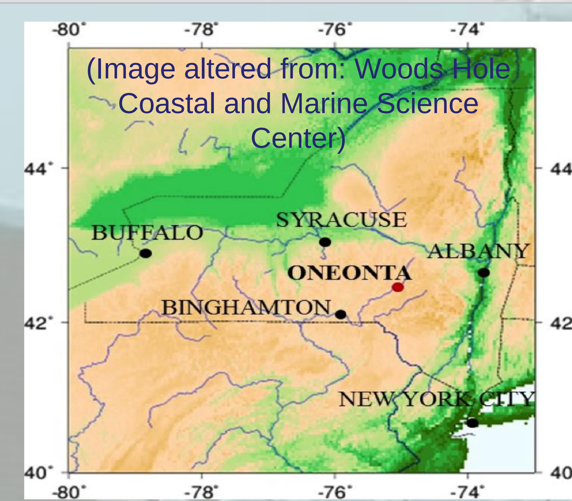
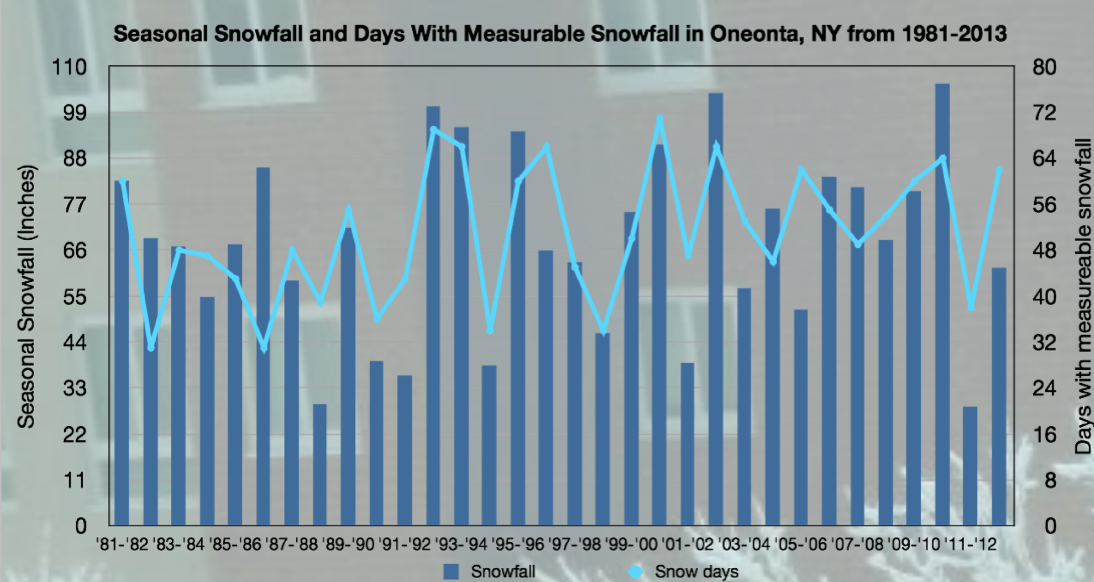
Introduction & Goals

Situated directly between Binghamton and Albany, Oneonta is an interesting location to analyze snowfall. Oneonta is in a unique geographical position allowing for the city to be significantly impacted from a wide variety of snowstorms including Nor'easters, Clippers, and Lake-effect storms. In addition, daily snowfall records have been collected by SUNY Oneonta, dating back to 1981. This is rare for any location outside a major city in NY. Similar to much of the Northeast, Oneonta has a large amount of seasonal variability in snowfall.





Goals:

- Analyze daily snowfall records for Oneonta, NY from 1981-2013.
- Identify the storms that produce snow most frequently.
- Identify the storms that produce the most intense snowfall.
- Identify the impacts that climate oscillations have on snowfall in Oneonta.
- Identify potential changes in the snow season over the 32 year record

Overall, the patterns found in this research should then be able to improve long-term (90 days) and short-term (days to weeks) winter forecasts for Oneonta and the Central Leatherstocking region.

Methods & Analysis

Storm Type Classification

➡ Daily snowfall records are measured and recorded by SUNY Oneonta.

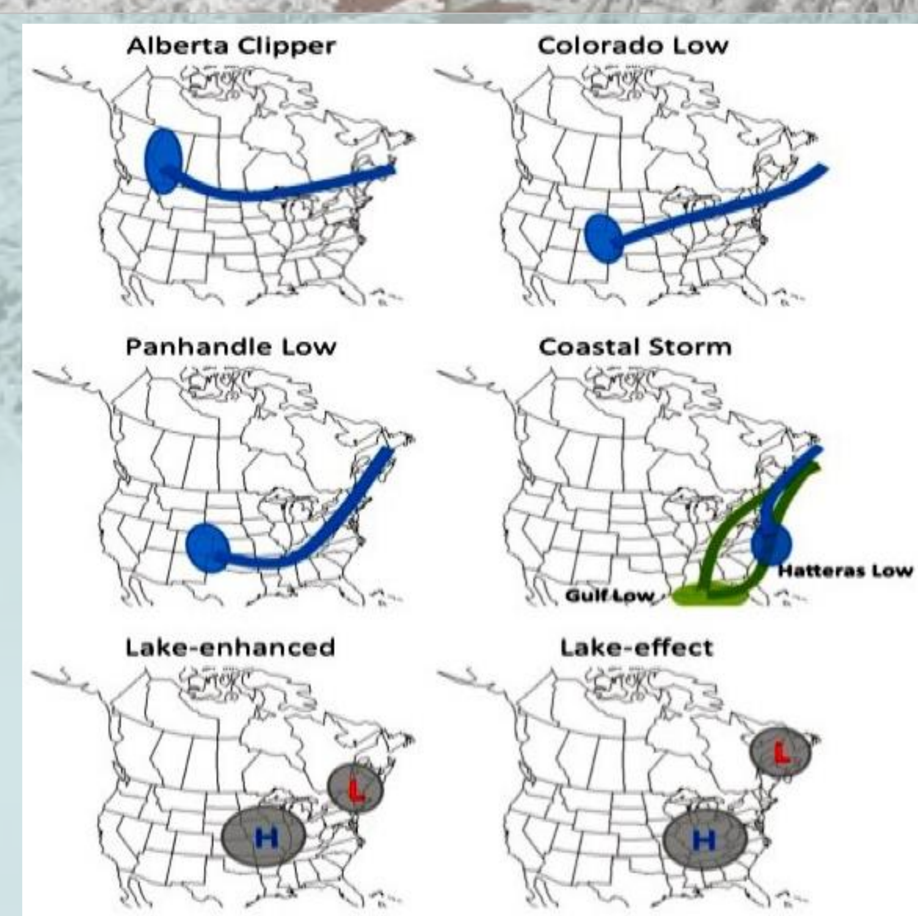
➡ Utilize daily weather maps created by the Weather Prediction Center to observe the synoptic and mesoscale weather conditions on days that resulted in measureable snowfall in Oneonta, NY.

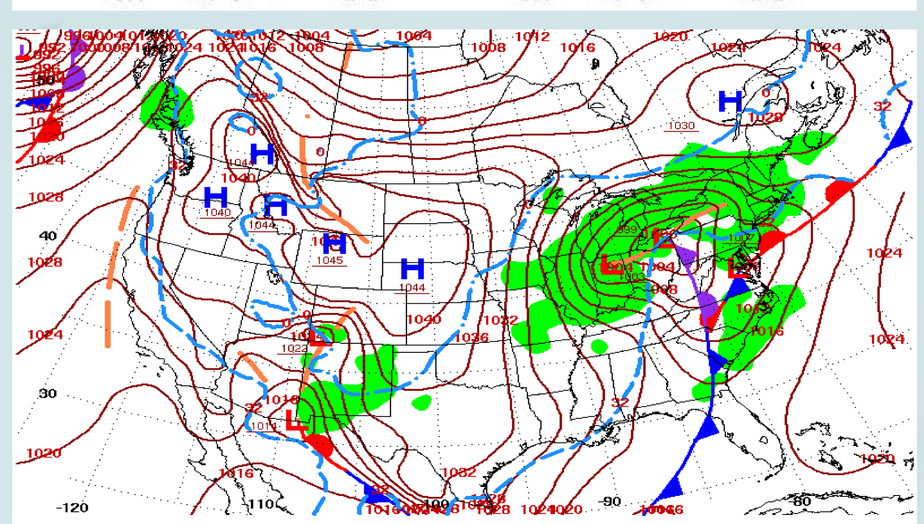
➡ Classify each snowfall event as a type of storm (Lake-effect, Lake-enhanced, Colorado Low, Panhandle Lows, Alberta Clipper, Coastal Storm).

➡ Classify each snowfall event into classification levels based on total snowfall for that event:

Trace < Level 1 ≤ 0.5"
0.5" < Level 2 < 2.5"
2.5" ≤ Level 3 < 6.0"
6.0" ≤ Level 4 < 10"
10" ≤ Level 5

➡ Determine which storms produced significant snowfall (at least 4.0" of snow) and which storms produced major snowfall (at least 10" of snow) (Kocin and Uccellini, 2004).





Example of WPC Daily Weather Map (2/2/11)

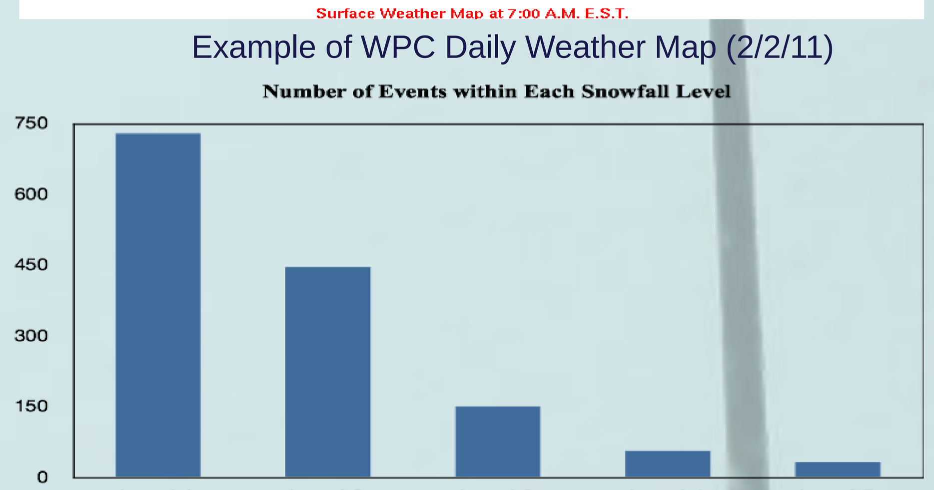
Seasonal Characteristics

➡ Identify timing and changes in the timing of 1) first measurable snowfall, 2) first plowable snowfall (at least 2.5" of snow), 3) last plowable snowfall, 4) last measurable snowfall, 5) length of season (number of days between the first and last measurable snowfall).

Climate Variability

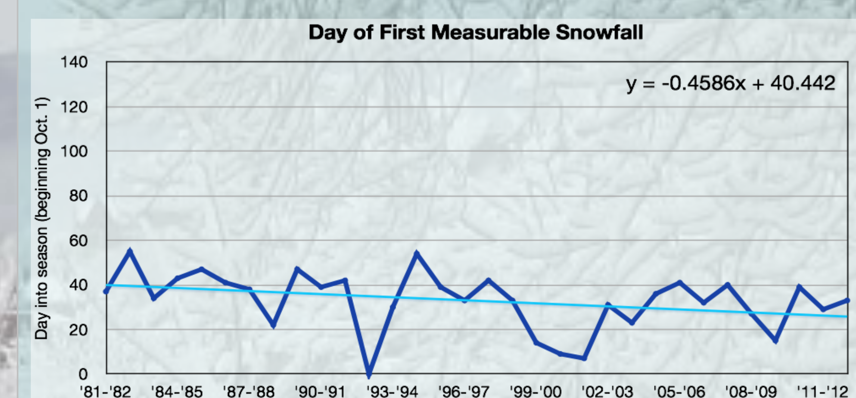
➡ Calculate correlation coefficients between monthly averaged North Atlantic Oscillation (NAO) and El Nino Southern Oscillation (ENSO) indices and monthly snowfall totals for November through March. The Oceanic Nino Index (ONI) is used to represent ENSO phase in this analysis.

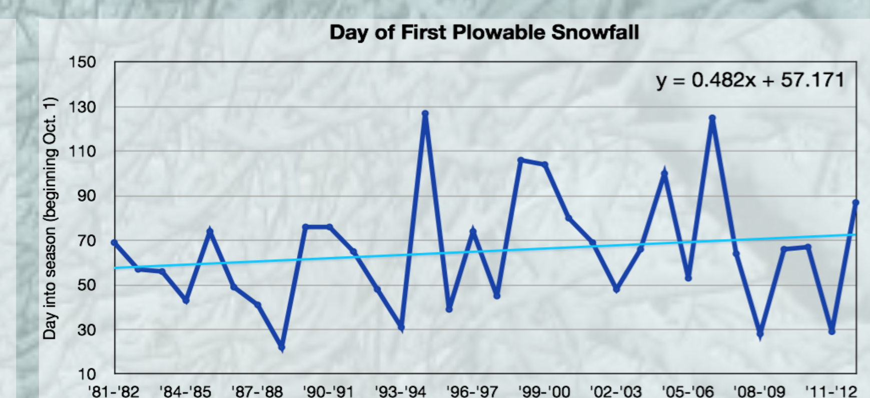
➡ Calculate snow day frequency per phase of the NAO, using daily NAO indices, for all snow days from 1981 to 2013.

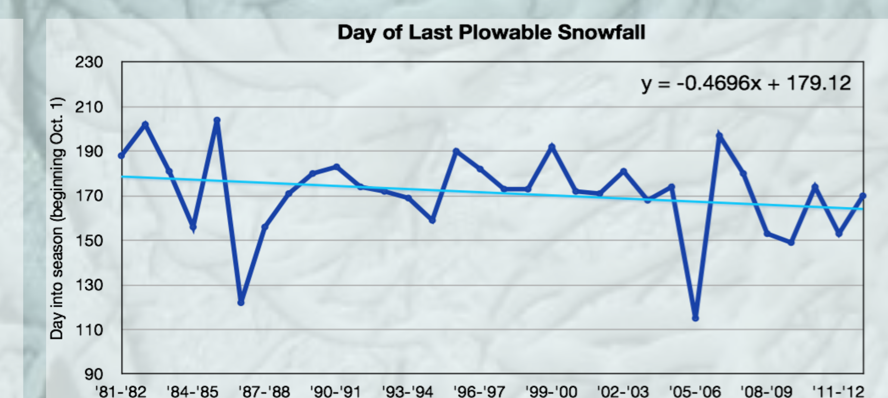


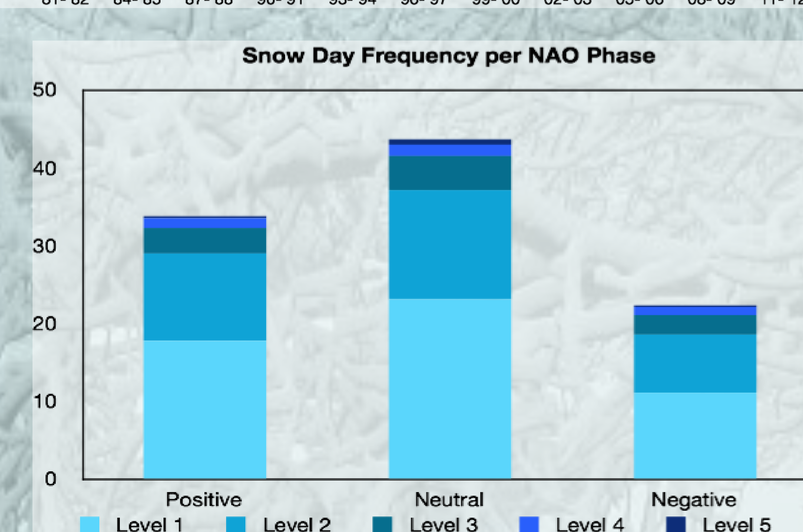
Observations & Results

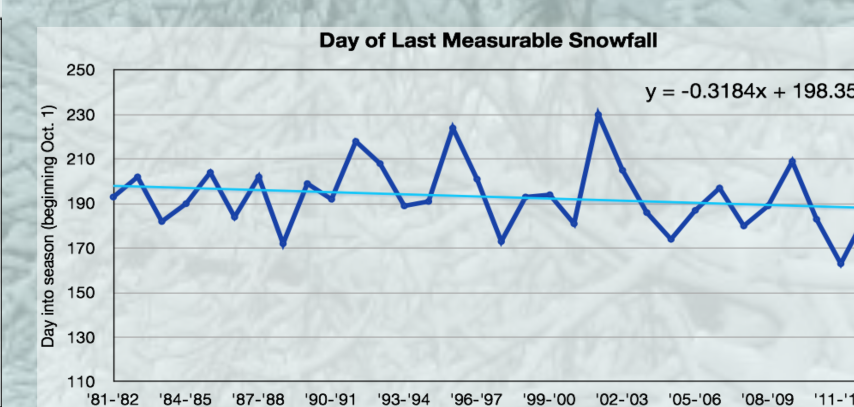
- The day of the first measurable snowfall is observed to be occurring **0.4586** days *earlier* each year.
- This is not what would be expected in a warming climate.
- The day of the first plowable snowfall (greater than 2.5") is observed to be occurring **0.482** days *later* each year.
- The day of the last plowable snowfall is observed to be occurring **0.4696** days *earlier* each year.
- The day of the last measurable snowfall is observed to be occurring **0.3184** days *earlier* each year.
- The length of the snow season is observed to be *increasing* by **0.1402** days per year.
- Trends in the day of the first measurable, first plowable, and last plowable snowfall are statistically proven to be non-zero trends using a Student's t-distribution.

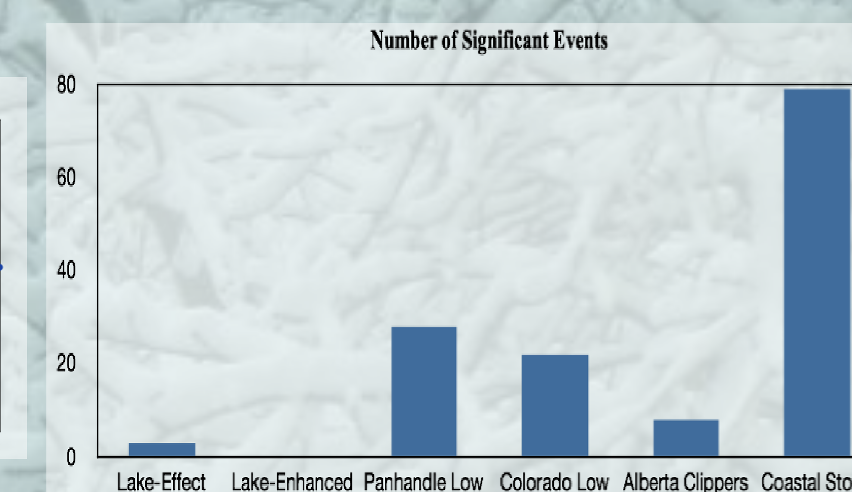










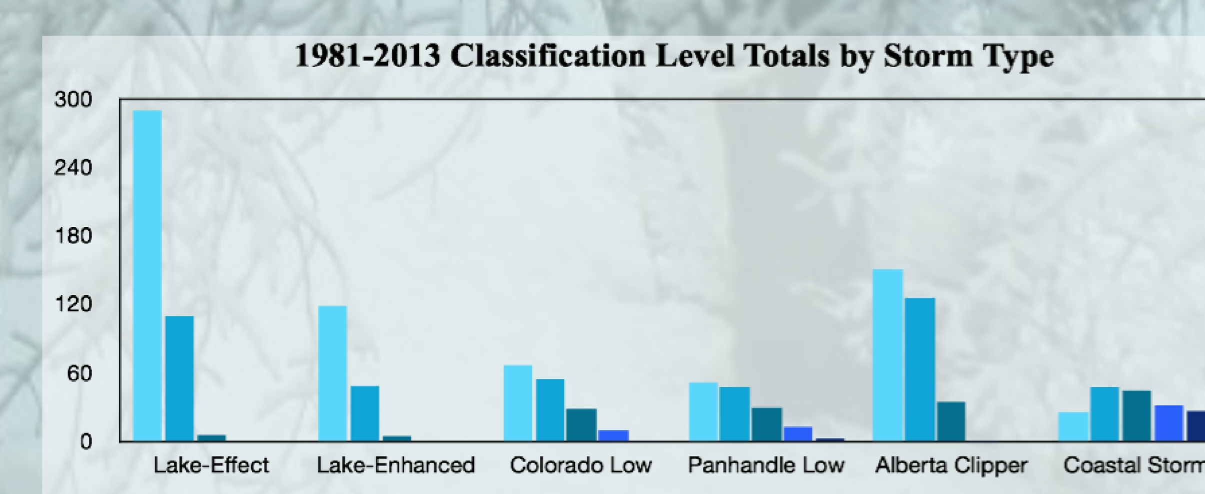


- Most snow days occur with a neutral phase of the NAO.
- More snow days occur under a positive NAO than a negative NAO.
- Greater than 30% of all level 4 and 5 days are under a positive NAO, while about 25% of all level 4 and 5 snow days occur under a negative NAO.
- Coastal Storms are the most frequent producers of significant snowfall.
- Both Panhandle Lows and Colorado Lows also produce a notable number of significant events.
- Clippers are capable of producing significant snowfall, but rarely do.

Conclusions & Forecasting Applications

- While the season for plowable snowfall events is getting *shorter*, the snow season as a whole (measurable snowfall) is actually getting slightly *longer*.
- A slightly longer snow season is observed in Oneonta, which goes against what has been observed across most of the Northern Hemisphere by Choi et al. 2010.
- However, it should be noted, the time in which plowable snowfall occurs is *decreasing* in length.
- Lake-effect snowfall occurs most often, but primarily produces low snowfall accumulations (Levels 1 and 2).
- Alberta Clippers also occur frequently, and also primarily produce lower snowfall accumulations.
- Coastal Storms produce more heavy snowfall accumulations (Levels 3, 4, and 5) than low accumulations. It is the only storm type with that attribute.

Month	NAO Coefficients	ONI Coefficients
November	-0.196	0.053
December	-0.543	-0.042
January	-0.297	-0.041
February	-0.334	0.203
March	-0.177	-0.144



- NAO has a much greater correlation with DJF snowfall than ENSO, with NAO explaining 30% of the variation during those months. Trend towards more snow in a negative NAO on a monthly time scale.
- ENSO has a very weak influence on monthly snowfall.
- Panhandle Lows and Colorado Lows primarily result in low snowfall accumulations, but are still more likely, than the other storms, to produce heavy snowfall.
- The storm tendencies identified in this research should help with both short and medium range forecasts.