# Similarities and Differences of Interactions among Synoptic and Mesoscale Weather Systems during March 3 – 5 2019, March 12 – 14 2019, April 11 – 13 2019, November 26 2019, December 16 - 17 2019, January 10 – 11 2020 and February 5 – 7 2020 events

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ABSTRACT

The 11 – 13 April 2019 event had a total of 64 tornadoes across the lower Mississippi valley, east Texas and Alabama. The winter weather included light to moderate snow that fell over North and South Dakota, Minnesota and the Upper Peninsula of Michigan. The 3 – 5 March 2019 event had a total of 80 tornadoes concentrated over southeast Alabama, southern Georgia and central South Carolina. The winter weather included heavy snow even blizzard conditions over the upper Mississippi valley and lower Great Lakes. The 12 – 14 March 2019 event had a total of 49 tornadoes across north-central Alabama/northwest Georgia, west Kentucky, south Indiana, northeast Ohio and southeast lower Michigan. The winter weather included a significant blizzard from the central High Plains through the upper Midwest. The 26 November 2019, 16 - 17 December 2019, 10 – 11 January 2020 and 5 – 7 February 2020 multi-day event had similar patterns severe and winter weather.

It is my belief which is supported by this research that understanding the similarities and differences of interactions among synoptic and mesoscale weather systems, including mesoscale processes, these events and others during which there were regional occurrences of significant winter and severe weather during the same event that further understanding can be acquired and more timely watches, warnings issued and accurate forecasts can be made by regional National Weather Service (NWS) regional Forecast Offices in cooperation with the NWS Storm Prediction Center. Thus, understanding these interactions can provide best practices on observing, forecasting and communicating such events to the impacted regions.

## Introduction

The March 3 – 5 2019, March 12 – 14 2019 and April 11 – 13 2019 events are three late winter or early spring events during which there were significant occurrences winter and severe weather during the same event. The November 26 2019, December 16 – 17 2019 and January 10 – 11 2020 are examples late autumn and early winter events during which there were significant occurrences winter and severe weather during the same event. January 10 - 11 2020 is an example of an event during which there were significant occurrences heavy rain, as well as significant occurrences of severe and winter weather during the same event.

During the 3 – 5 March 2019 event, there were interactions among synoptic and mesoscale weather systems during moderate/heavy snow across the central Rockies, central Plains, middle Mississippi valley, Ohio valley, middle Atlantic states, northeast and New England and the severe weather, mainly tornadoes, across south/southeast Alabama, central Florida panhandle, central/southern Georgia, central South Carolina. During the 11 – 13 April 2019 event, there were interactions among mesoscale weather systems during moderate/heavy snow across northern/central Rockies, northern/central Plains, upper Mississippi valley, upper peninsula of Michigan and tornadoes, high straight-line winds, large hail over the lower Mississippi valley and Southeast. The 12 – 14 March 2019 event featured interactions among mesoscale weather systems during light to moderate snowfall with occasional blizzard conditions across the northern/central Plains and upper Midwest, moderate to heavy rainfall across the Ohio, Tennessee, Mississippi valleys and the severe weather outbreak, including the tornadoes across north-central Alabama, west Kentucky, northeast Ohio and southeast lower Michigan. Although these events occurred in late winter and very early spring, they are “classic fit” to the Galway and Pearson (1979) research of winter weather, including heavy snow

occurring 200 – 400 kilometers (320 – 640 miles) northwest, north of severe weather, including tornadoes, large hail and damaging winds further southeast, south. The 26 November 2019, 16 – 17 December 2019 and 10 -11 January 2020 events were “classic fits” to the Galway and Pearson (1979) research for late fall and early winter events. The 5 – 7 February 2020 event is” classic fit” to the Galway and Pearson (1979) research a mid-winter multiday event.

## Data sources and methods

The 3 – 5 March 2019, 12 – 14 March 2019 and 11- 13 April 2019 events have been chosen since they show challenges presented to Storm Prediction Center (SPC) and National Center for Environmental Prediction (NCEP) meteorologist forecasters each year. Accordingly, this ongoing research has made extensive use of SPC Storm Reports, SPC Mesoscale Discussions and NCEP Storm Summaries, not only for detail analysis and description but for the guide provided to my “thinking analysis.”

As mentioned above, Galway and Pearson (1979) was an invaluable reference. Although 3 – 5 March 2019, 12 - 14 March 2019 and 11 – 15 April 2019 were late winter and early spring events significant/heavy snow did indeed occur 200 – 400 kilometers or 320 – 640 miles to the northwest, north, north/northeast (over the central/northern Rockies, upper Mississippi valley, upper Peninsula of Michigan, Middle Atlantic states, northeast and New England) and severe weather, mainly tornadoes, to the south and southeast (over the lower Mississippi valley and southeast United States). The 26 November 2019, 16 -17 December 2019, 10 – 11 January 2020 events and 5 – 7 February 2020

multi-day event provided other examples of the regional applications Galway  and Pearson (1979) to events during which regional occurrences of severe weather, in particular tornadoes, and winter weather, mainly significant snow, occurred.

## Results and Discussion

The pictorial analyses figures are included to show similarities and differences of interactions among synoptic and mesoscale weather systems during the 3 – 5 March 2019, 12 – 14 March 2019 and 11 – 13 April 2019 events.  The 26 November 2019, 16 – 17 December 2019 and 10 – 11 January 2020 events have been added to show different events which similarities and differences of interactions among synoptic and mesoscale weather systems during events which there are regional occurrences tornadoes, significant snow and even significant rain during the same event. This has made an effort to show that events which tornadoes, significant snow, even significant rain that typically occur late winter and early spring can occur throughout the autumn and winter seasons. To demonstrate that this is ongoing research, the February 5 -7 2020 event has

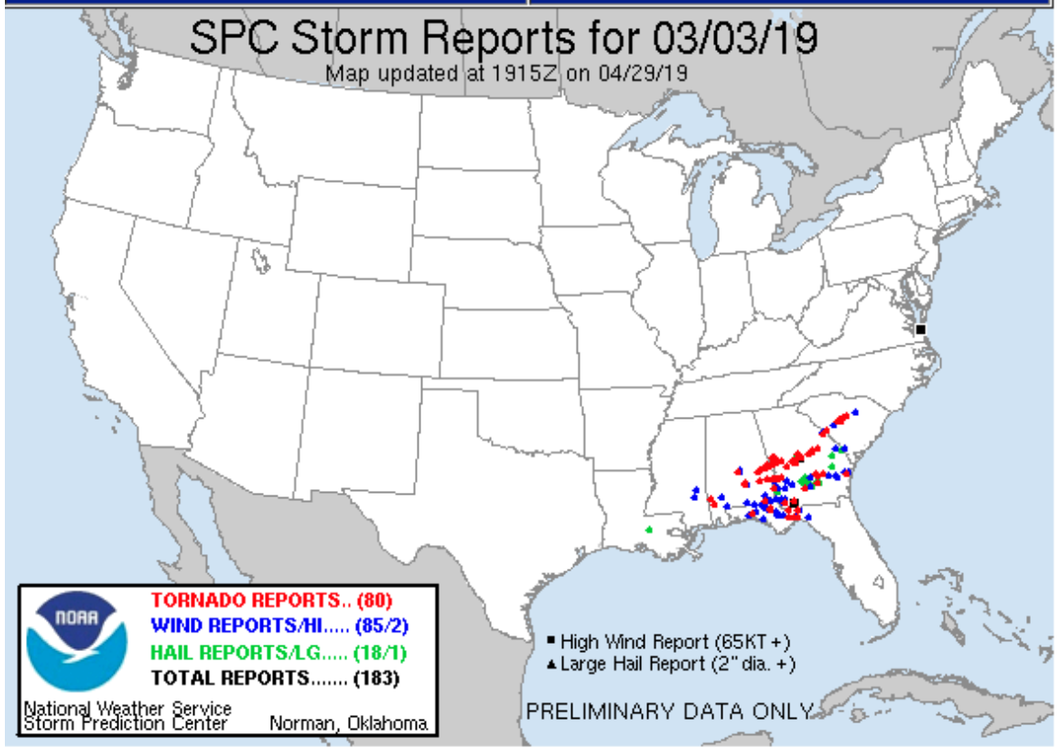
been added to show a multi-day event which severe weather, mainly tornadoes, and winter weather, mainly significant snow, occurred in different regions of the contiguous United States on consecutive days during the event.

**20190303's Storm Reports (20190303 1200 UTC - 20190304 1159 UTC) (Print Version)**

< 190302 Reports  190304 Reports >

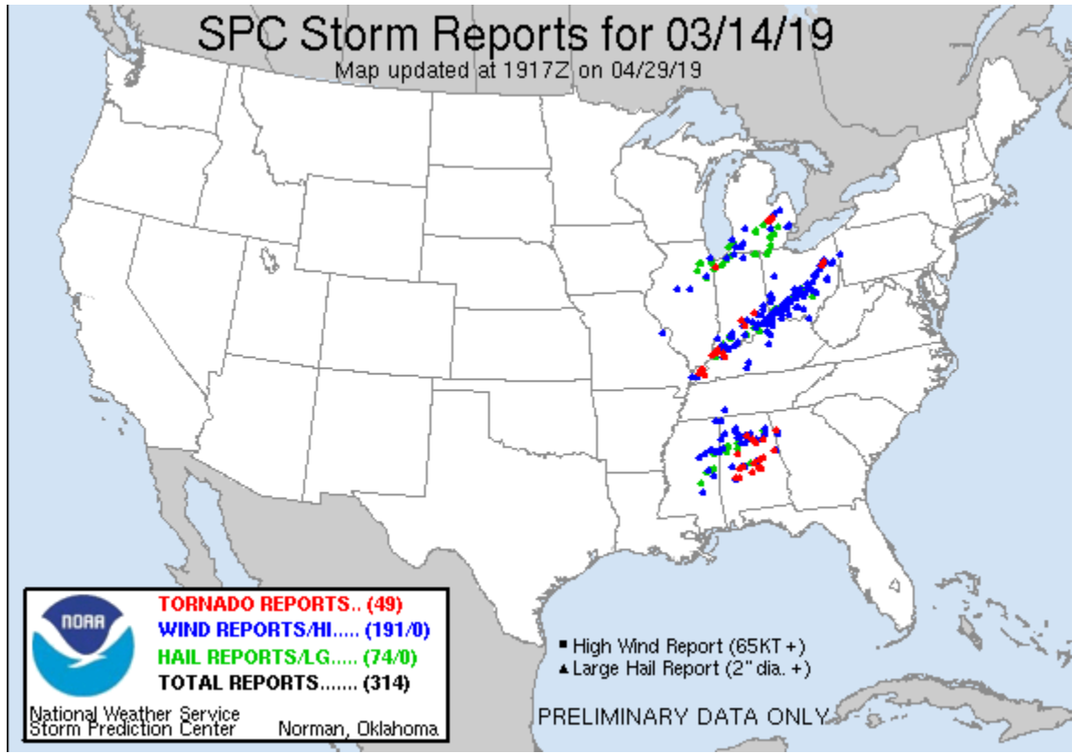
Note: All Reports Are Considered Preliminary

Unfiltered Reports (Google Maps) | Filtered Reports (Google Maps) (More Info)




**Tornado Reports (CSV) (Raw Tornado CSV)(?)**

| Time | | Location | County | State | Lat | Lon | Comments |
|---|---|---|---|---|---|---|---|

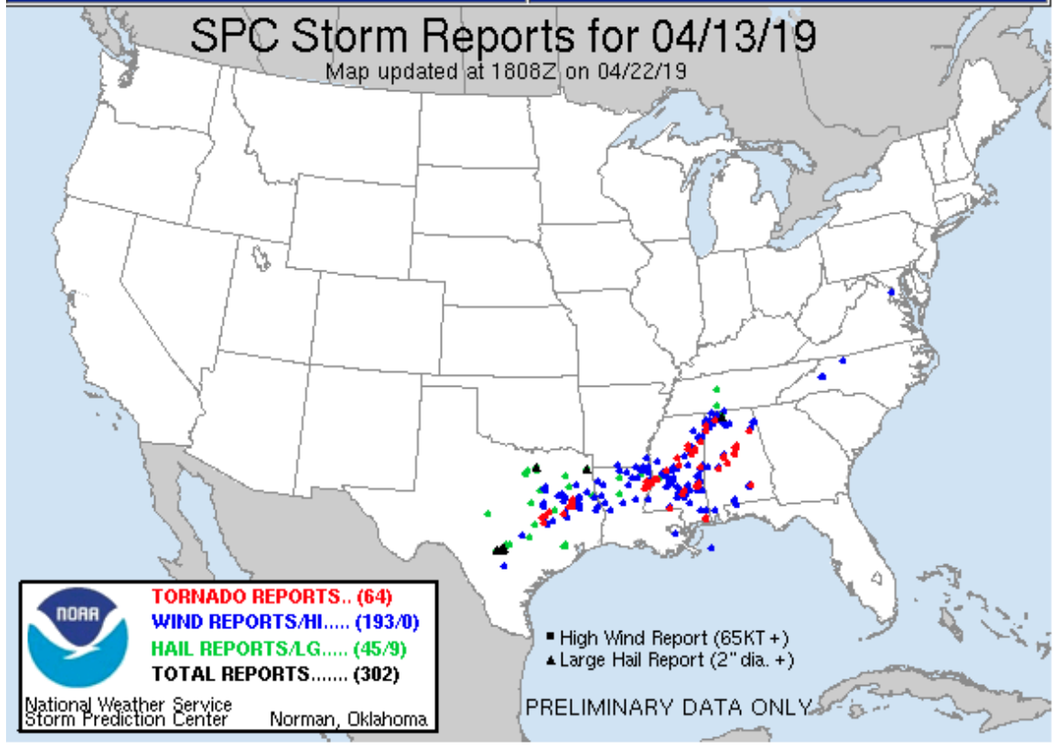

SPC Storm Reports for 03/14/19
Map updated at 1917Z on 04/29/19
TORNADO REPORTS.. (49)
WIND REPORTS/HI..... (191/0)
HAIL REPORTS/LG..... (74/0)
TOTAL REPORTS..... (314)
National Weather Service
Storm Prediction Center
Norman, Oklahoma
High Wind Report (65KT+)
Large Hail Report (2" dia.+)
PRELIMINARY DATA ONLY

**20190413's Storm Reports (20190413 1200 UTC - 20190414 1159 UTC) (Print Version)**

< 190412 Reports  190414 Reports >

Note: All Reports Are Considered Preliminary

Unfiltered Reports (Google Maps) | Filtered Reports (Google Maps) (More Info)

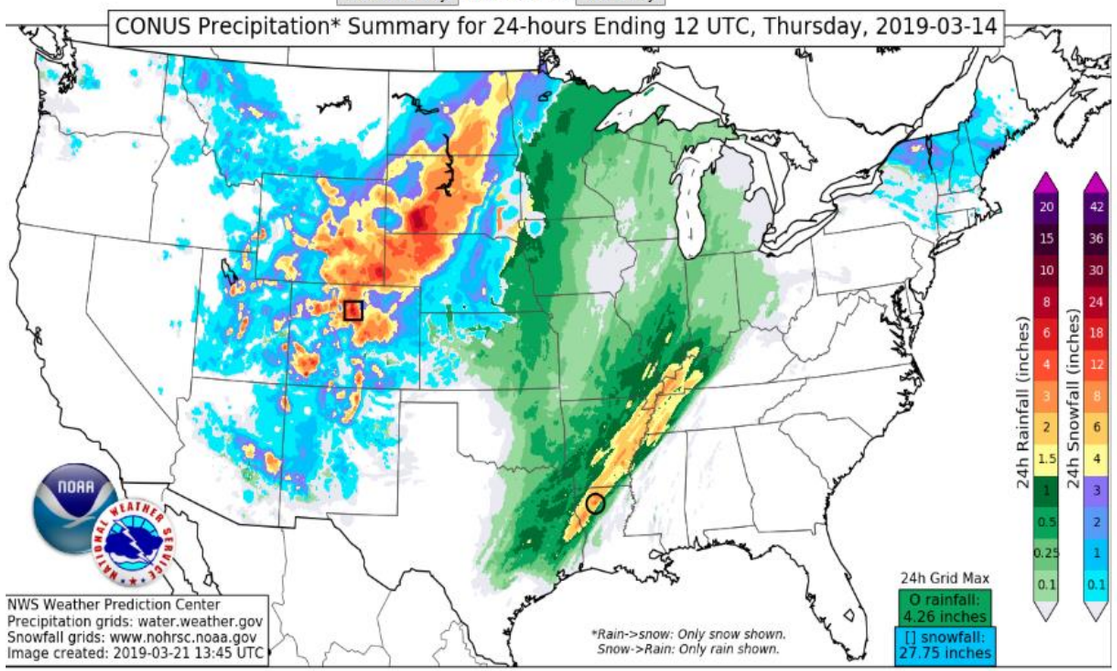



**Tornado Reports (CSV) (Raw Tornado CSV)(?)**

| Time | | Location | County | State | Lat | Lon | Comments |
|---|---|---|---|---|---|---|---|

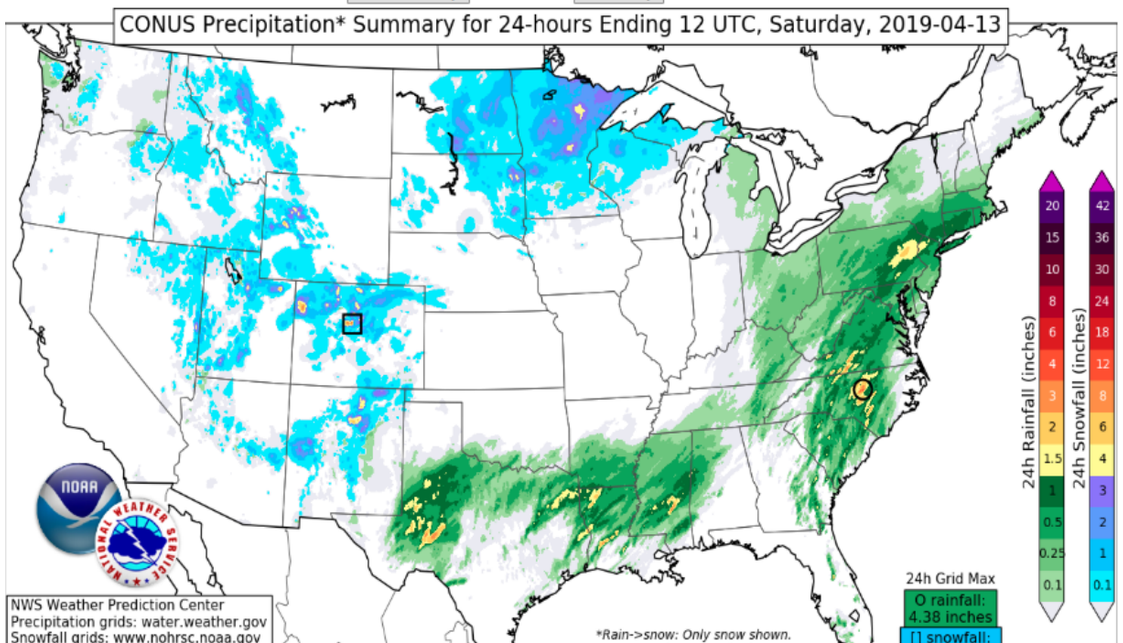
*Menu is populated with significant winter weather events as they occur.

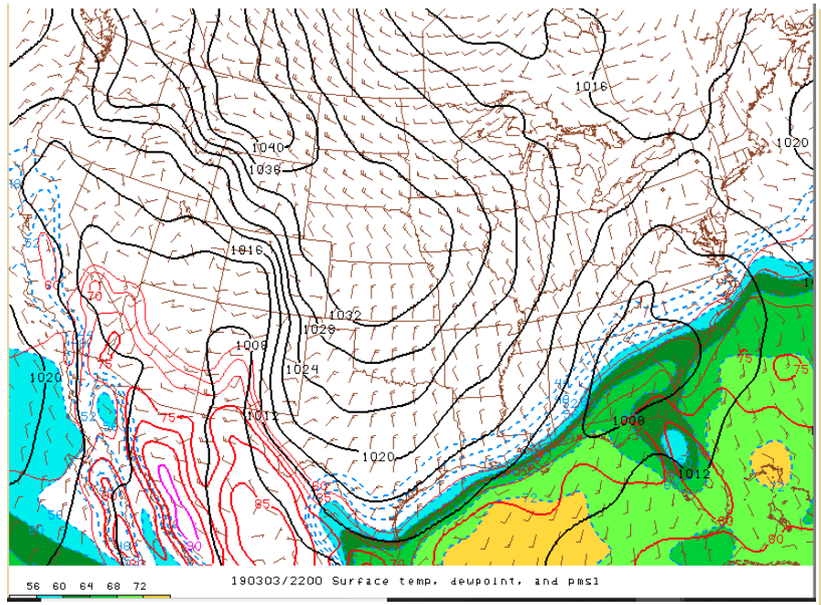
Previous Day March 14 2019 Next Day

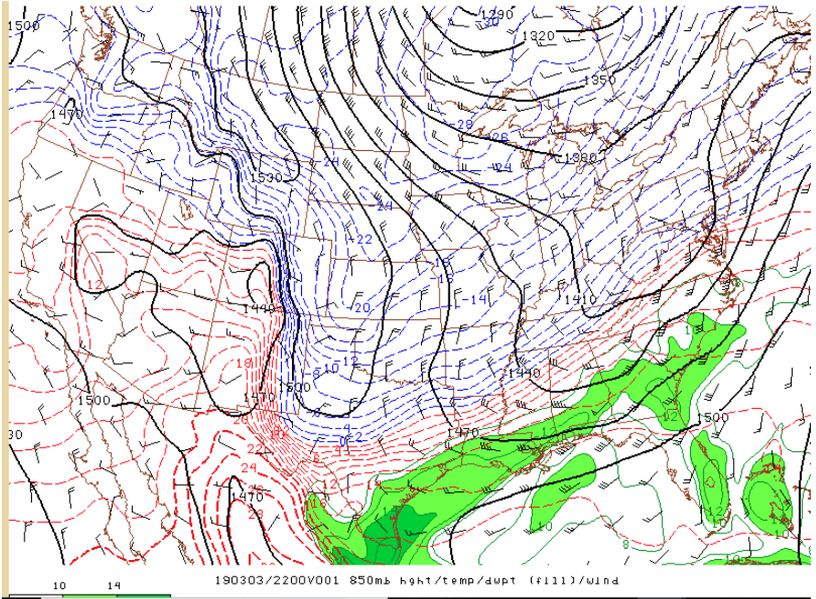


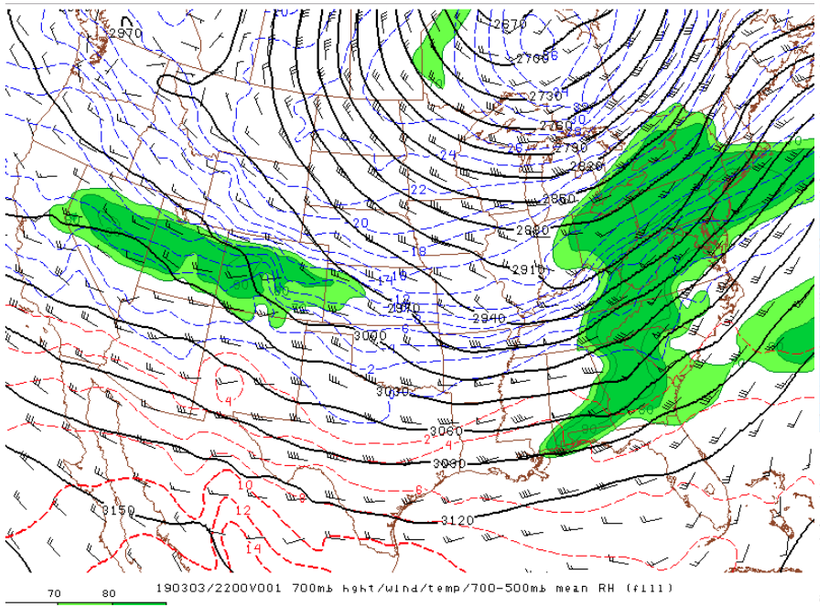

*Menu is populated with significant winter weather events as they occur.

Previous Day April 13 2019 Next Day




190303/2200 Surface temp, dewpoint, and pmsl


190303/2200V001 850mb hght/temp/dwpt (fill)/wind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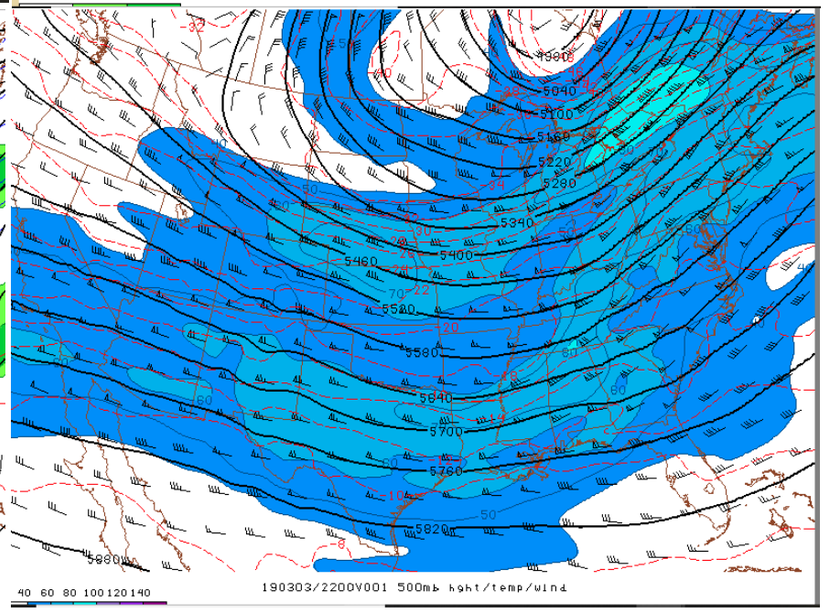
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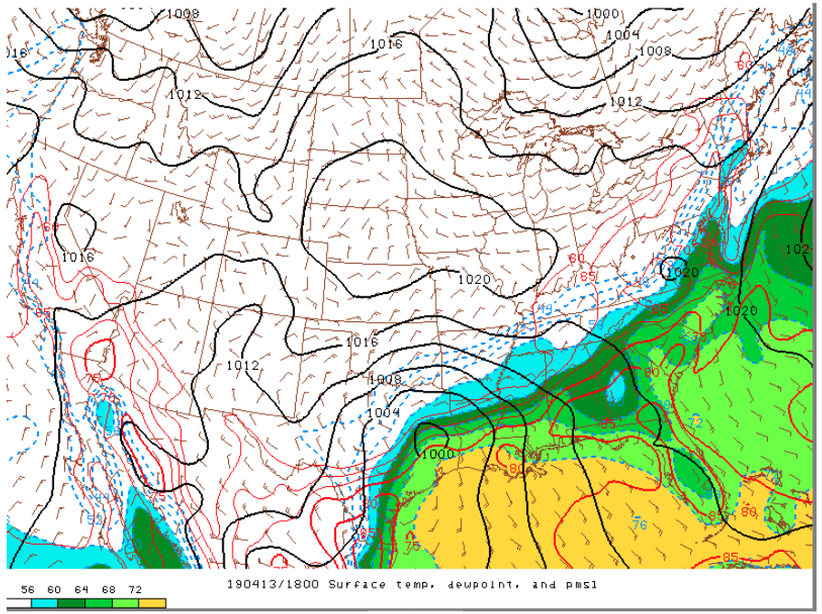
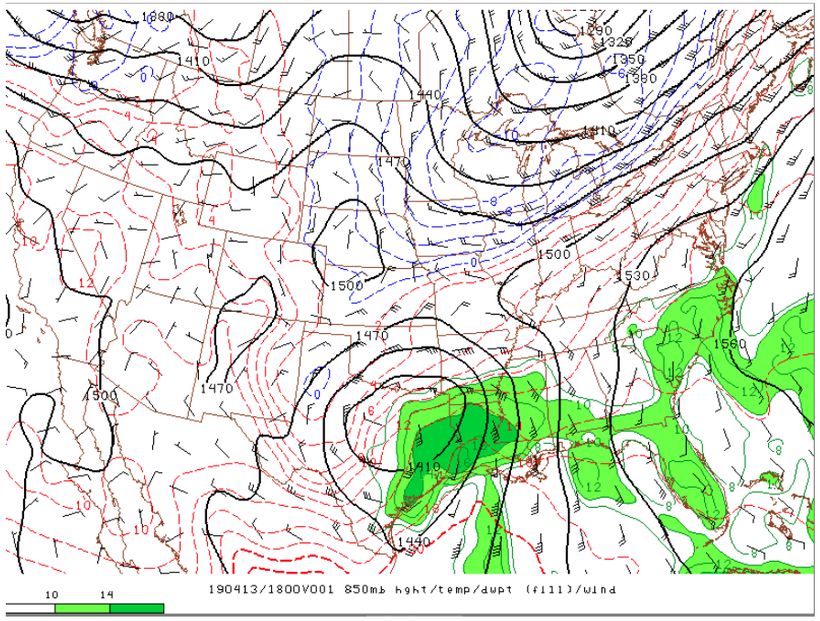
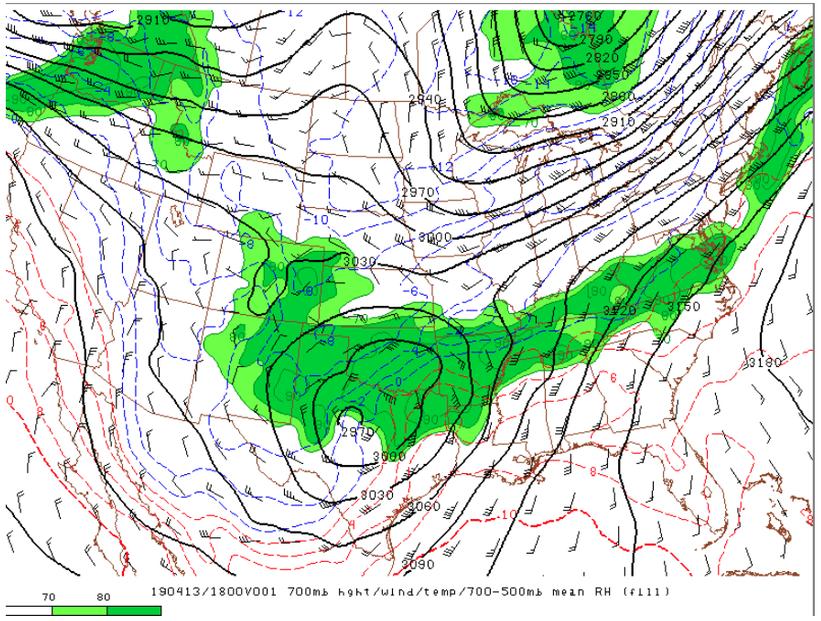
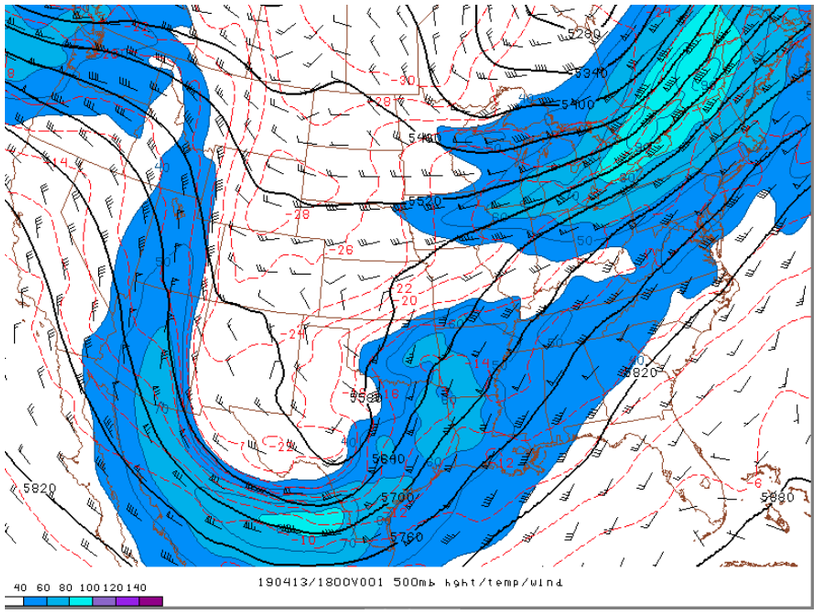

190413/1800 Surface temp, dewpoint, and pmsl
56 60 64 68 72


190413/1800V001 850mb hght/temp/dwpt (fill)/wind
10 14


190413/1800V001 700mb hght/wind/temp/700-500mb mean RH (fill)
70 80


190413/1800V001 500mb hght/temp/wind
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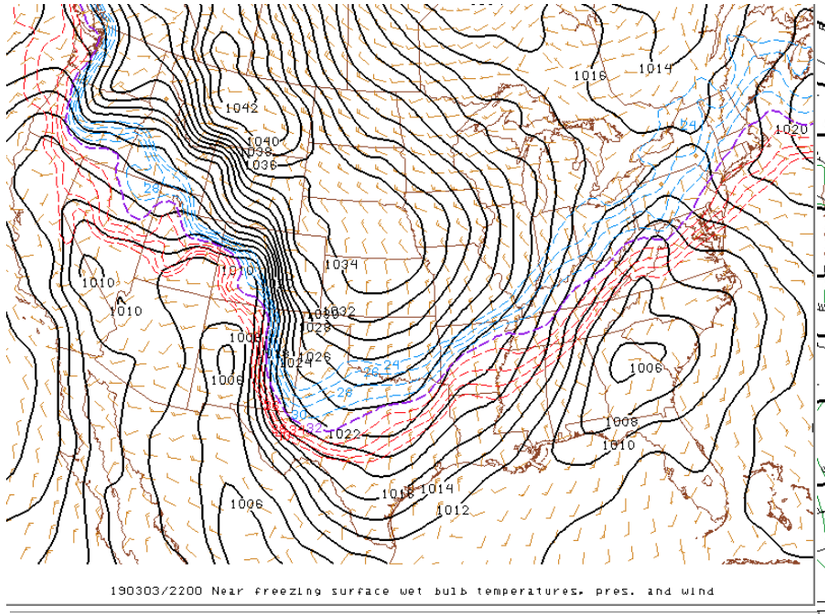
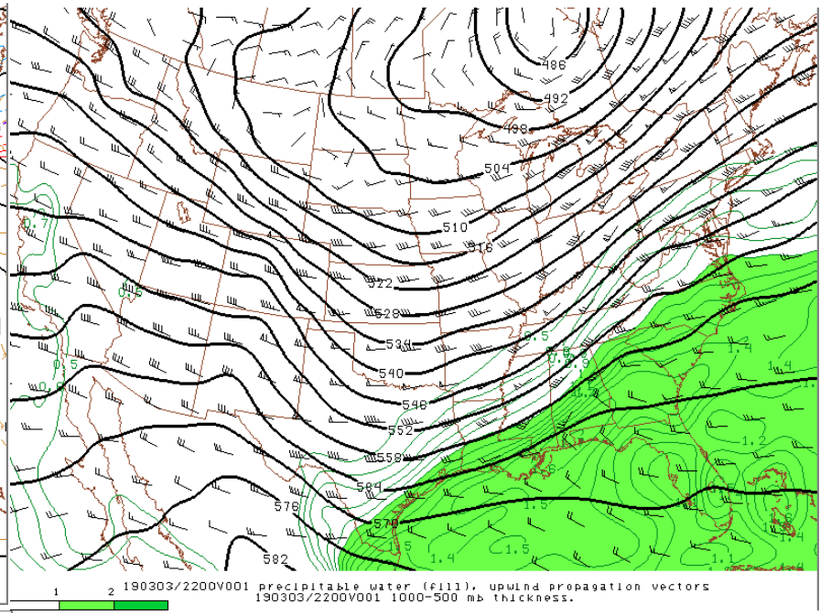
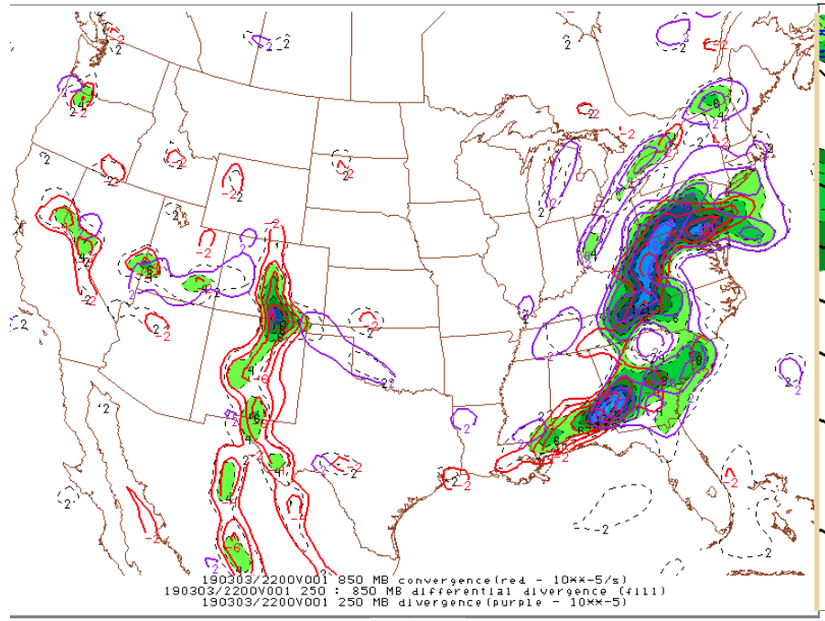
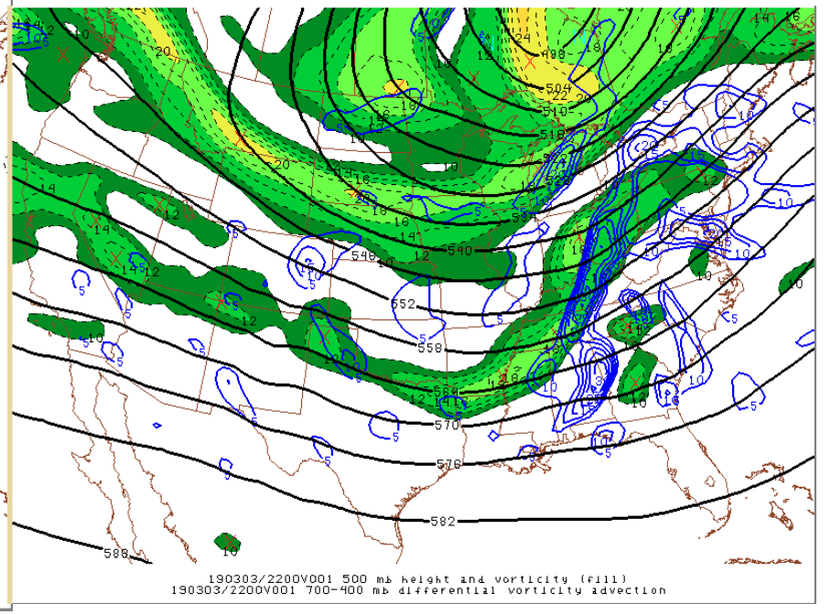

190303/2200 Near freezing surface wet bulb temperatures, pres, and wind


190303/2200V001 precipitable water (fill), upwind propagation vectors
190303/2200V001 1000-500 mb thickness.


190303/2200V001 850 MB convergence(red - 10**-5/s)
190303/2200V001 250 : 850 MB differential divergence (fill)
190303/2200V001 250 MB divergence(purple - 10**-5)


190303/2200V001 500 mb height and vorticity (fill)
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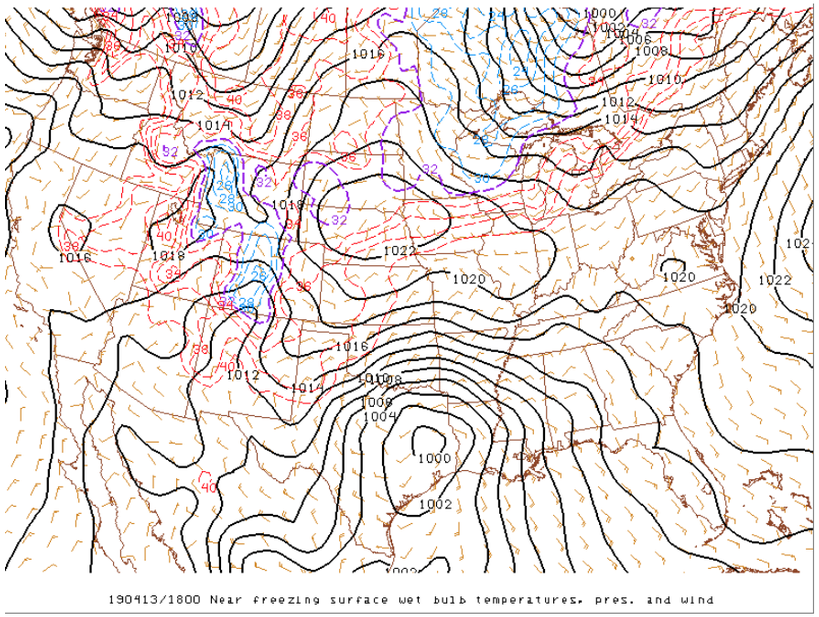
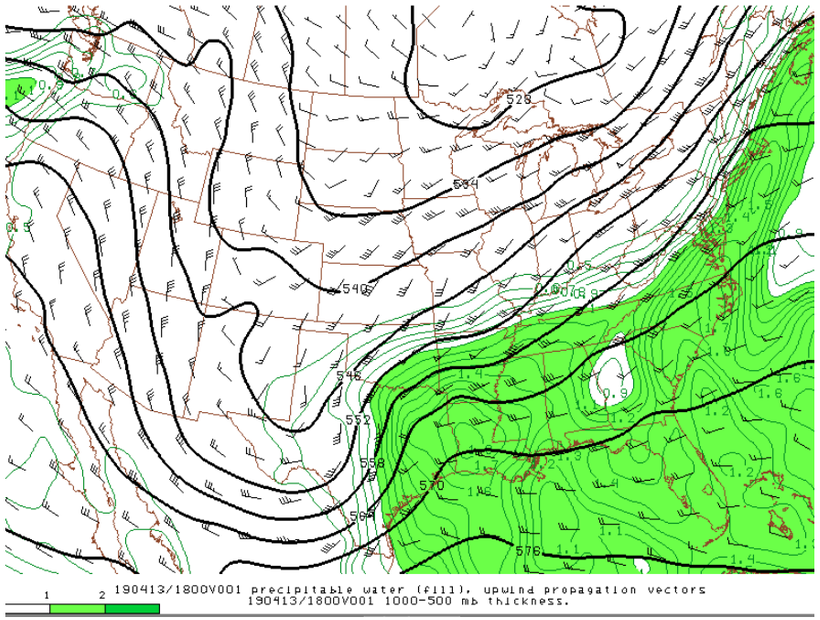

190413/1800 Near freezing surface wet bulb temperatures, pres, and wind


190413/1800V001 precipitable water (fill), upwind propagation vectors
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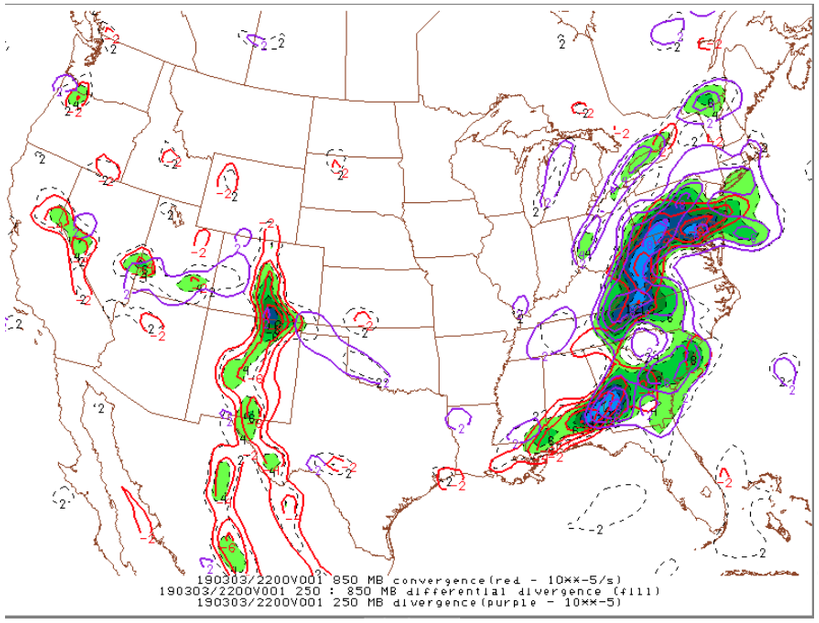
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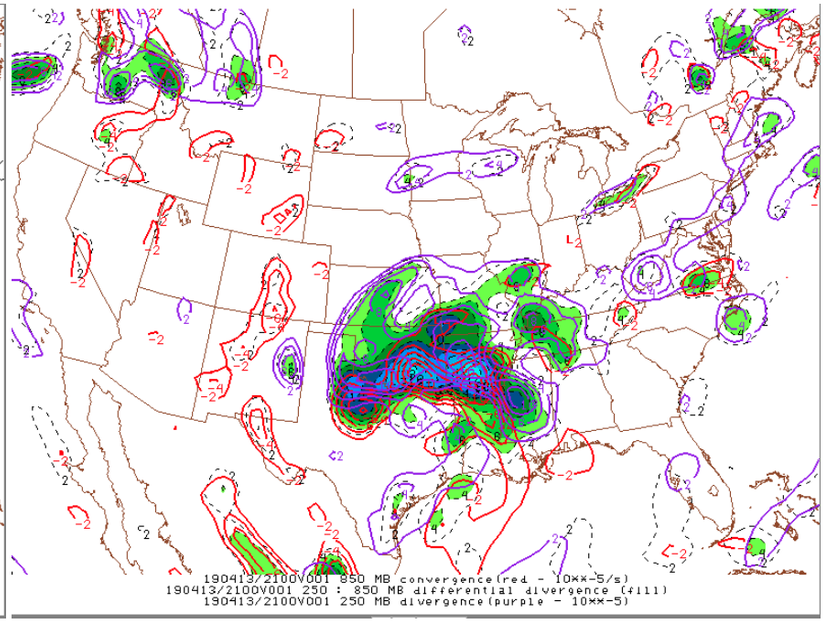
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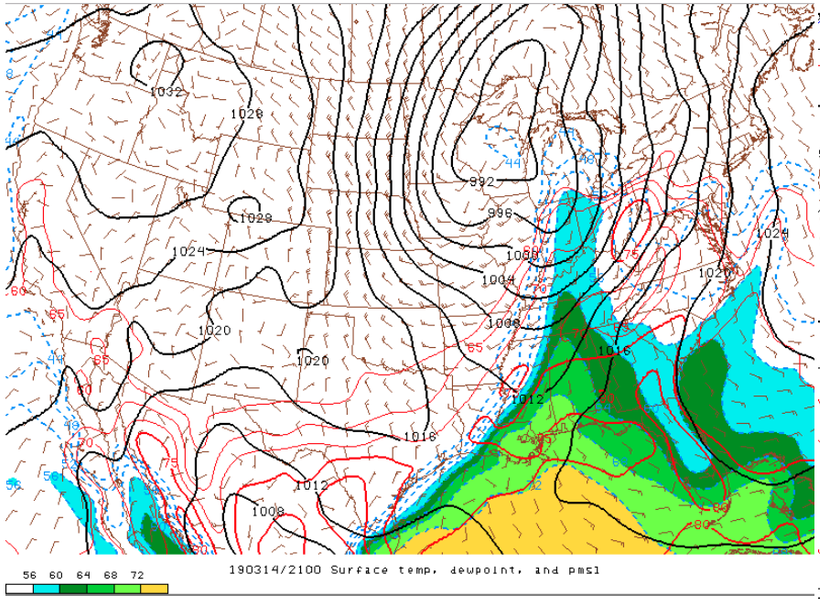
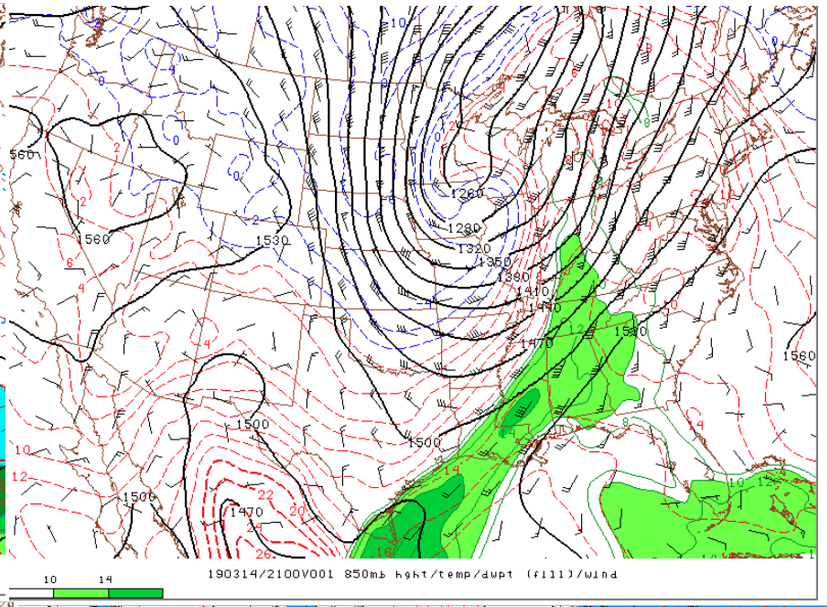
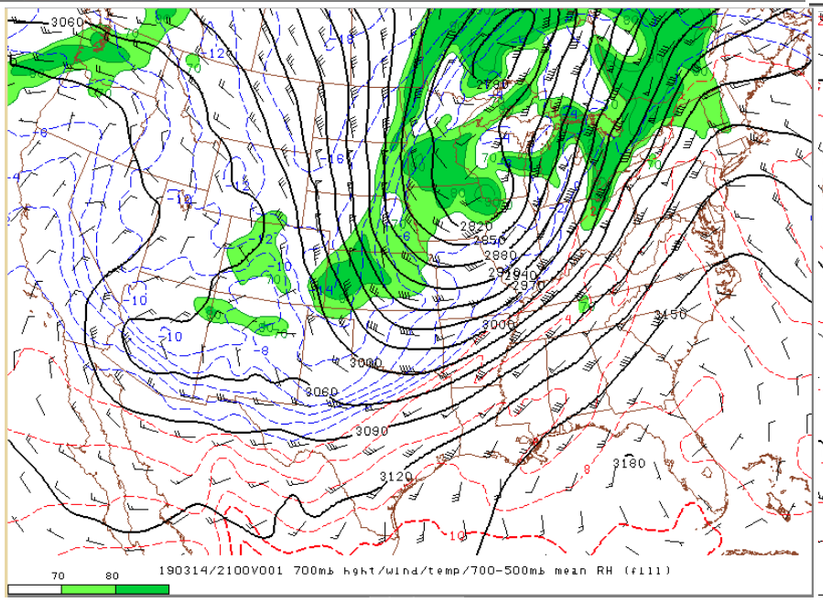
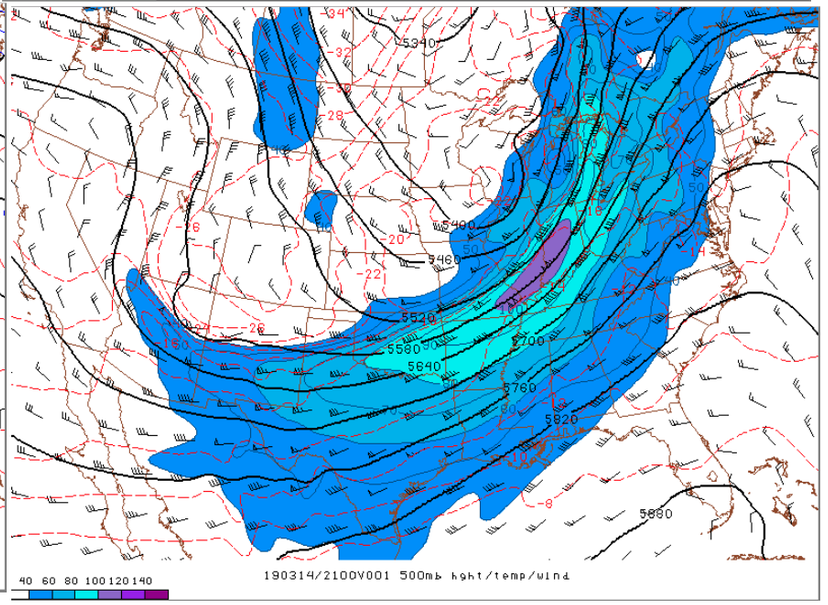

190314/2100 Surface temp, dewpoint, and pmsl
56 60 64 68 72


190314/2100V001 850mb hght/temp/dwpt (fill)/wind
10 14


190314/2100V001 700mb hght/wind/temp/700-500mb mean RH (fill)
70 80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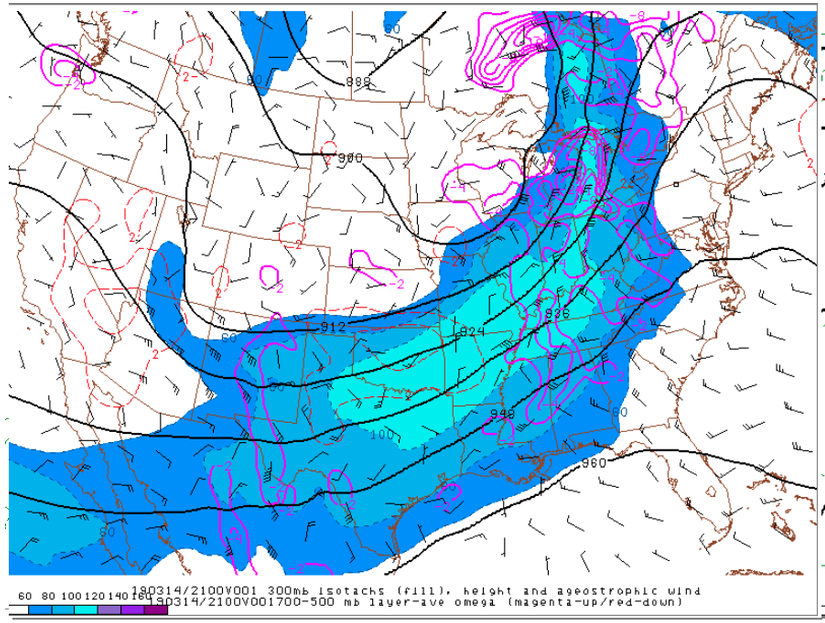
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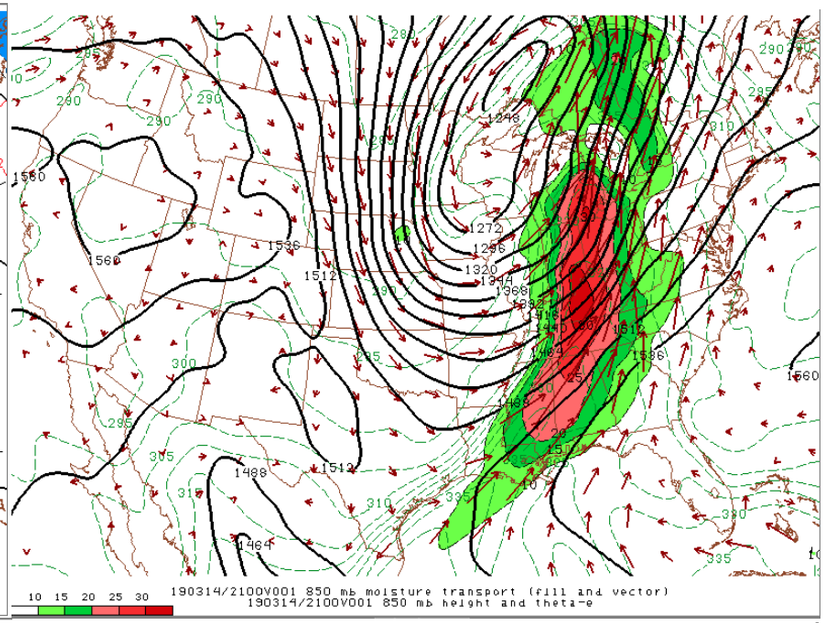
190314/2100V001700-500 mb layer-ave omega (magenta-up/red-down)
60 80 100 120 140 160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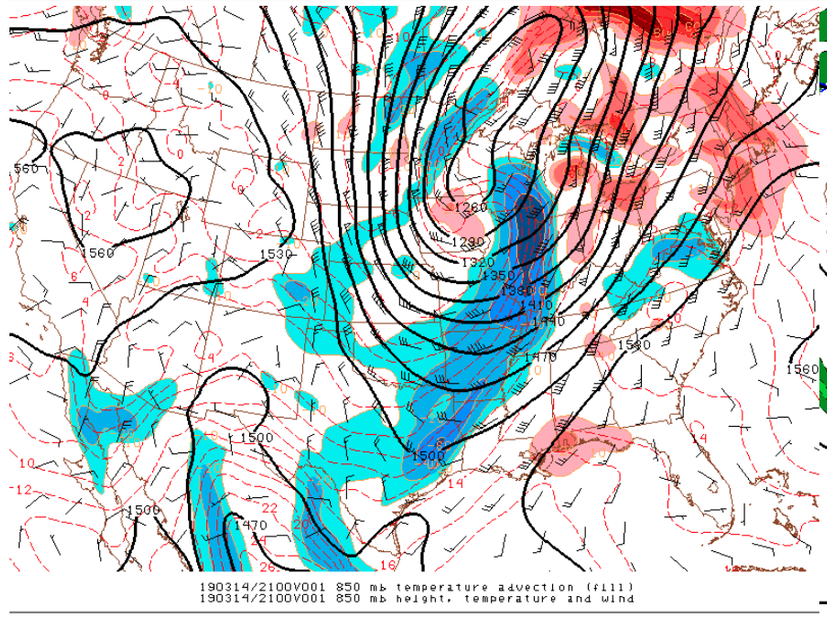
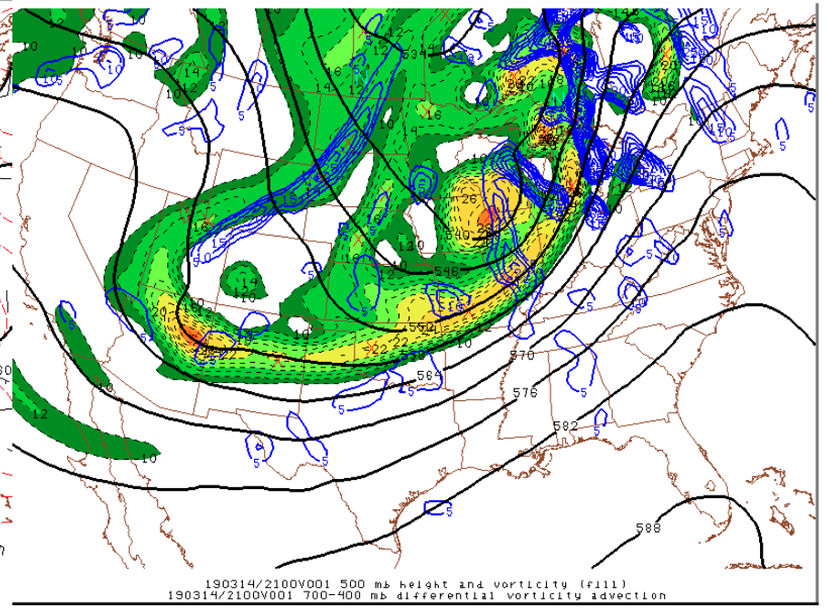
190314/2100V001 850 mb height and theta-e
10 15 20 25 30


190314/2100V001 850 mb temperature advection (fill)
190314/2100V001 850 mb height, temperature and wind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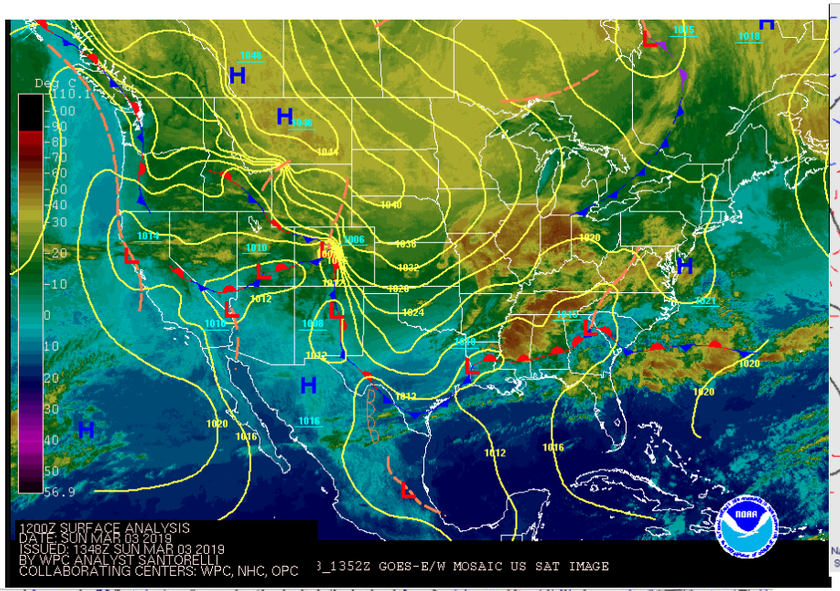
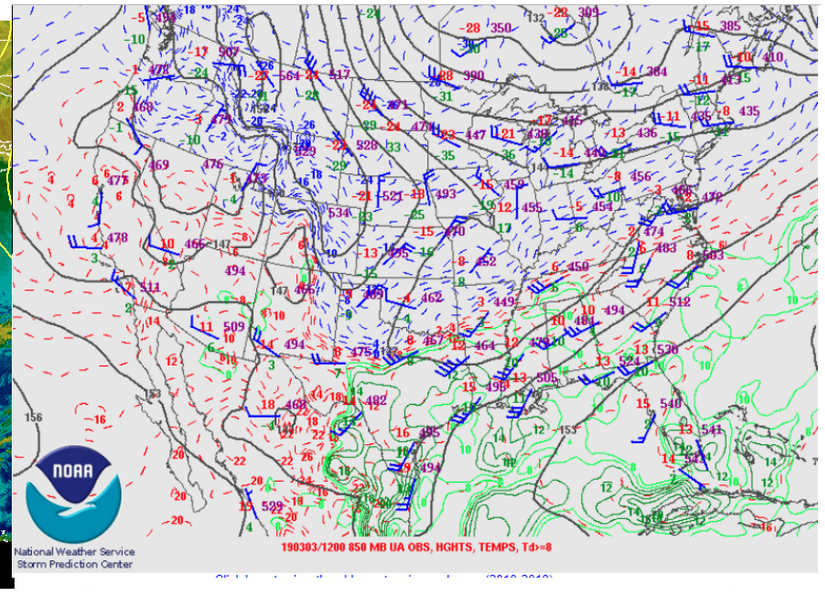

1200Z SURFACE ANALYSIS
DATE: SUN MAR 03 2019
ISSUED: 1348Z SUN MAR 03 2019
BY WPC ANALYST SANTORELLI
COLLABORATING CENTERS: WPC, NHC, OPC
3_1352Z GOES-E/W MOSAIC US SAT IMAGE


National Weather Service
Storm Prediction Center
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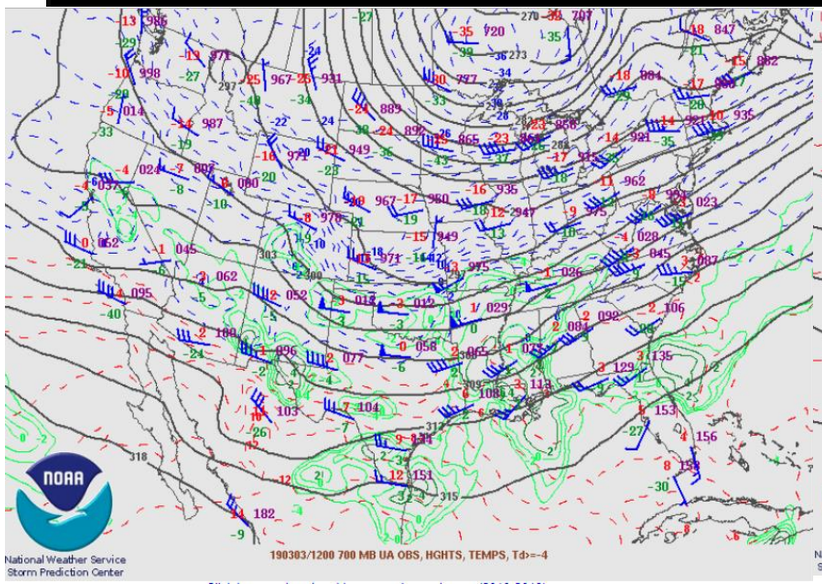
National Weather Service
Storm Prediction Center
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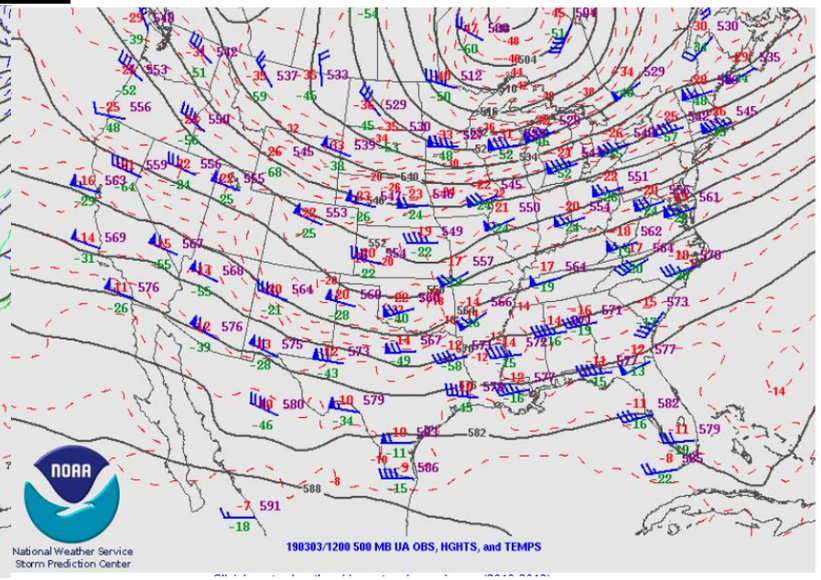
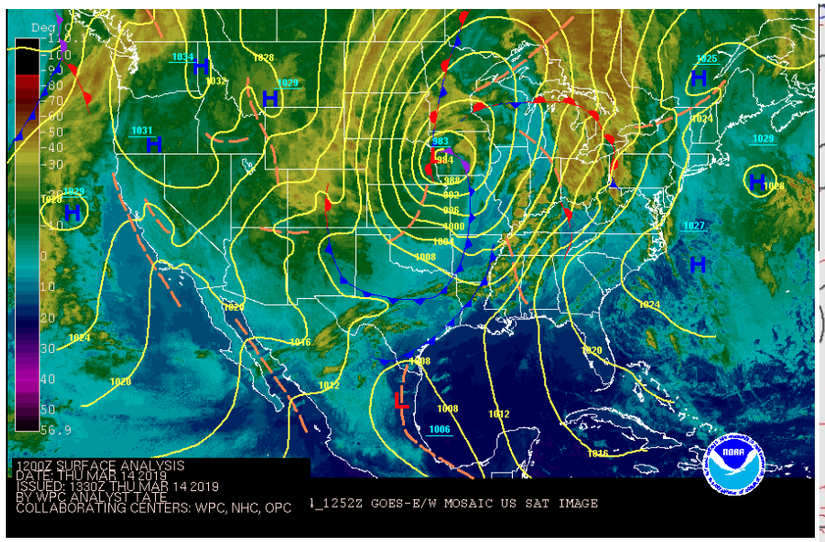
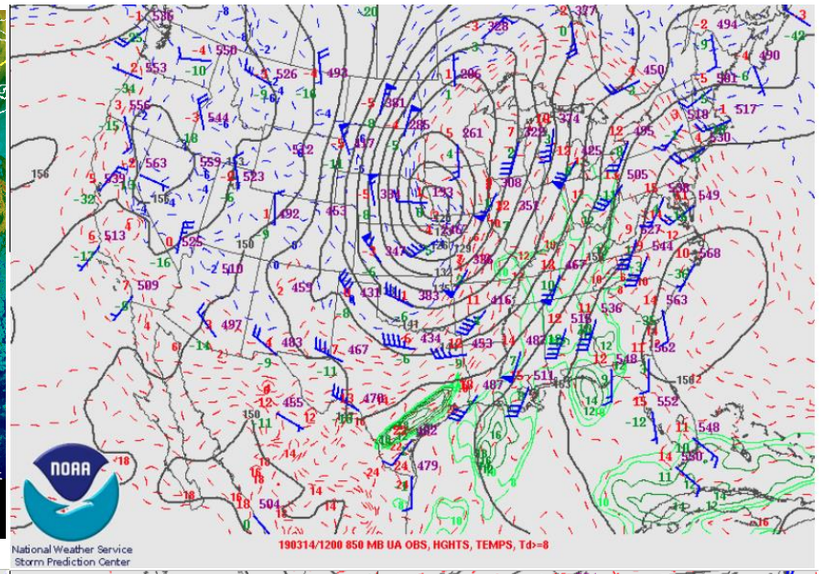
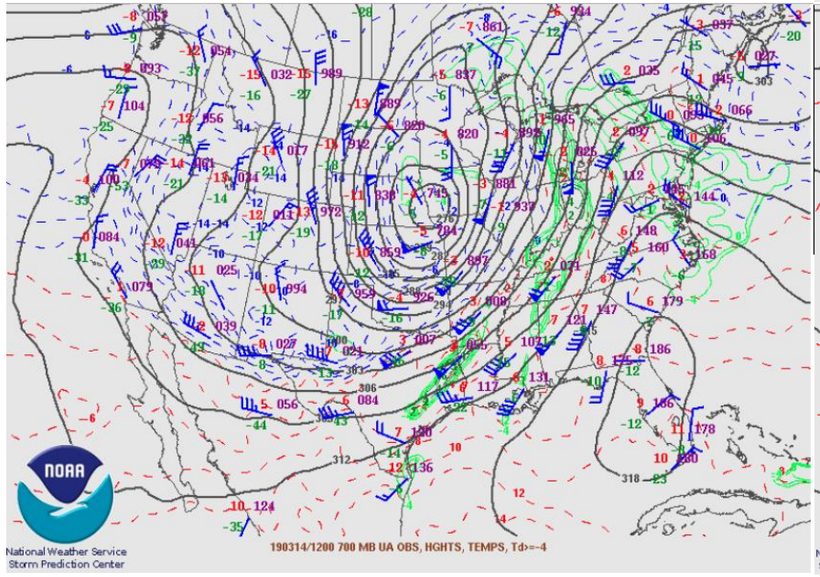

National Weather Service
Storm Prediction Center
190303/1200 500 MB UA OBS, HGHTS, and TEMPS


1200Z SURFACE ANALYSIS
DATE: THU MAR 14 2019
ISSUED: 1330Z THU MAR 14 2019
BY WPC ANALYST TATE
COLLABORATING CENTERS: WPC, NHC, OPC
1_1252Z GOES-E/W MOSAIC US SAT IMAGE


National Weather Service
Storm Prediction Center
190314/1200 850 MB UA OBS, HGHTS, TEMPS, Td>=8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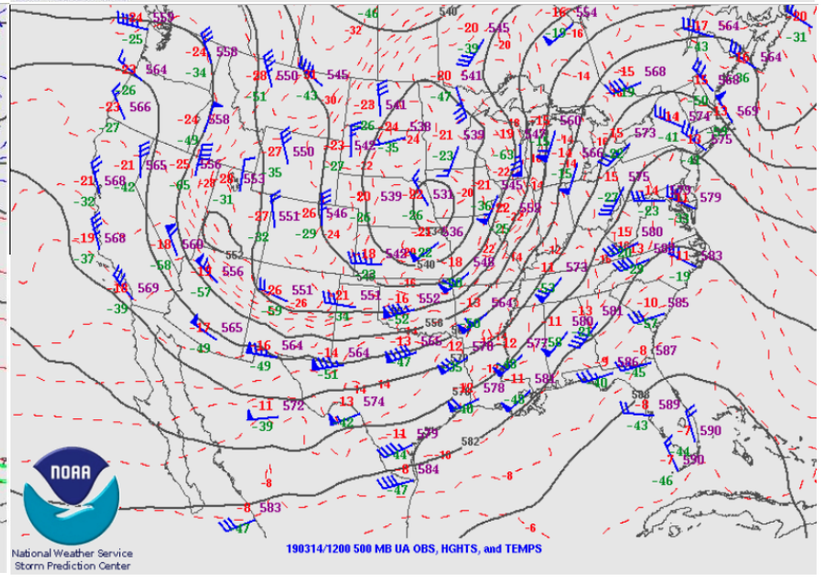
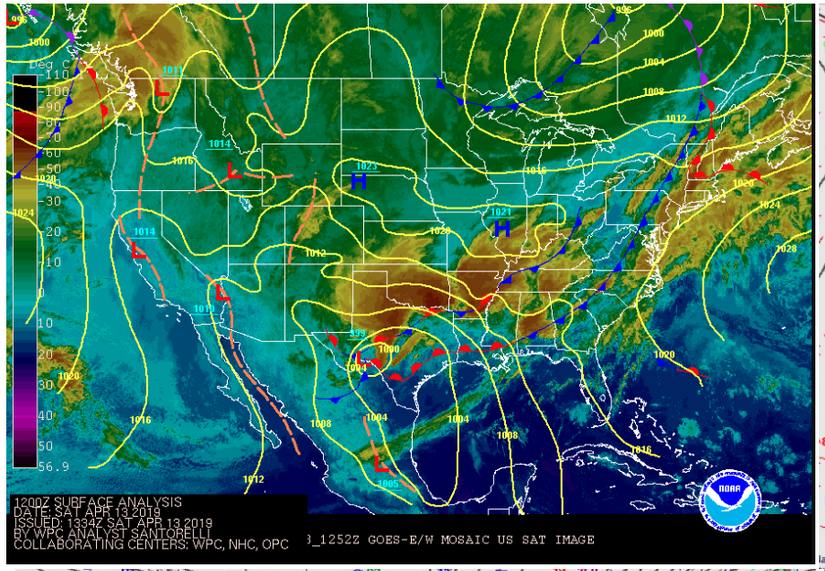
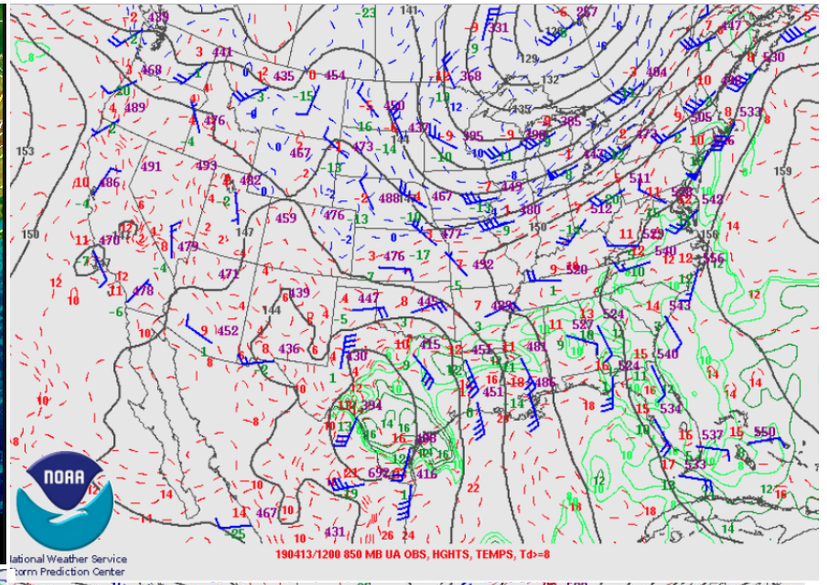
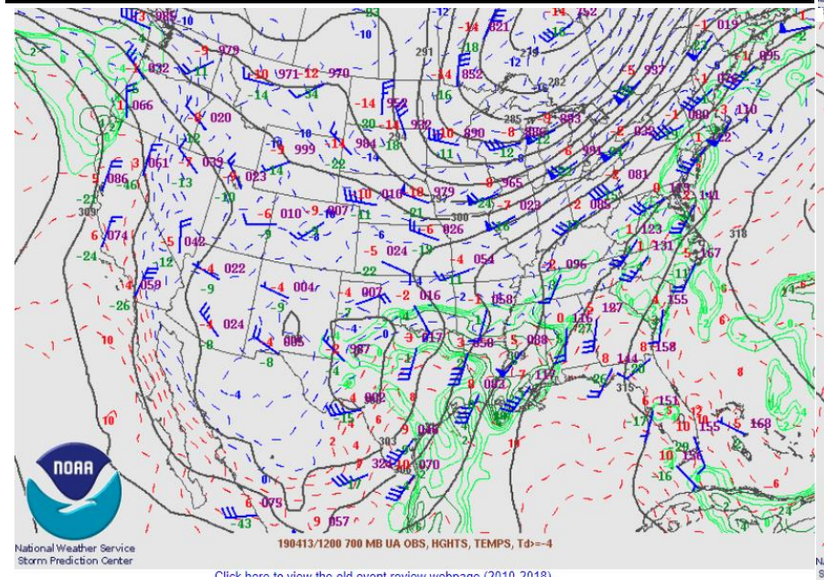
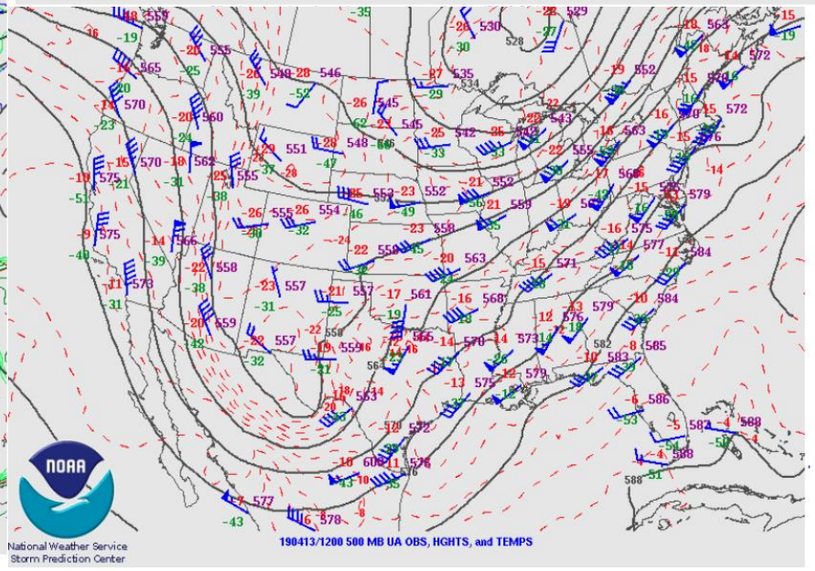
Storm Prediction Center
190314/1200 700 MB UA OBS, HGHTS, TEMPS, Td>=-4


National Weather Service
Storm Prediction Center
190314/1200 500 MB UA OBS, HGHTS, and TEMPS

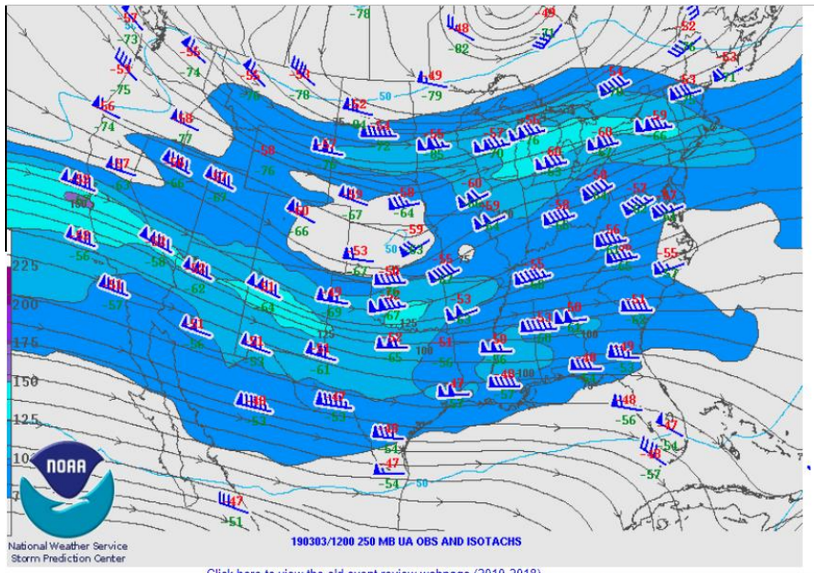



Click here to view the old event review webpage (2010-2018)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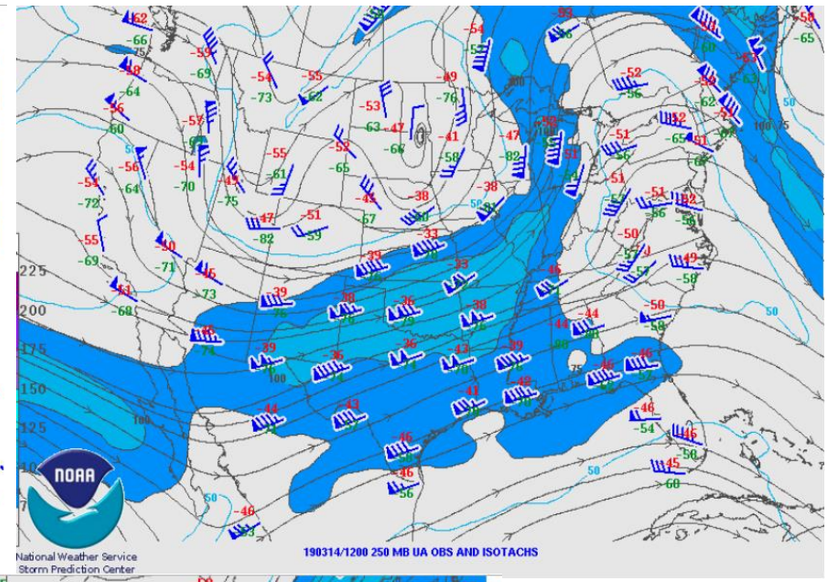
Storm Prediction Center
190303/1200 250 MB UA OBS AND ISOTACHS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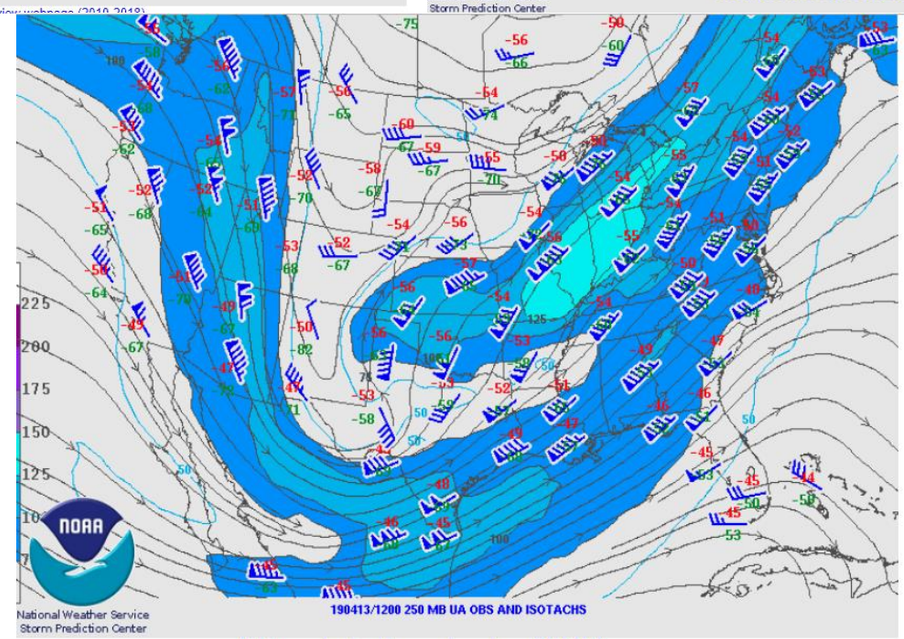
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