

15/15

Emily Lucy
ATM 400 Research Proposal

OK to use first person for proposal but not in paper

I will be studying the 15^{on dash} 17 December 2020 nor'easter. This event resulted in heavy snow accumulations across much of the Northeast, due to an intense snowband that set up from central Pennsylvania to southwestern Maine. Over 40"^{Use MKS units} of snow was recorded in the Southern Tier of New York State, as well as other localized pockets in Vermont and New Hampshire. High snowfall rates were an important factor in these accumulations. Flights were canceled at airports across the Northeast, vehicle accidents were numerous, and a sports complex dome collapsed in Binghamton as a result of the accumulations. In addition, guidance trended northward for several days prior to the event, with the GFS^{Define acronyms} exhibiting a storm track that was too far south, even at a short lead time. This right-of-track bias has been recorded several times in winter storms impacting the northeast. ^{→ should provide a reference in paper}

A surface low formed off the Southeast coast late on 15 December, and tracked northward along the Eastern Seaboard of the United States downstream of an upper-level trough. As it ^{→ vague} moved, it brought rain and freezing rain to the Mid-Atlantic throughout 16 December. However, I intend to focus on the region that experienced the largest snowfall, as the forecast for this region changed significantly leading up to the event. A coupled jet, with ^{its} a southern portion oriented northeast ^{on dash} southwest over the Carolinas, and ^{its} a northern portion exhibiting the same orientation over Maine and the Canadian Maritimes, enhanced the large-scale divergence downstream of the trough axis. As the cyclone deepened and reached the Northeast coast by 0900 UTC ~~on~~ 17 December, frontogenesis, especially at 700mb[^], resulted in an intense snowband that contributed to the majority of the accumulation. Co-located with this region of frontogenesis was a region of weak stability, promoting vertical motion. At the same time, the surface circulation, while not incredibly intense, brought moisture from the Atlantic into this region of enhanced frontogenetic forcing, elevating the potential for heavy precipitation. The low pressure off the Northeast coast and a surface high over Quebec contributed to a steep pressure gradient, and ³ thus, stronger onshore winds. The result was over 2 feet of snow in a narrow band from central Pennsylvania to southwestern Maine, with localized pockets of over 40 inches. ^{MKS units}

Good S dynamics

In order to analyze this event from a synoptic perspective, I will examine the evolution of forcings at several vertical levels using the UAlbany CFSR^{Spell out first time used} data sets, as well as the evolution of the GFS from the Iowa State archive. These plots will be done in Python. At 300mb[^], I will look

at the coupled jet and associated divergence in the poleward exit of the southern jetstreak and the equatorward entrance of the northern jetstreak. I will examine vorticity at 500mb, in order to see how regions of positive/cyclonic vorticity advection contributed to upward vertical motion. At 700mb, I will plot temperature advection and frontogenesis to show the forcing ^{responsible for} behind the band of heaviest snowfall. I would like to plot moisture convergence in the low-levels to evaluate the role of the orientation of the cyclone in providing the source for the heaviest band of precipitation, as I hypothesize that this was one of the most important factors in the event. I will use surface observations to aid in the analysis of ^{to} what the upper-level support contributed ~~to~~. Besides the synoptic forcing mechanisms involved, I wanted to take a look at model progression from the perspective of a winter storm exhibiting a right-of-track bias. To do so, I will plot sea level pressure at 0900 UTC ~~on~~ December 17th (just prior to the most intense snowfall in the band), from several GFS runs leading up to the event. } Nice!

→ This is an excellent summary of the storm & plan for examining its interesting aspects. I especially like that you will examine moisture convergence & model trends. I look forward to seeing your results.

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Evan Belkin
ATM 400 – Research Proposal

The Blizzard of 26–27 January 2015 brought considerable societal impacts to a large portion of the Northeast Contiguous United States (CONUS) due to the combination of very heavy snowfall accumulations and strong winds. The heaviest snowfall accumulations of 65–90 cm occurred from eastern Long Island of New York State into much of eastern New England. The 24-hour snowfall accumulation record was broken in Worcester, MA which received a staggering 88 cm of snow! One challenging aspect for meteorologists forecasting this storm was the anticipated sharp westward cutoff of the snowfall accumulations. Due to a last-minute eastward shift in the storm track, New York City, which was originally forecast to receive upwards of 60 cm of snow, ended up only receiving half of the forecasted amount. This resulted in several members of the public calling this storm a “bust” and even criticizing former Mayor De Blasio for his decision to shut down the subways. A tightening pressure gradient also resulted in impressive wind gusts. Widespread blowing and drifting of the snow ensued which greatly reduced visibilities. MacArthur Airport in Islip, NY gusted to 22 ms^{-1} and reported a visibility of an eighth of a statute mile during the peak of the storm at the 0800 UTC 27 January observation. Several schools and businesses were closed for one or more consecutive days due to travel bans. As a result of the large population impacted, the Blizzard of 26–27 January 2015 was rated a significant category 2 on the Northeast Snowfall Impact Scale (NESIS). This research project aims to understand the synoptic forcings that resulted in the blizzard’s intensity and to provide analysis on the last-minute eastward shift in storm track.

Unqualified
This
Best
to use
MKS

Excellent!

At 1200 UTC 24 January 2015, the base of a shortwave trough was located over southwest Canada near Alberta. A weak surface low pressure system associated with this shortwave developed and moved quickly to the southeast following the typical Alberta Clipper track. At 1800 UTC 25 January, the Weather Prediction Center (WPC) surface analysis placed the center of the low overhead Illinois downstream of the base of the shortwave trough. Analysis of the winds at 300 hPa indicated two separate jet streams, one of which was located over a large portion of the central Plains and the other across the Southeast CONUS associated with the subtropical jet stream. Twenty-four hours later at 1800 UTC 26 January, the two jet streams had phased and the energy associated with the Alberta Clipper began to get transferred to the mid-Atlantic Coast consistent with a Miller Type-B storm track. The base of the now negatively-tilted upper-level trough was located over the Southeast CONUS. A jet streak was positioned just east of Florida and the Mid-Atlantic States were within the poleward-exit region of this jet. Upper-level ridging was also beginning to build into southeastern Canada where an Arctic surface high pressure system had developed. A tightening baroclinic zone developed across the Northeast CONUS due to the moist Gulf of Mexico air being advected poleward competing with the Arctic air. A second jet streak developed across northern New York and New England, which placed the Mid-Atlantic States in its equatorward-entrance region. Convection and associated diabatic heating on the northern quadrant of the deepening cyclone likely acted to further tighten the baroclinic zone and strengthen the northern jet streak. More importantly, this coupled jet structure and strong upper-level divergence would result in the forcing for ascent required for the rapid deepening of the cyclone off the Mid-Atlantic Coast. This deepening was further enhanced by strong cyclonic vorticity advection in the form of both curvature and shear vorticity. Six hours later, by 0000 UTC 27 January, explosive cyclogenesis was well underway and southeast New York into southern New England were experiencing very heavy snowfall and strong wind gusts in the northwest quadrant of the storm.

Great
Summary
of the
important
dynamics!

Vague...
vorticity?

To further research the synoptic forcings, it is critical to connect back to the quasi-geostrophic (QG) Omega and Chi equations. Data from both the Climate Forecast System Reanalysis (CFSR) repository and Global Forecast System (GFS) will be plotted to further examine the synoptic forcings responsible for this blizzard. Specifically, 300-hPa and 700-hPa temperature advection as well as 500-hPa vorticity will be plotted to determine height tendencies from QG Chi. To understand where vertical motion was

Why
both? S

maximized, vorticity advection at several levels will be plotted since positive differential vorticity advection will result in negative omega. The thermal wind will also be plotted to use the Sutcliffe-Trenberth Omega Equation which states that positive vorticity advection by the thermal wind results in upward vertical motion. A particularly interesting aspect of this blizzard that should be researched ^{en dash} ~~were~~ ^{are} the pivoting snow bands that set up across eastern New England. Strong 850–700-hPa frontogenesis coupled with low-level warm air advection resulted in pivoting mesoscale snow bands consistent with the findings from Kenyon et al. (2013). Therefore, frontogenesis at these levels and low-level temperature advection will be plotted and analyzed. Areal soundings will also be used to determine if the strongest frontogenesis coincided within the dendritic growth zone (DGZ). Finally, several GFS model runs will be plotted to try to figure out why several numerical models struggled with the storm track. One area that could be explored is the effect that the speed of the shortwave trough had on the phasing of the two jet streams.

* Great job, Evan! You're a fantastic scientific writer and touched on all of the important dynamics! I look forward to reading your paper 😊

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Kelly Geiger
ATM 400 Research Proposal

For this research project, I am going to investigate the synoptic forcings for the Super Outbreak of April 2011. The Super Outbreak of 2011 occurred across four days, from April 25th to April 28th. This outbreak spanned mainly across the Southeast United States. However, storm reports ~~had~~ ^{were} also ~~been~~ recorded up the East Coast and into New York. It was recorded by NOAA that at least 350 tornadoes ~~had~~ ^{ing} occurred during the four days, ~~this~~ included four EF-5 tornadoes. Sadly, this outbreak injured thousands and the number of casualties was recorded to be around 300. The worst of the tornado outbreak occurred during the afternoon and evening hours of April 27th and continued into the early morning hours of April 28th with a total of 292 tornado reports on the 27th and 15 tornado reports on April 28th. Because of this, I will be focusing my research project on the days of April 27th and April 28th of 2011.

Good summary of severity & impacts

Define acronyms

By the late evening hours of April 26th, a high amplitude 500mb trough was starting to place itself over the Great Plains. There was a jet streak of around 80 knots upstream of the trough that extended from California all the way to Texas. By 0100Z on the 27th, the base of the trough was situated over Northern Mexico, New Mexico, and Texas. At 0100Z, a well-defined short-wave trough was embedded in the flow over Texas and Oklahoma. Also, at 850mb, a strong low-level jet with winds around 60 knots, focused over Texas, Louisiana, Arkansas, and Mississippi. This ^{jet} helped to organize a massive QLCS in the early morning hours of the 27th that ended up moving through Mississippi and Alabama at around 0900Z and continued until around 1200Z before falling apart. This produced several tornado reports. At 1200Z, the jet streak of 80 knots continued to round the base of the trough, which was still situated over Northern Mexico, New Mexico, and Texas. By 1800Z, the exit region of the jet streak was located right over the states of Arkansas, Louisiana, Mississippi, and Tennessee., with the poleward exit region located over Northern Arkansas. This caused there to be a strong area of upper-level divergence and a surface low to develop and strengthen right under it. Associated with the surface low, a dry line and cold front feature ~~was~~ extended down over Arkansas and Louisiana. This boundary moved through the Southeast United States and caused dangerous, severe storms to pop up and move through the rest of the day and into the early morning hours of the 28th. These are the storms that produced the bulk of the tornadoes for those two days.

Unqualified this

Good review of jet & trough evolution

To conduct research by looking at the synoptic perspective of this outbreak, I intend on looking at the SPC Hourly Mesoanalysis archive and plotting UAlbany Climate Forecast System Reanalysis data on Python to evaluate the forcings at different levels of the atmosphere. My main

Define

Good!

goal for this project is to evaluate how the strengthening of the jet streak at 500 mb aided in the formation and strengthening of storms. I also plan on looking at how Quasi-Geostrophic height tendencies played a role in strengthening this jet streak. I will do this by looking at the temperature advection at different levels of the atmosphere. At 300mb, I will be looking at the jet and associated trough to find and examine areas of upper-level divergence and upward vertical motion. At 500mb, I will be looking at vorticity and vorticity advection to also find areas of upward vertical motion. At 700mb, I will be evaluating frontogenesis and temperature advection to look at the dry line and cold front features that moved over the southeast United States. I will also examine surface observations to look at the dry line and cold front features.

↳ Good summary of this very strong event!
You've identified key synoptic forcings to examine and not gotten too far into the mesoscale. I look forward to reading about your results!