The Washington Post

SUNDAY, FEBRUARY 7, 2010

A HISTORIC MESS

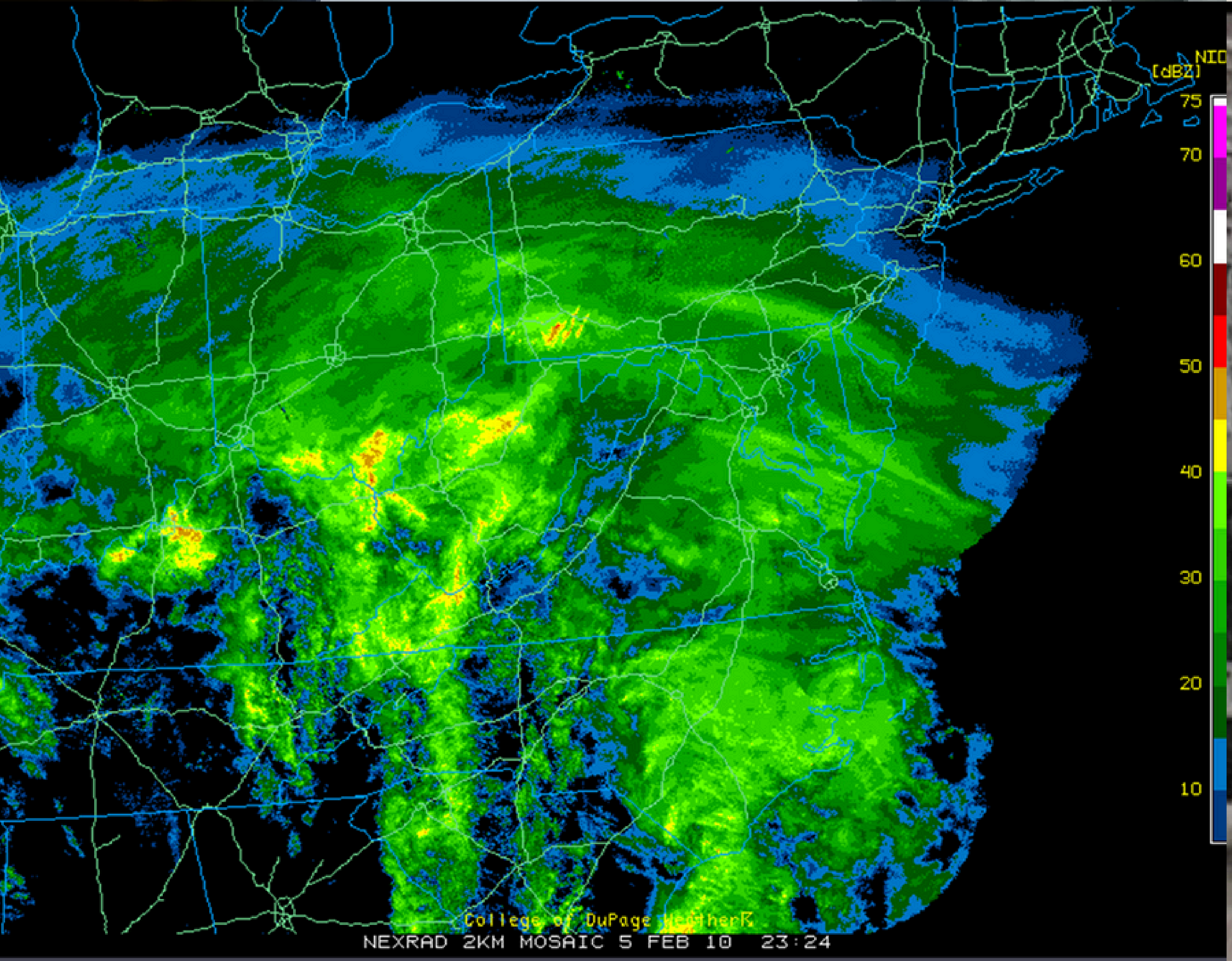
POWERLESS: Officials across area consider opening shelters for tens of thousands without heat.

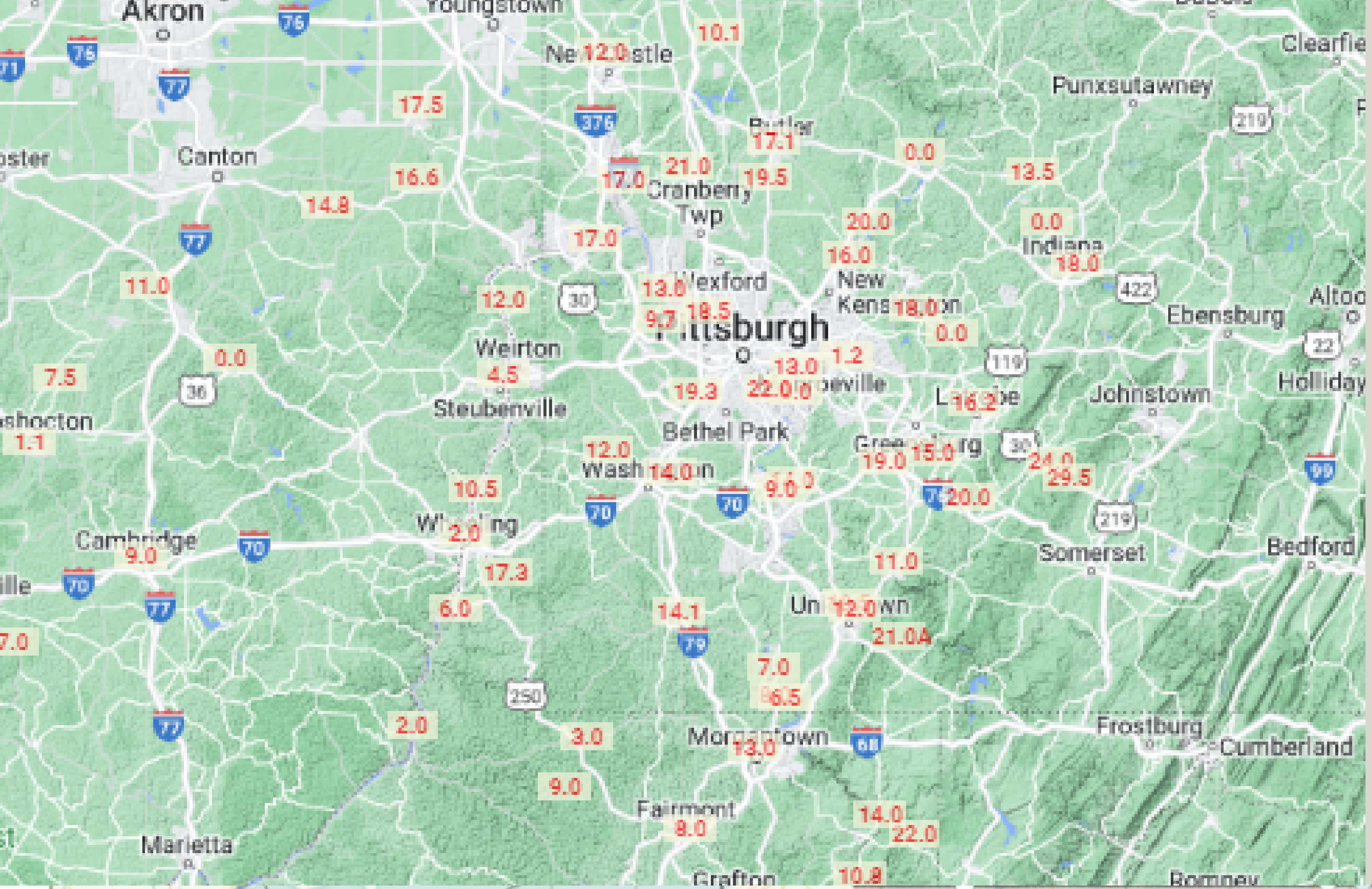
STALLED: 32 inches of snow shutters Dulles; other airports, rail and roads still struggling to dig out.

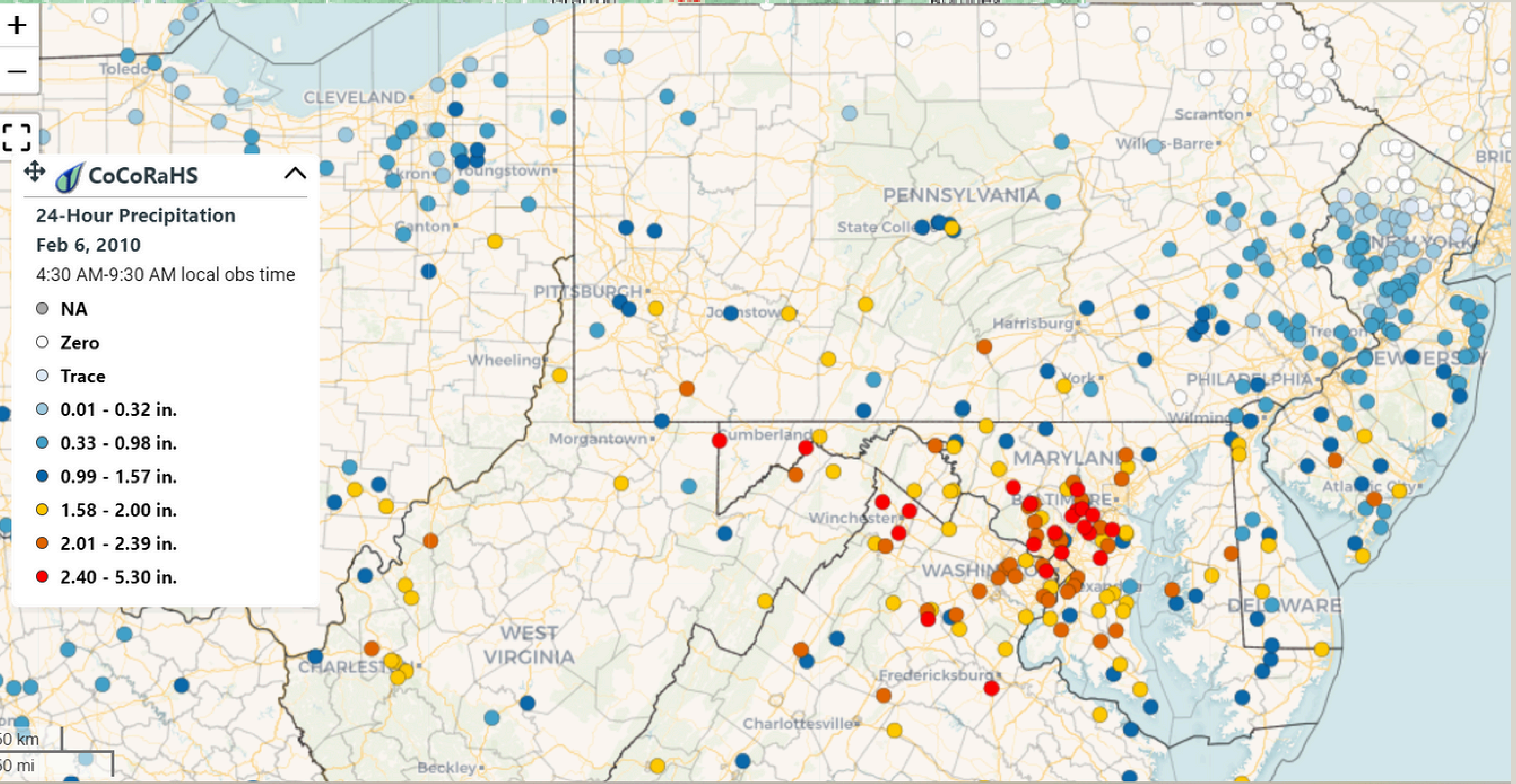
Extreme Weather Events: A Study of Snowmageddon and the Great Thanksgiving Storm

By: Marco A. Monrouzeau

"Snowmageddon": February 4th-6th, 2010





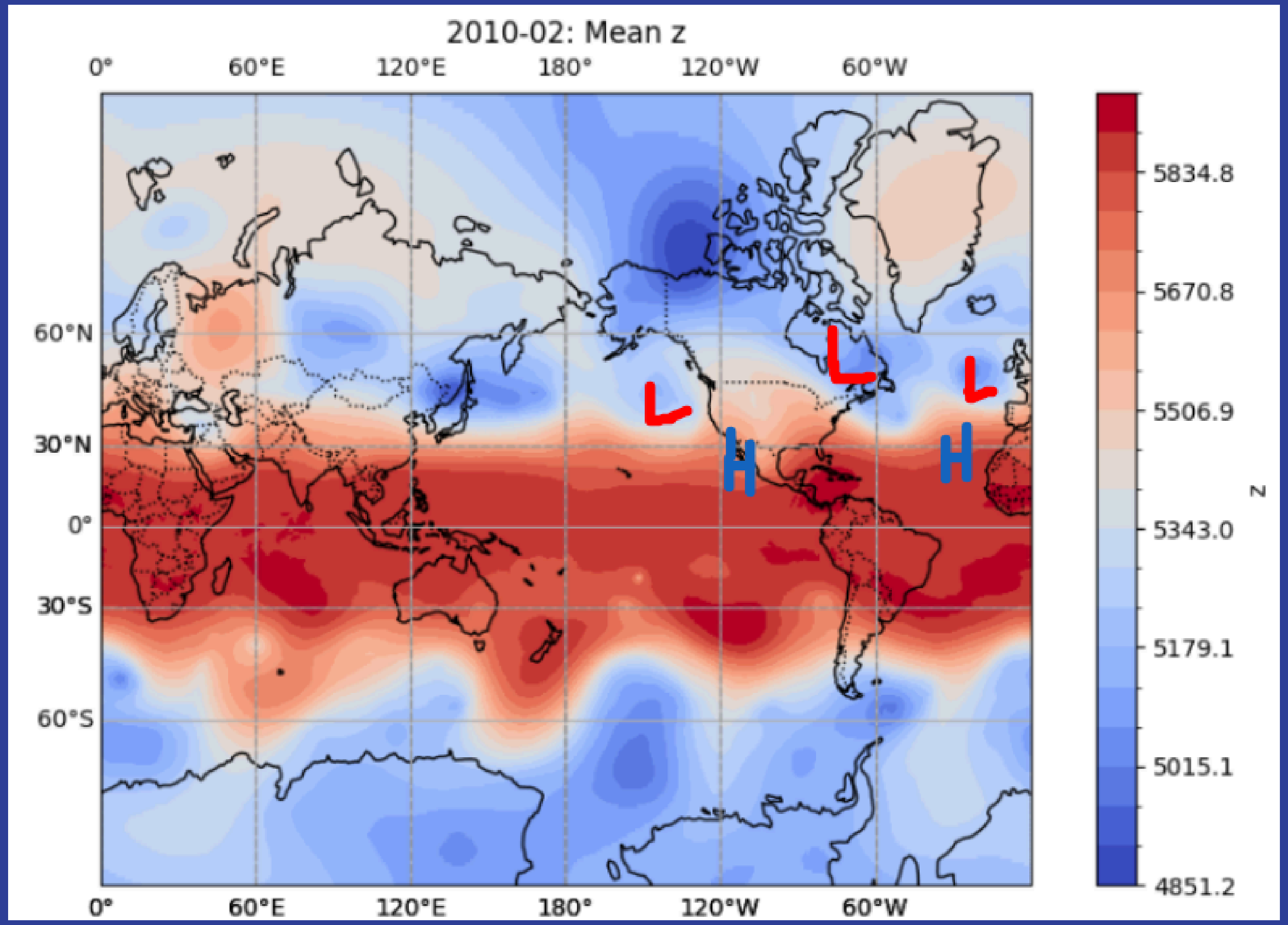


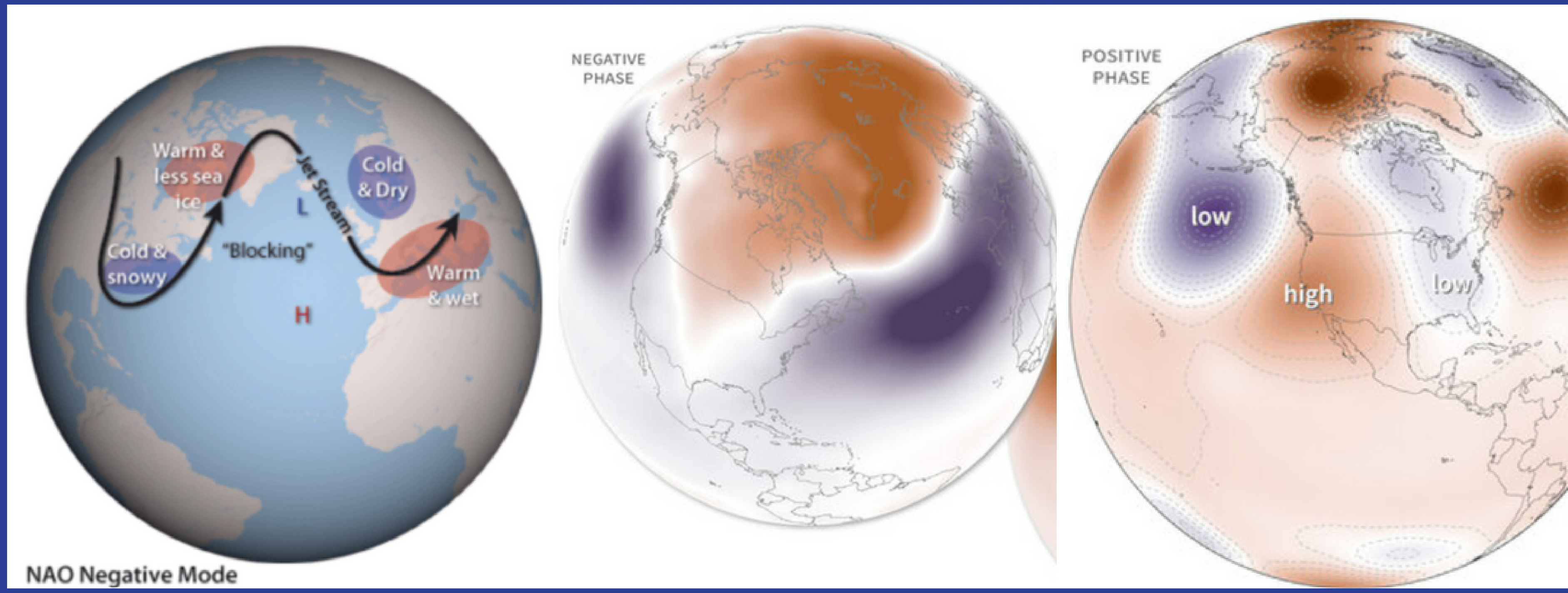
"Snowmageddon"

- Brought widespread blizzard conditions to the Northeastern CONUS
- Dumped more than 30 inches in parts of Pennsylvania, Maryland, Virginia , and West Virginia
- Resulted in 41 fatalities and left more than 200,000 homes and businesses without power for days.

Despite being an El Niño year , La Niña-like conditions with a polar jet, negative NAO and AO, and positive PNA enhanced a winter storm set up in eastern CONUS

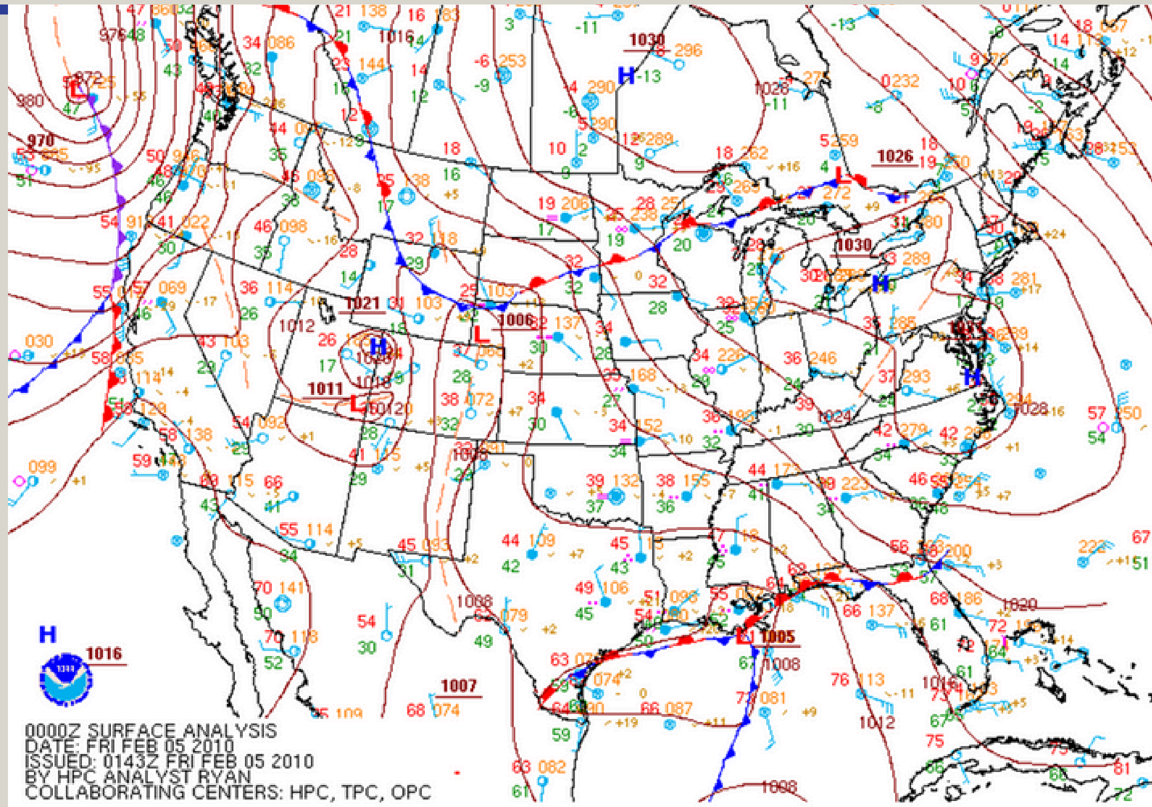
- The event developed during moderate-strong El Niño conditions (1.2)
- A strong negative North Atlantic Oscillation (-1.98) associated with weaker subpolar low and subtropical high, made cold temperatures likely in eastern CONUS
- Negative Arctic Oscillation (-4.27) set up conditions for strong winter storms by enabling the jet stream to dip equatorward
- Positive Pacific North American Pattern (0.48) during the event was associated with lower 500 mb heights and below average temperatures in eastern CONUS

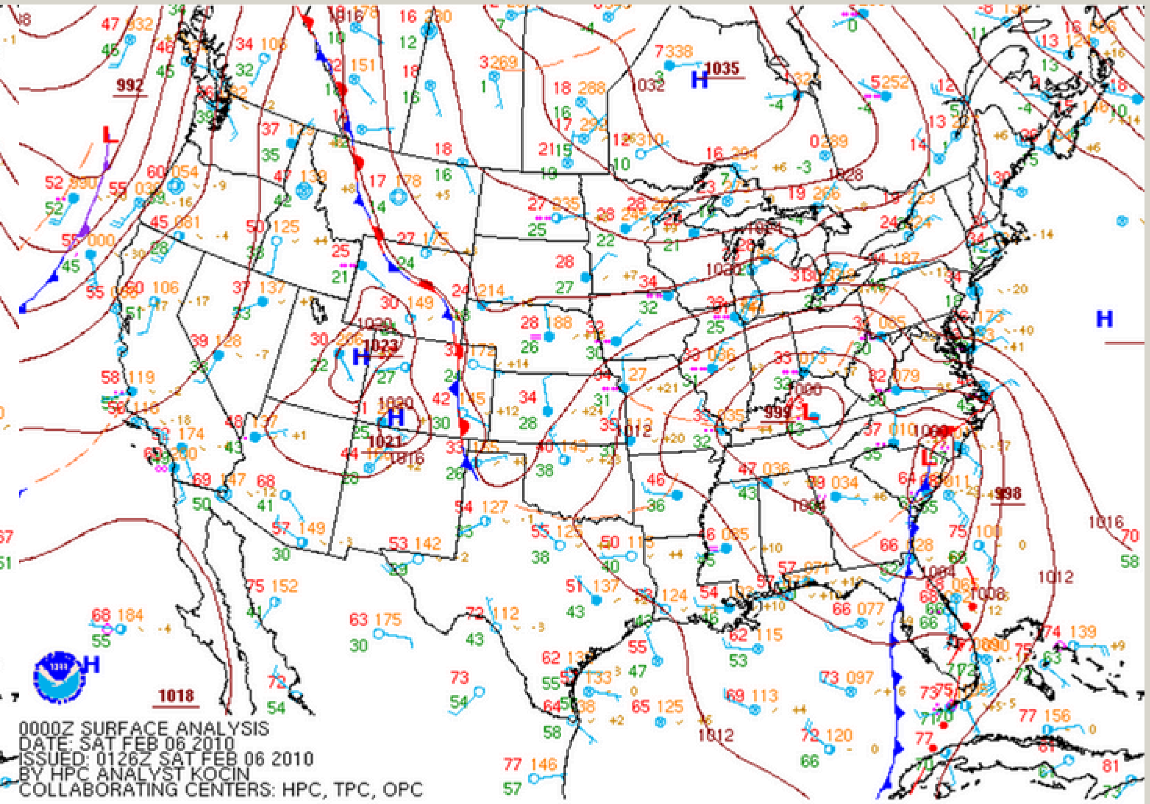


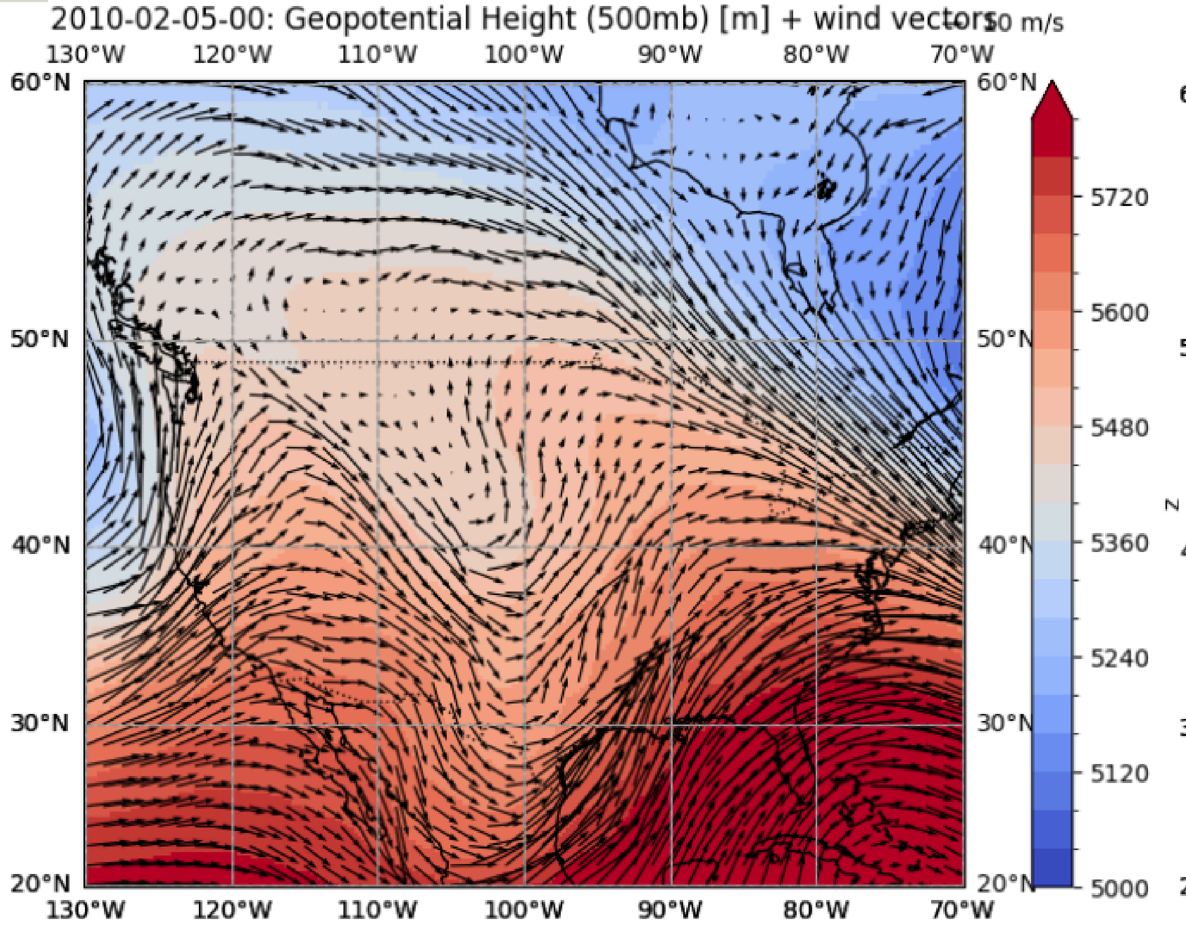


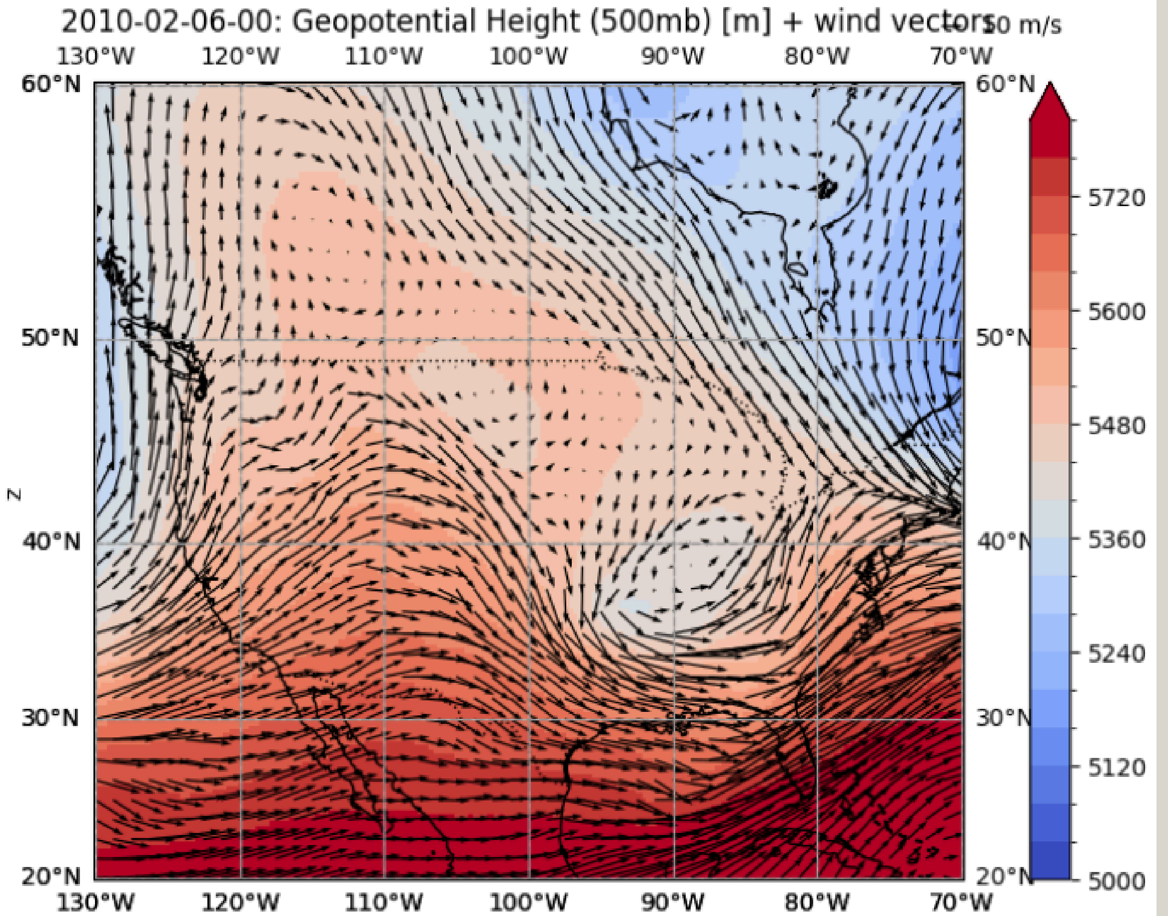
Atmospheric jet dynamics over the southern U.S. facilitated surface low development and vertical ascent over Kentucky

- A surface high was predominant as a shortwave trough moved eastward
- A strong subtropical jet set up over the southern U.S., supporting surface low development
- The left exit region of the southern jet streak and the right entrance region of the northern jet streak coupled for enhanced vertical ascent over Kentucky

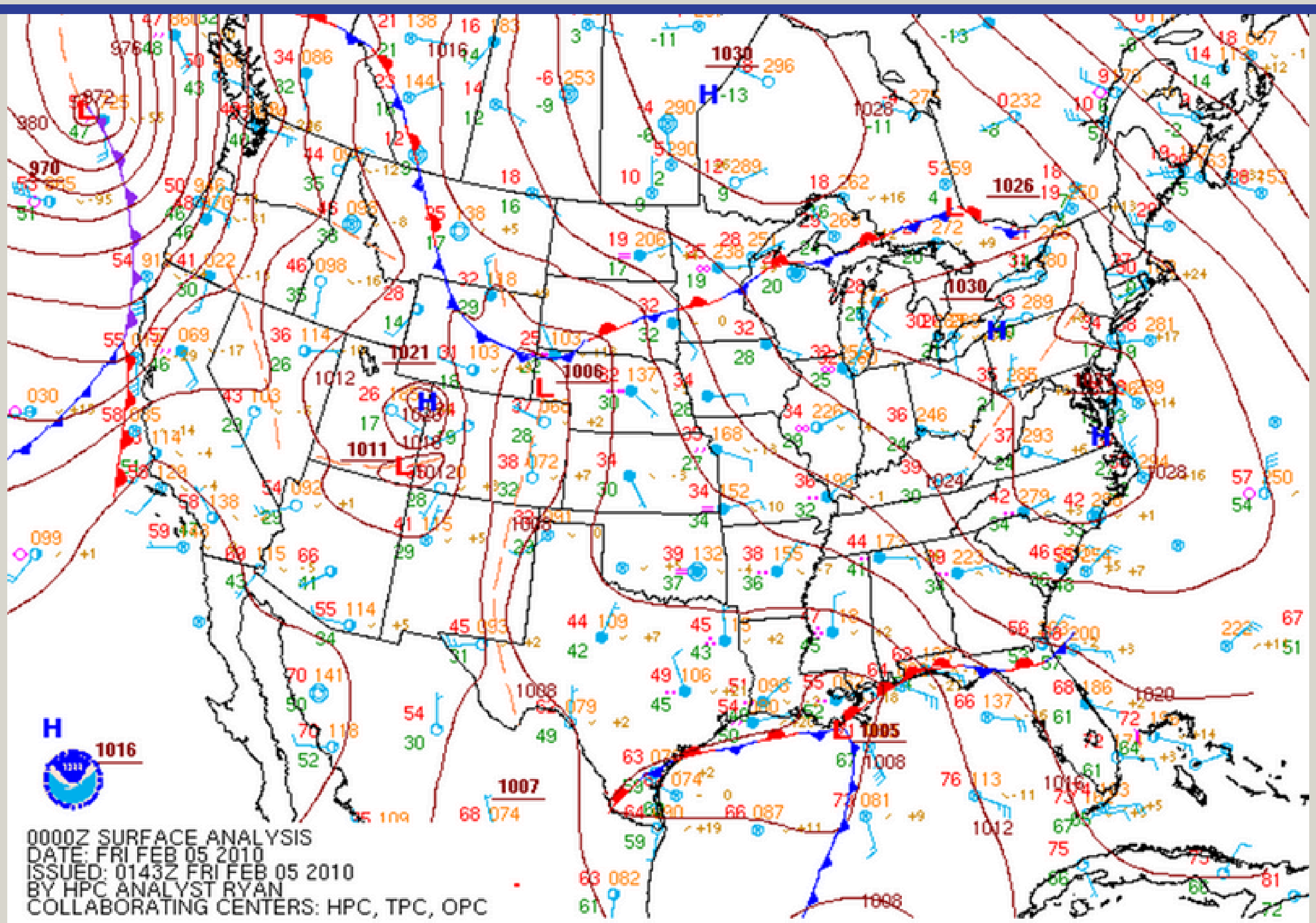


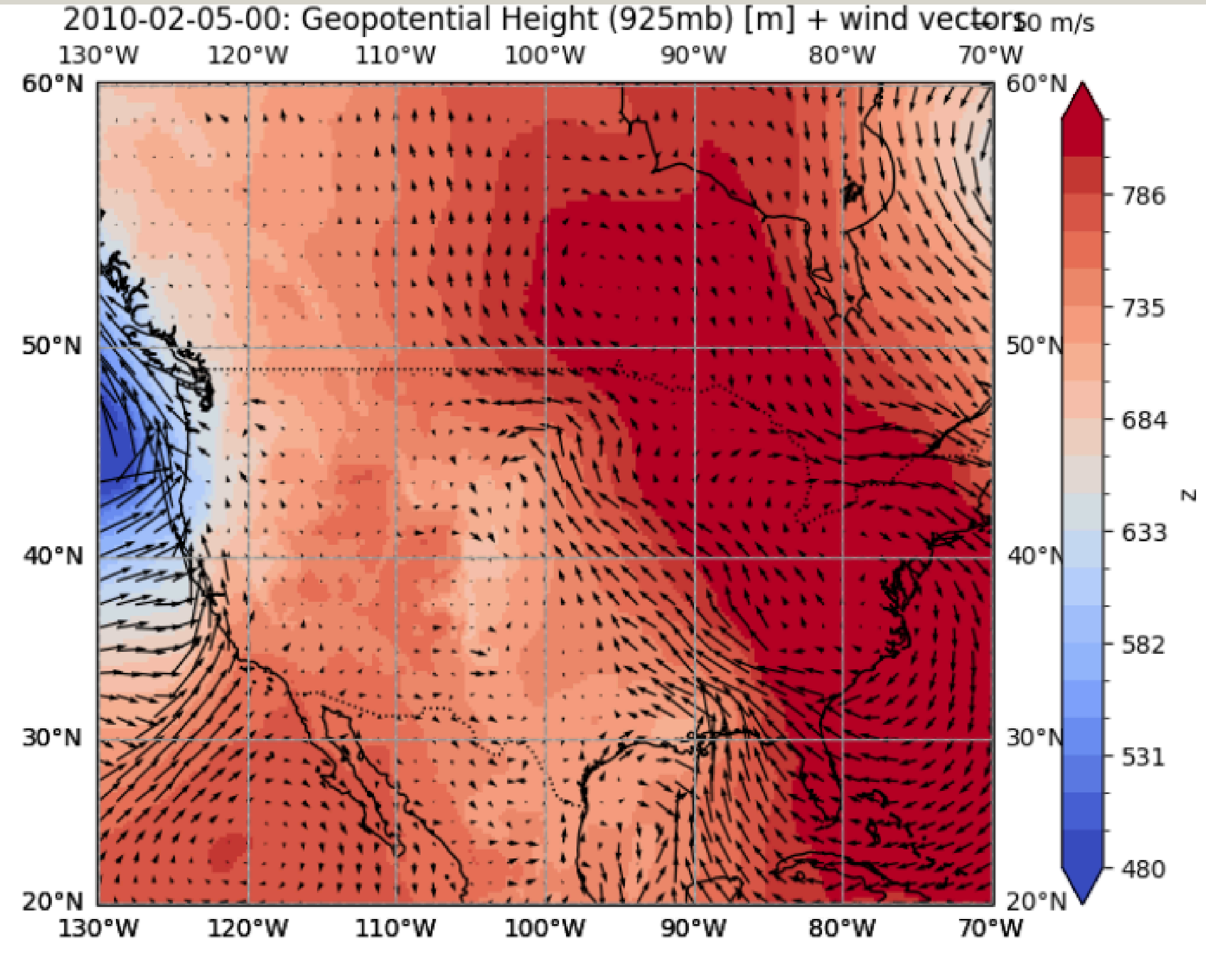


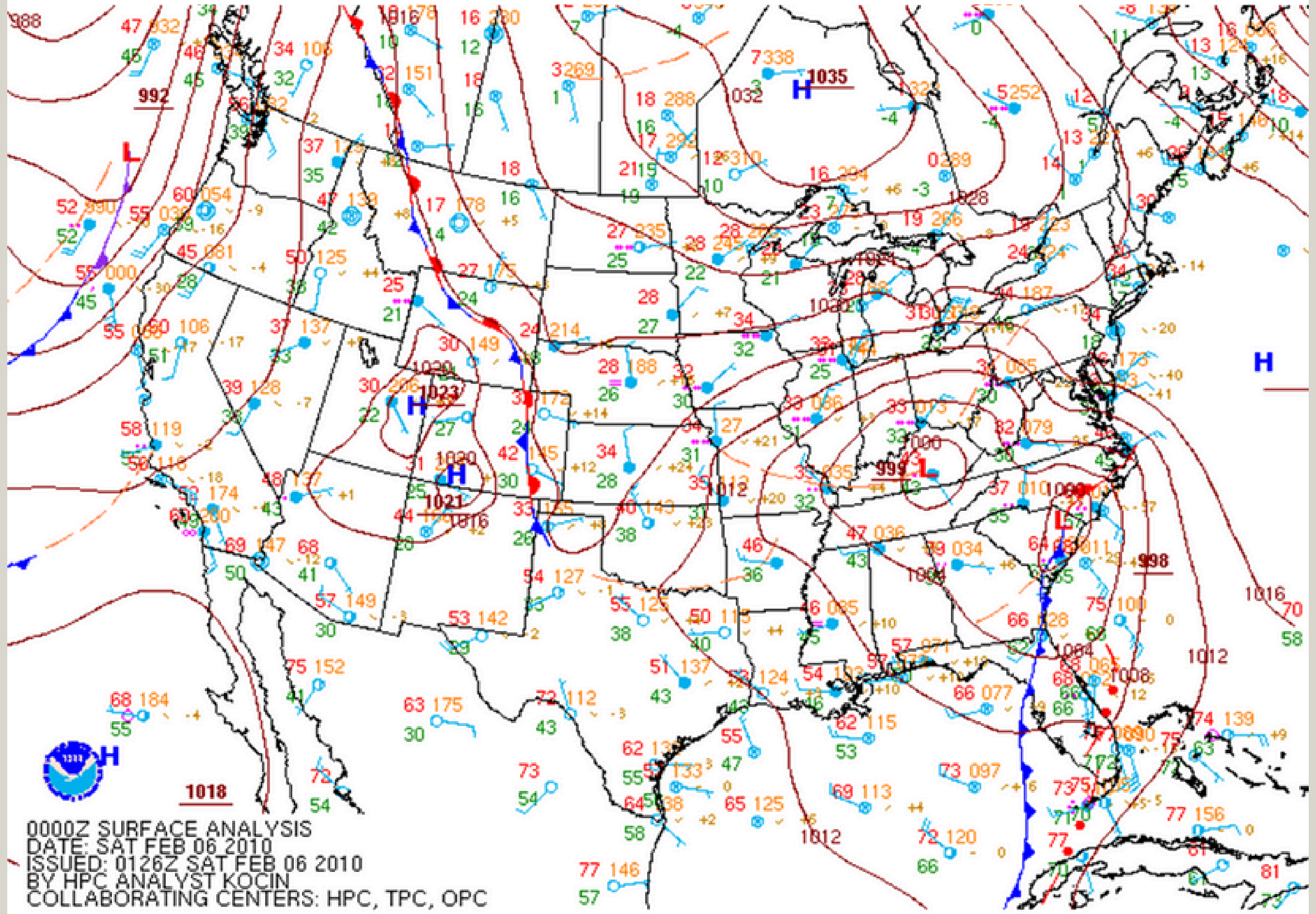


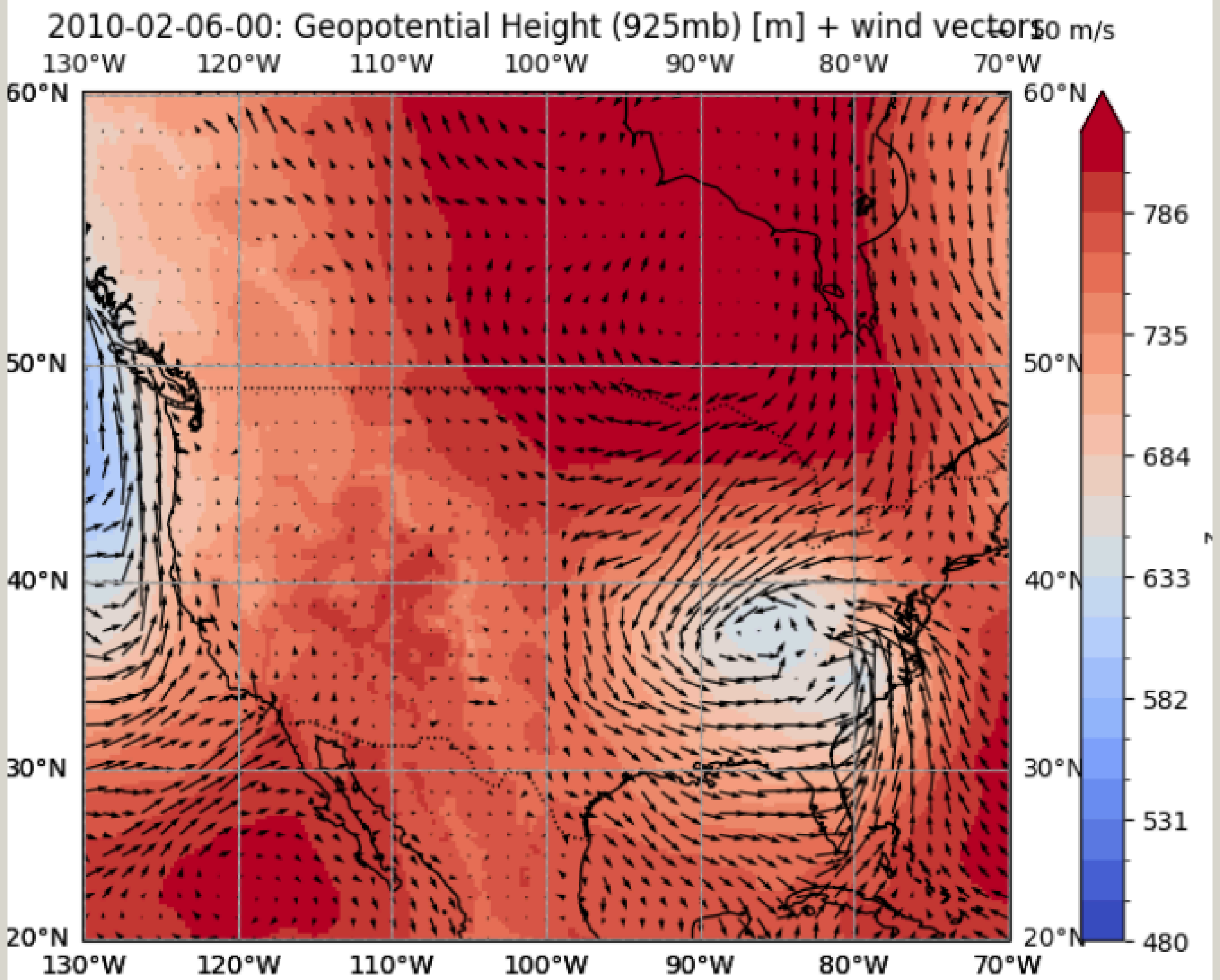


Surface analysis plots VS Reanalysis plot

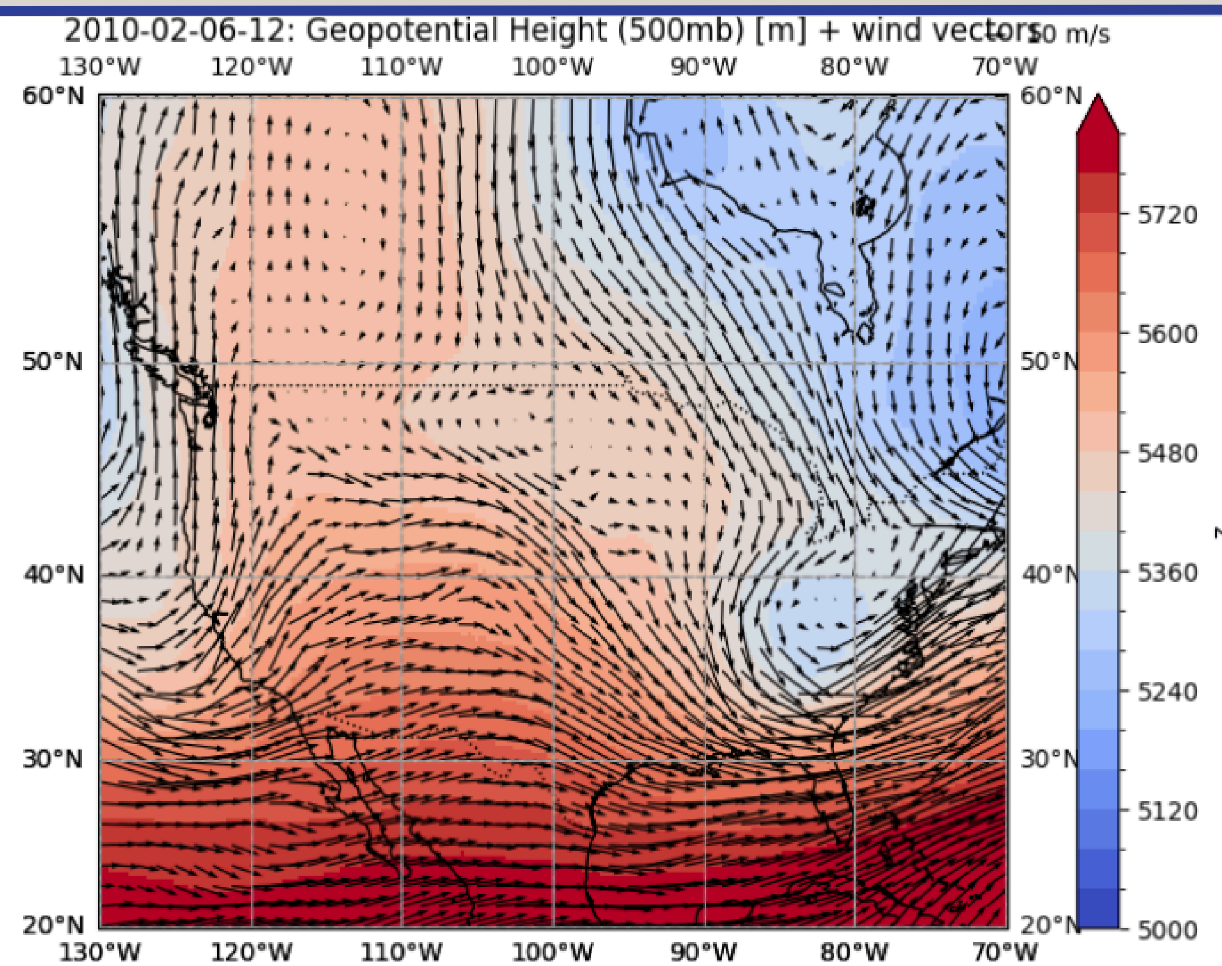


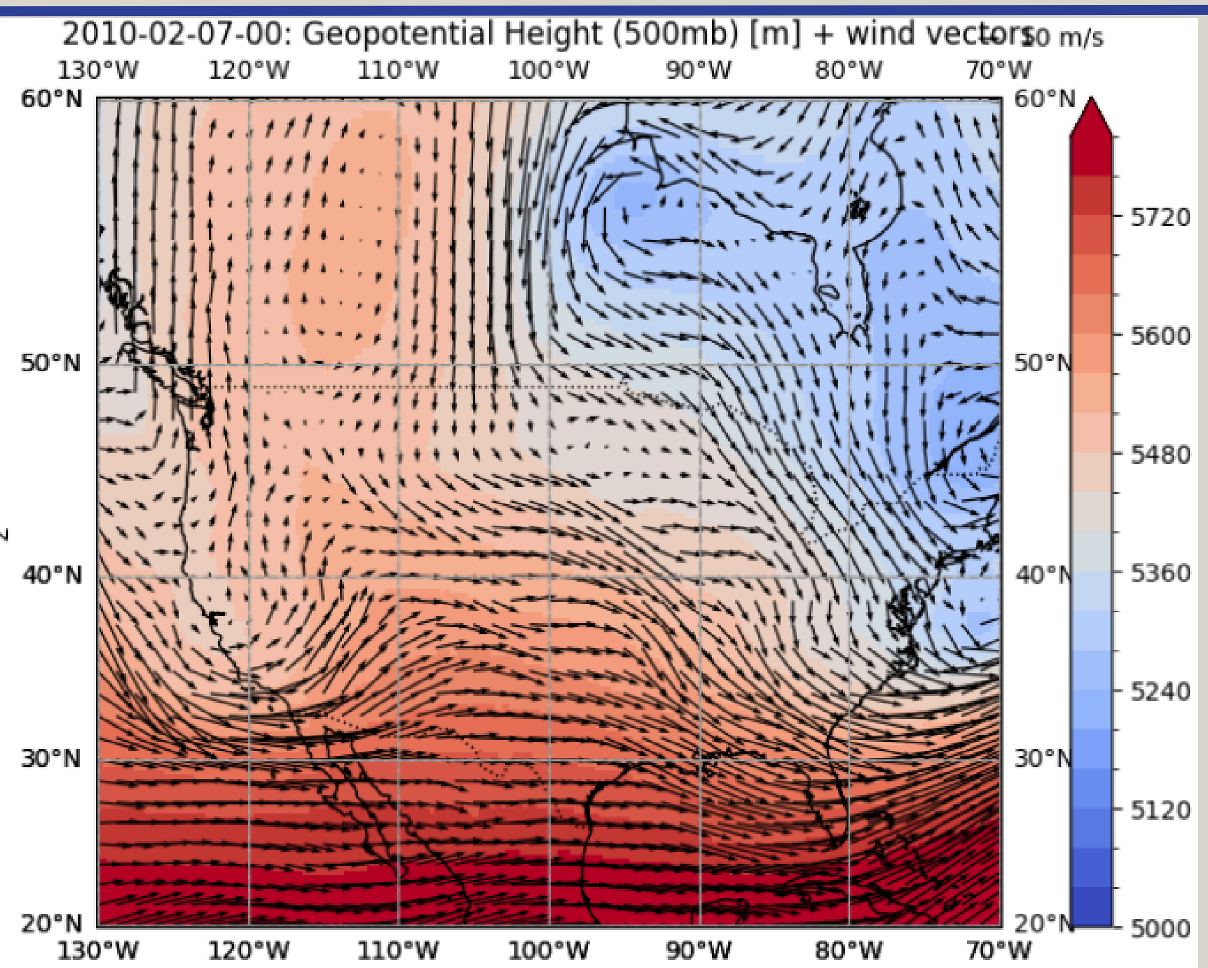




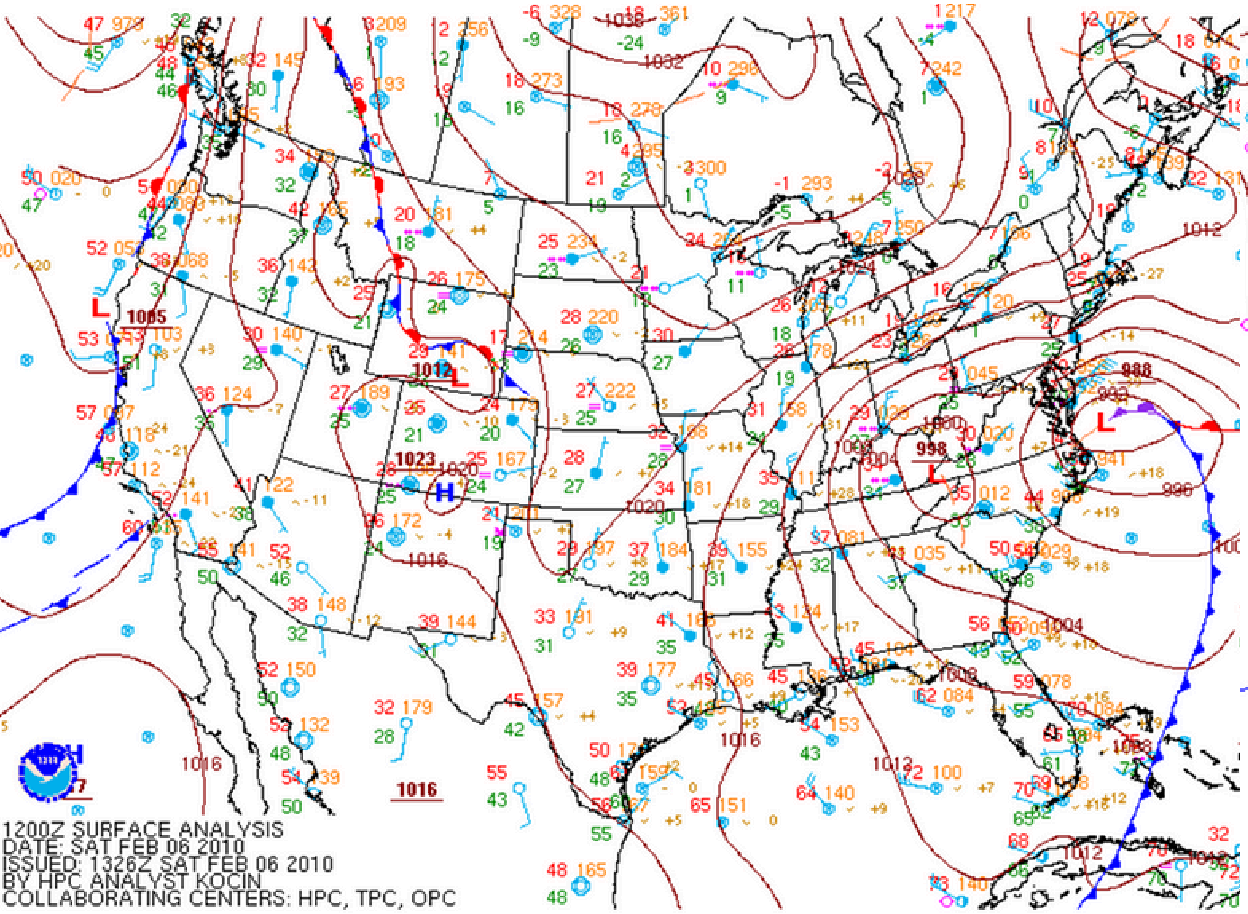


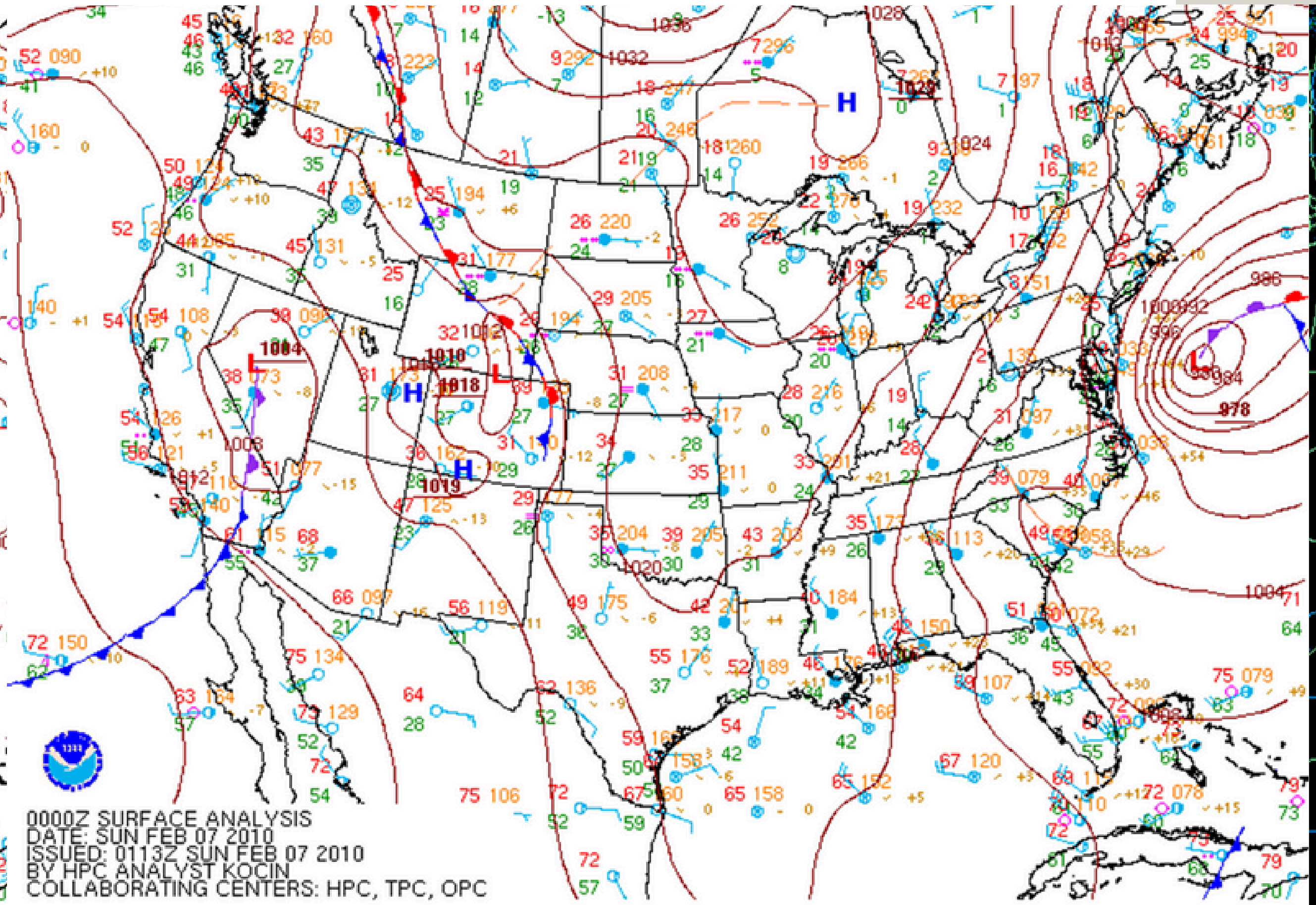
The coastal low's movement and strengthening were influenced by the evolving atmospheric conditions along the East Coast

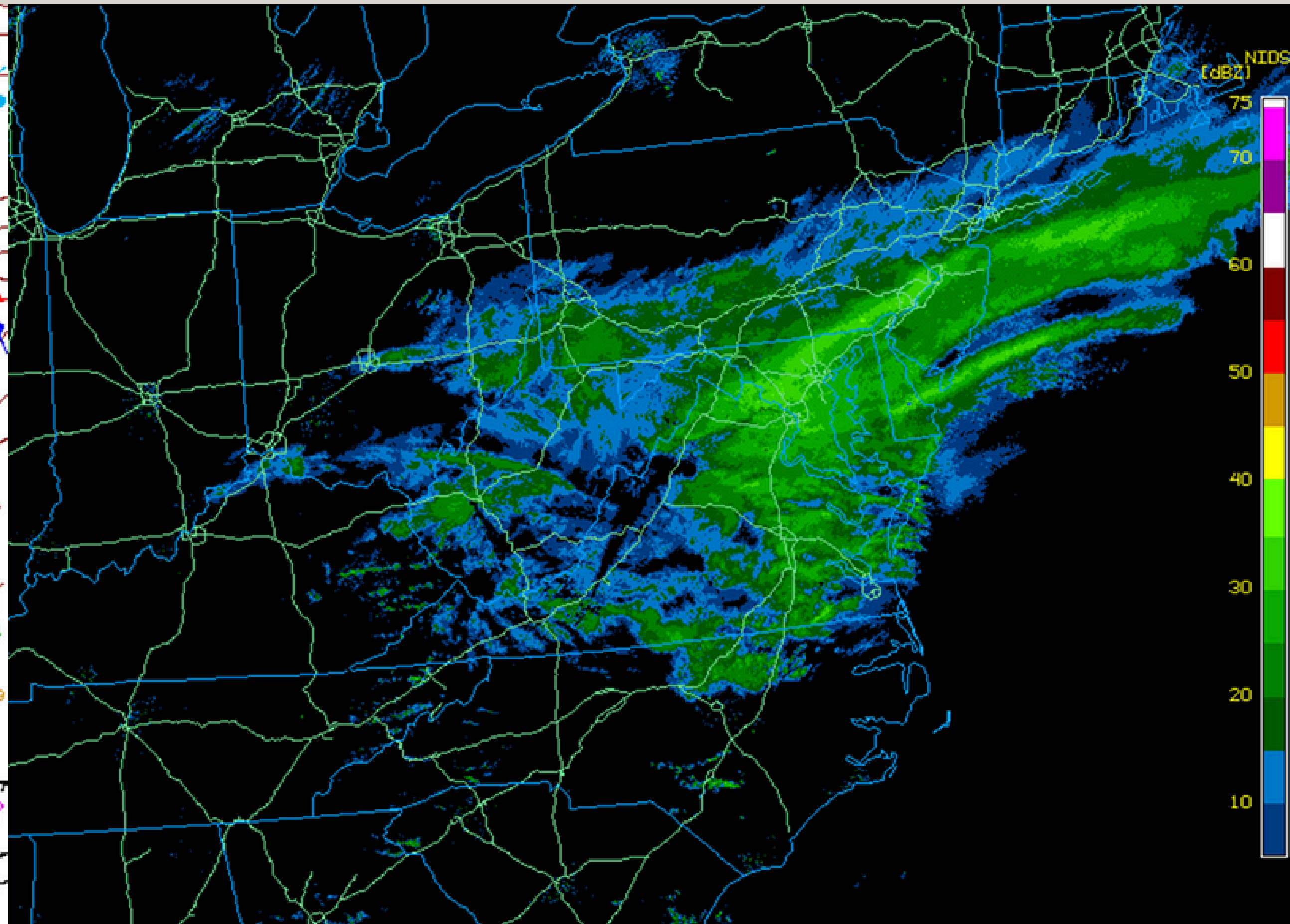




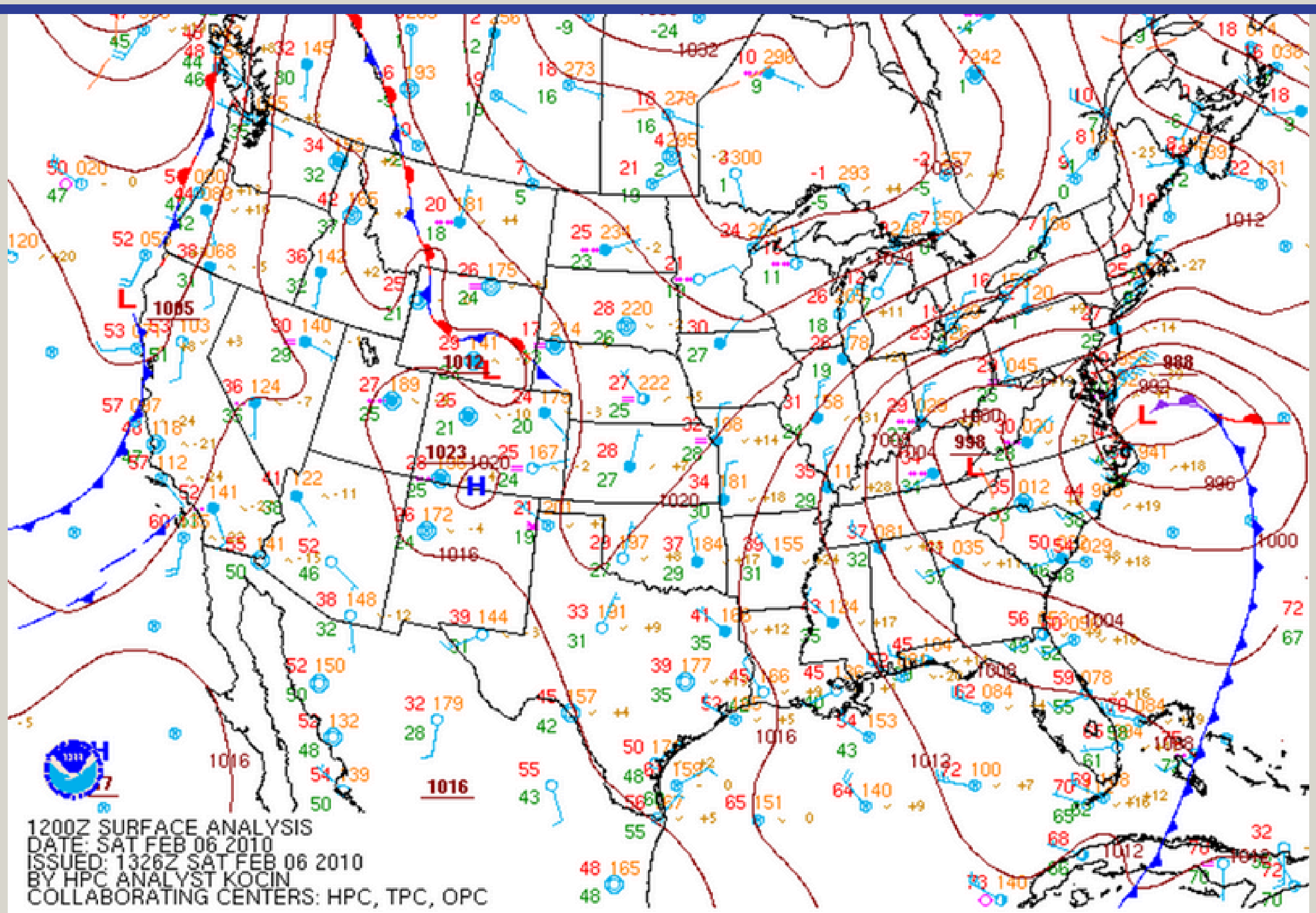
- The inland surface low pressure weakened as the mid-level jet dug southward
- The coastal low moved north along the East Coast and strengthened due to the northward shift of the coupled jet
- As the jet streak wrapped around the trough and it became negatively tilted, the left exit region enhanced vertical ascent/cyclogenesis along the coast

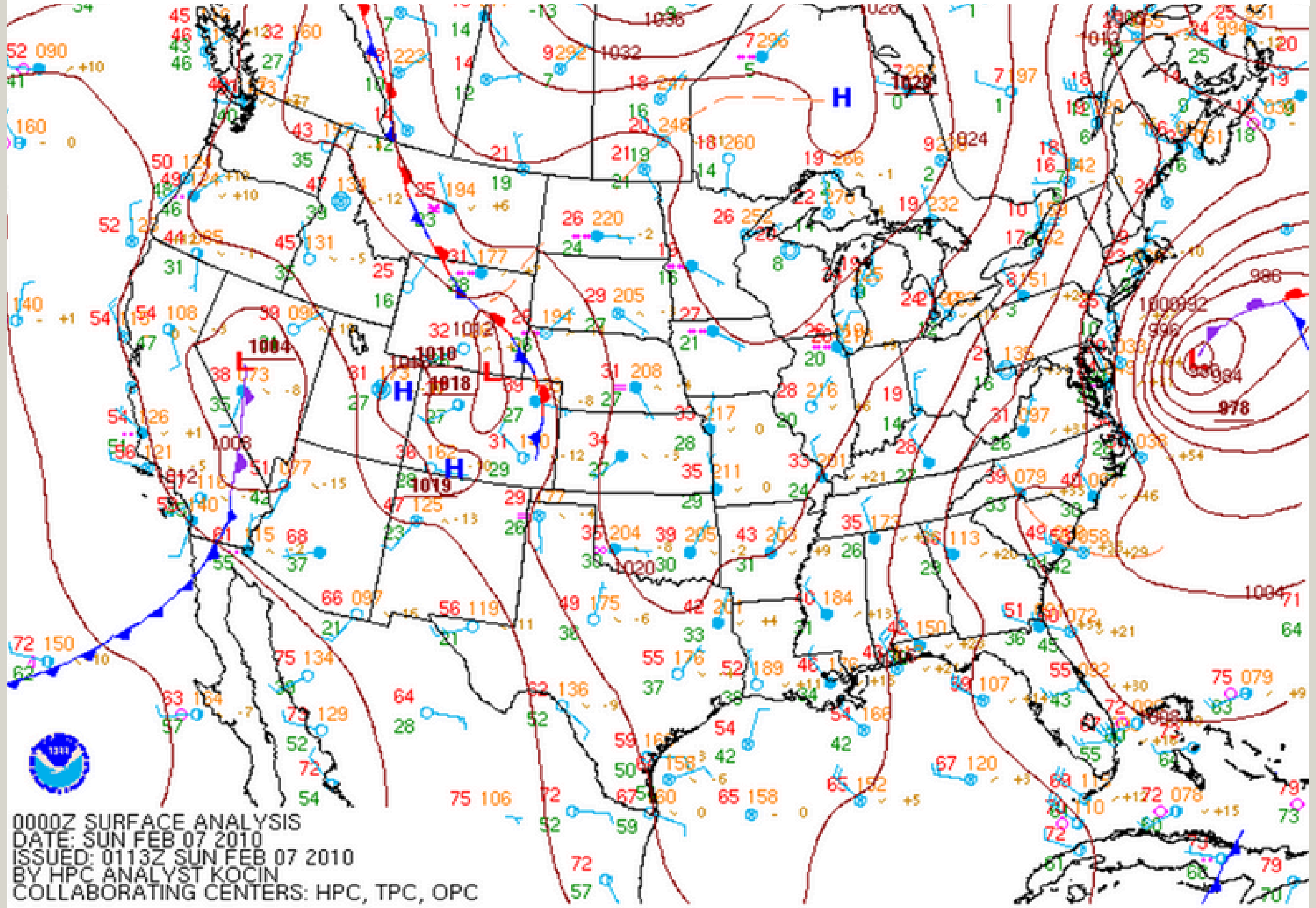


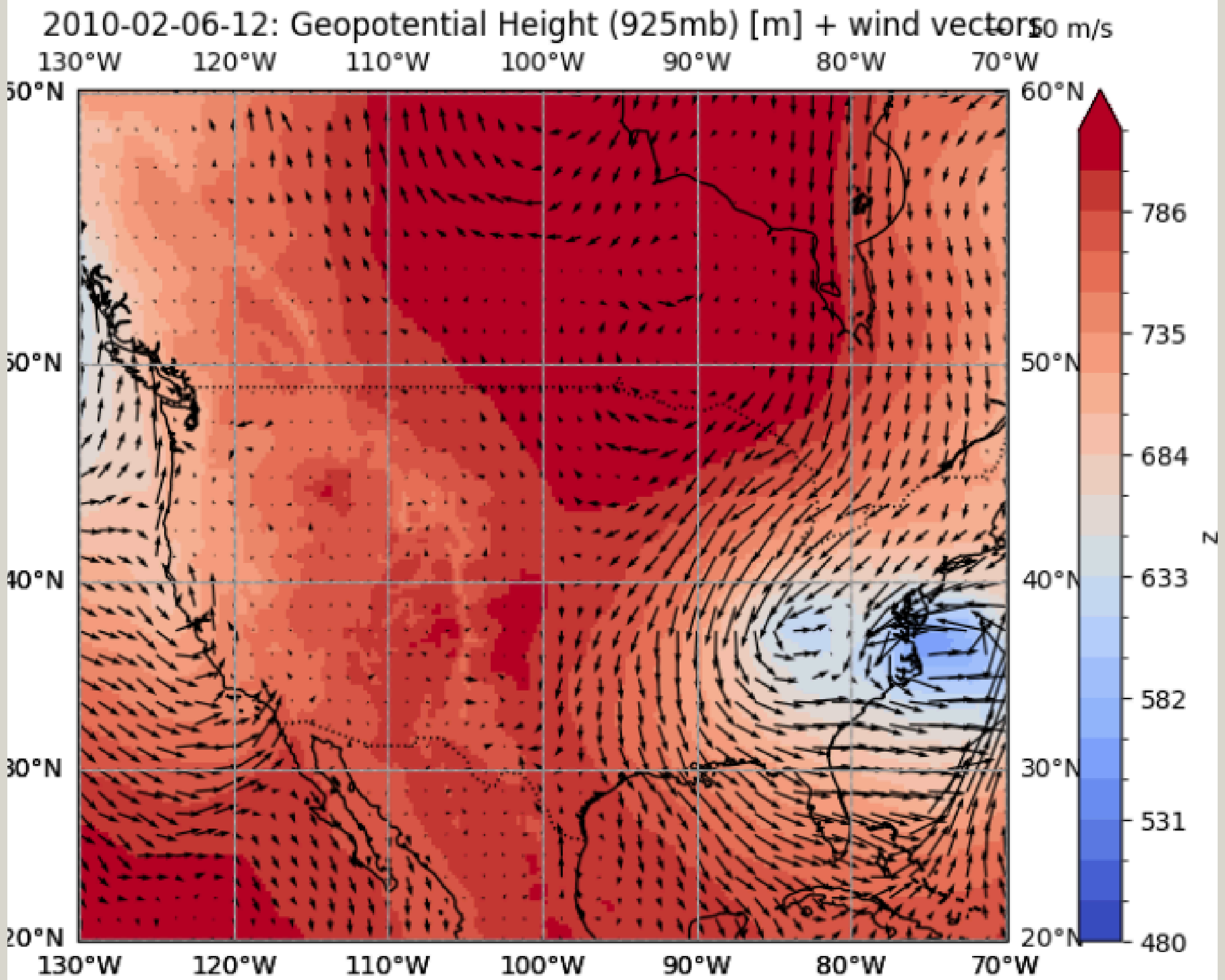


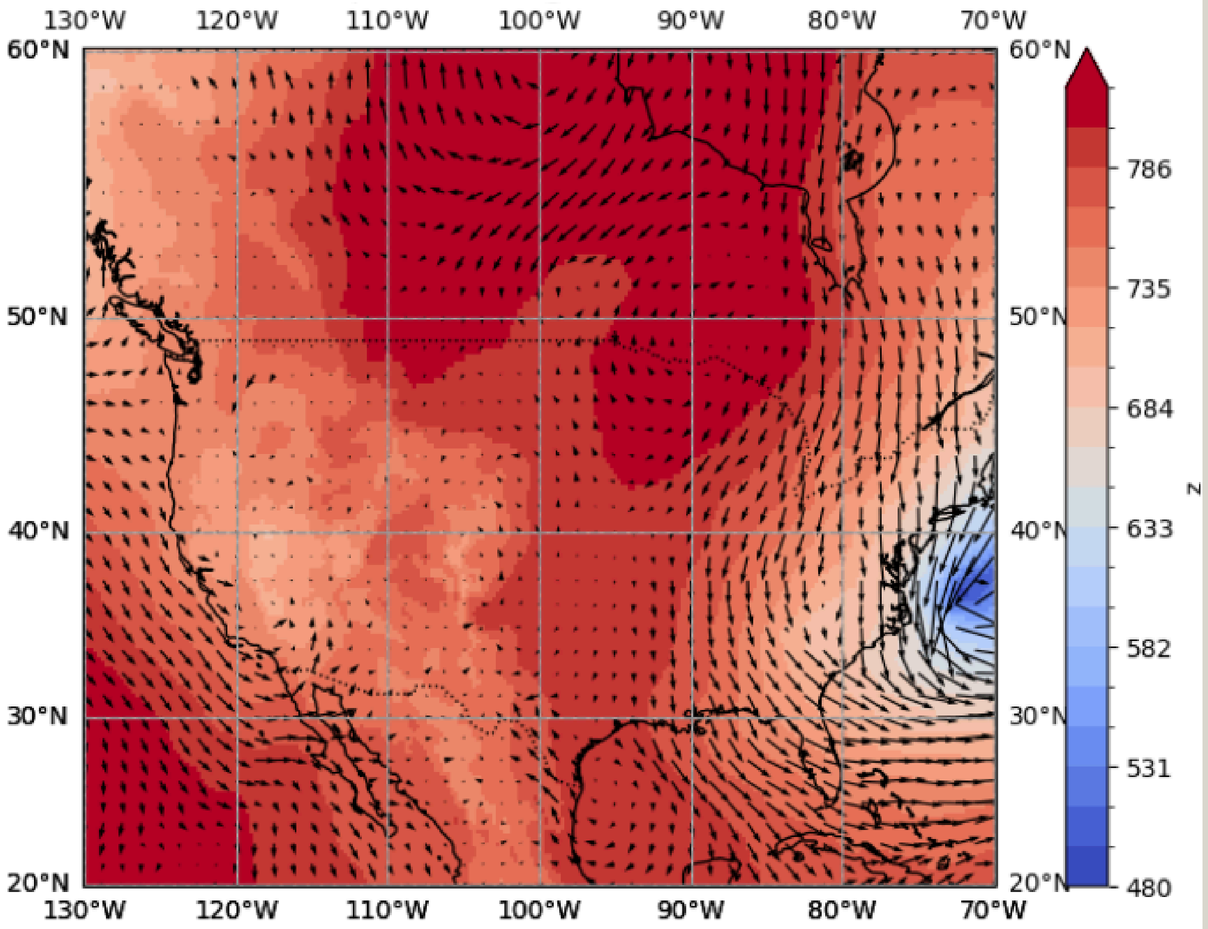


Surface analysis plots VS Reanalysis plot

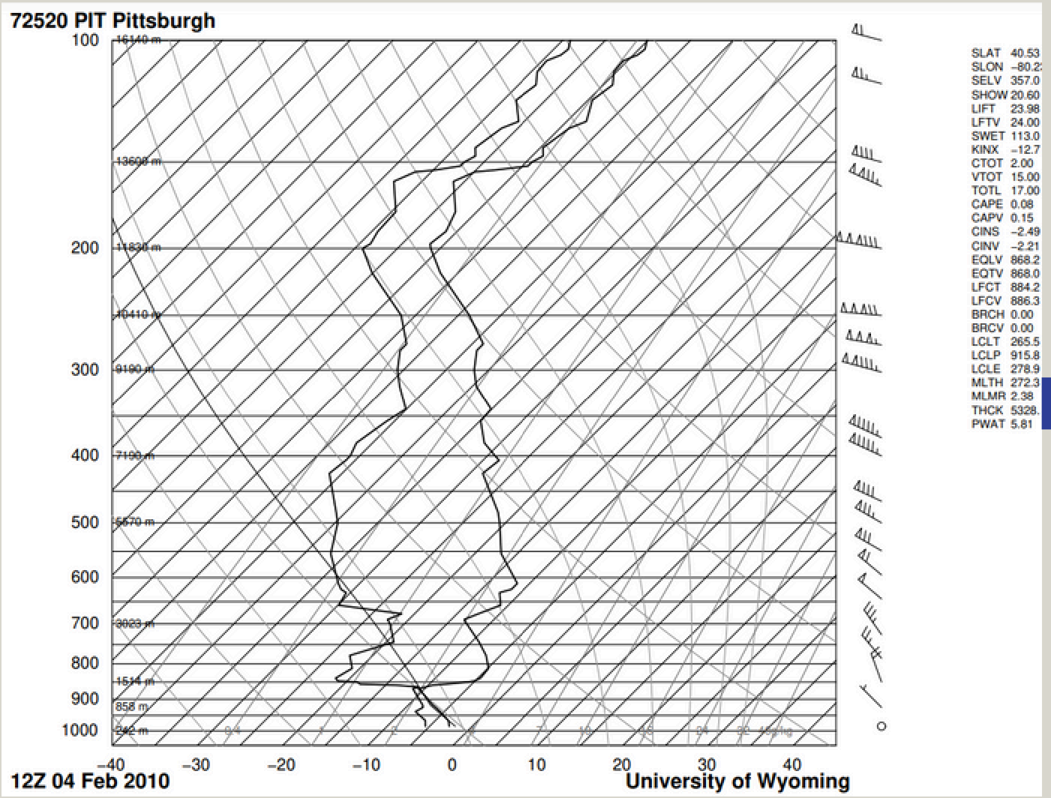


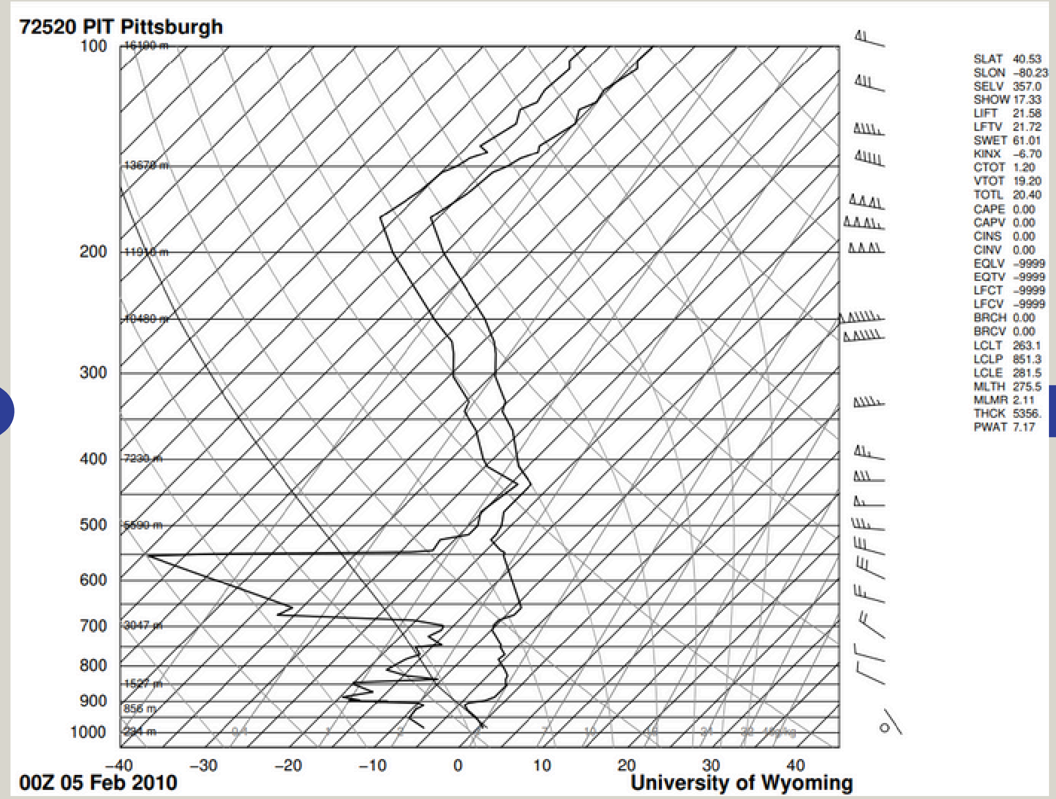


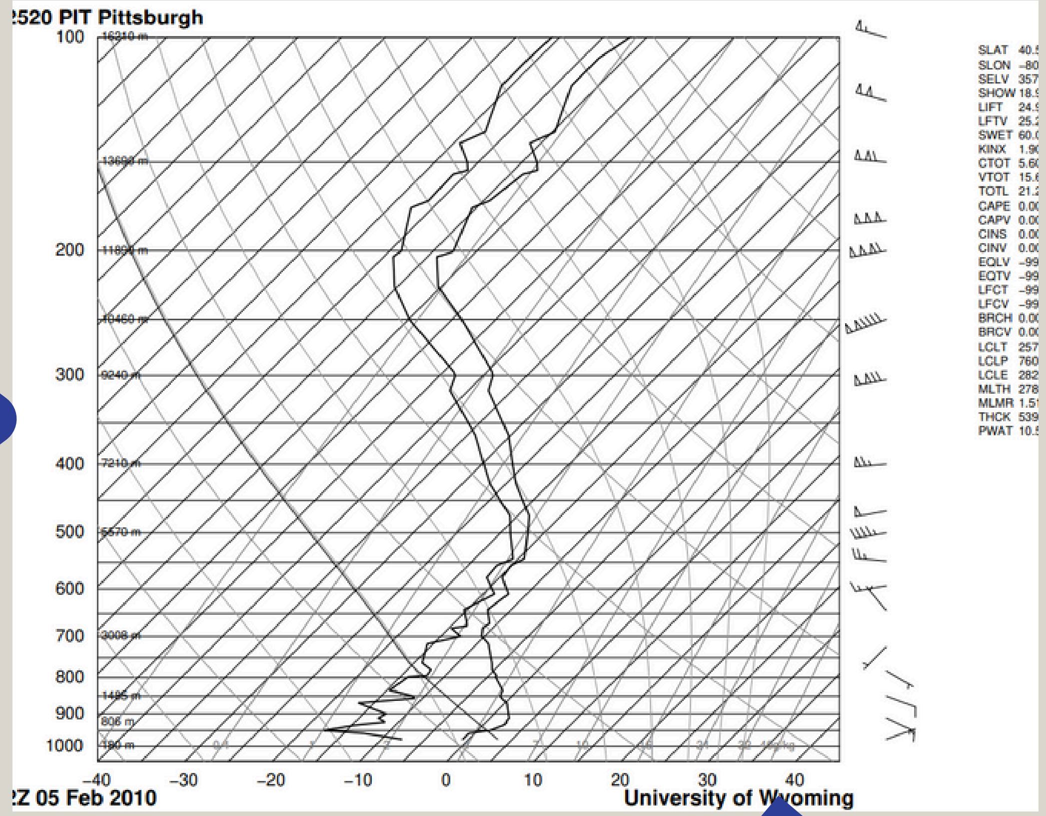


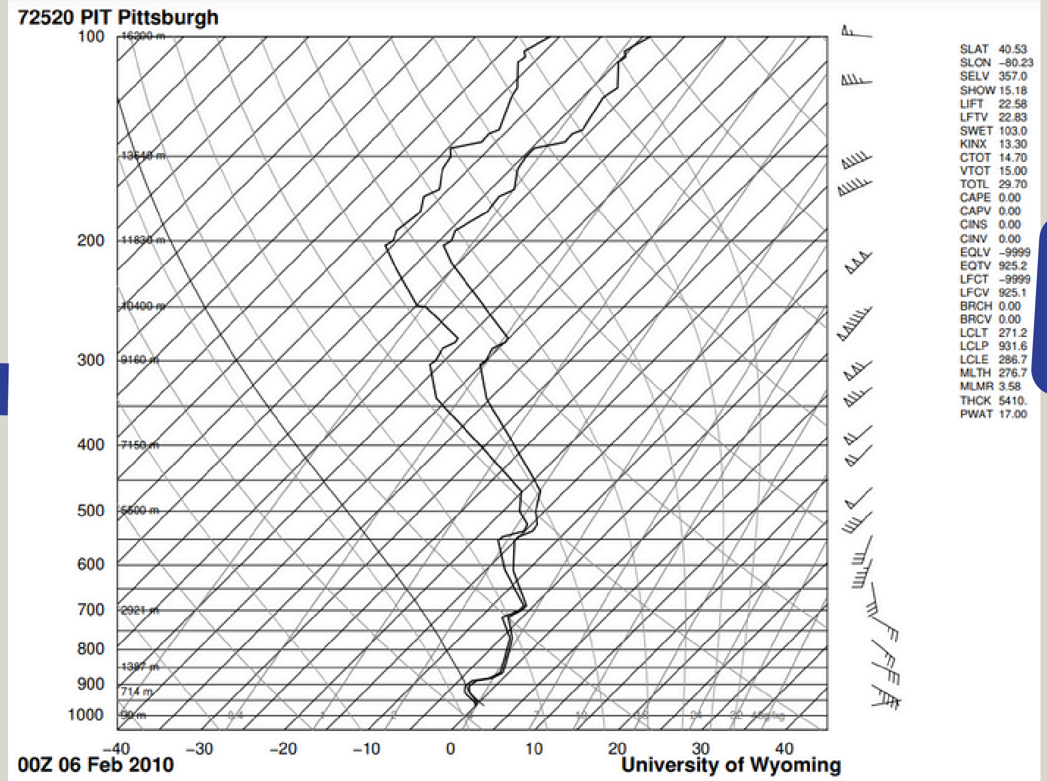


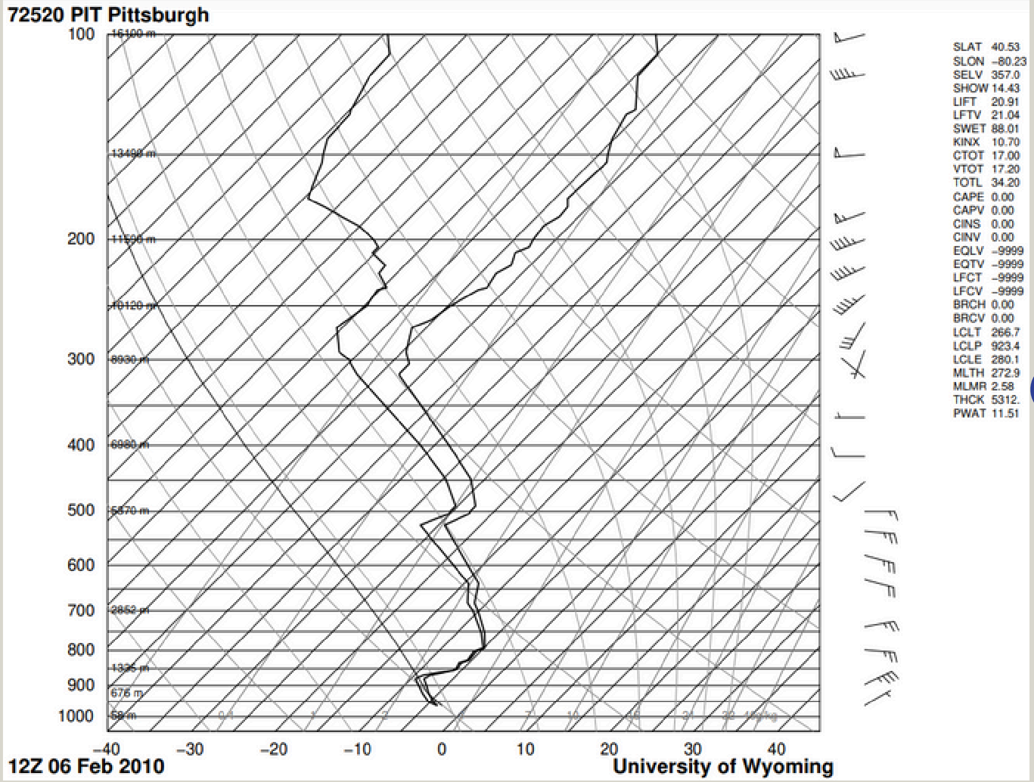
Pittsburgh sounding data from February 4th to 6th illustrates the progression of environmental conditions, providing insights into the atmospheric processes before, during, and after the snowstorm



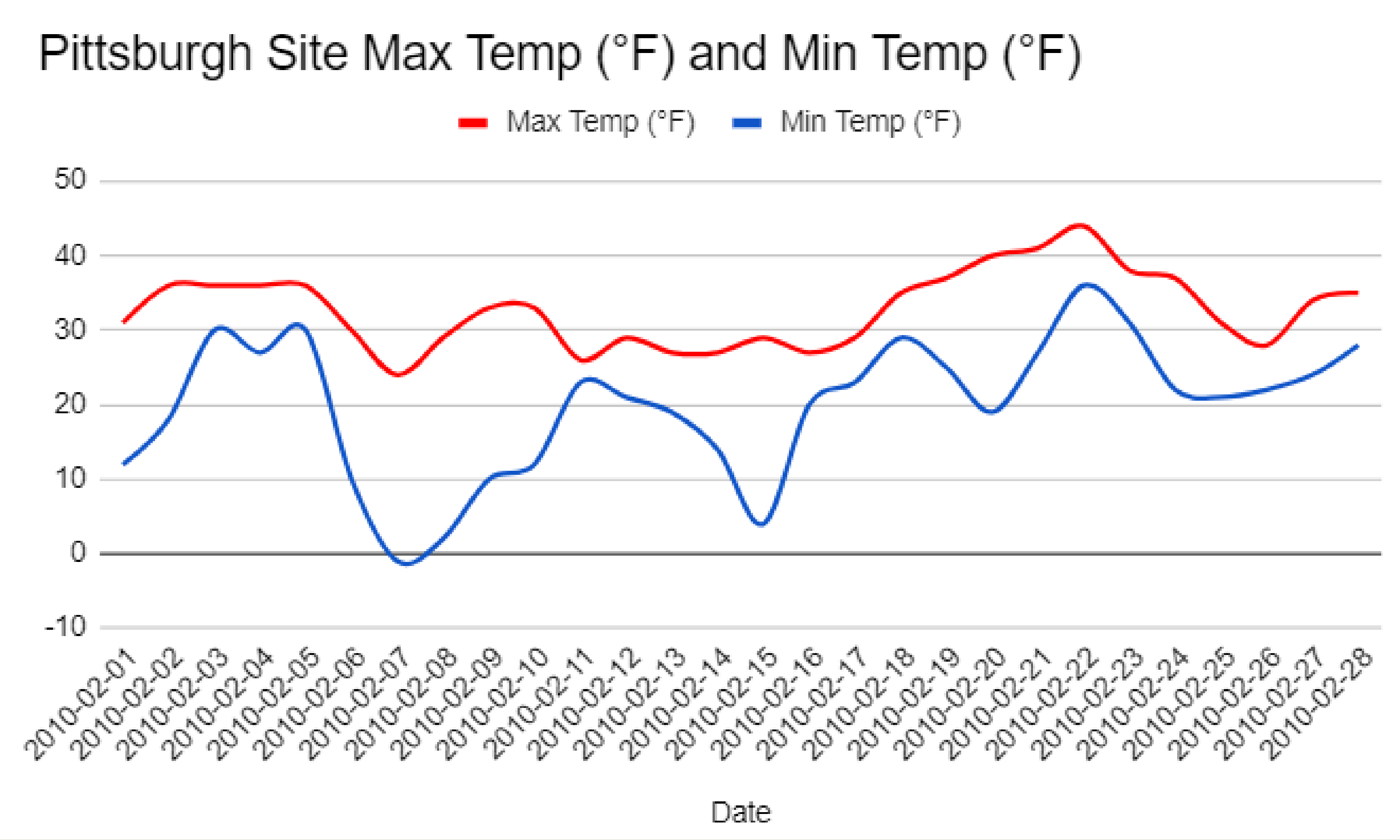


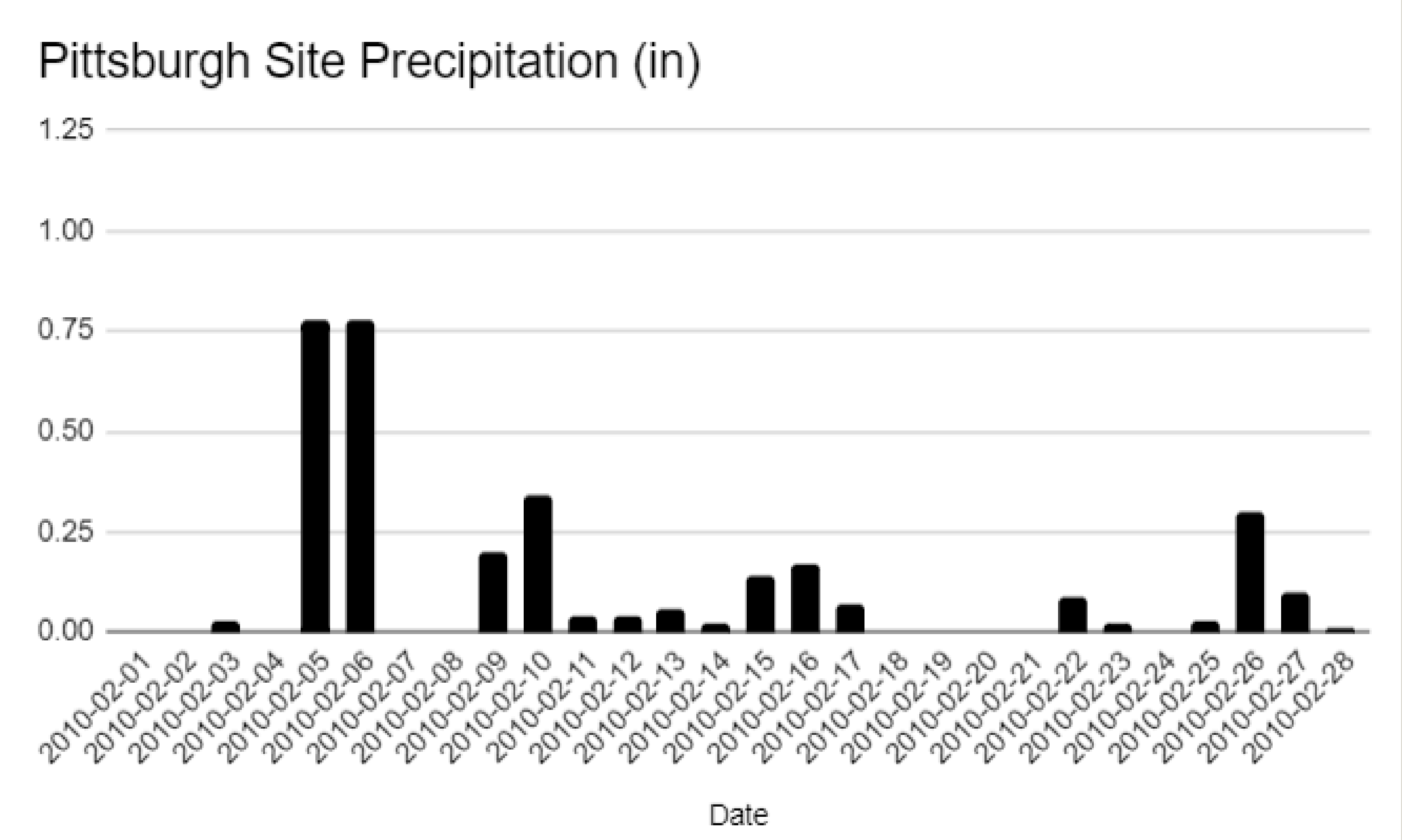


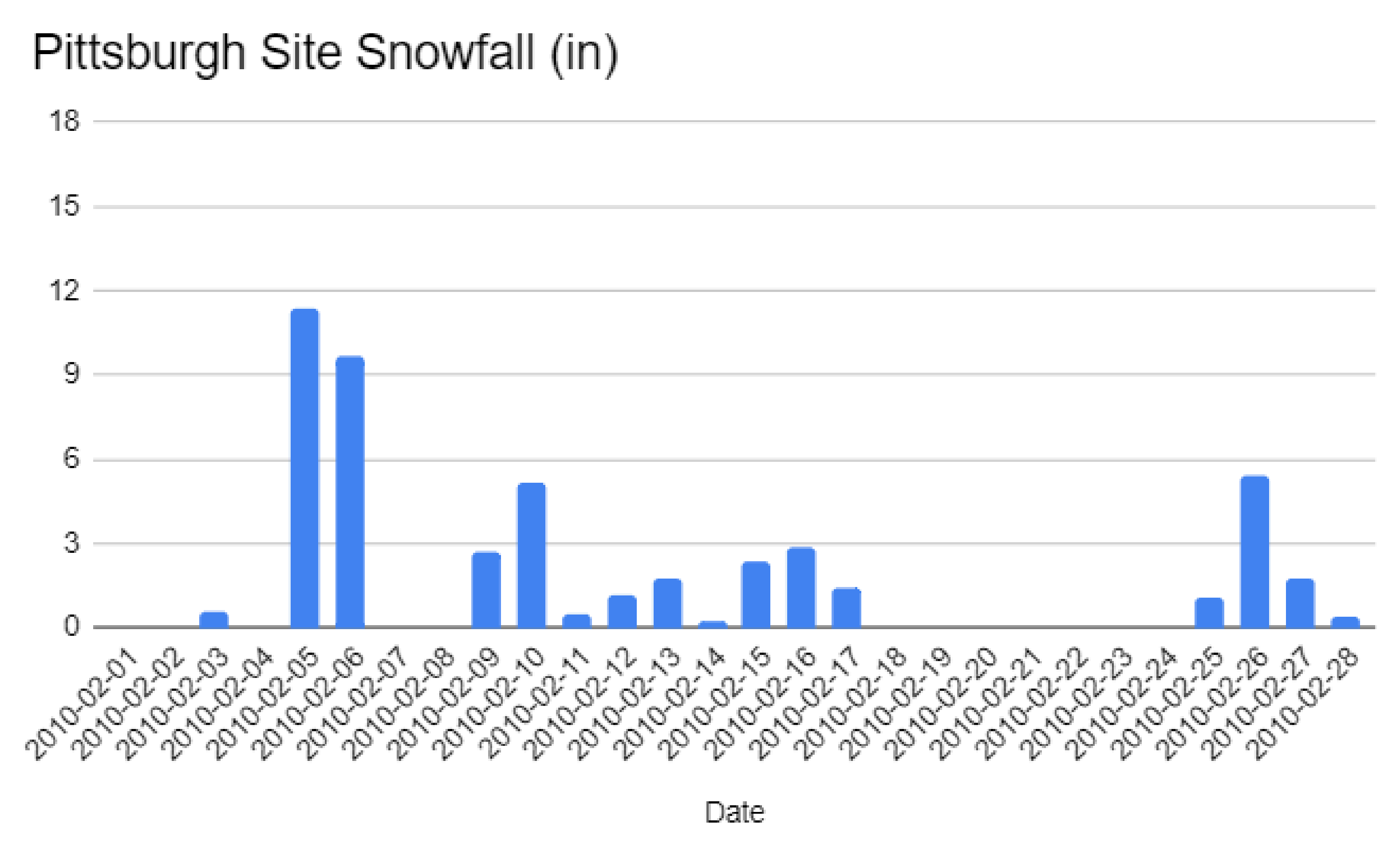


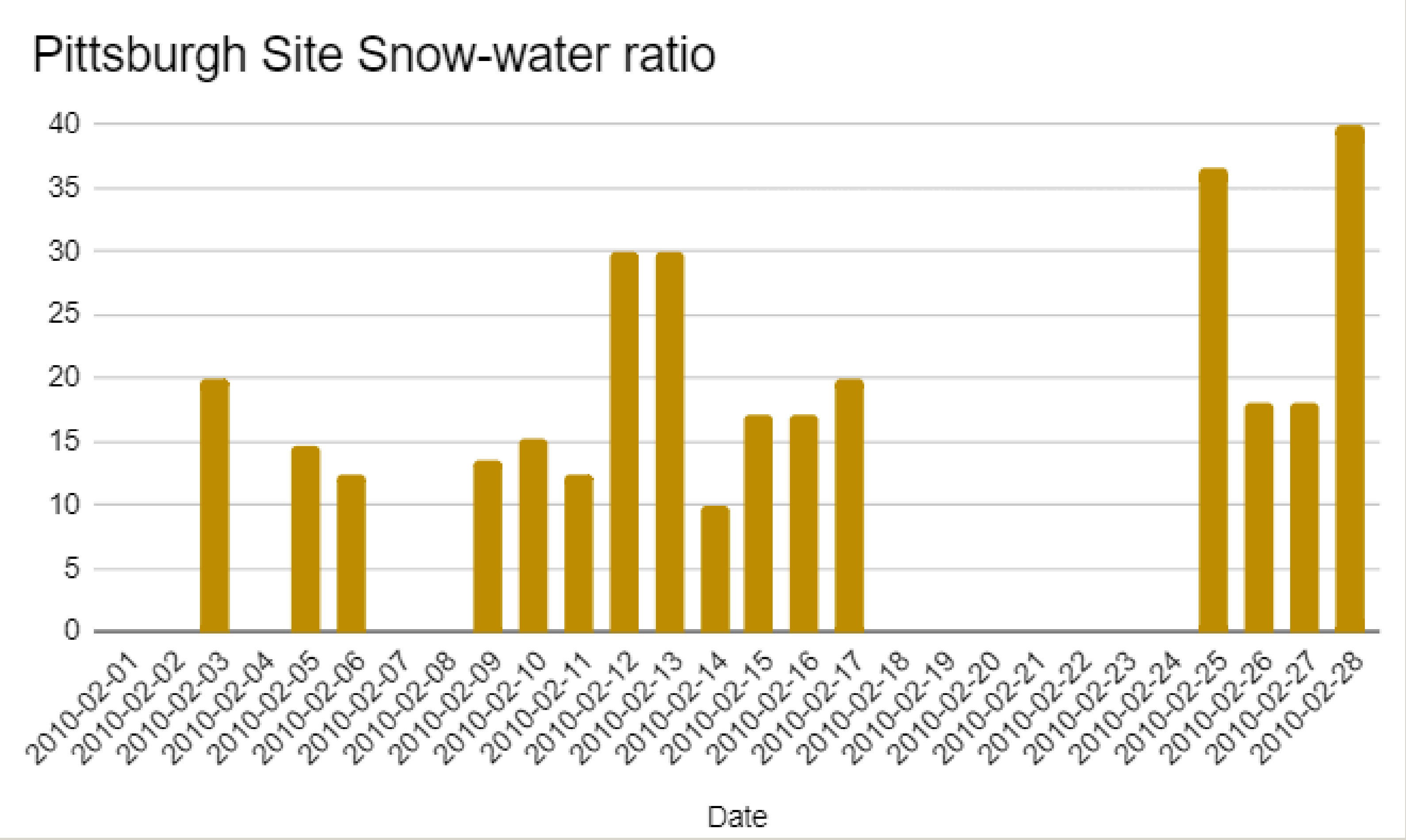


An Observational Analysis: Pittsburgh



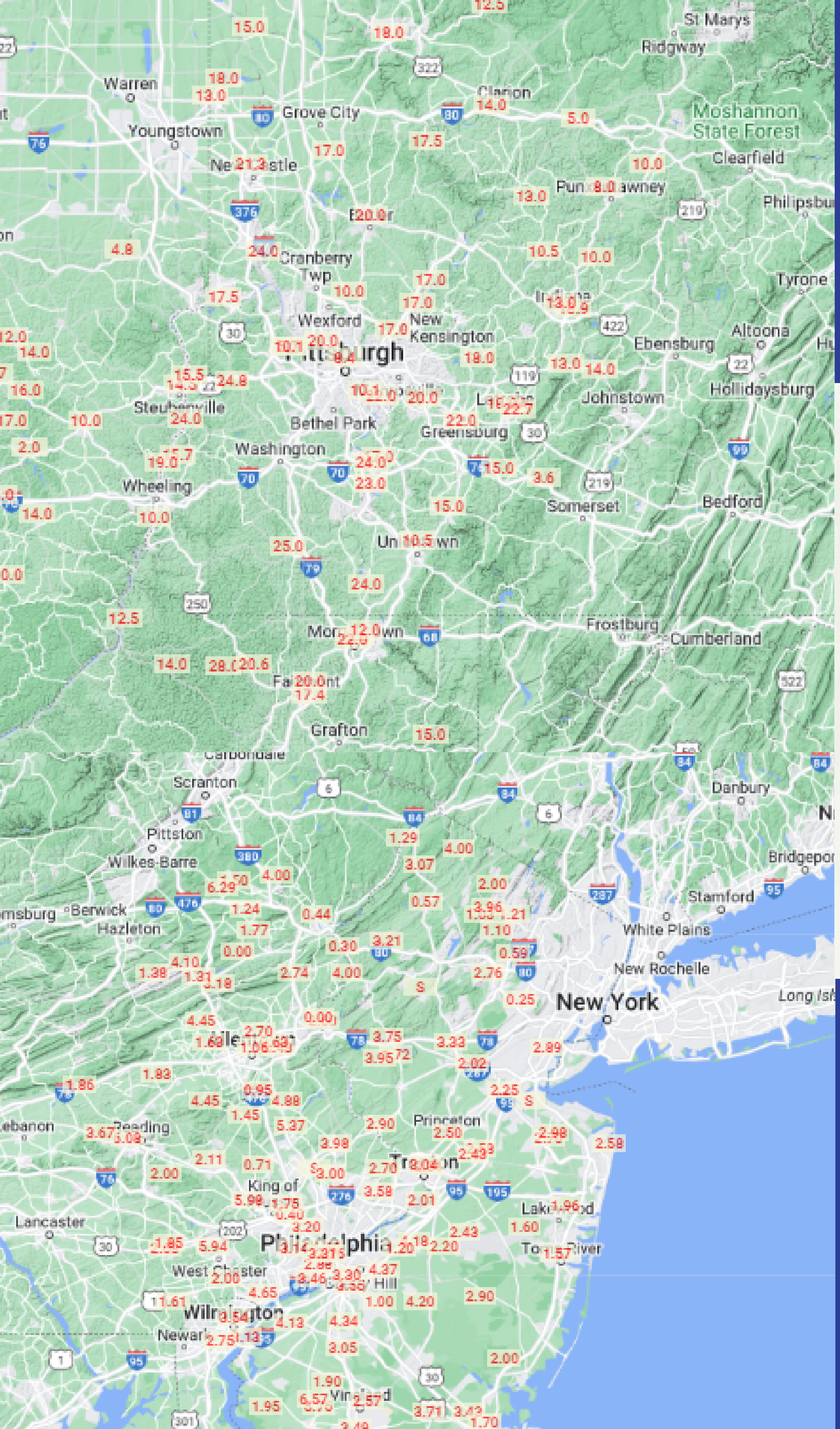






"The Great Thanksgiving Storm": November 24th-26th, 1950

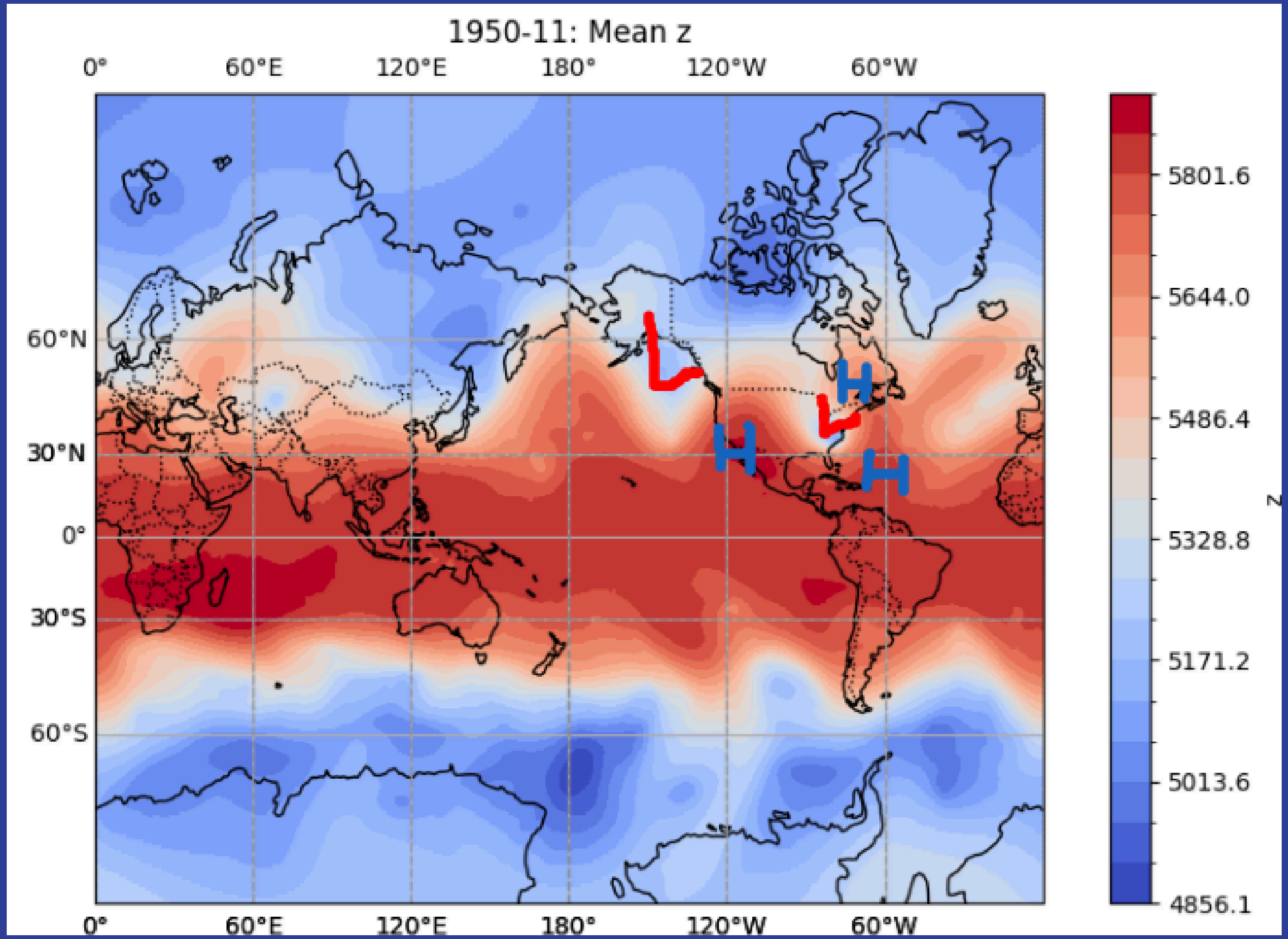
- Sharp temperature gradients
- A blocking high located over the Labrador region, creating a strong pressure gradient across New England
- High wind speeds (>35 mph) and gusts exceeding 100 mph (94 mph in New York City, 108 mph in Newark, 140 mph in Bear Mountain ~40 miles north of NYC)
- Heavy rainfall and flooding associated with warm sector (NY, NJ, eastern PA)
- Predominant blizzard conditions in the cold sector (western PA, West Virginia, Ohio Valley)
- The central Appalachians were covered by 57 inches of snow, with localized accumulations reaching up to 62 inches at Coburn Creek, WV
- Approximately 160 fatalities



High snowfall values recorded in Pittsburgh CWA, while Eastern PA, NJ, and parts of NY received copious rain on November 25th/26th

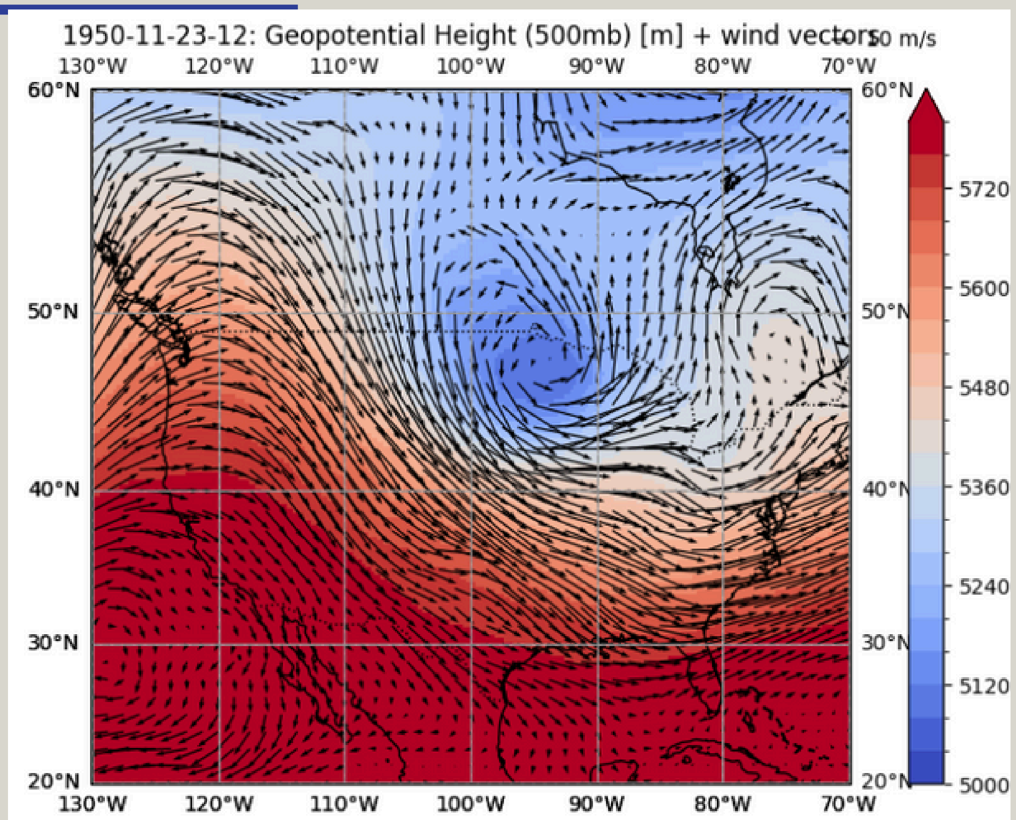
The Great Appalachian Storm of 1950 developed under nearly neutral Pacific sea surface conditions, trending toward a weak La Niña, which influenced atmospheric dynamics and contributed to the storm's severity

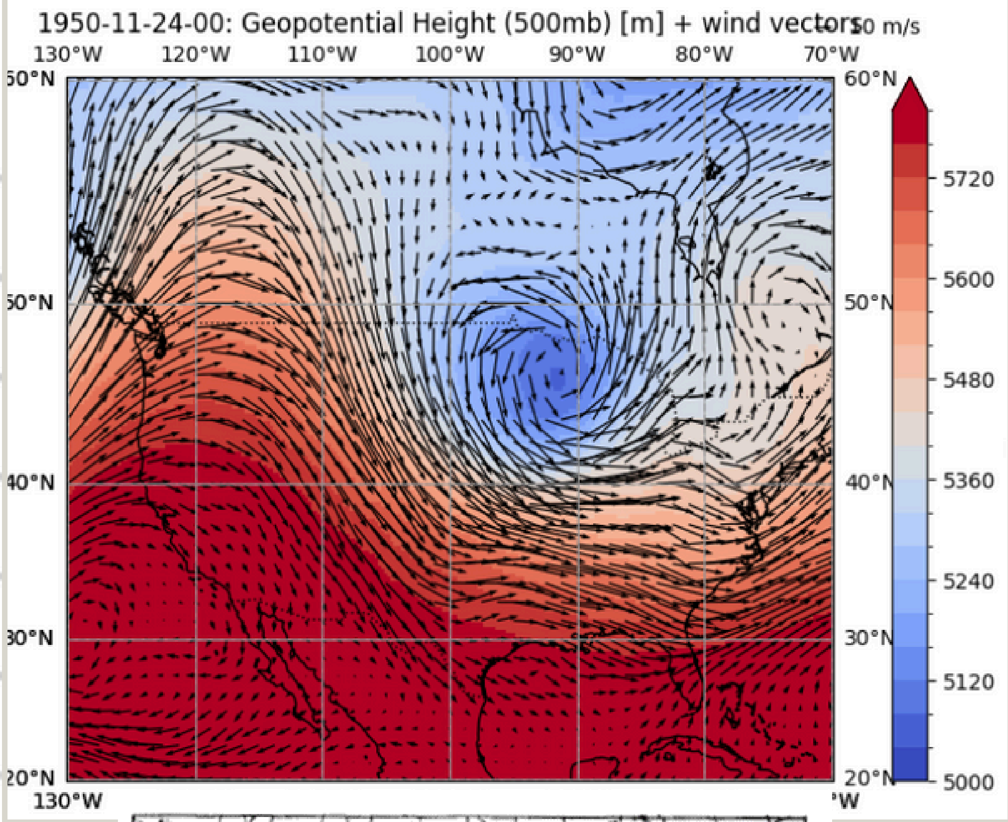
- Weak La Niña conditions allowed the polar jet to fluctuate and enhanced moisture advection from the Gulf
- A strong NAO (-1.26) lowered pressure in the northeastern region, increasing the likelihood of colder temperatures
- Negative AO (-0.515) as allowed for the Jet Stream to shift equatorward , making arctic air intrusion more probable, raising the chance of snowstorms
- Negative PNA (-1.9) may have enhanced the blocking high over Labrador, favoring ridging
- The combined influence of the NAO and AO overpowered the typical winter storm suppression by the negative PNA, leading to storm development.

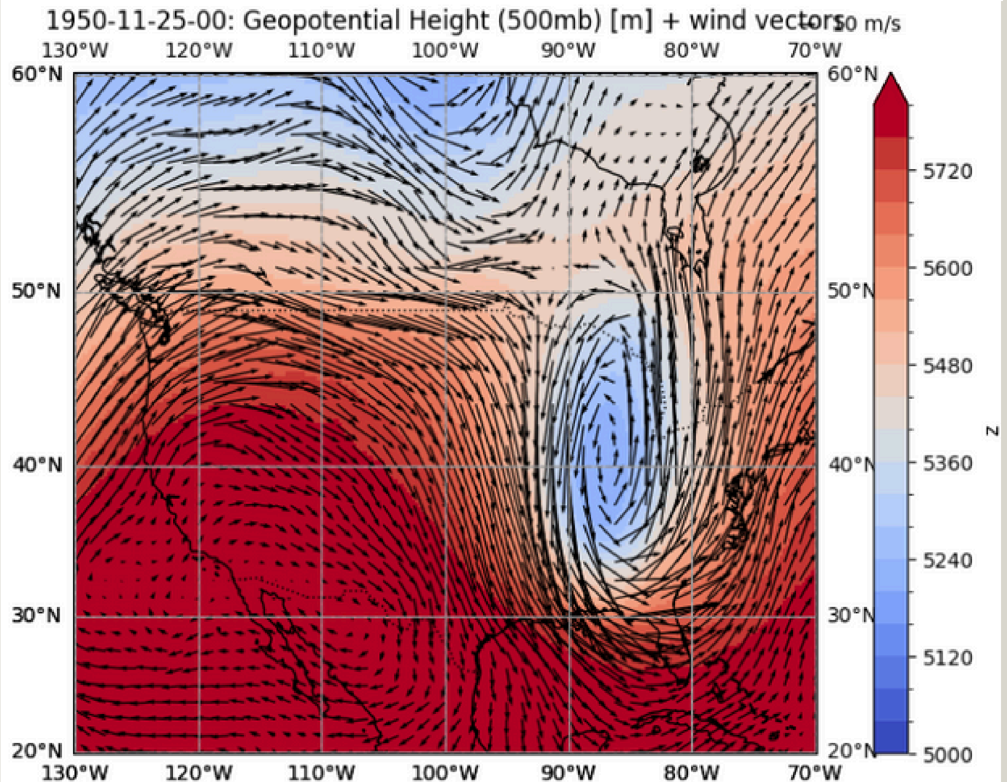


Arctic air mass moves southward behind trough as curved jet streak induces cyclogenesis

- An upper-level trough over Northern Plains dislodged arctic air southward
- Deep northerly flow behind trough supported arctic air invading eastern US and setting record low temps in Midwest and Ohio Valley
- Highly curved jet streak along southern side of trough supported cyclogenesis in southeastern US







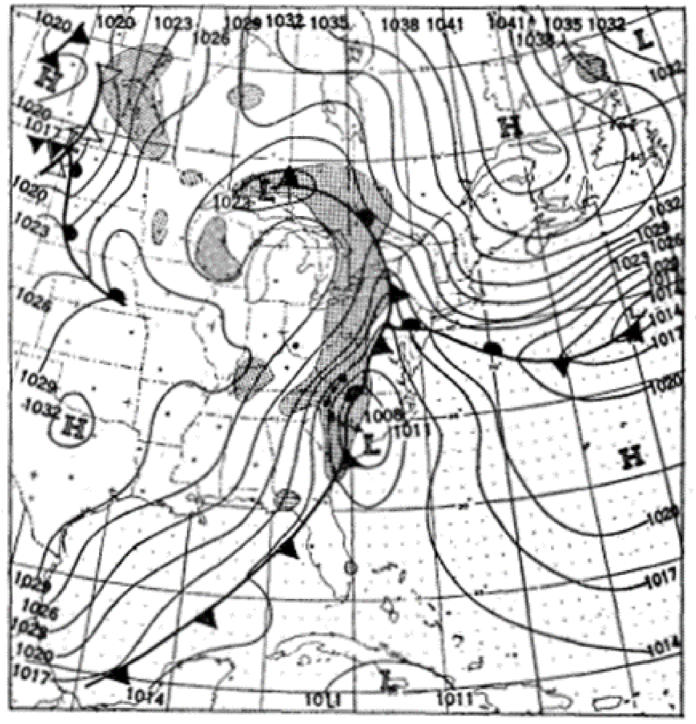
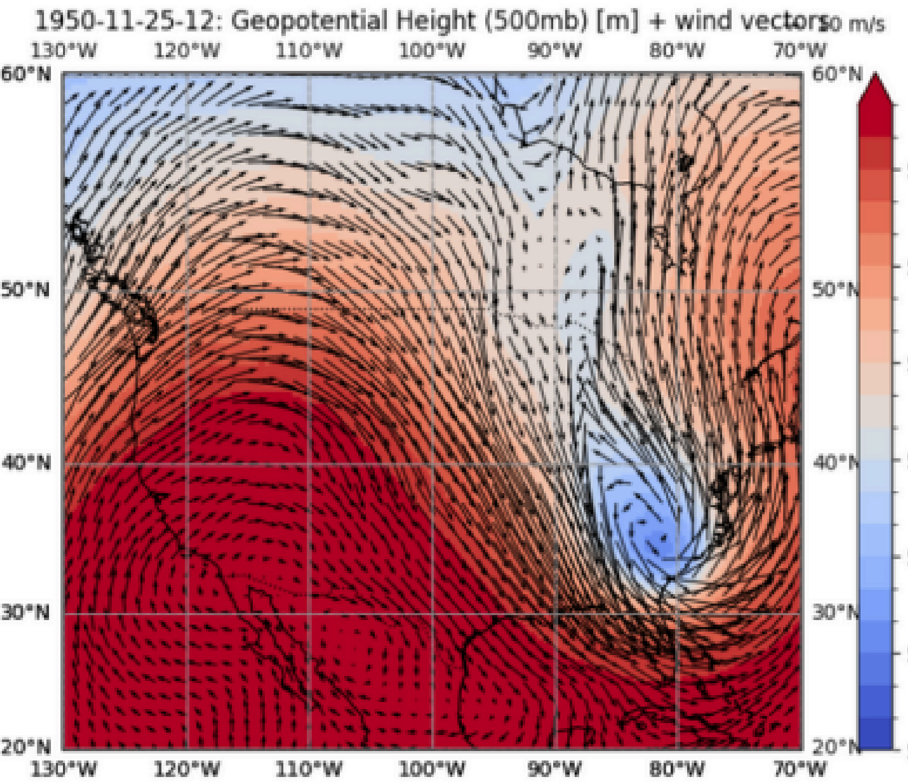


FIGURE 2.—Surface weather chart for 0030 GMT, November 25, 1950. Small squares connected by arrows indicate past positions of main Low at 12-hour intervals.

Strong cyclogenesis, driven by mid-level jet interaction and the convergence of arctic and warm air masses, resulted in efficient and heavy snowfall



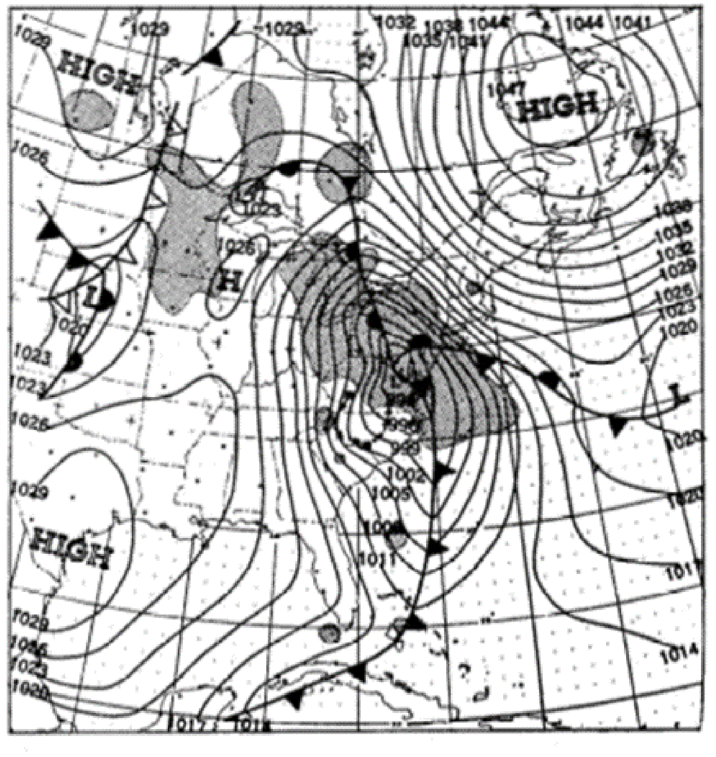
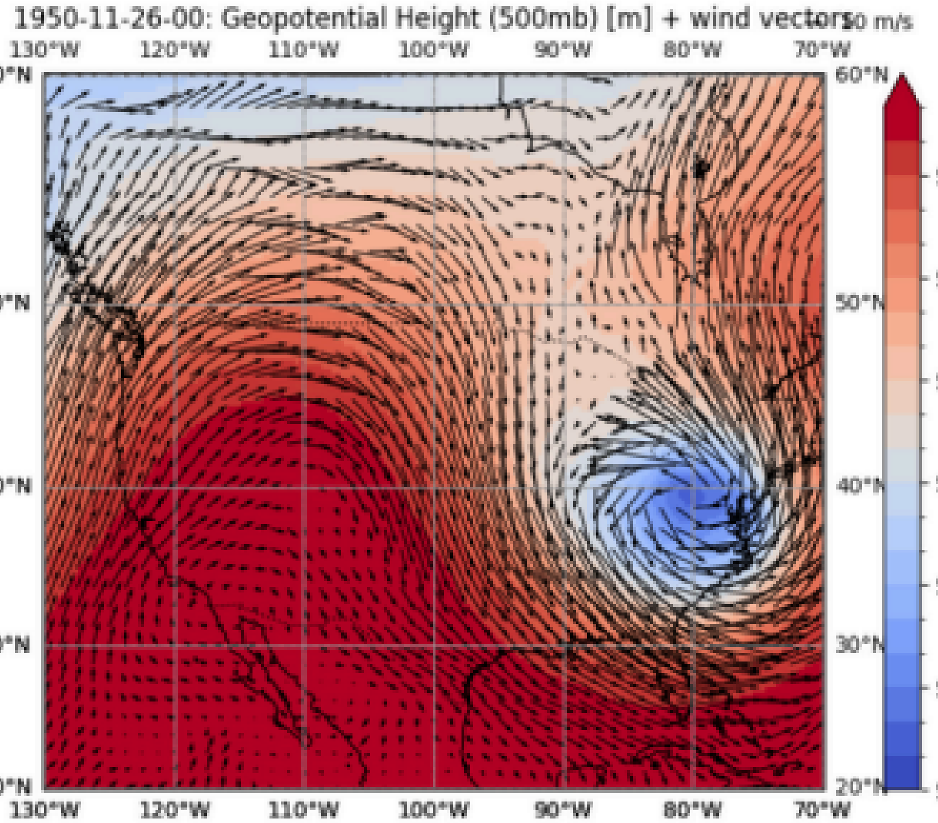


FIGURE 5.—Surface weather chart for 1230 GMT, November 25, 1950.



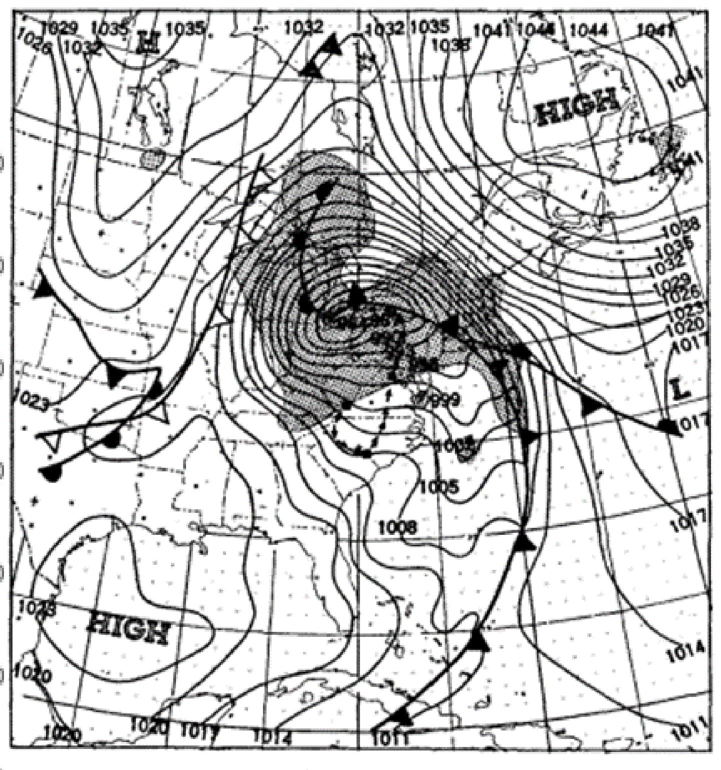
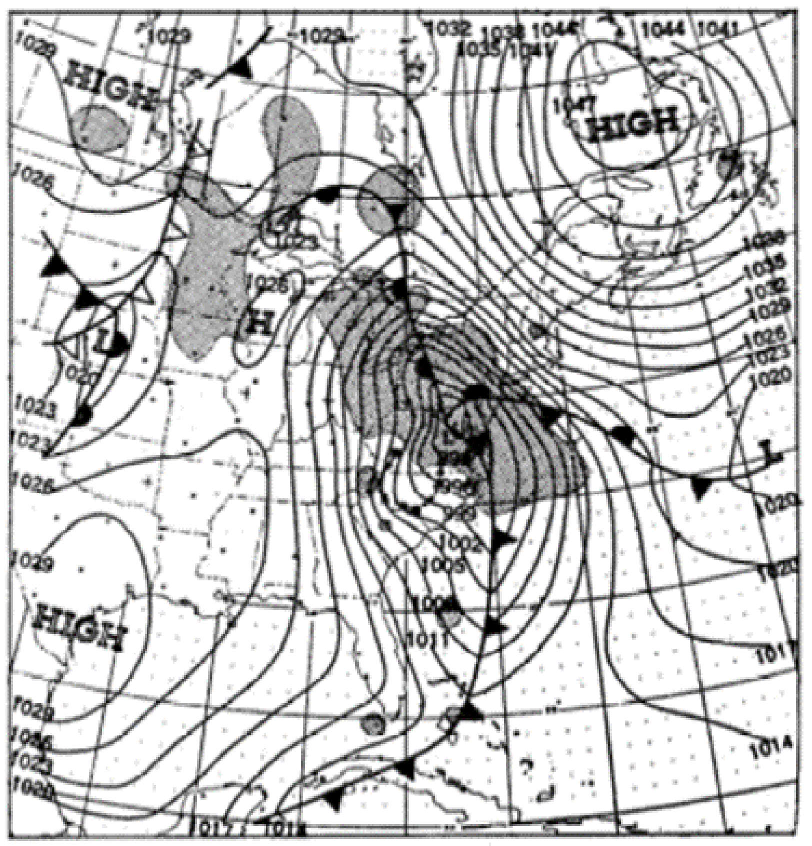


FIGURE 6.—Surface weather chart for 0030 GMT, November 26, 1950.

- Strong cyclogenesis sustained by strong mid-level jet interaction
- Arctic air accelerated southeastward within strong frontogenetical forcing region of jet, while strong warm advection occurred along and north of stationary/warm frontal zone
- Surface winds backed to southeasterly in PA/NY in response to strong low pressure, drawing moisture from the Atlantic
- Warm advection and TROWAL in dendritic zone, deformation zone promoted efficient, heavy snowfall

Surface analysis plots VS Reanalysis plot



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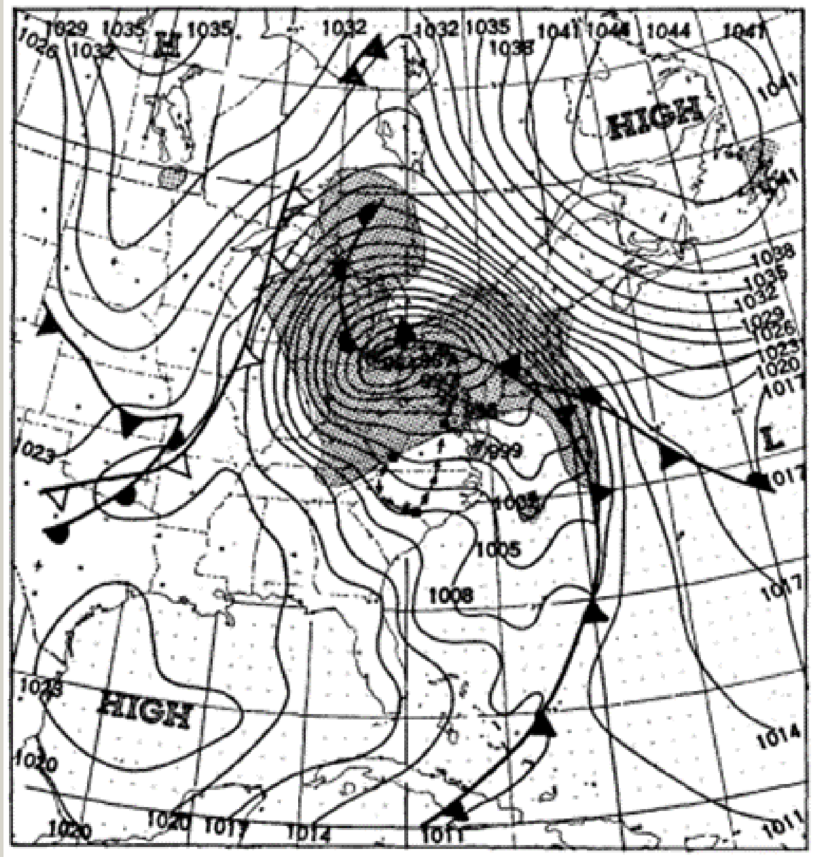

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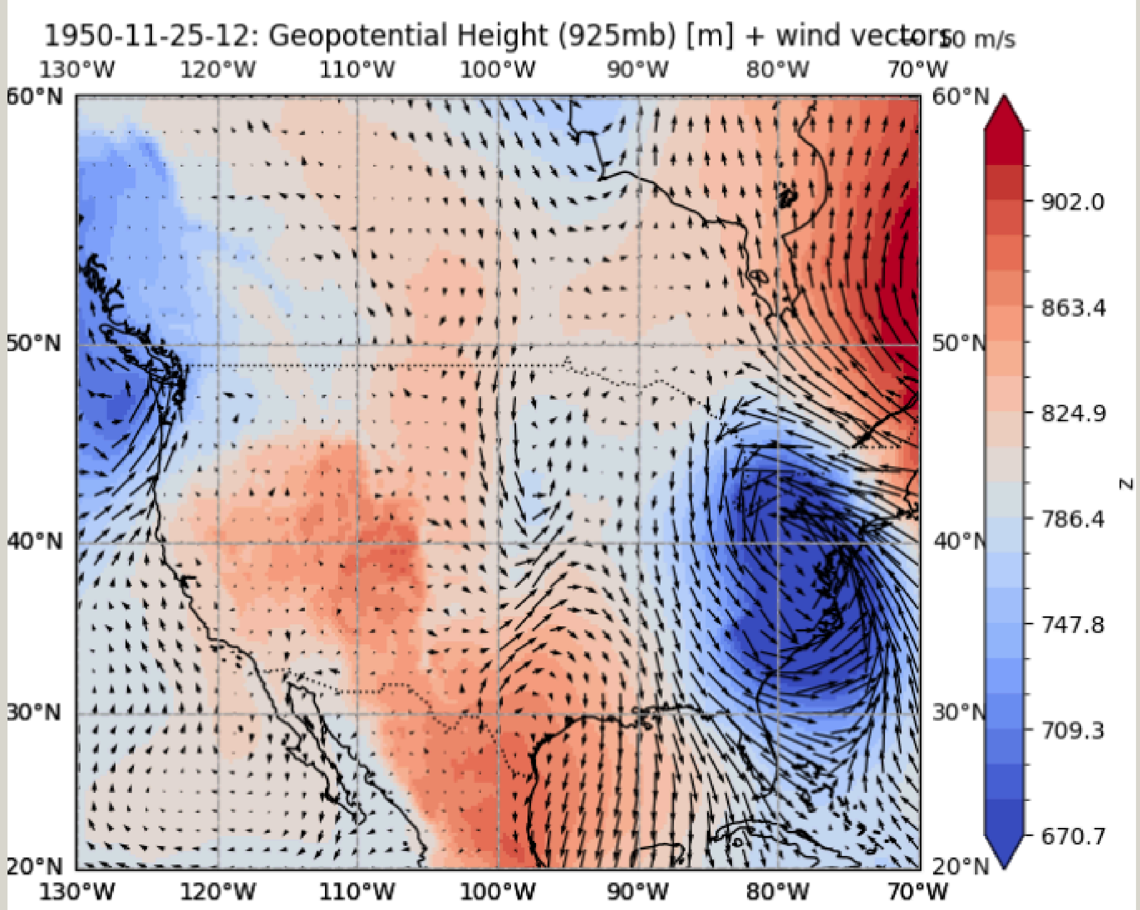
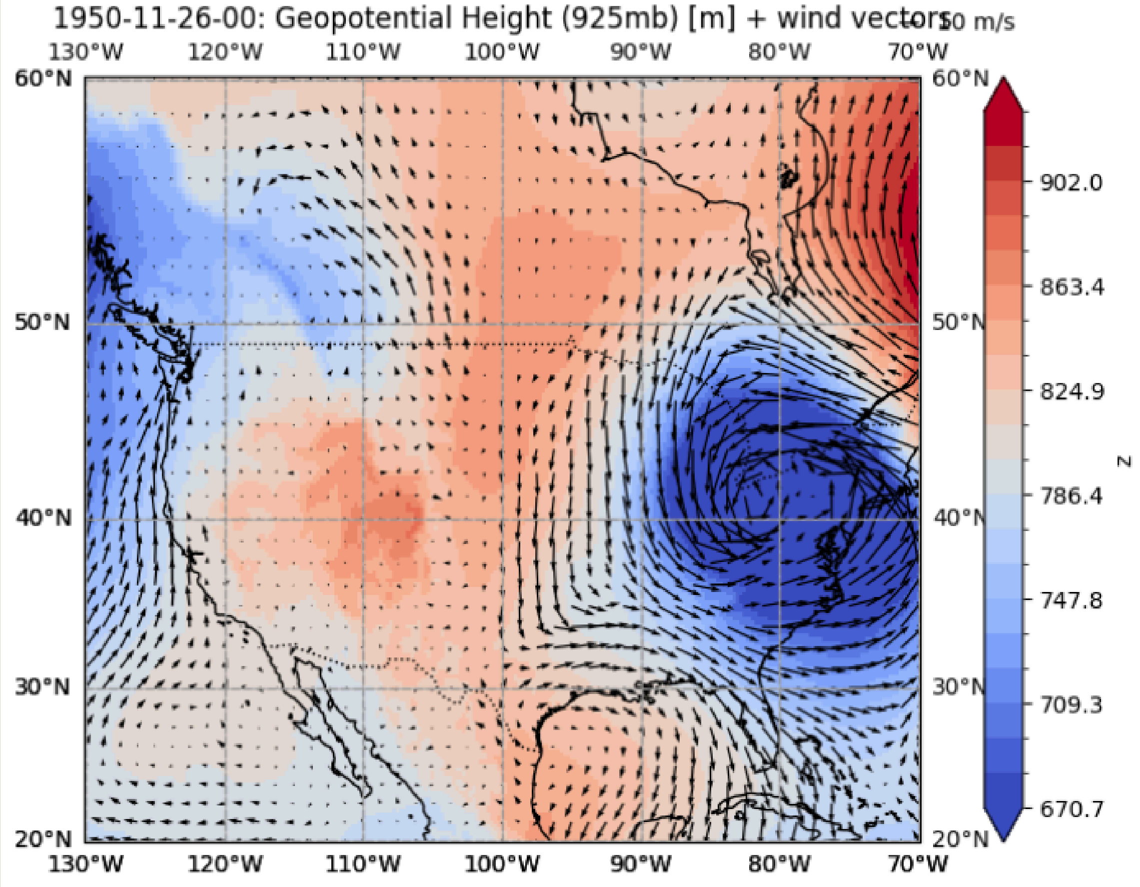
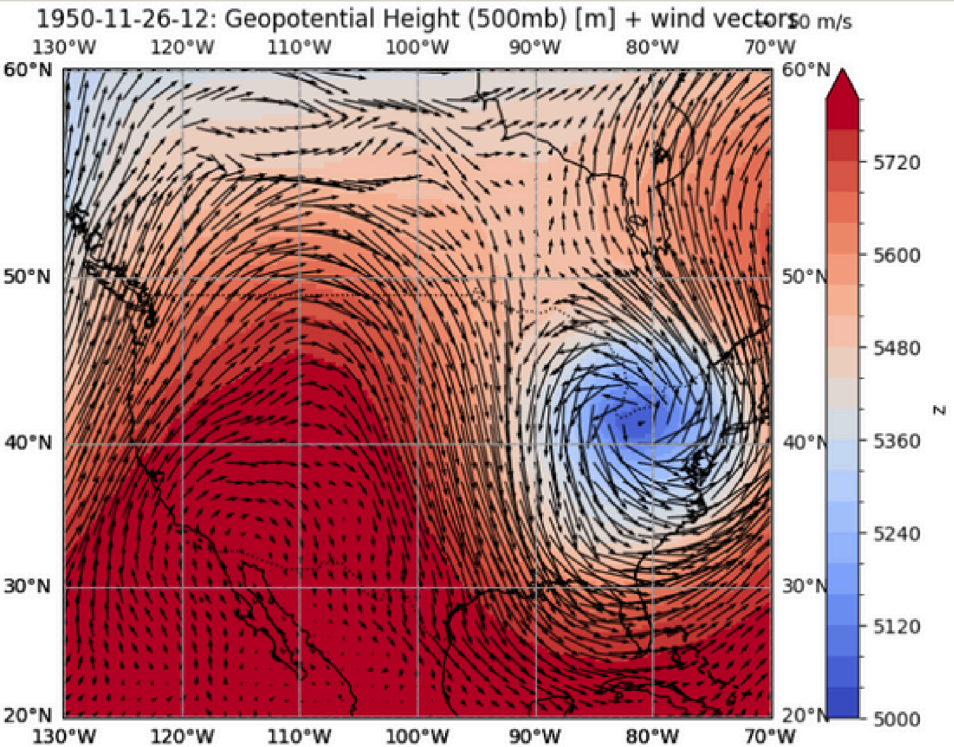
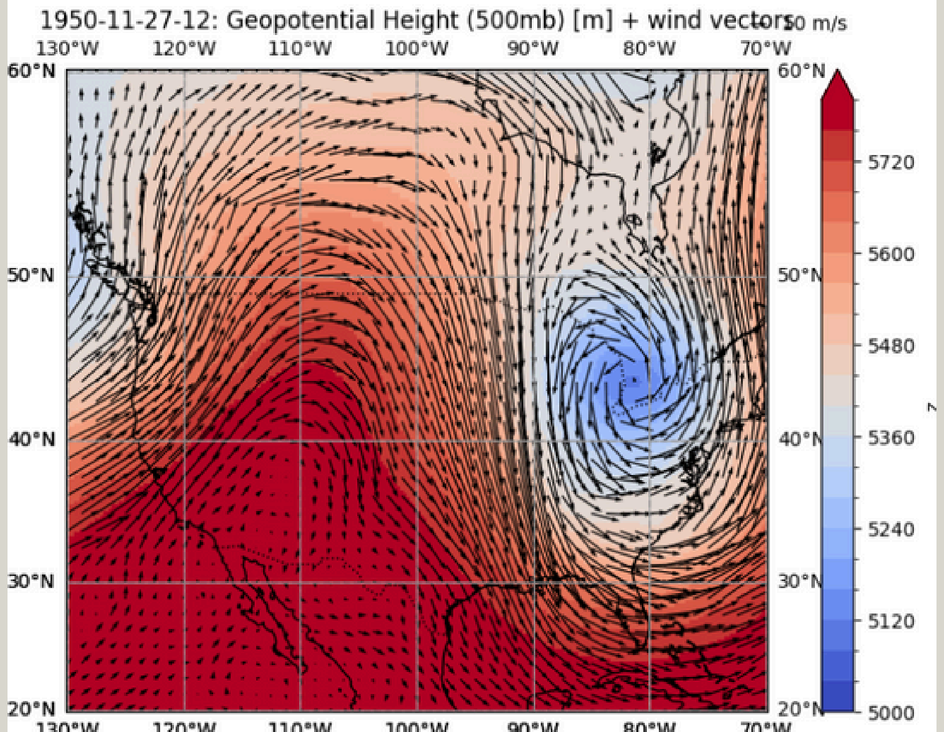


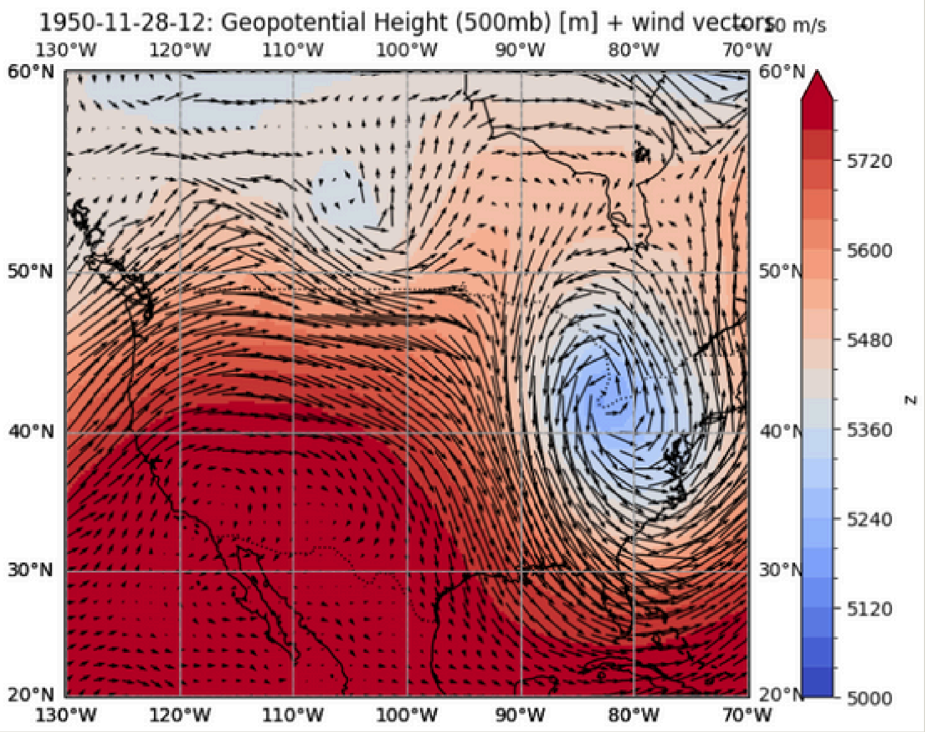


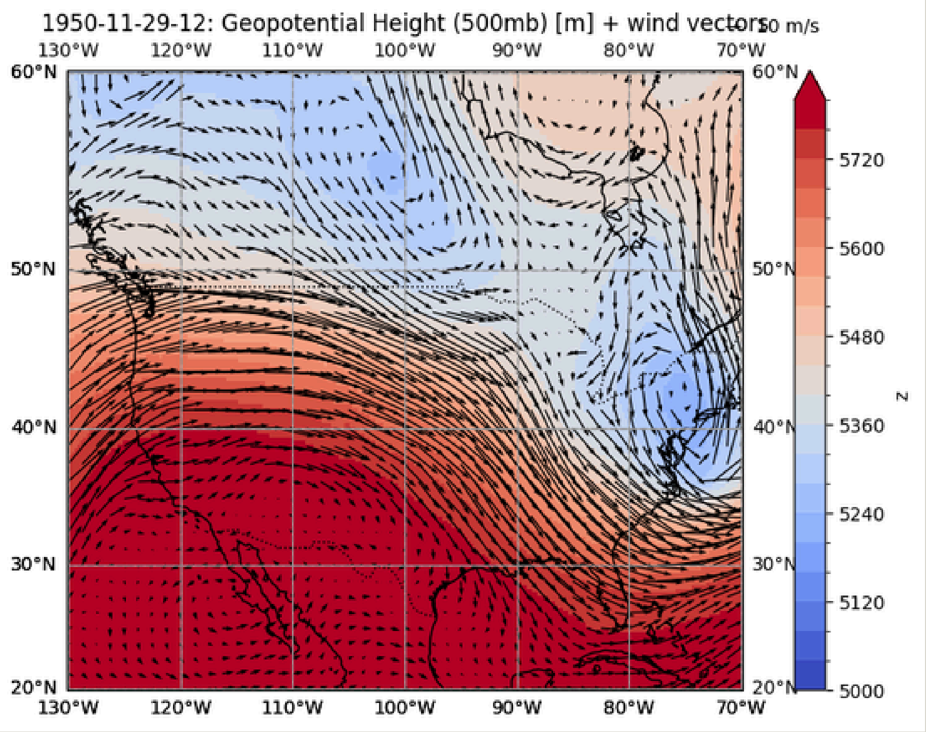
The low's interaction with a blocking high over Labrador diverted it northwest, stalling over Lake Erie and causing prolonged blizzard conditions

- The low encountered a blocking high over Labrador, slowing progress of the upper-level trough while strong jet helped re-orient trough axis
- This interaction diverted the low on a northwestern track toward Ohio, stalling over Lake Erie from the 27th to the 28th
- The strong pressure gradient induced hurricane-force wind at the surface
- The stalled storm caused prolonged snowfall over Pennsylvania and eastern Ohio
- Pittsburgh received up to 30.3 inches of snow by the end of the event

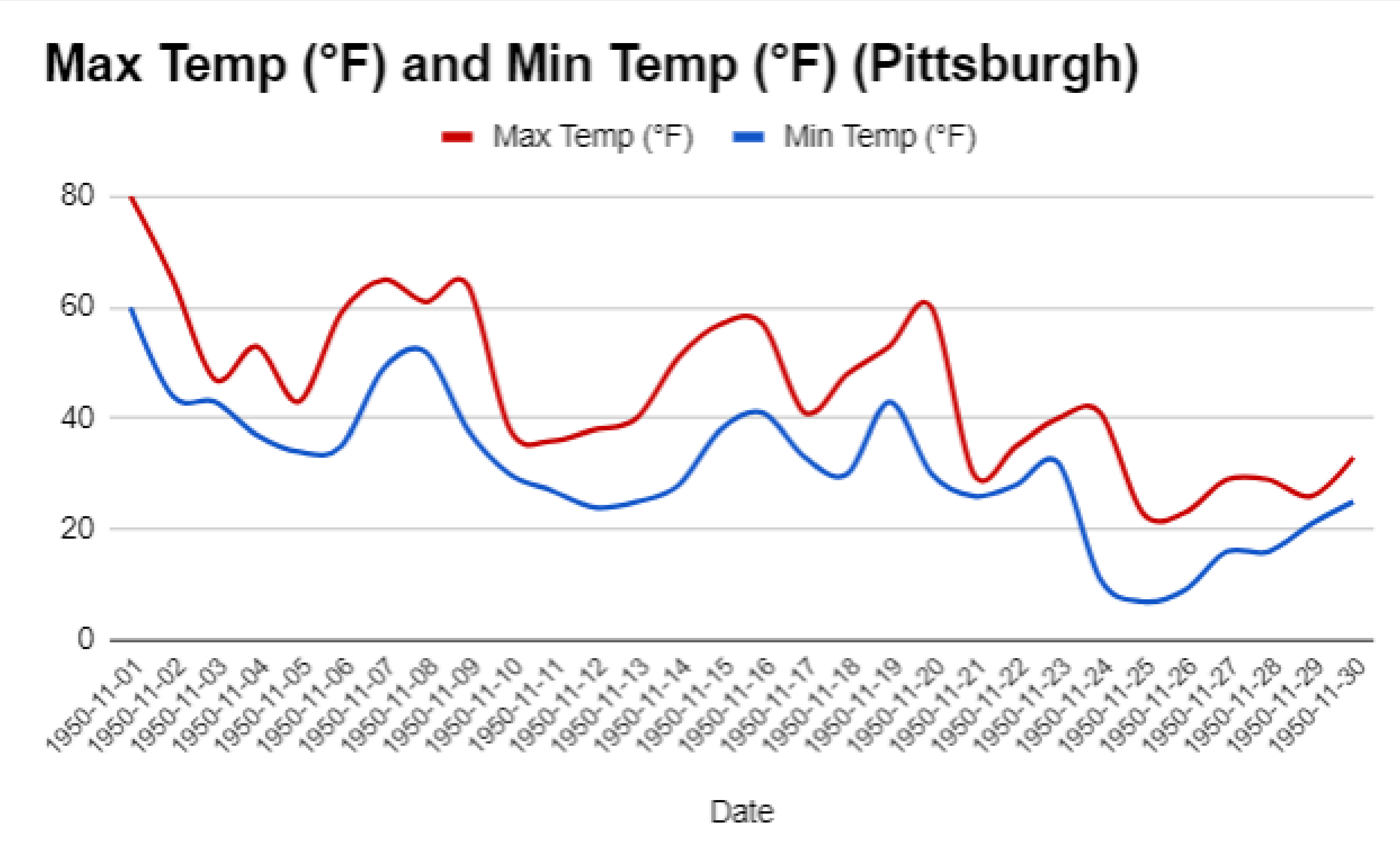


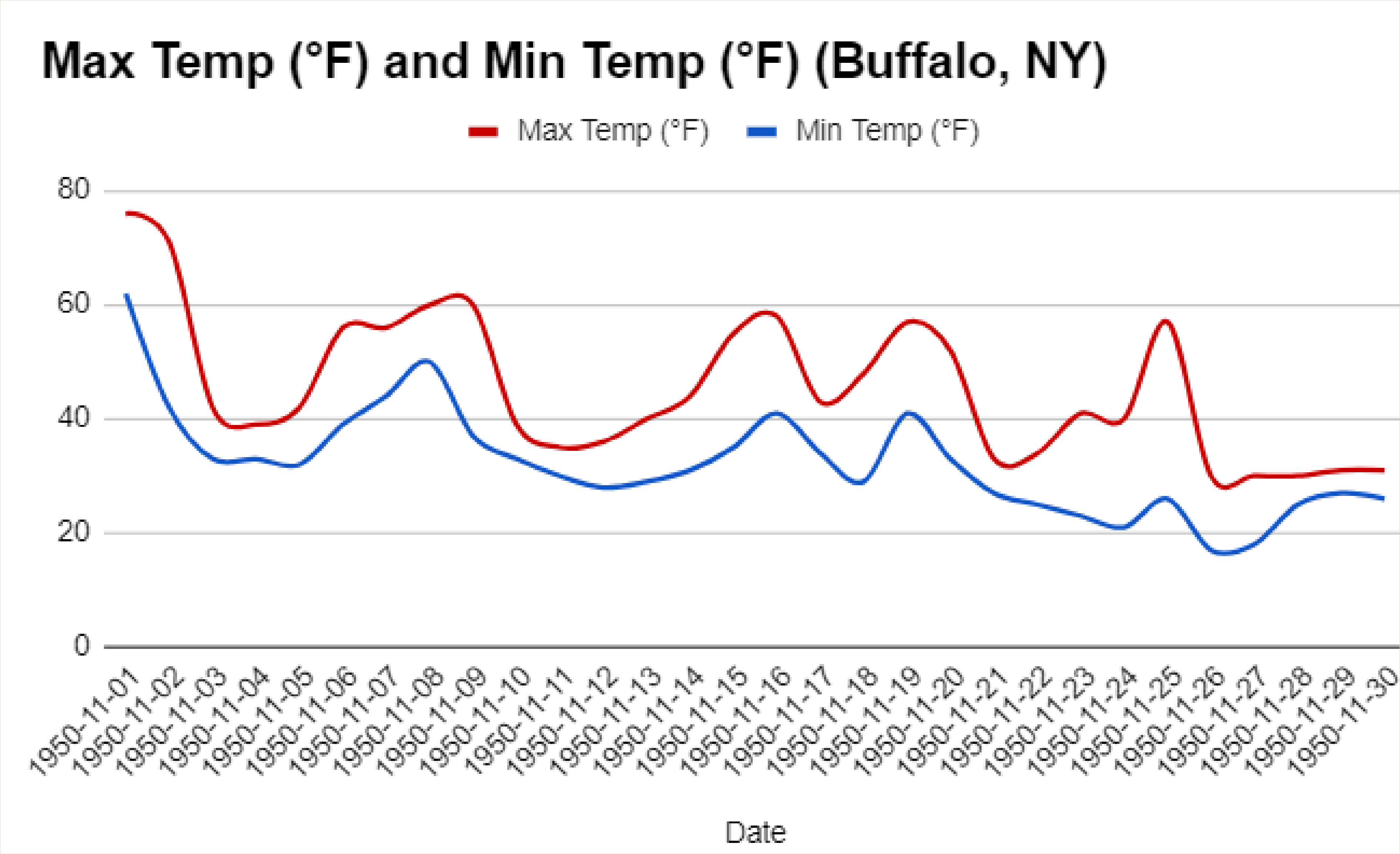




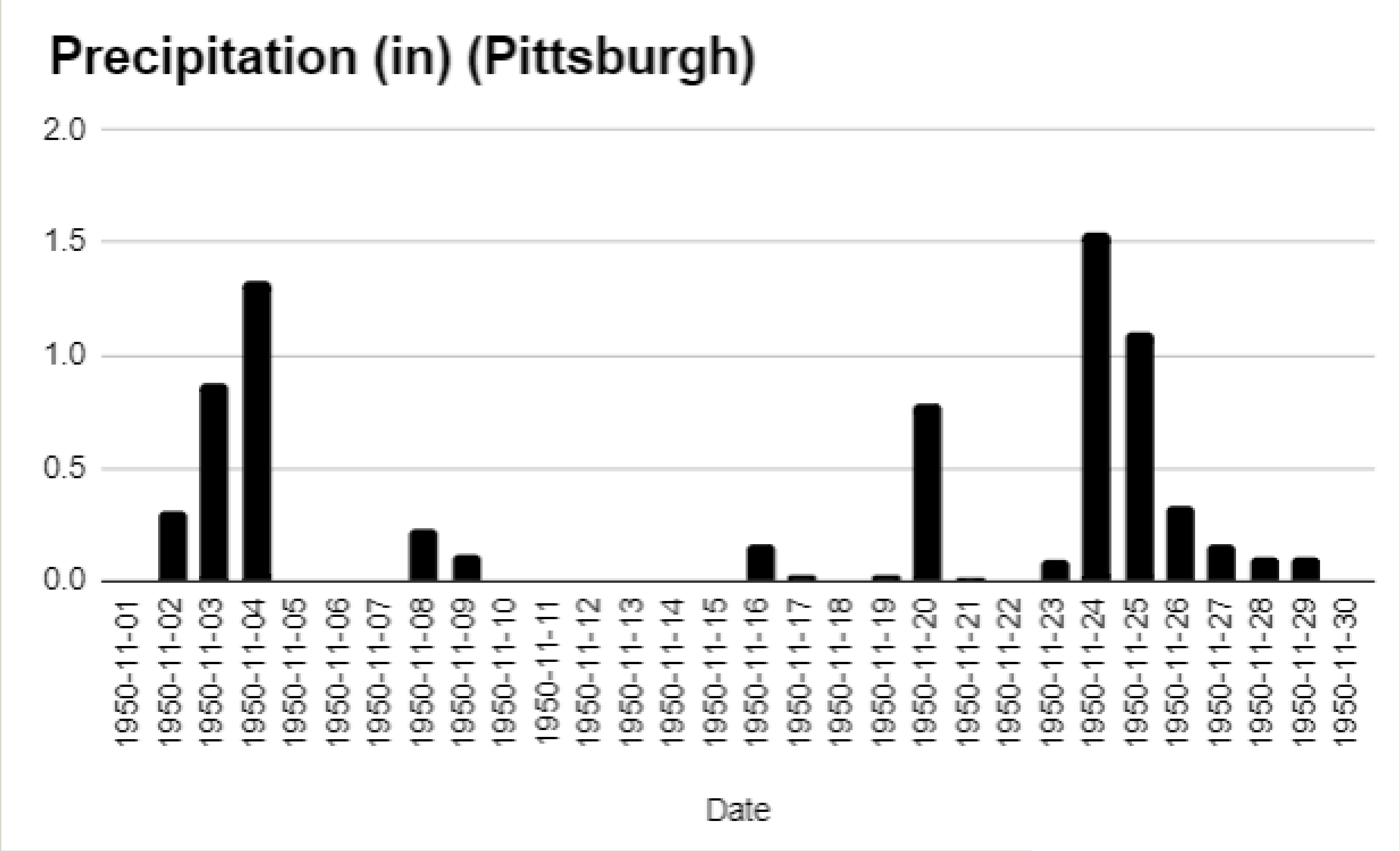


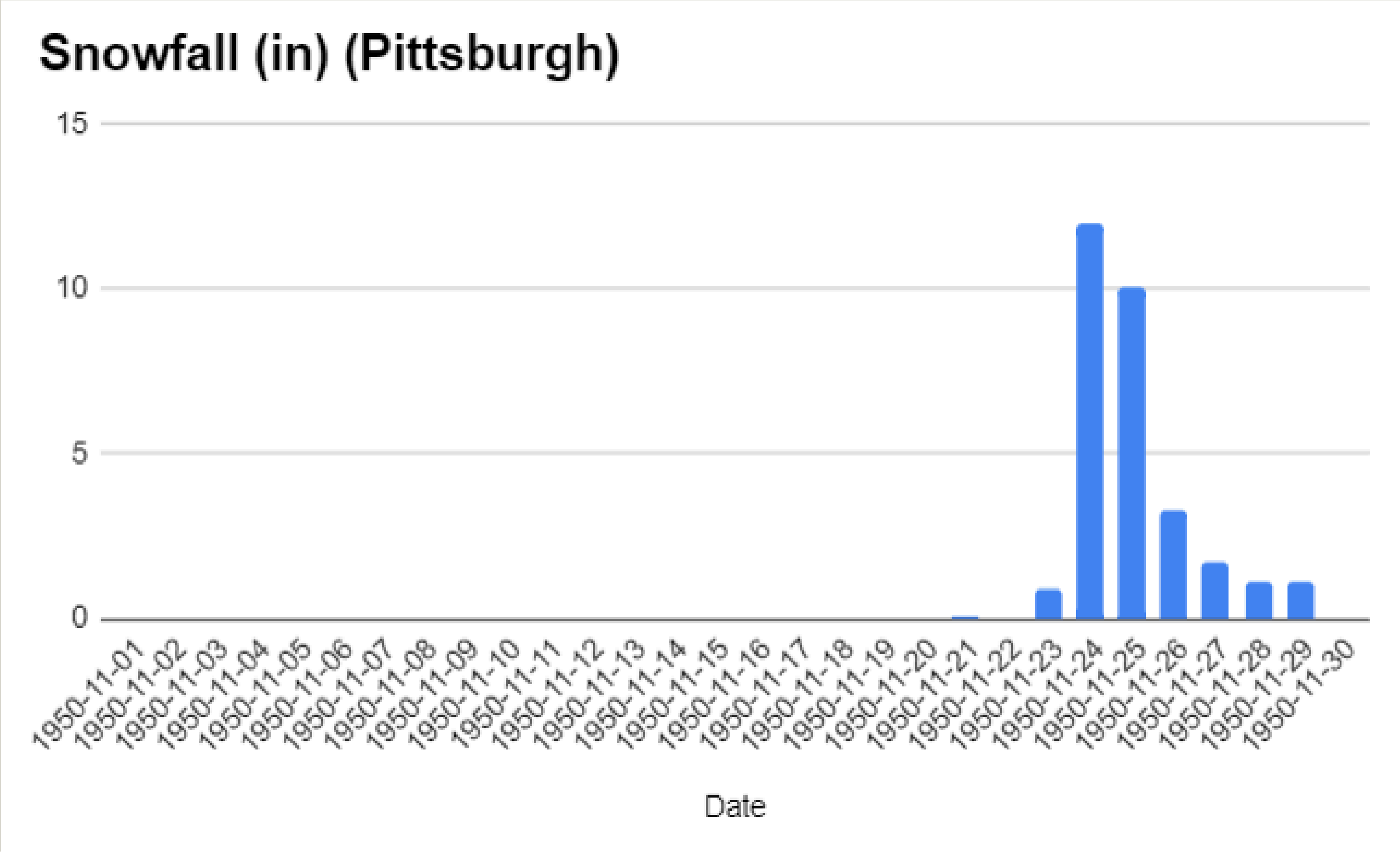
The cold front created a sharp contrast in weather conditions, bringing snow and frigid temperatures to western Pennsylvania while leaving Buffalo, New York, significantly warmer

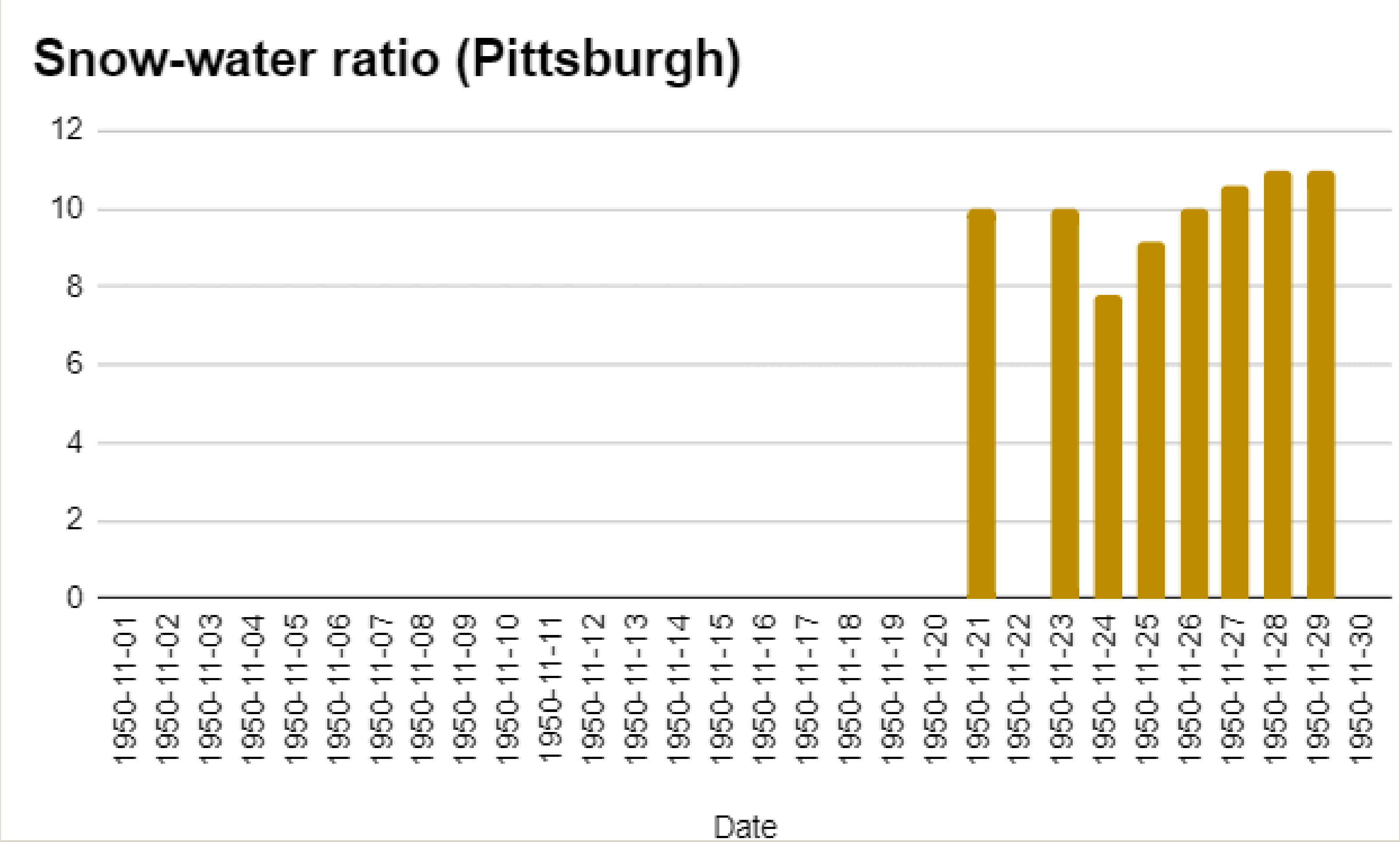




An Observational Analysis: Pittsburgh







THE FEBRUARY 2010 "SNOWMAGEDDON" AND THE GREAT THANKSGIVING STORM OF 1950 WERE TWO HISTORIC WINTER STORMS THAT LEFT SIGNIFICANT IMPACTS ON THE EASTERN US

- **February 2010 "Snowmageddon":**

- An interaction of climatological factors, including moderate-strong El Niño conditions, negative phases of the NAO and AO, and positive phase of PNA, set the stage for the storm
- Synoptic conditions, such as the development of a coupled jet enhanced vertical ascent over Kentucky, contributing to the storm's development
- The event resulted in heavy snowfall, blizzard conditions, and widespread disruptions, with 41 fatalities and over 200,000 homes and businesses without power.

- **Great Thanksgiving Storm of 1950:**

- Developed under nearly neutral Pacific sea surface temperatures, influenced by a negative phases of NAO and AO.
- A blocking high over the Labrador region and a significant temperature gradient led to a powerful storm with hurricane-force winds, heavy snowfall, and record low temperatures
- The storm caused extensive damage, with around 160 fatalities and Pittsburgh receiving up to 30.3 inches of snow

The Pittsburgh Press

FINAL

'Final' Offensive Gains 15 Miles

10-12 INCH SNOW, 5° DUE

MacArthur Sees Victory By Christmas

It Will Take Some Doing—

Dewey Blames Human Failure For 77 Deaths

All-Time Record Fall Predicted

What Happened to Men Who Didn't Come to Dinner?

- **Both events underscore the importance climatological factors play in prolonging the impacts of coastal winter storms.**

Resource Page

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