Winter Weather Experiment NBM Evaluation

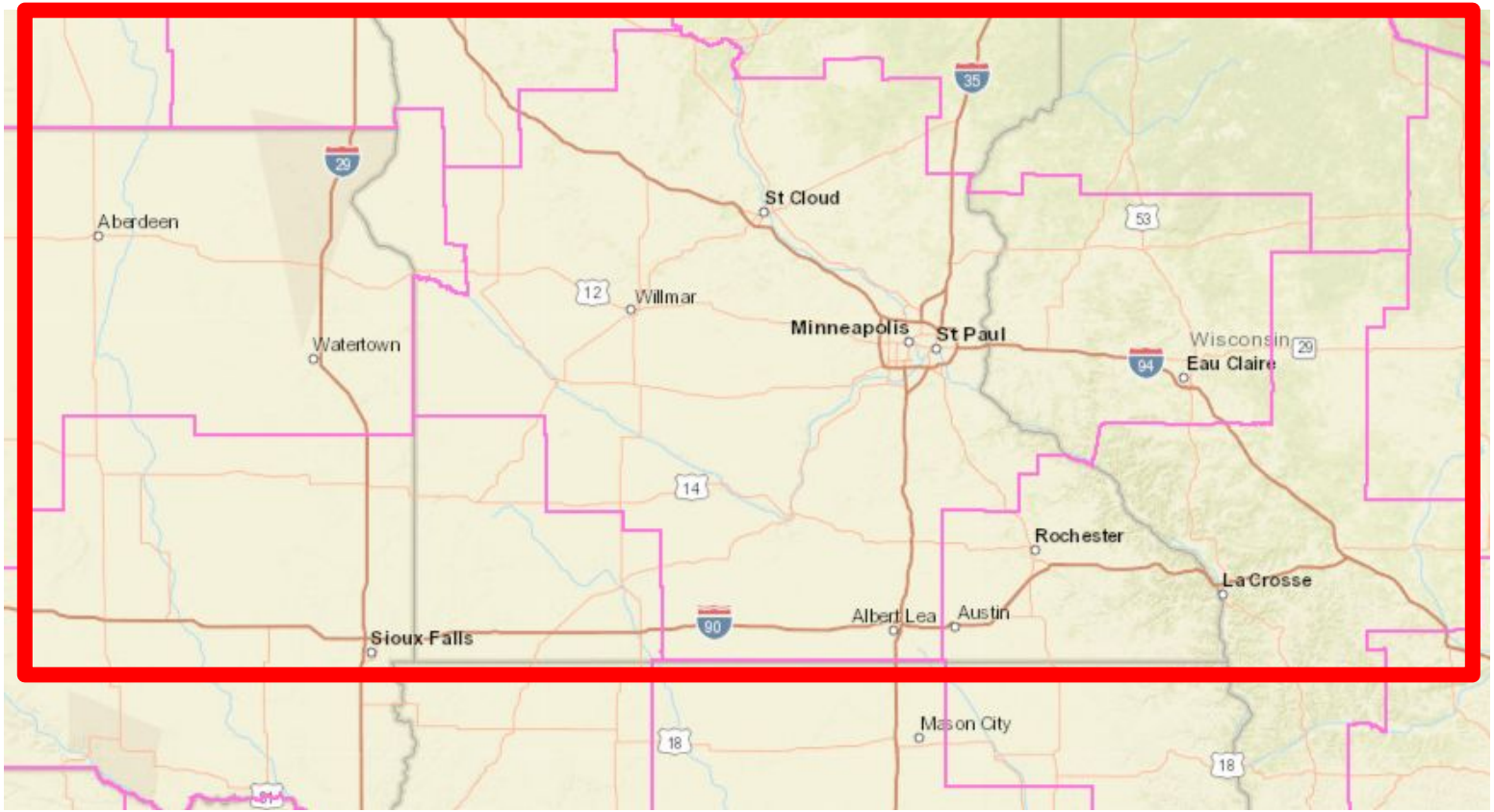
Feb 23 Winter Storm in Minnesota
12Z Feb 22 to 12Z Feb 23

Outline

- **Meteorological Overview**
- **Snow Forecasts and Messaging**
- **NOHRSC Observed Snowfall Analyses**
- **NBM 4.1 Snowfall Review: Day 3 to 1** (84 hrs, 60 hrs, and 36 hrs)

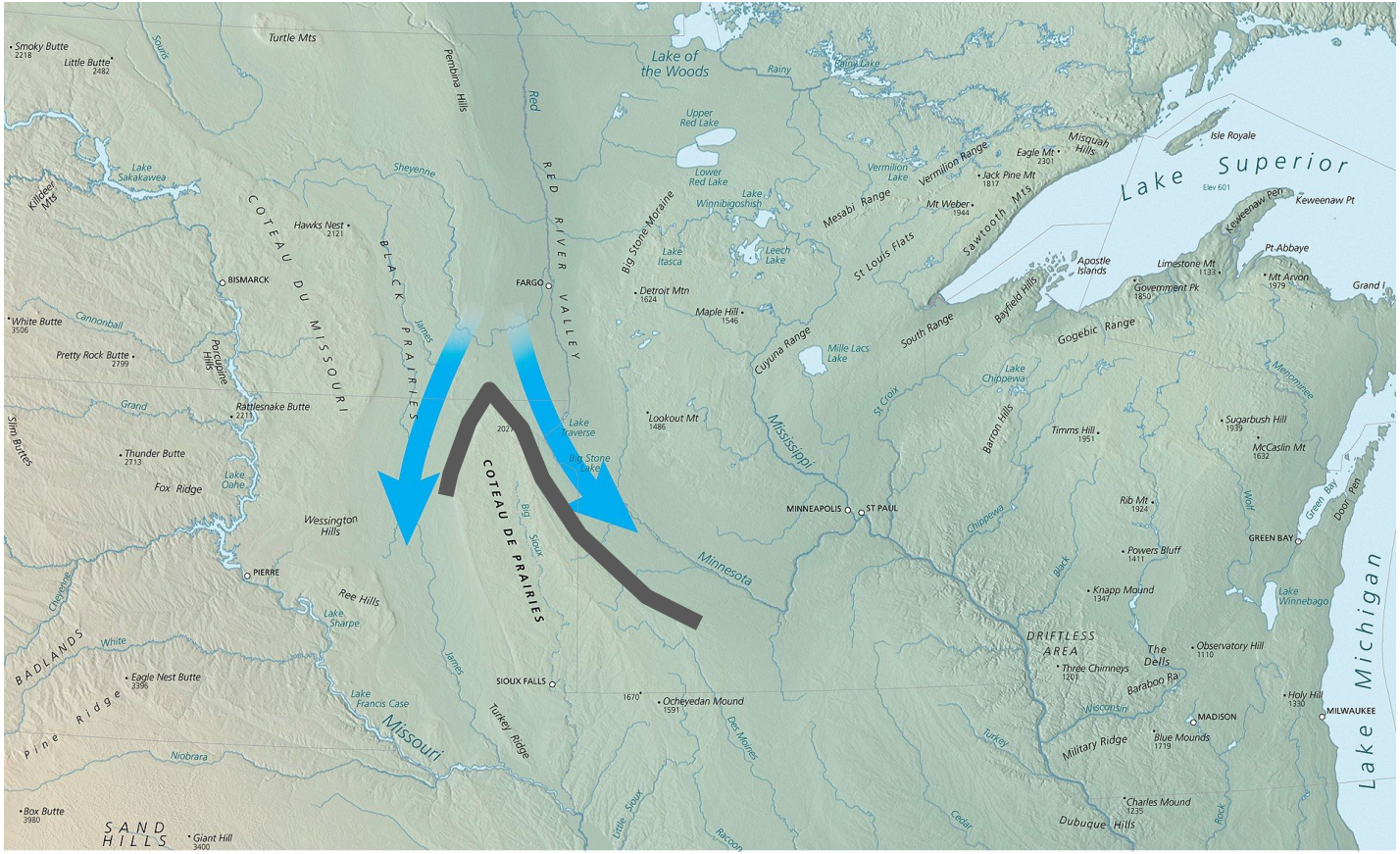
Today's Domain

We will focus from the Dakotas through Minnesota and into western Wisconsin

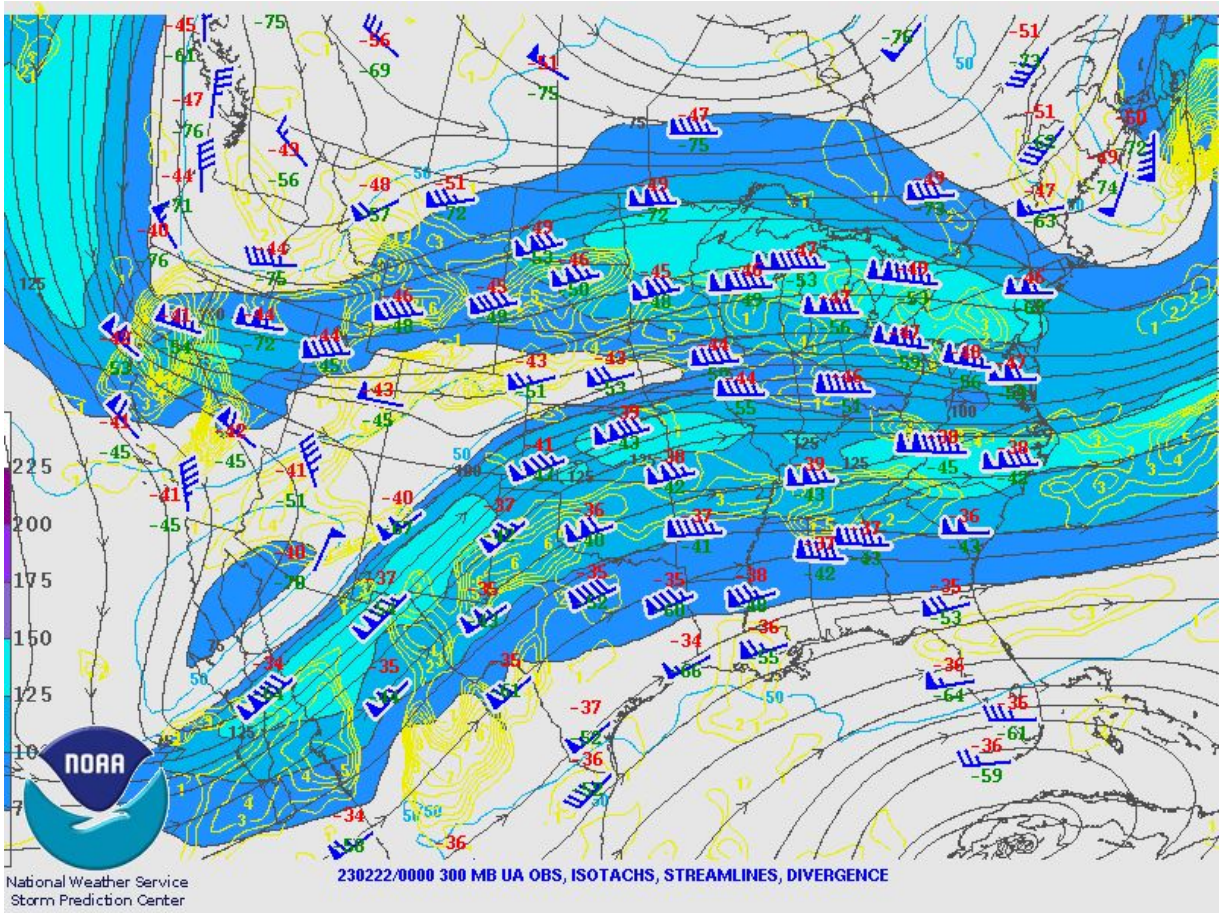


Coteau des Prairies and Buffalo Ridge

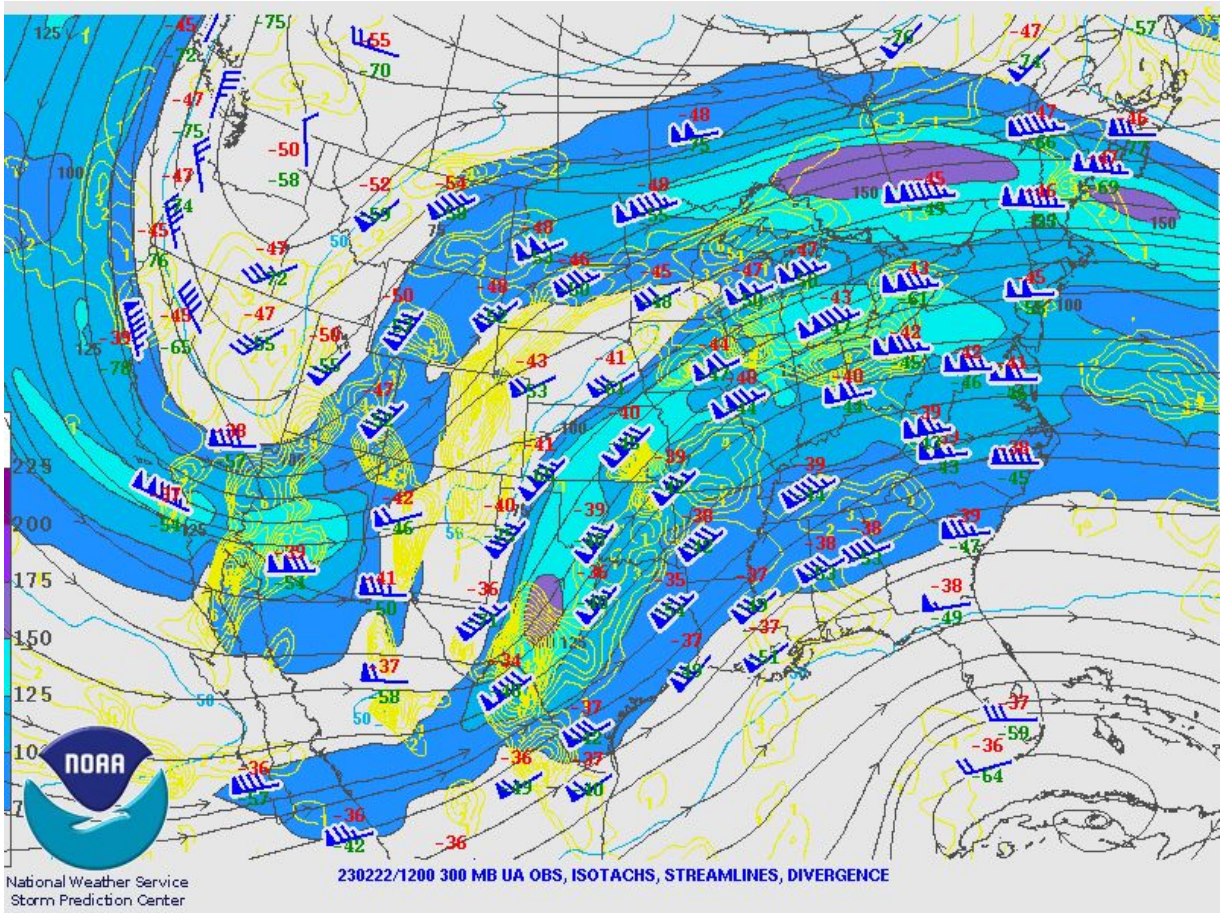
It is not all flat in the Midwest and this feature often impacts snow and wind



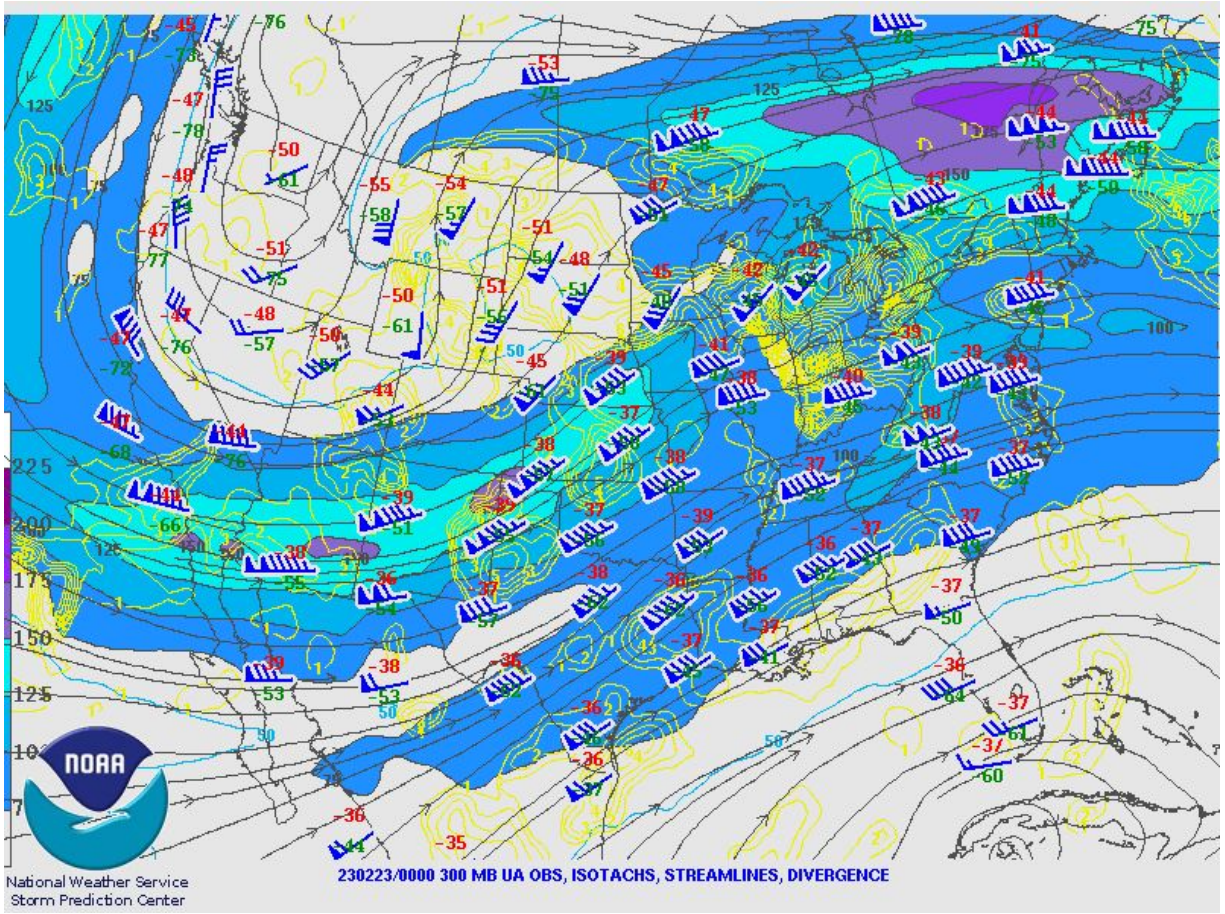
300mb Analysis - 2/22/23 00Z



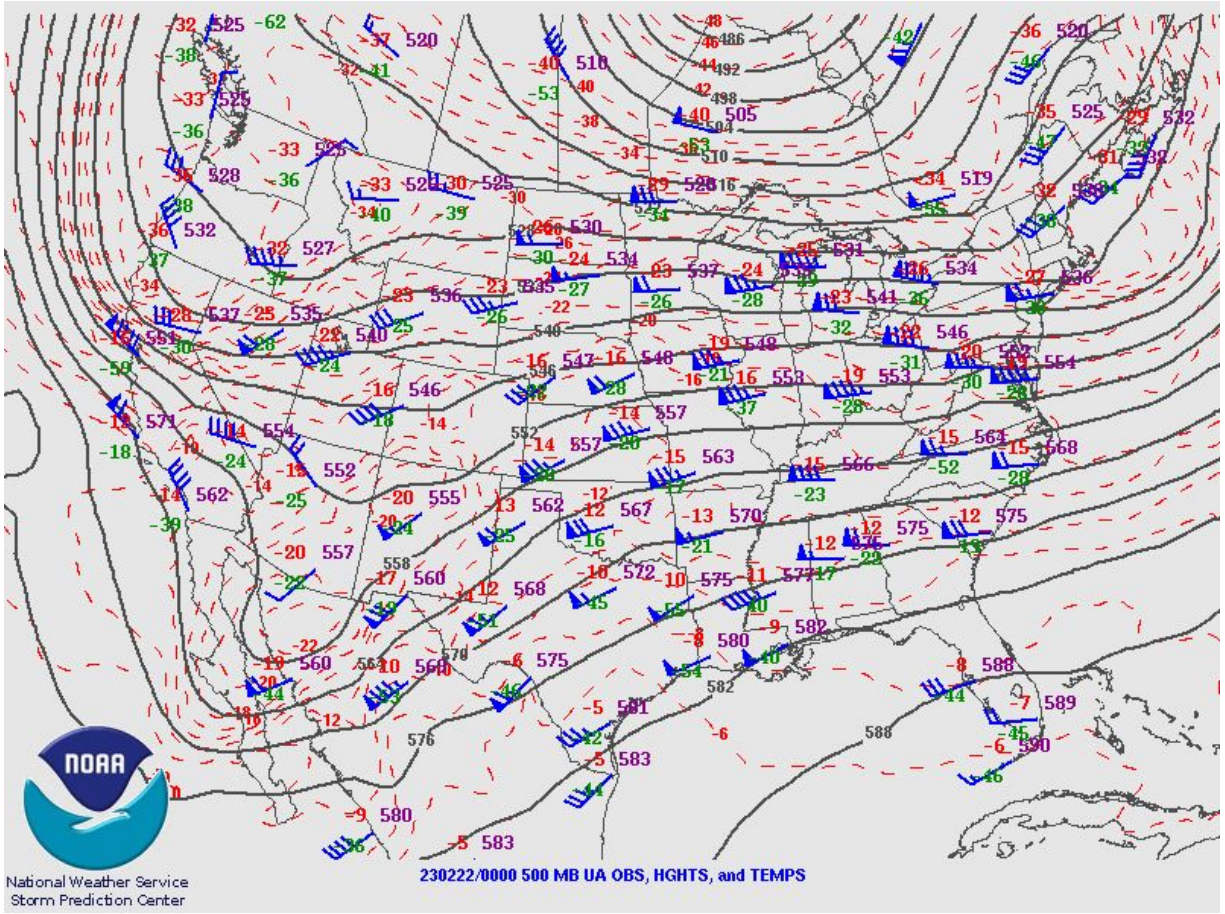
300mb Analysis - 2/22/23 12Z



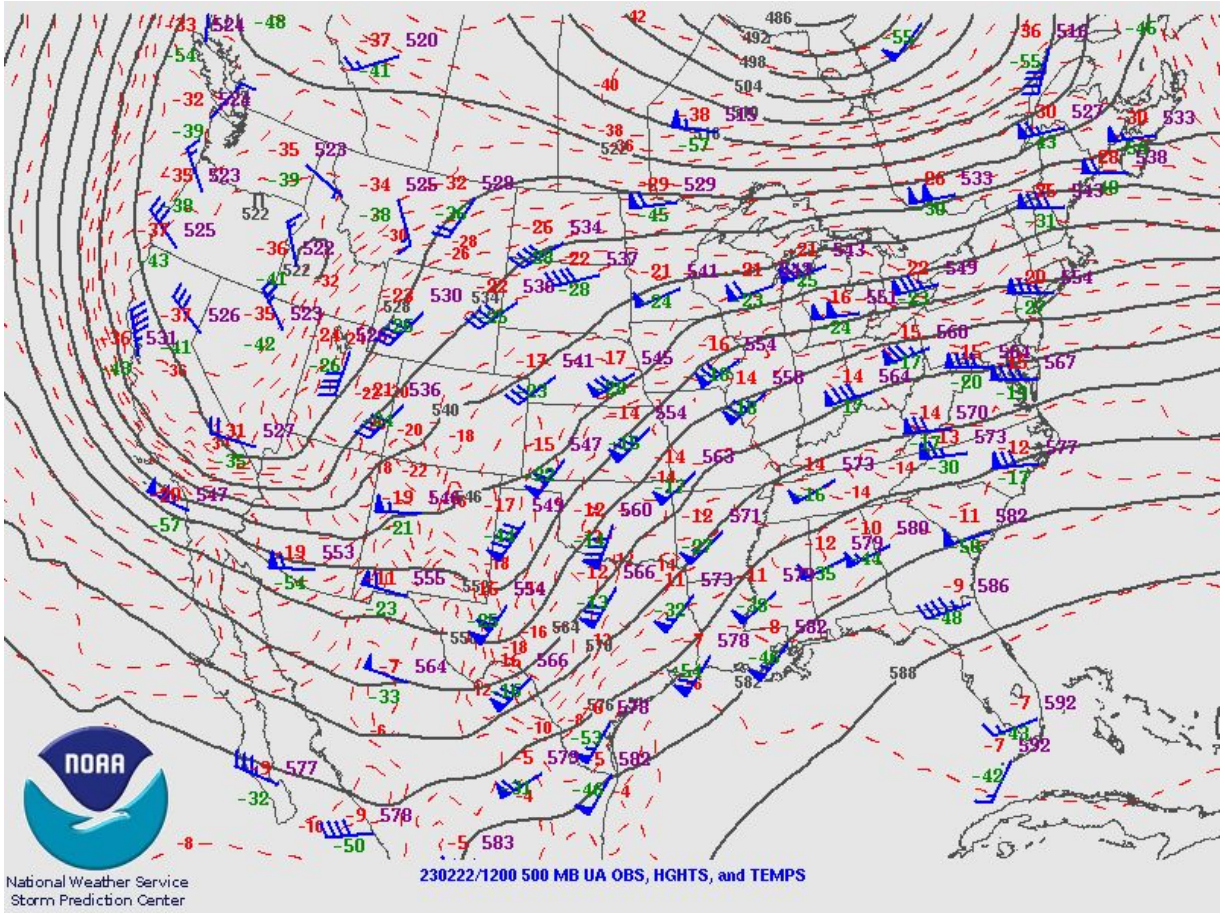
300mb Analysis - 2/23/23 00Z



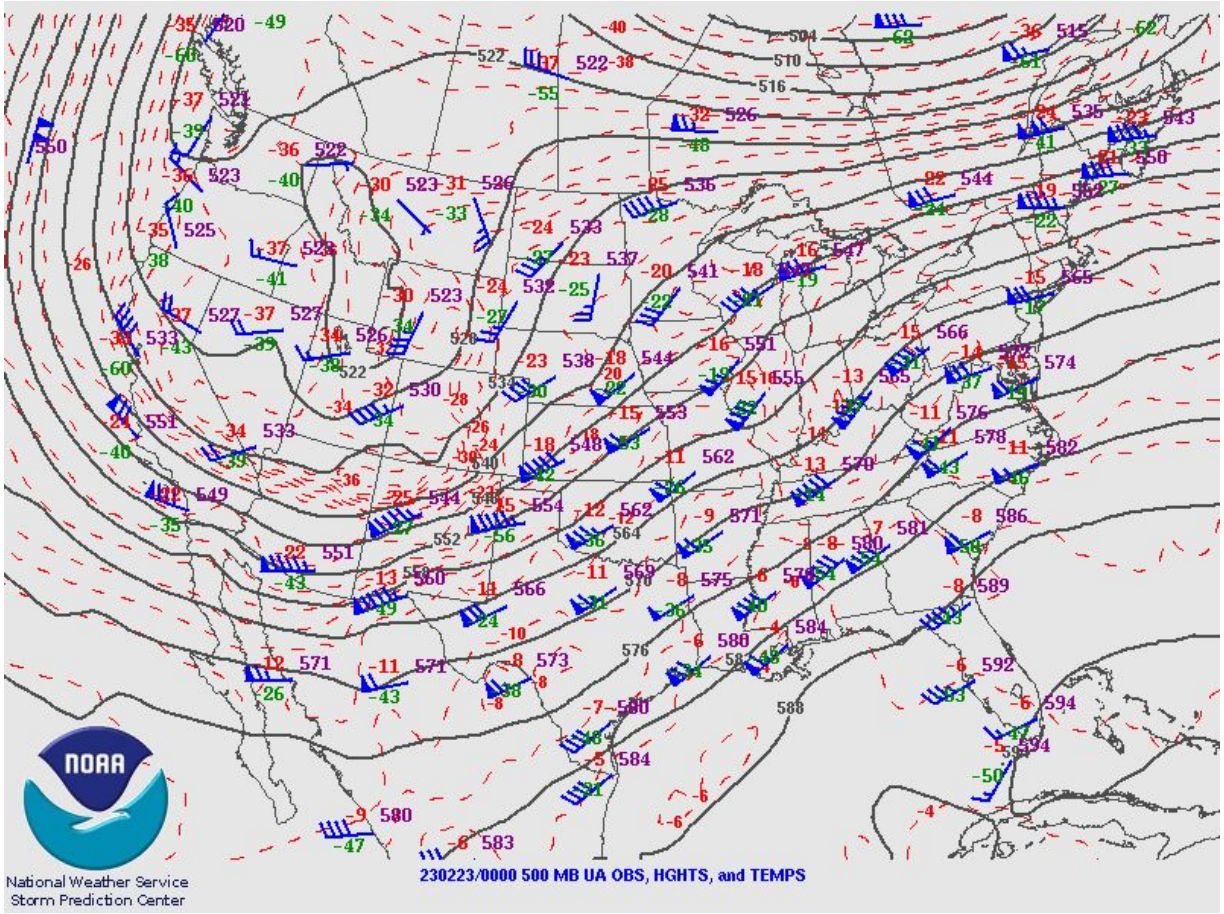
500mb Analysis - 2/22/23 00Z



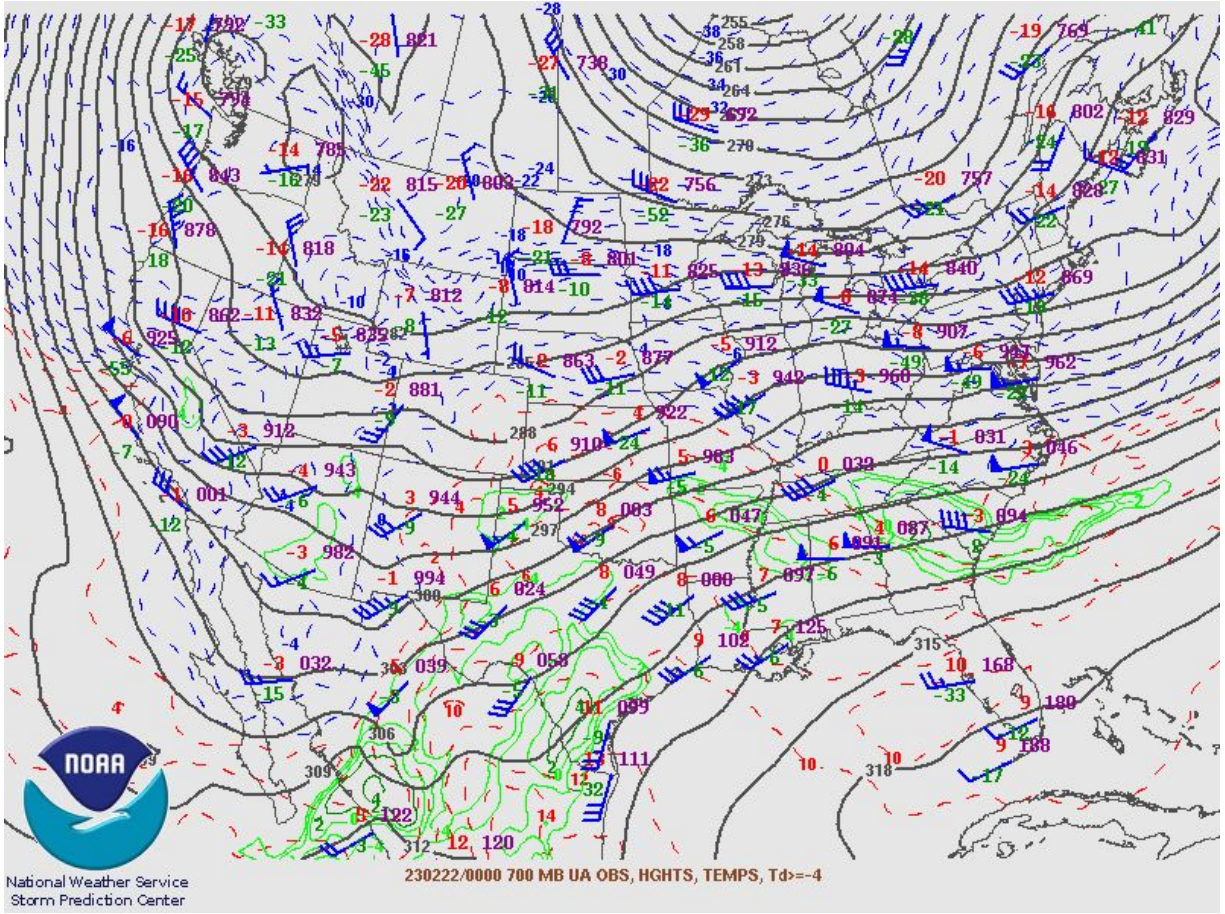
500mb Analysis - 2/22/23 12Z



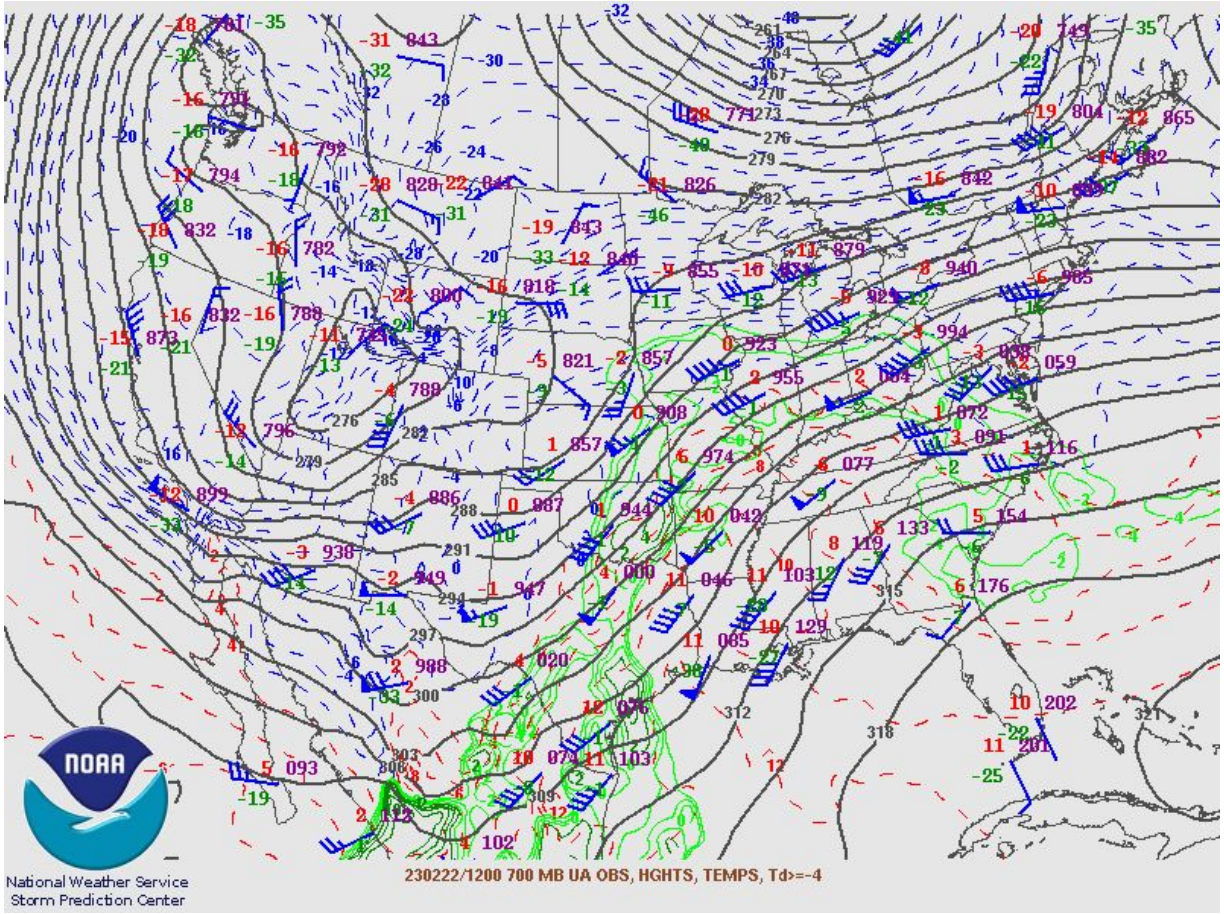
500mb Analysis - 2/23/23 00Z



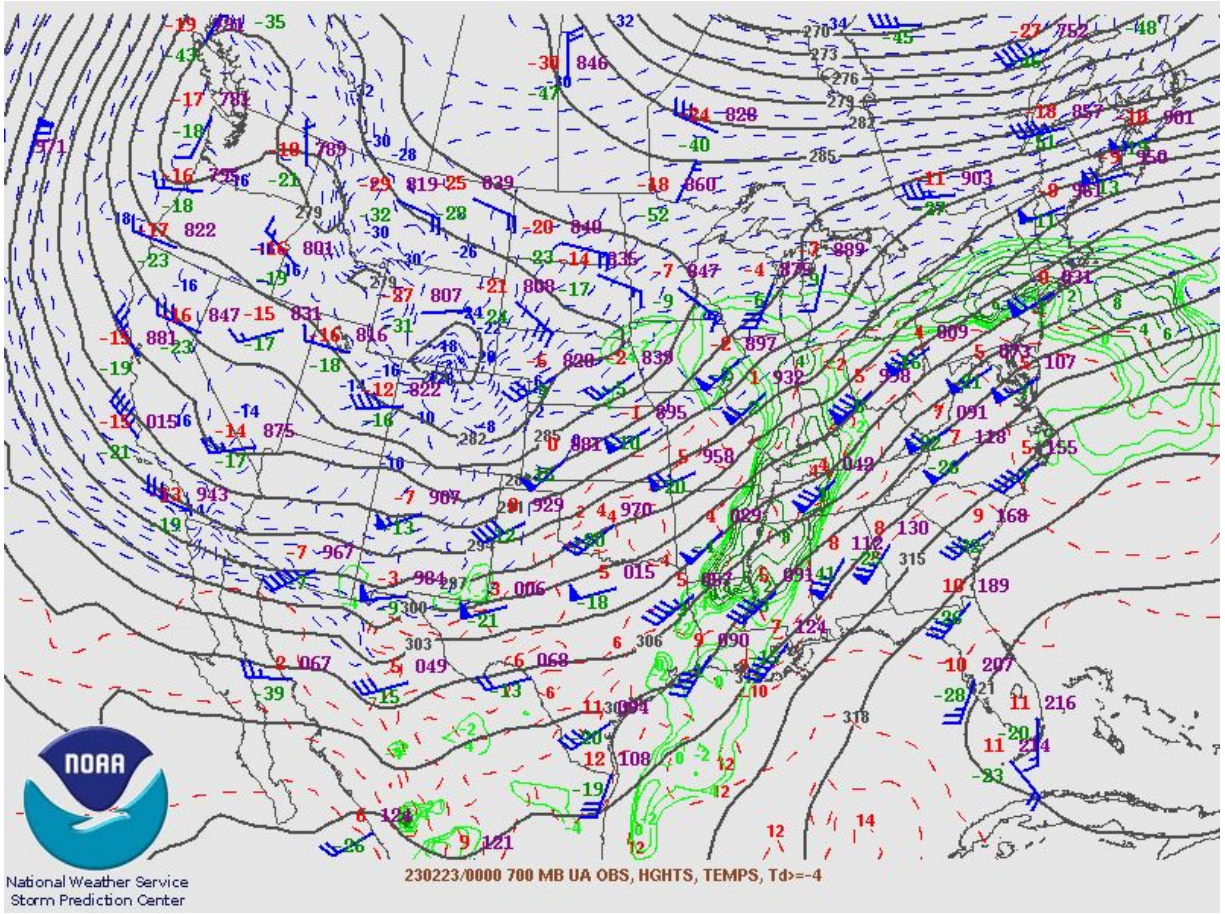
700mb Analysis - 2/22/23 00Z



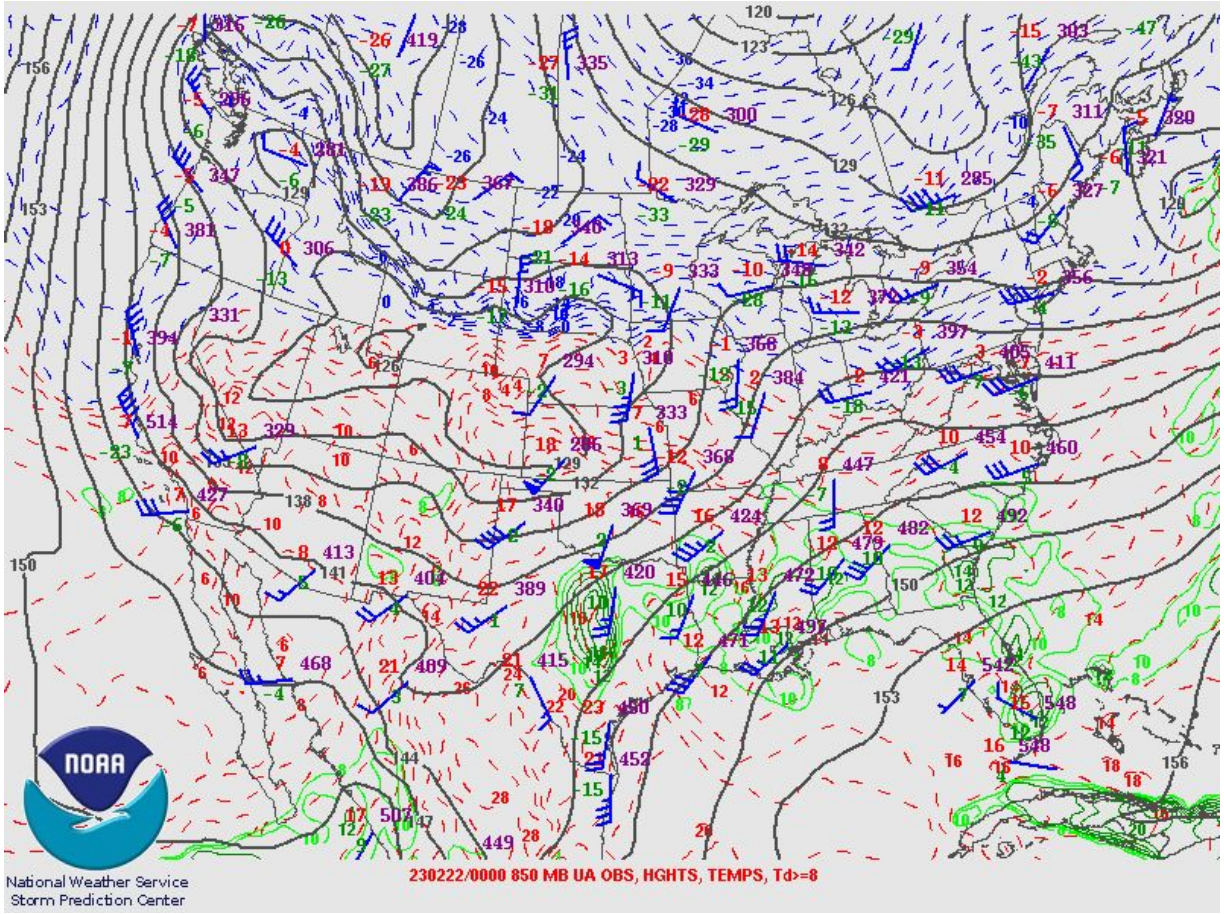
700mb Analysis - 2/22/23 12Z



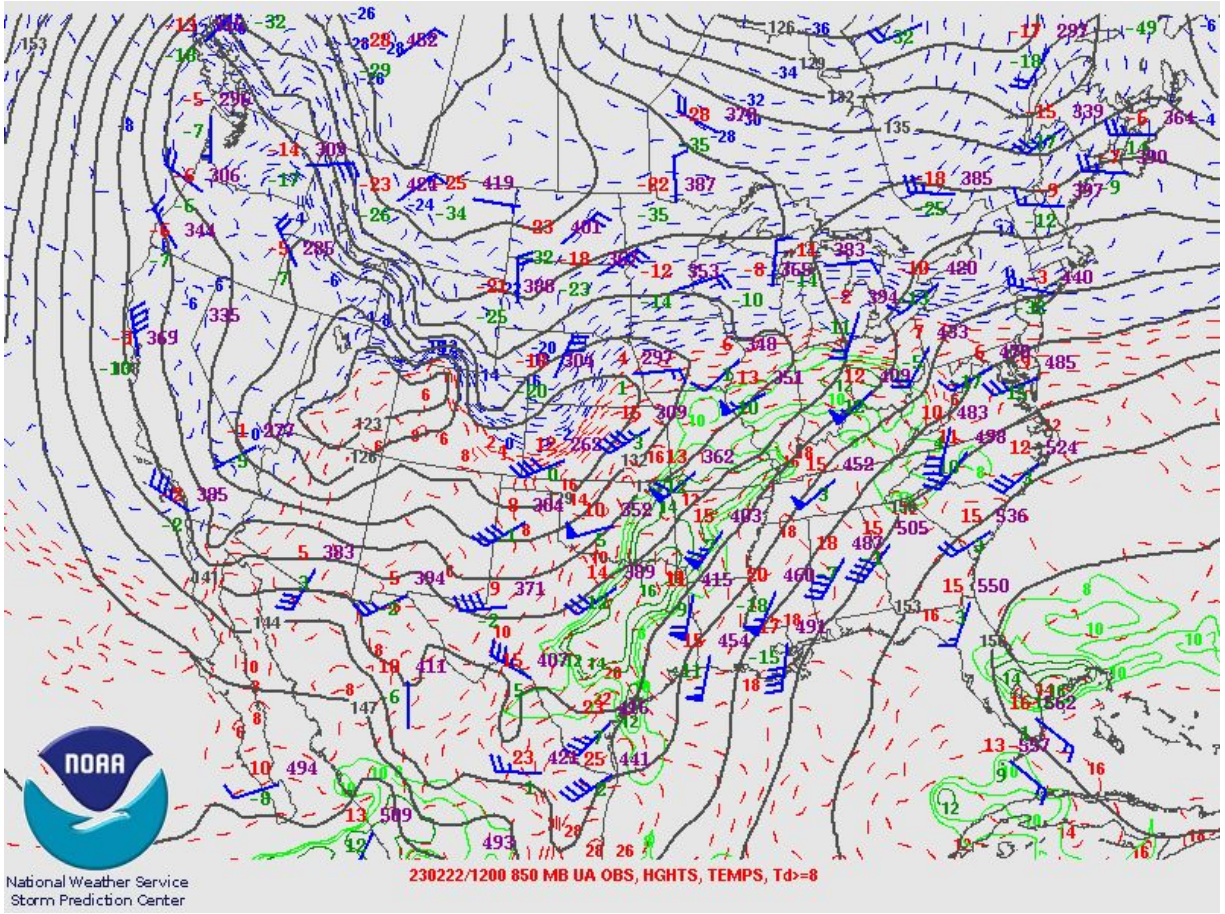
700mb Analysis - 2/23/23 00Z



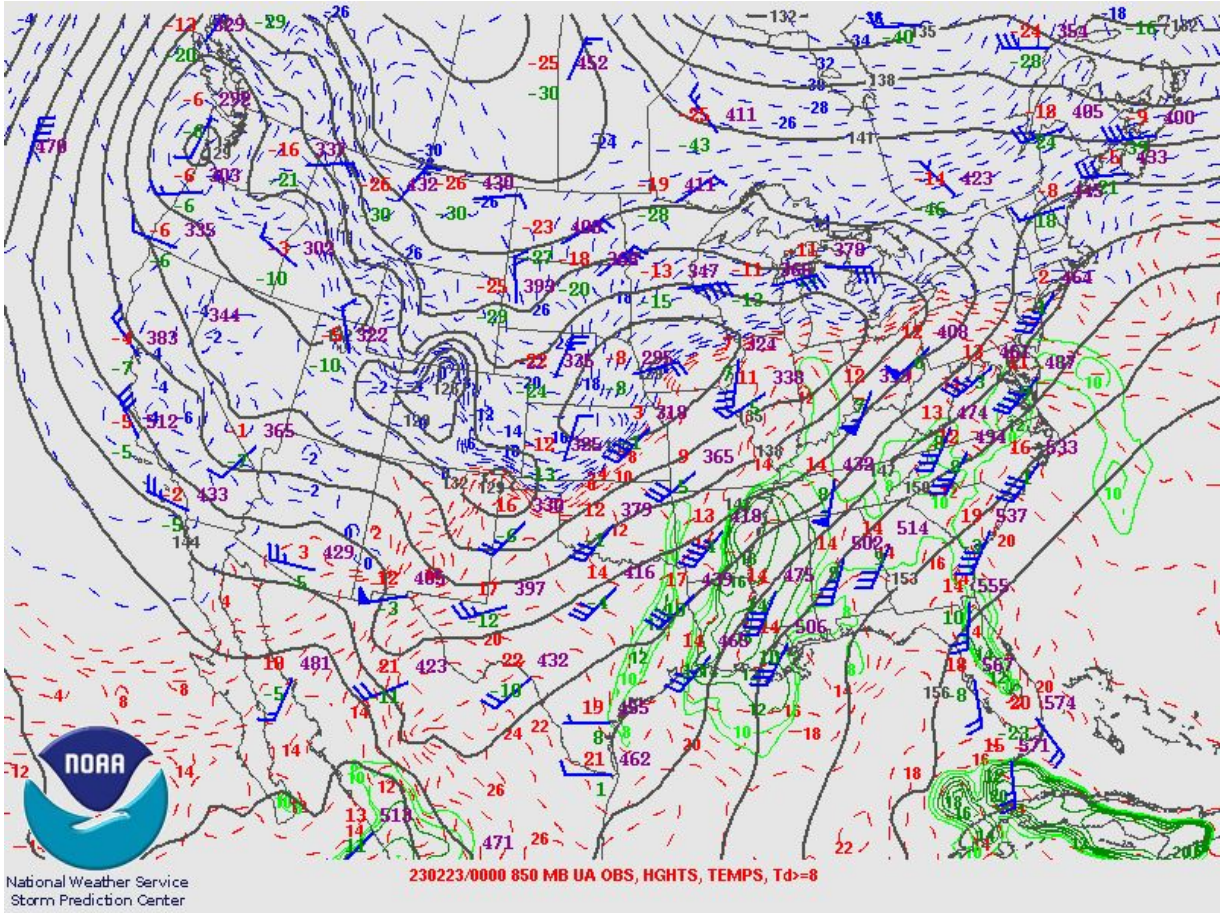
850mb Analysis - 2/22/23 00Z



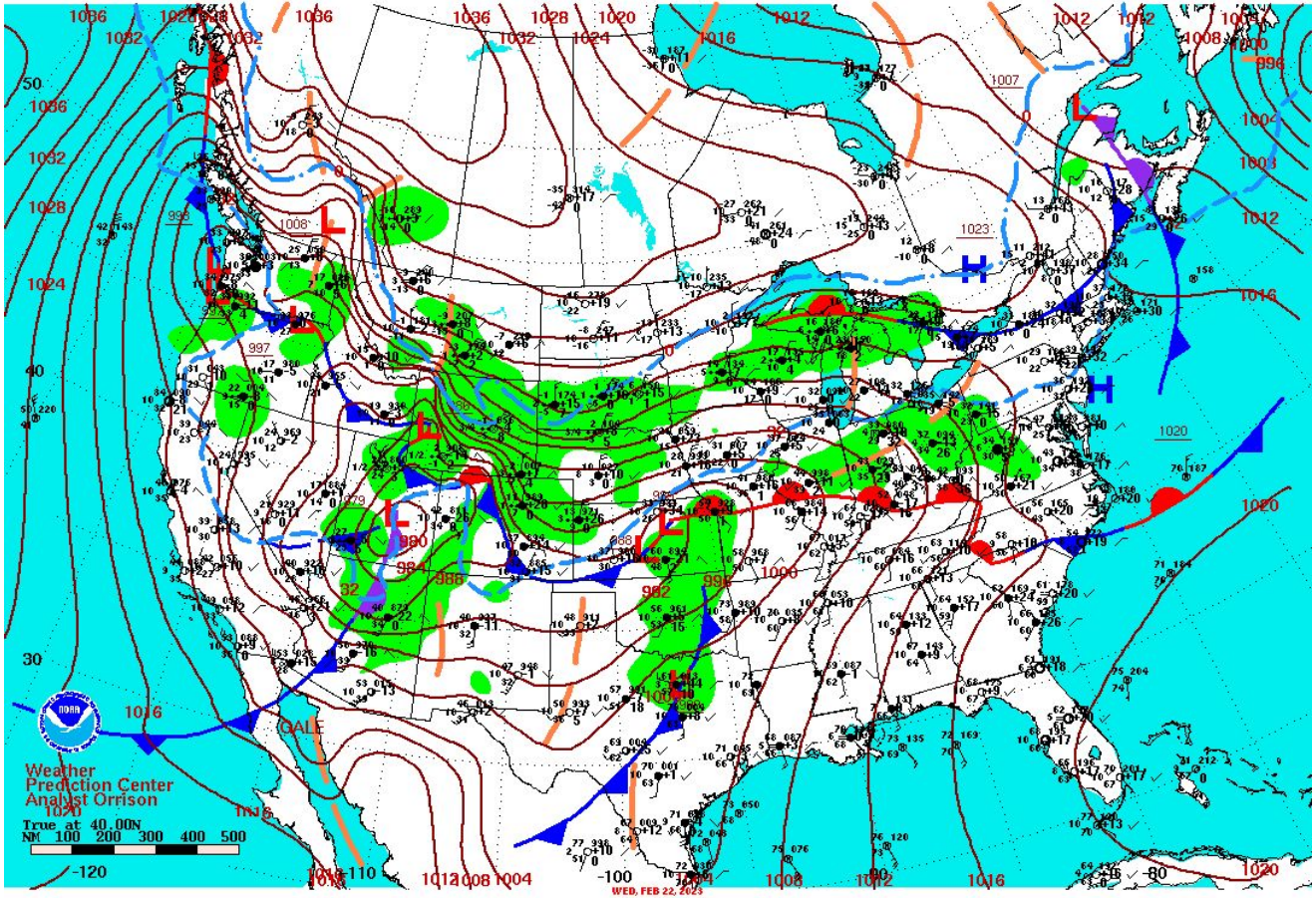
850mb Analysis - 2/22/23 12Z



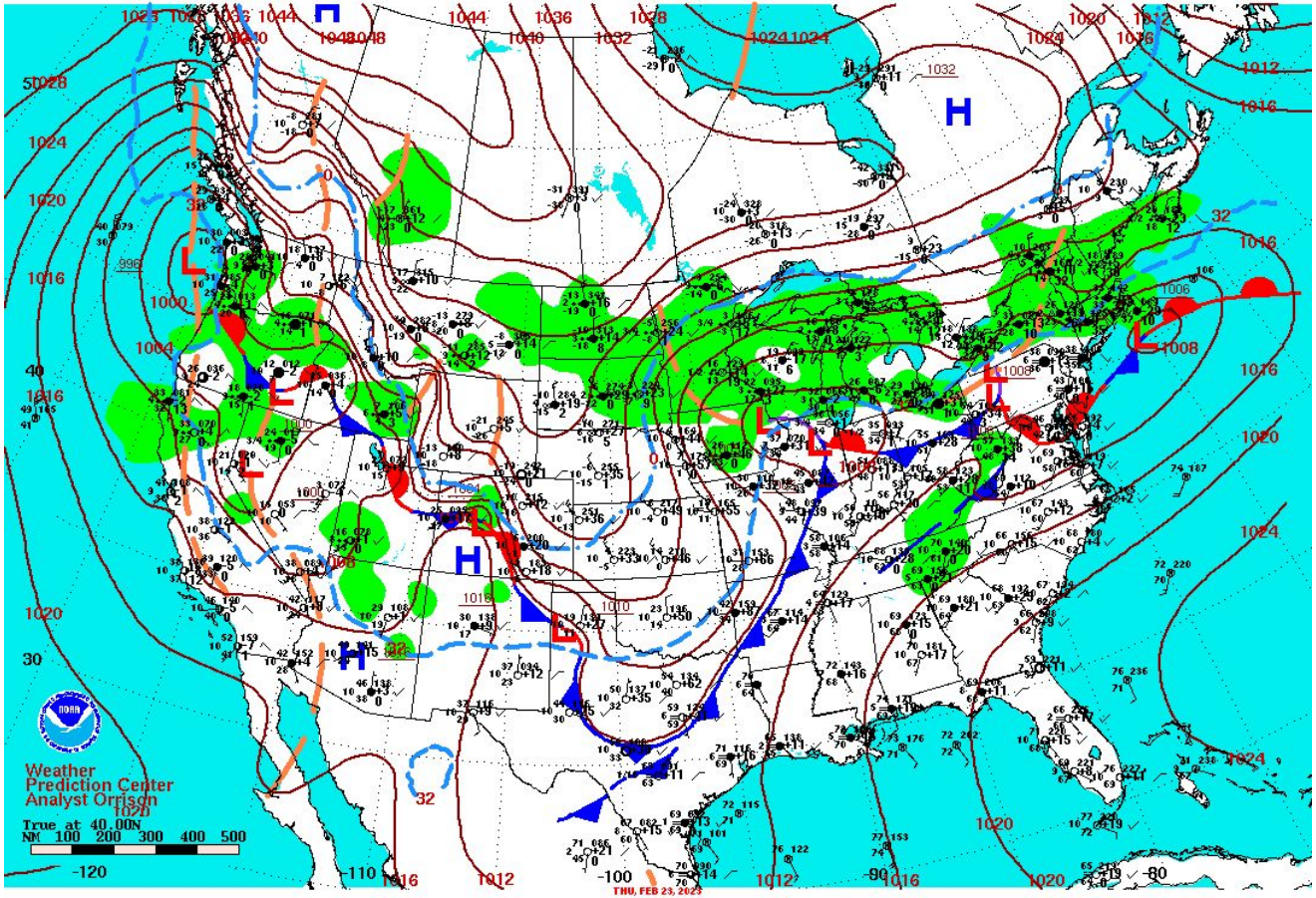
850mb Analysis - 2/23/23 00Z



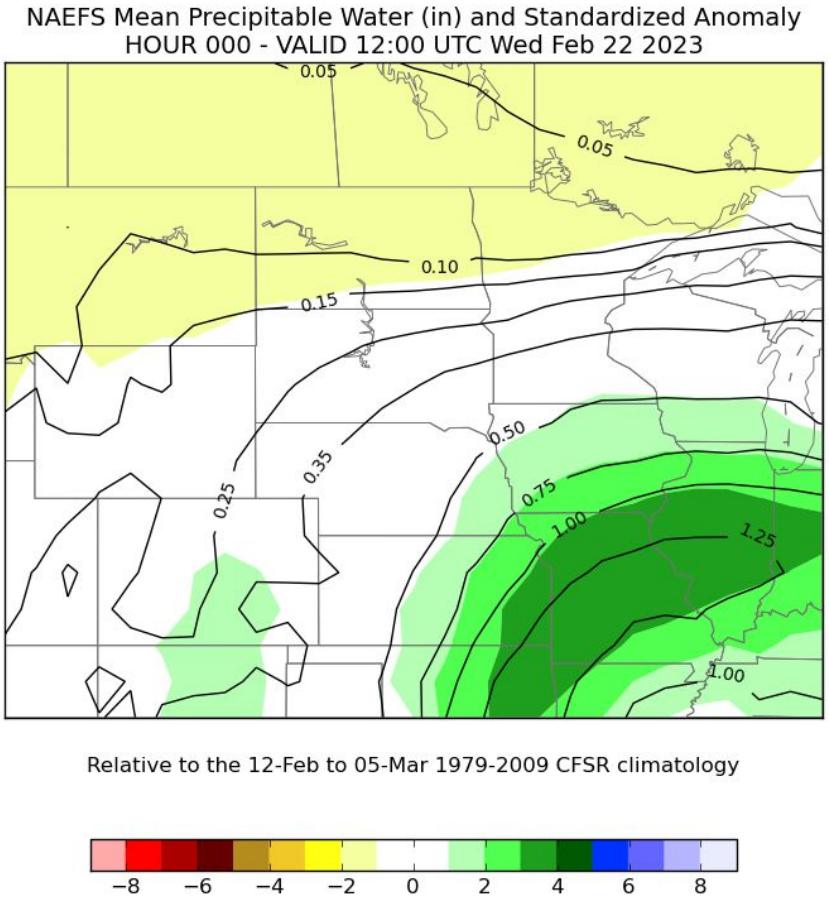
Surface Analysis - 2/22/23 00Z



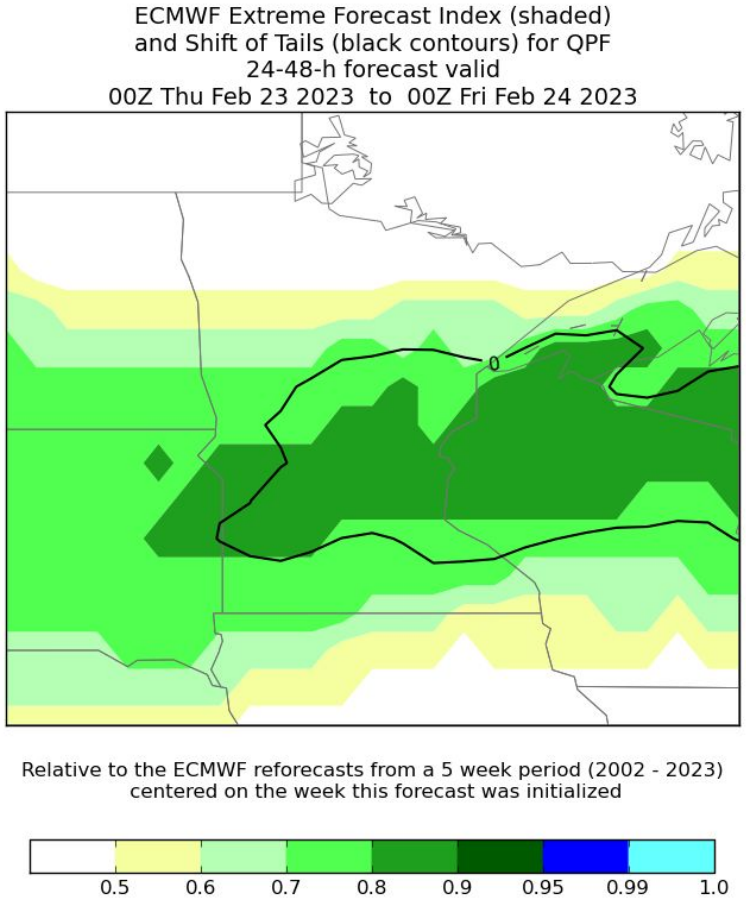
Surface Analysis - 2/23/23 00Z

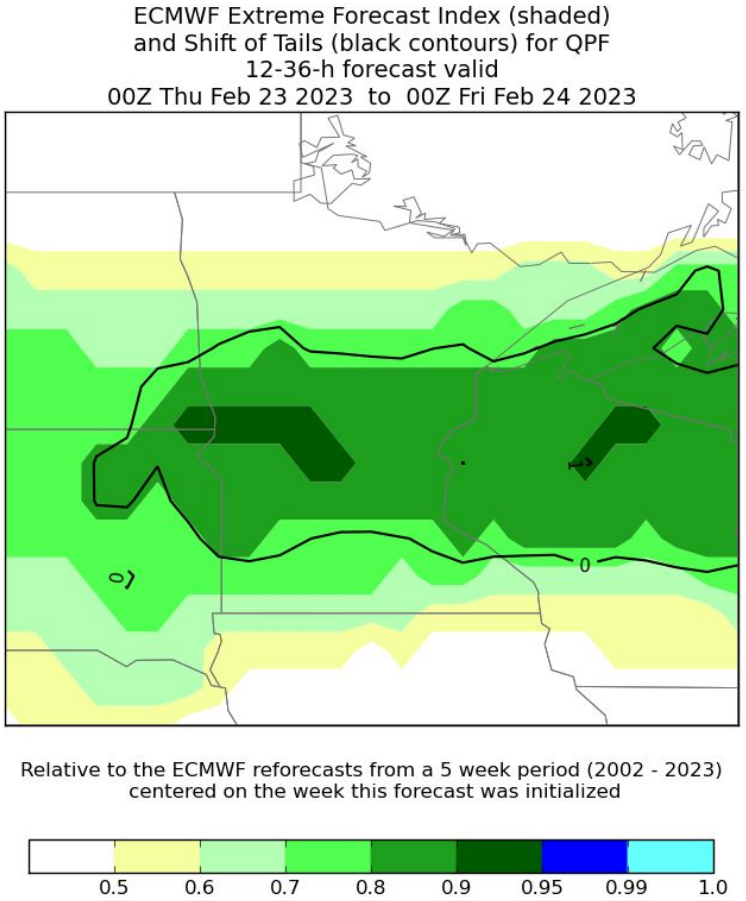


NAEFS PWAT Anomalies - 2/22/23 12Z



ECMWF Extreme Forecast Index





High NBM Probabilities 4 Days Out

Midweek Snowstorm

WHAT WE KNOW

- A large & slow-moving storm system will bring **significant snow** across the Upper Midwest. Blowing/ drifting snow & blizzard conditions possible across parts of the region.
- Winter Storm Watch decision to come later today after better grasp on timing. It isn't a question of amounts, rather, timing and duration of watch.
- Travel impacts are near certain, **especially Tuesday night, Wednesday night, & Thursday.**

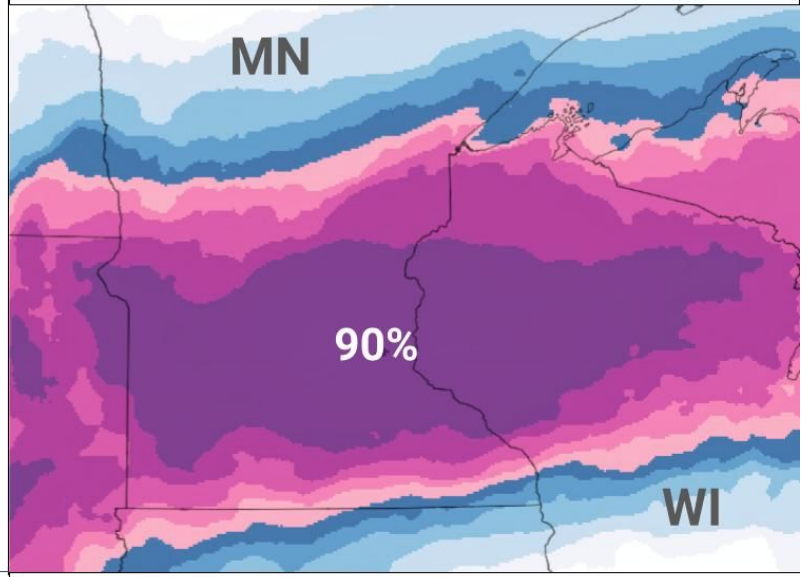
WHAT CAN CHANGE

- The *storm is a few days away*, so we still don't have details such as:
  - Snowfall amounts
  - Exact timing and placement of heaviest snow bands

National Weather Service
Twin Cities
Issued: Sun, Feb 19, 2023 3:57 AM

Probability of seeing 8" snow over 48 hour period:

Tuesday 6PM - Thursday 6PM



NWS Snow Forecast - 00z Feb 23 - 00z Feb 24

An earlier round of snow fell on Feb 21

NOTE this is 12hrs after the defined event has already started and includes 12hrs after event ends.

Additional Snowfall

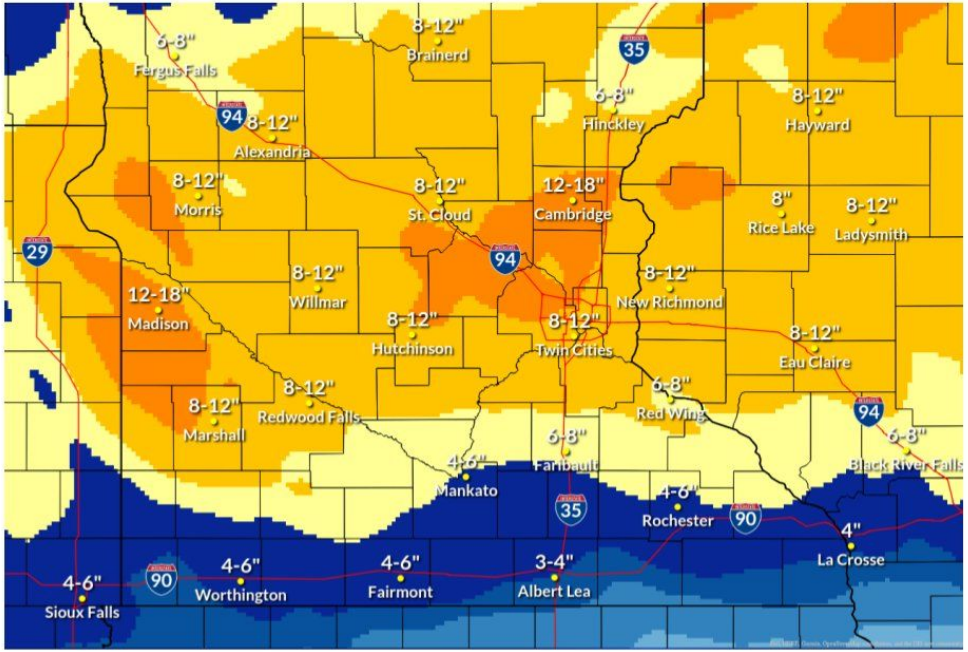
6 PM Wednesday to 6 PM Thursday

February 22, 2023
4:48 PM

Forecast Additional Snowfall Amounts (inches)

Key Message: The map to the right shows expected snowfall from 6 PM Wednesday through 6 PM Thursday. **This is in addition to what has already fallen.**

- Widespread 8 to 12 inches across western and central MN and western WI, with locally higher amounts of 14 inches possible.
- The heaviest amounts will be in the orange-shaded region.

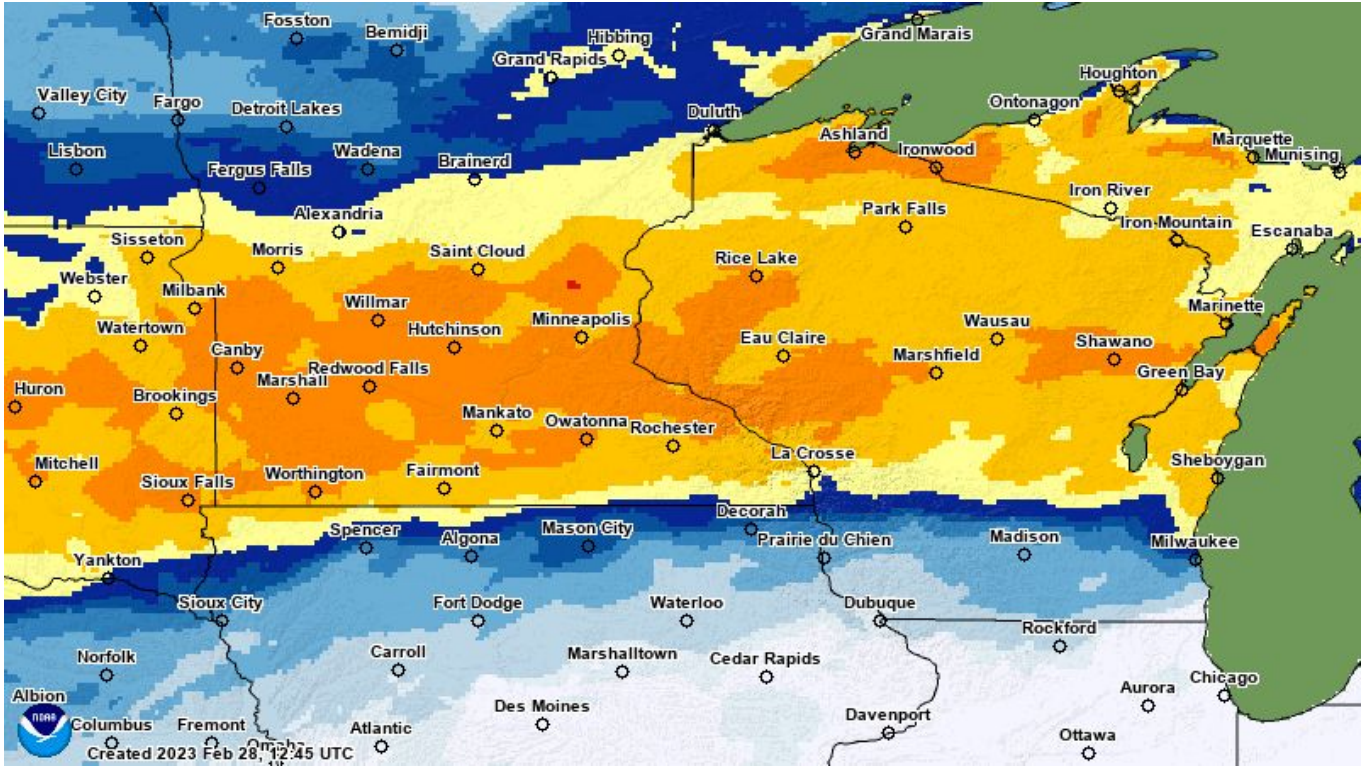


National Oceanic and Atmospheric Administration
U.S. Department of Commerce

National Weather Service
Twin Cities/Chanhassen, MN

Both Rounds Observed Snowfall

NOHRSC



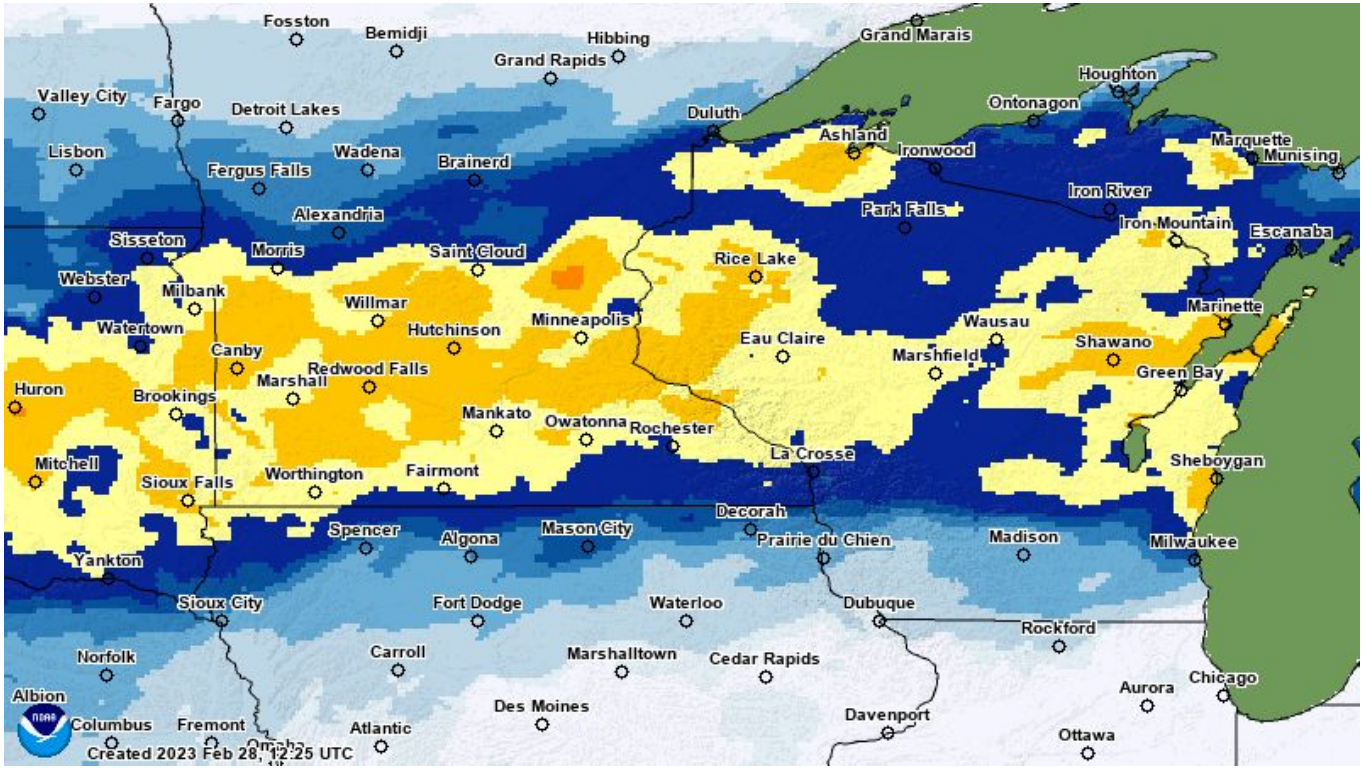
Inches of depth

	>	48
36	to	48
30	to	36
24	to	30
18	to	24
12	to	18
8.0	to	12
6.0	to	8.0
4.0	to	6.0
3.0	to	4.0
2.0	to	3.0
1.0	to	2.0
0.10	to	1.0
0.00	to	0.10
0.00		

February 21 - 23, 2023
12Z to 12Z

24 hr Observed Snowfall

NOHRSC

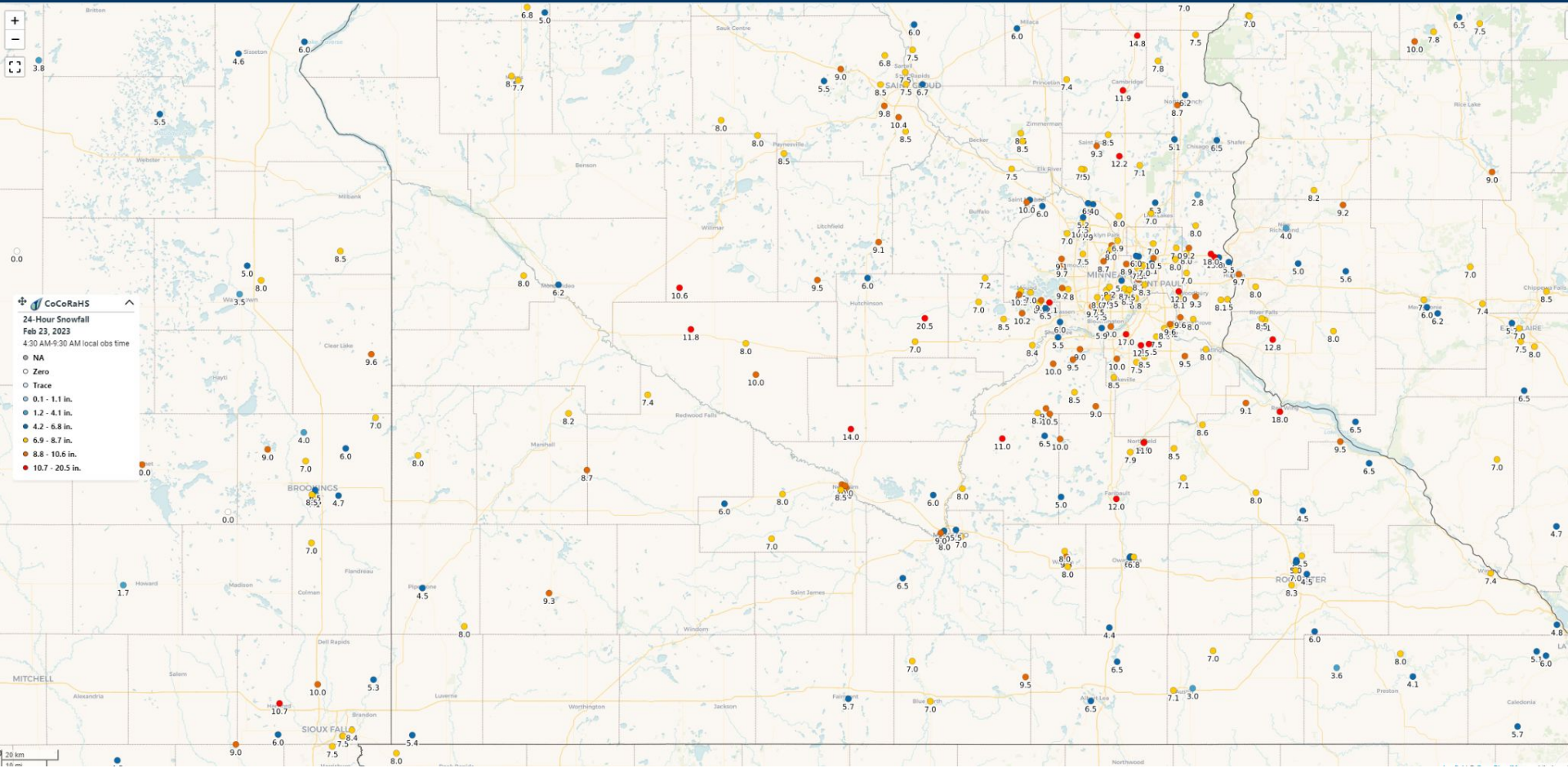


Inches of depth

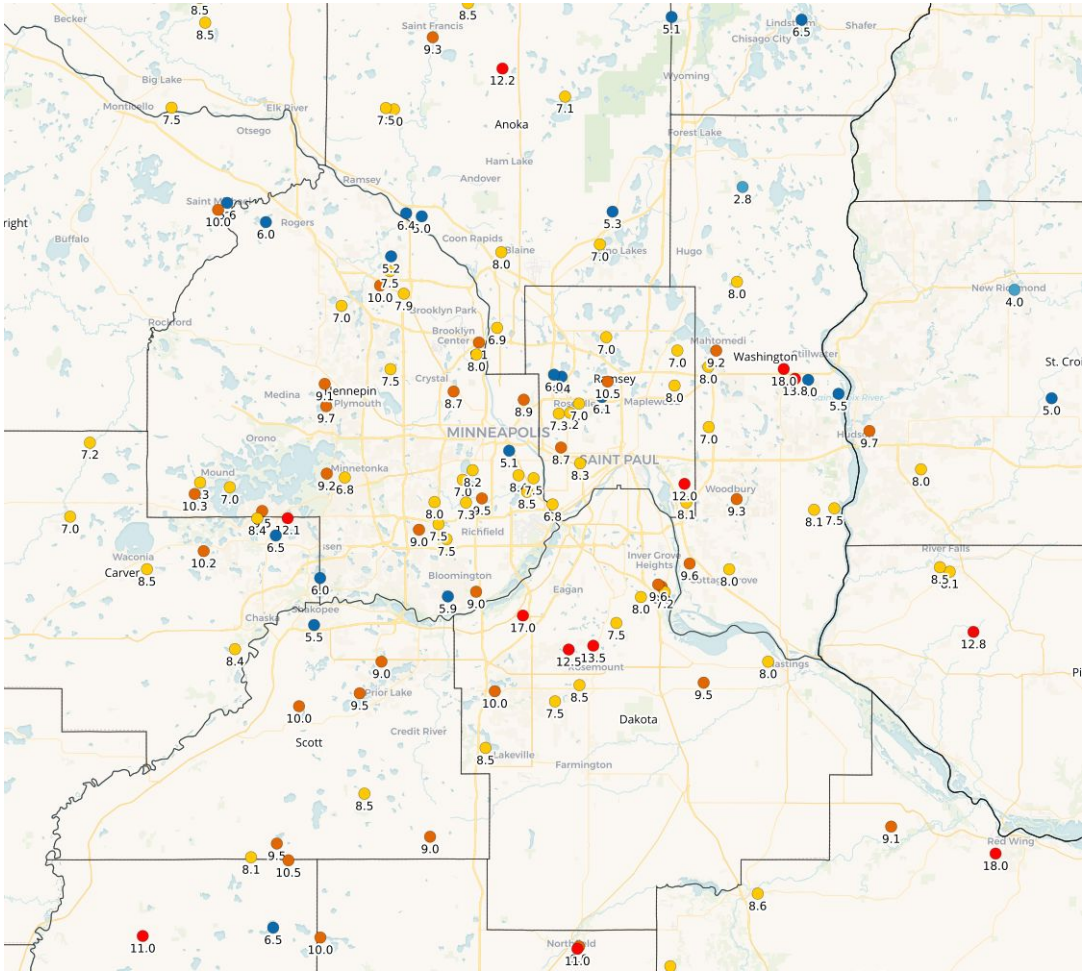
	>	48	
36	to	48	
30	to	36	
24	to	30	
18	to	24	
12	to	18	
8.0	to	12	
6.0	to	8.0	
4.0	to	6.0	
3.0	to	4.0	
2.0	to	3.0	
1.0	to	2.0	
0.10	to	1.0	
0.00	to	0.10	
0.00			

February 22 - 23, 2023
12Z to 12Z

CoCoRaHS Observations



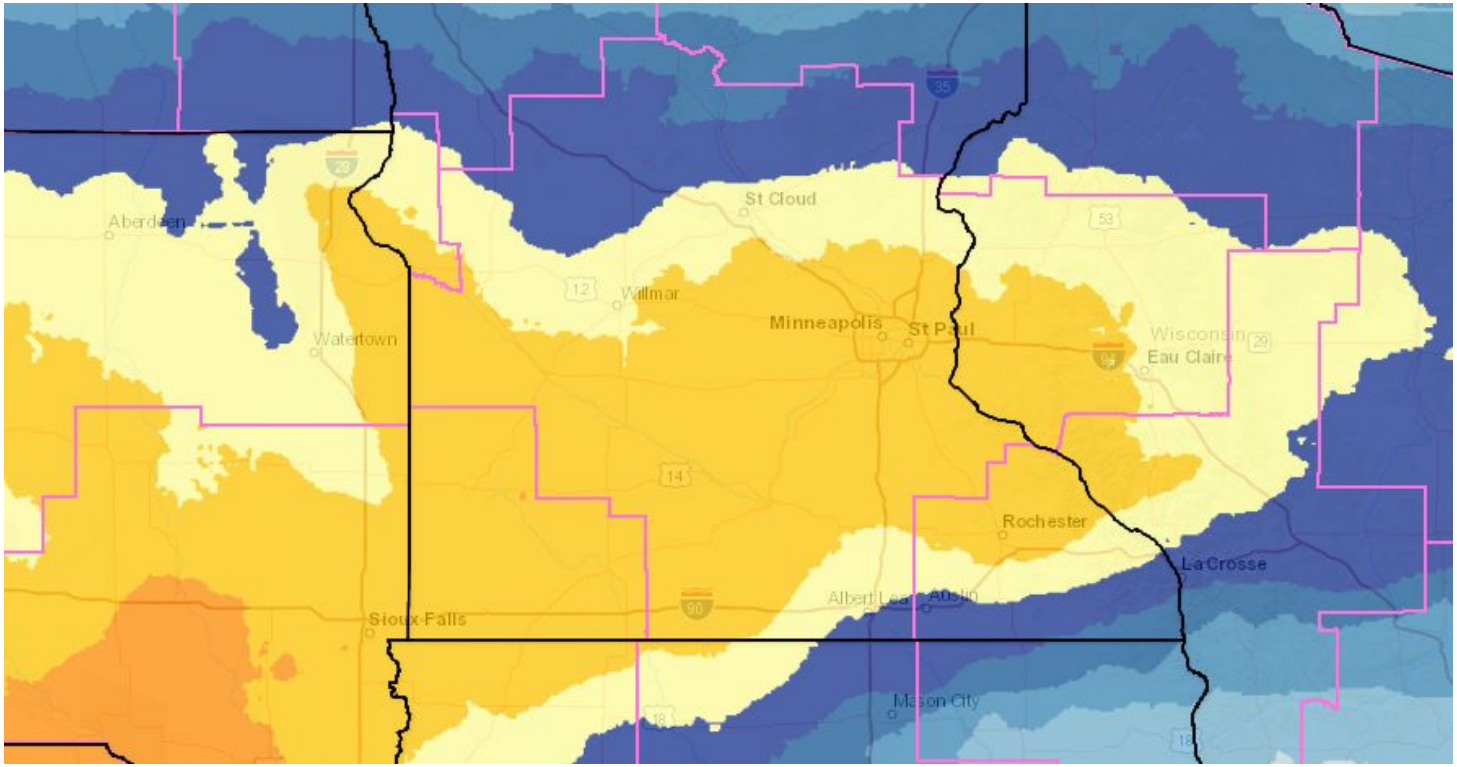
CoCoRaHS Observations (Metro)



Day 3 Forecast Evaluation

84 hr lead time

Day 3 NBM Deterministic Snow Forecast

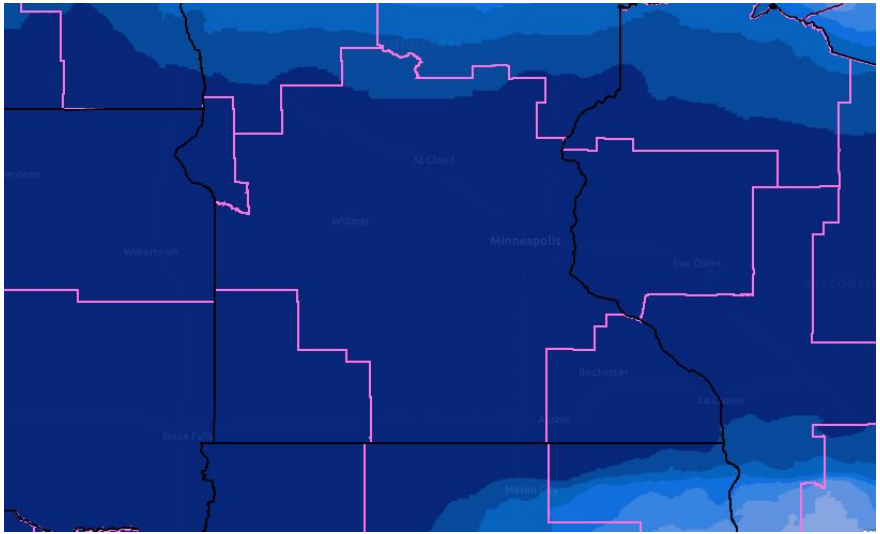


Snow Accumulation (in)

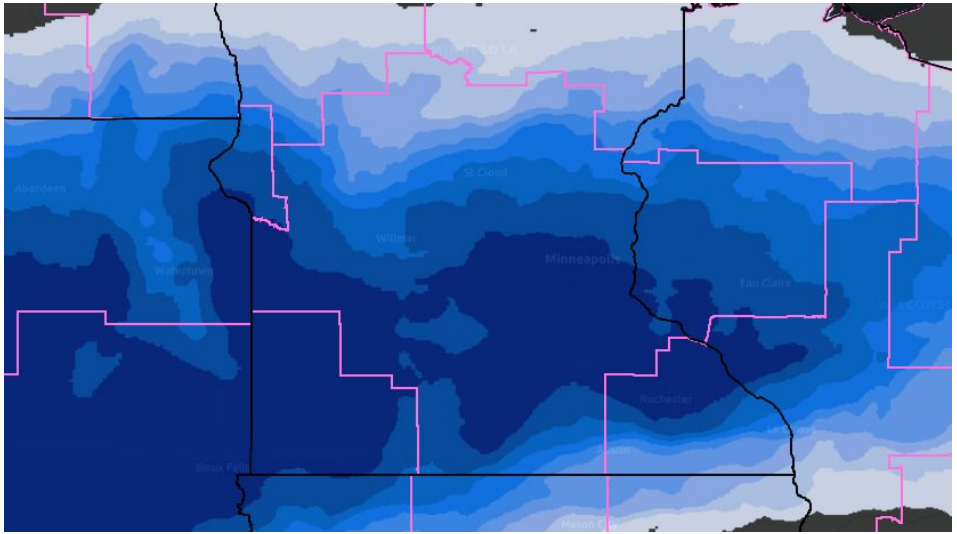
0 0.1 1 2 3 4 6 8 12 18

Day 3 NBM Probabilistic Snow Forecast

1 inch

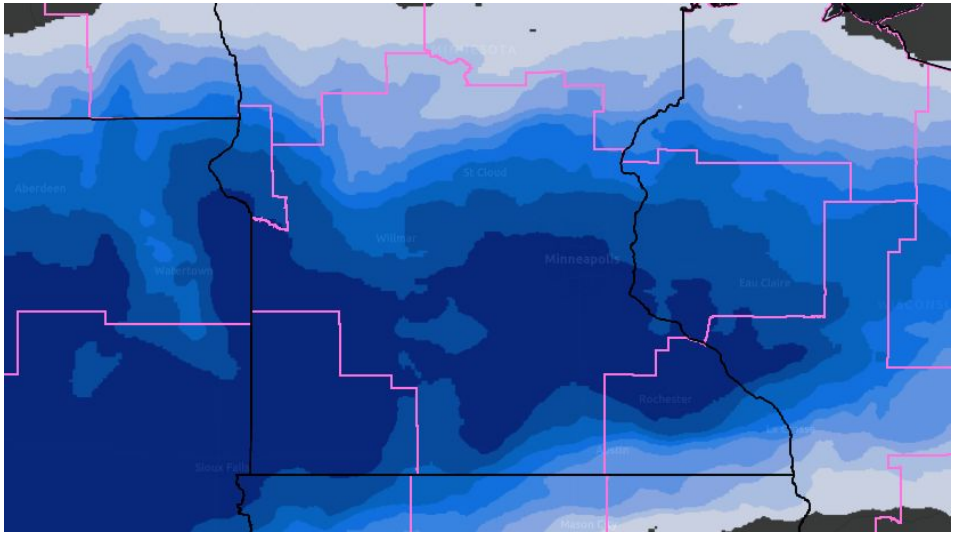


6 inch

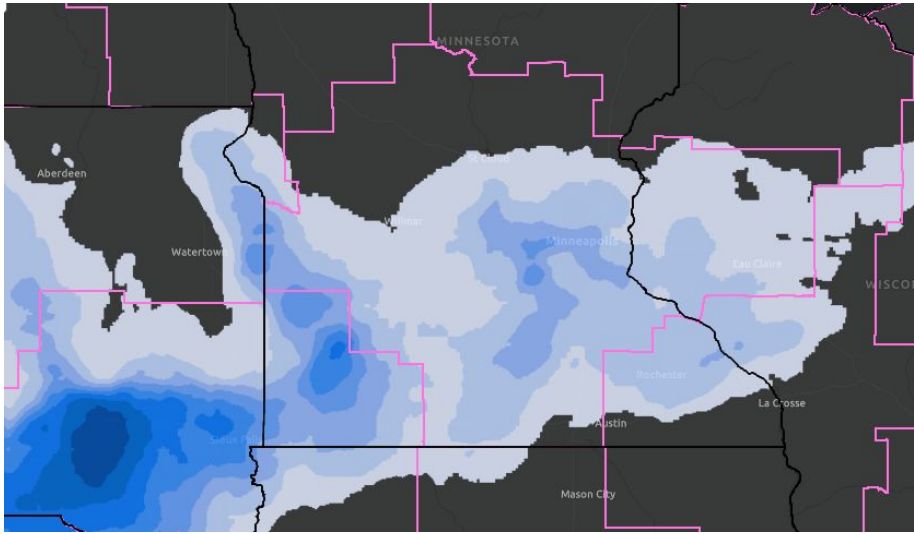


Day 3 NBM Probabilistic Snow Forecast

6 inch



12 inch



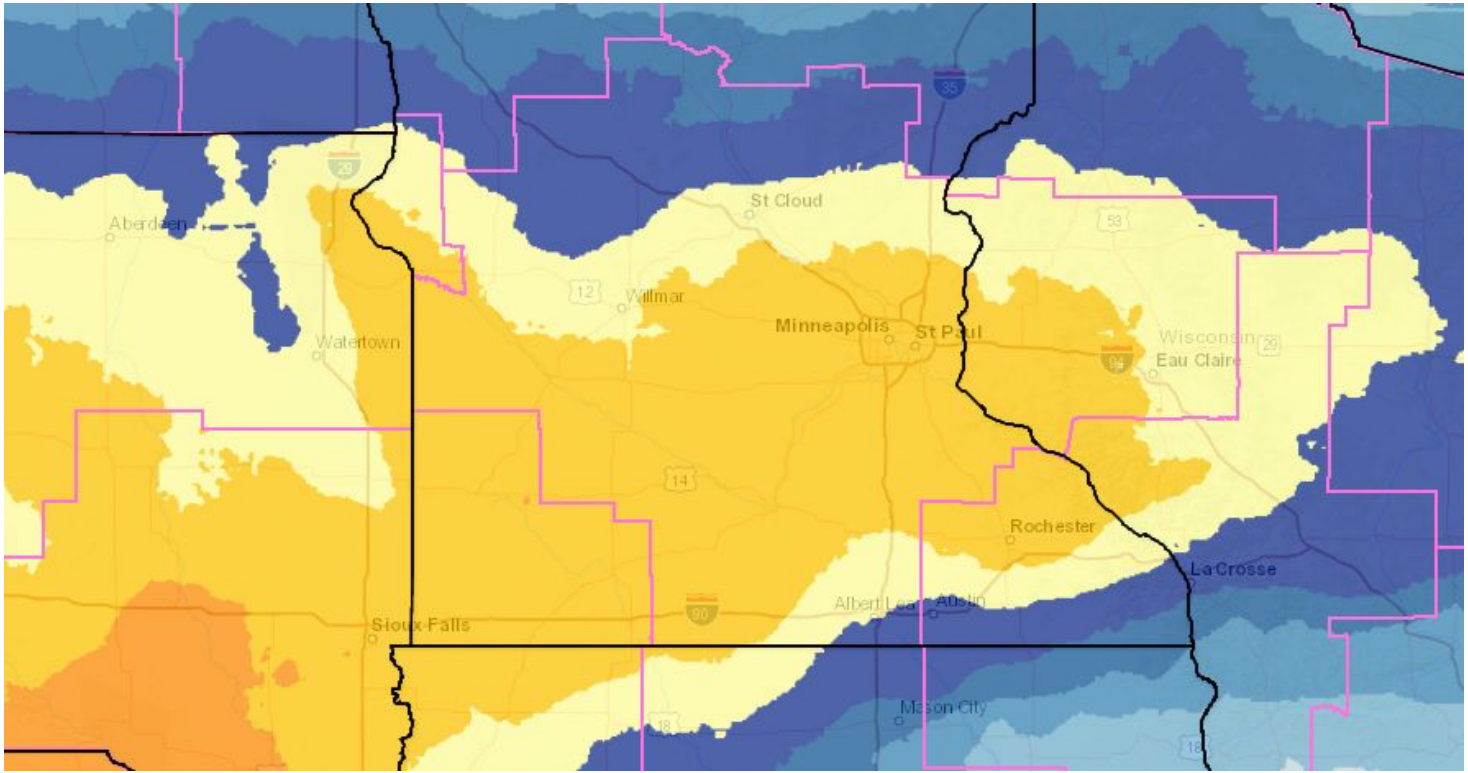
Day 3 Discussion Questions

- What is the best way to message at day 3? Snow ranges or snow amount exceedance?
- Looking at the 6 hour totals is there a concern for snow rate or is this impactful as more of a duration snow event?
- What is your overall confidence level and how would you convey that to partners?
- What kind of headline (watch/warning/advisory) would you like to have out at this time?
- Are you seeing any enhancement along the Coteau or Buffalo Ridge?

Day 2 Forecast Evaluation

60 hr lead time

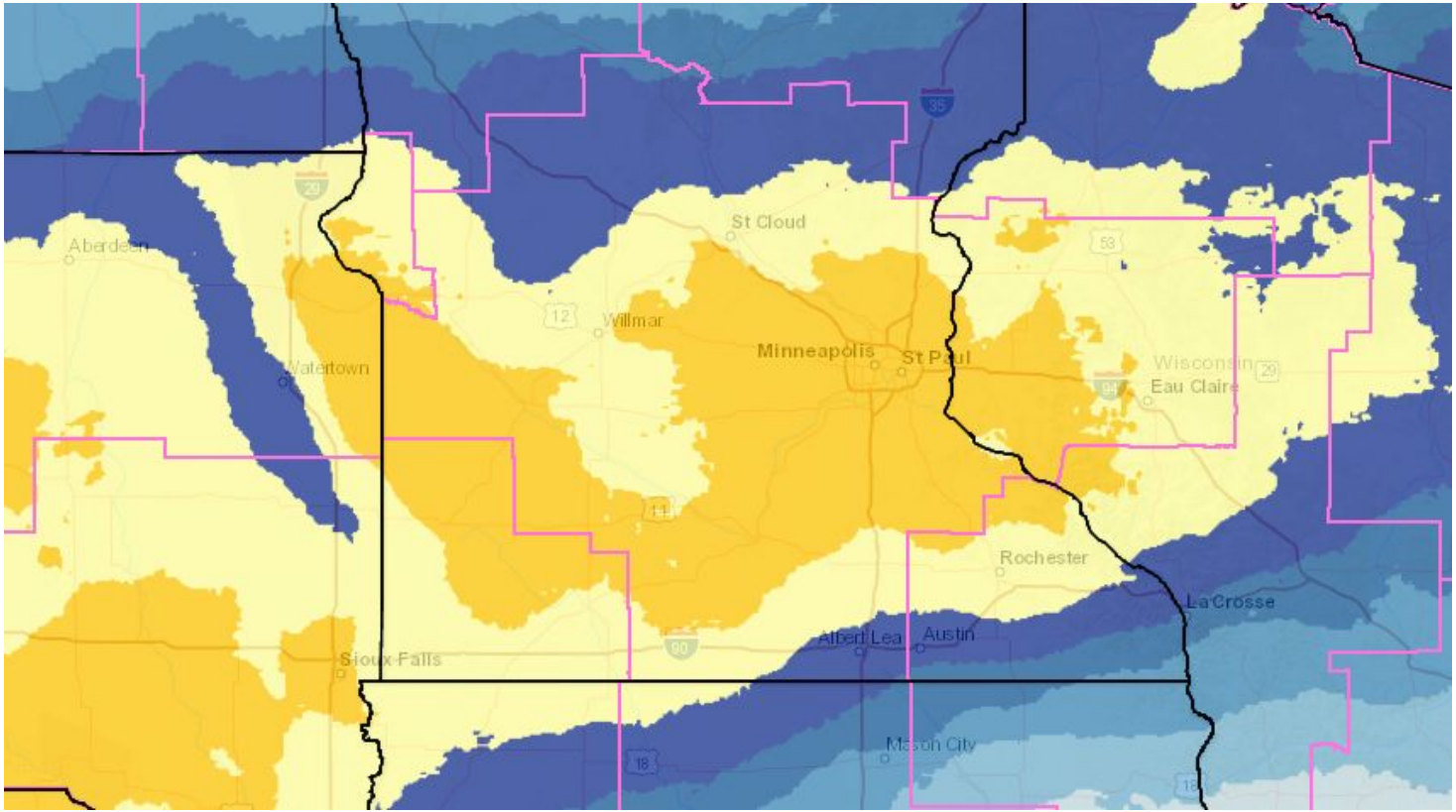
Day 3 NBM Deterministic Snow Forecast



Snow Accumulation (in)

0 0.1 1 2 3 4 6 8 12 18

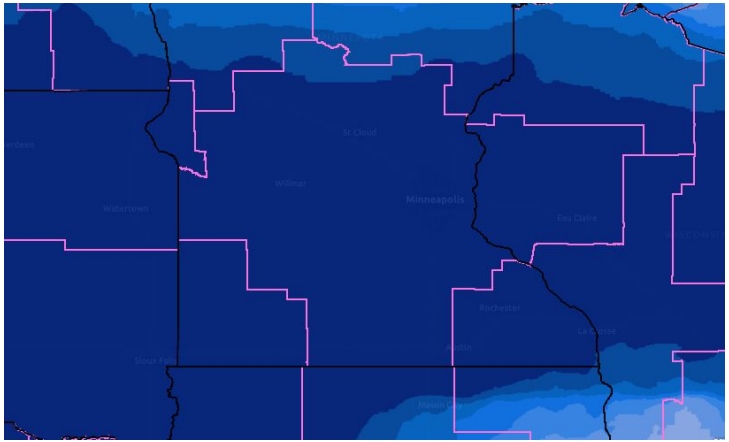
Day 2 NBM Deterministic Snow Forecast



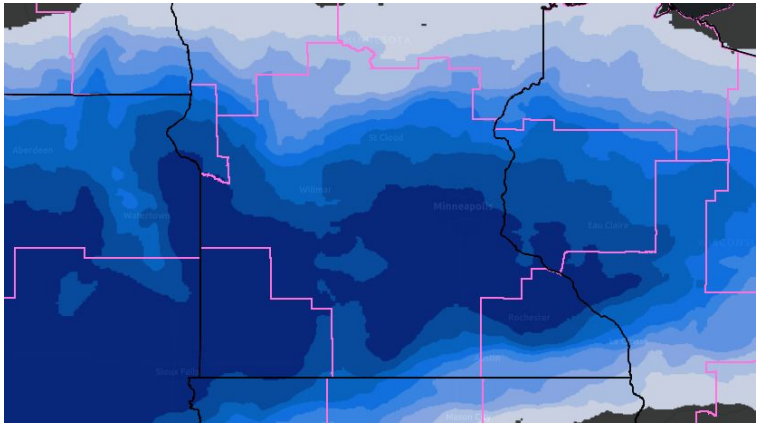
Snow Accumulation (in)

0 0.1 1 2 3 4 6 8 12 18

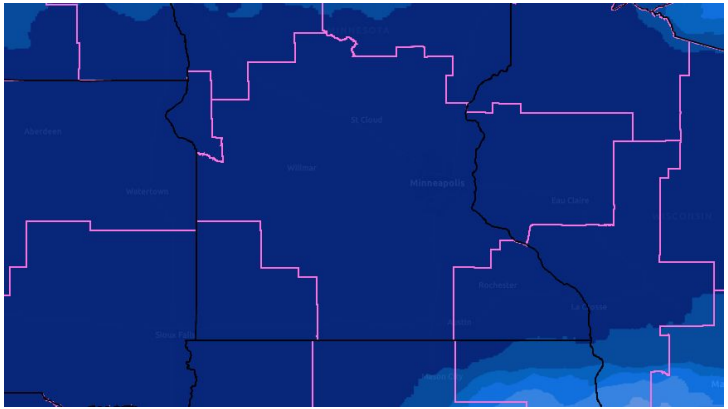
Day 3 to 2 NBM Probabilistic Snow Forecasts



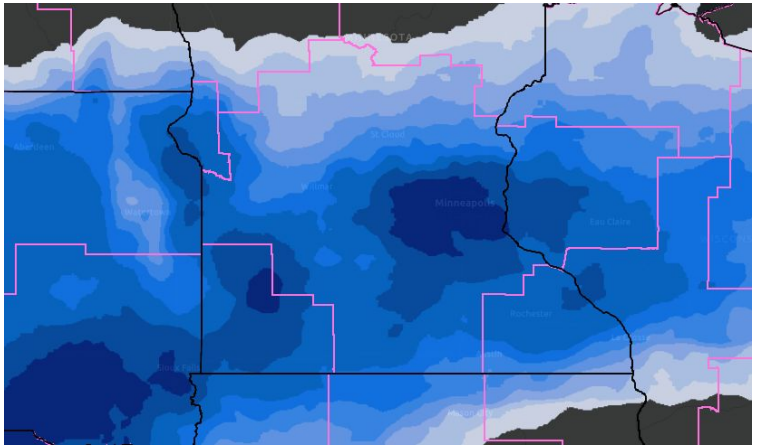
Day 3 1 inch



Day 3 6 inch



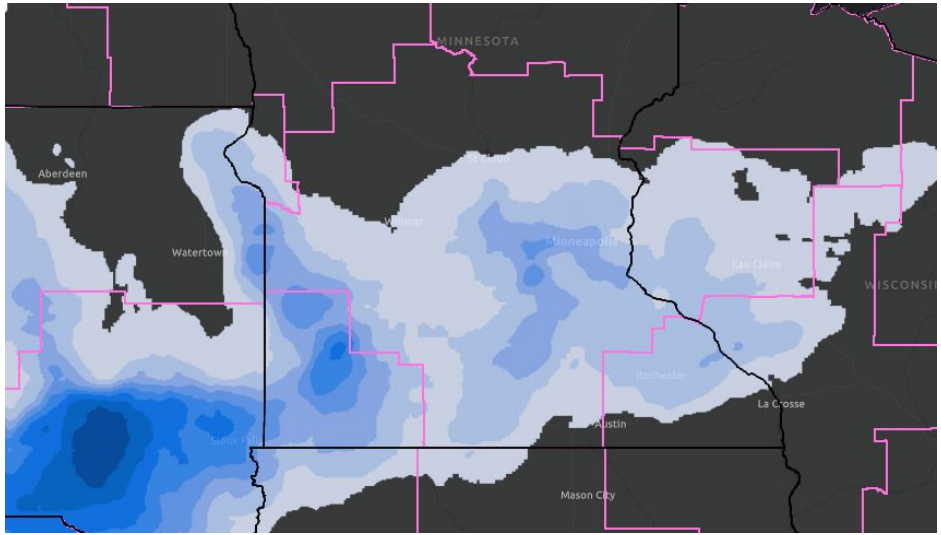
Day 2 1 inch



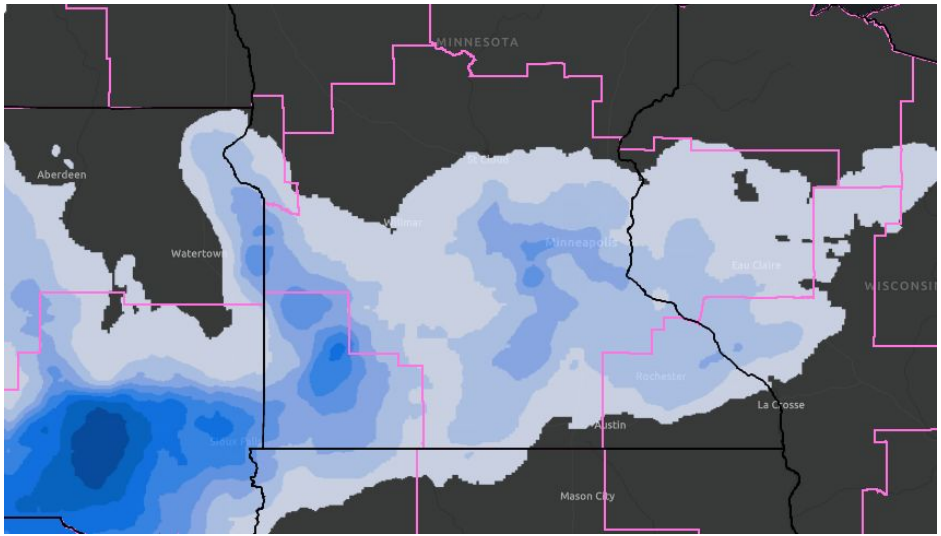
Day 2 6 inch

Day 3 to 2 NBM Probabilistic Snow Forecasts

Day 3
12 inch



Day 2
12 inch

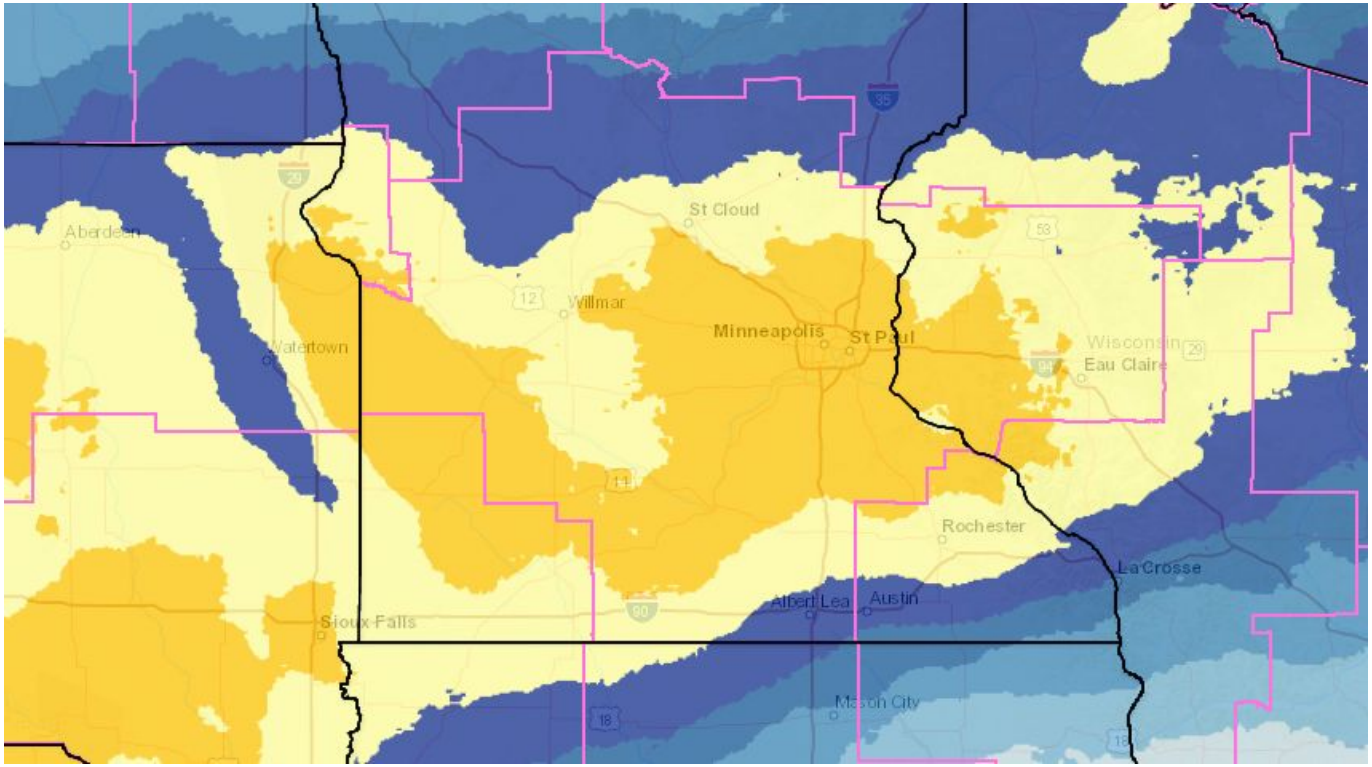


Day 2 Discussion Questions

- How did the change from day 3 to day 2 in the NBM change your confidence?
- Did the change in the NBM from day 3 to day 2 change your forecast?
- Now that is day 2 would you change how you message the snow amounts?
- What changes, if any, would you make to headlines (watch/warning/advisory)?
- Are you seeing any enhancement along the Coteau or Buffalo Ridge?

Day 1 Forecast Evaluation

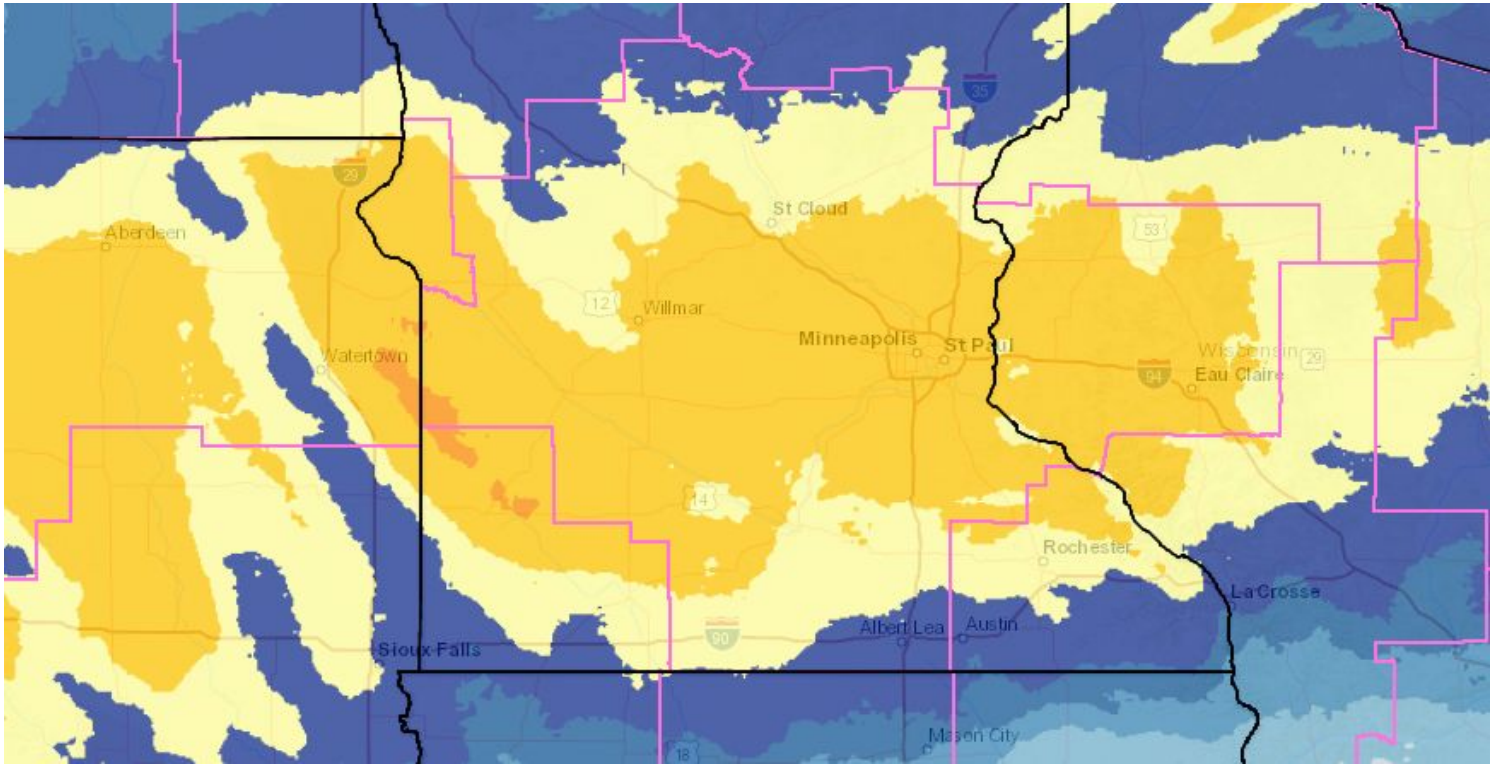
Day 2 NBM Deterministic Snow Forecast



Snow Accumulation (in)

0 0.1 1 2 3 4 6 8 12 18

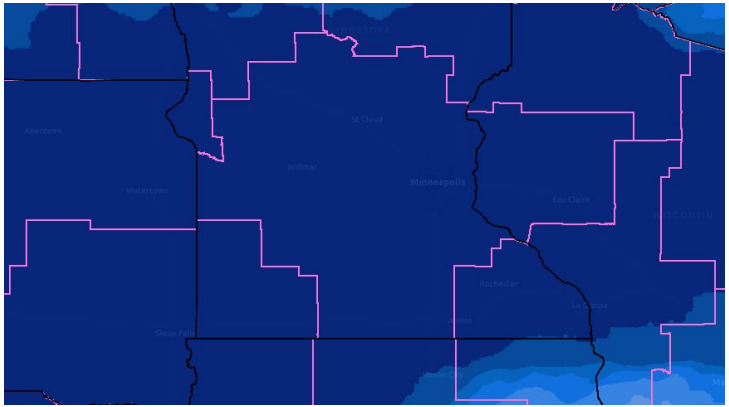
Day 1 NBM Deterministic Snow Forecast



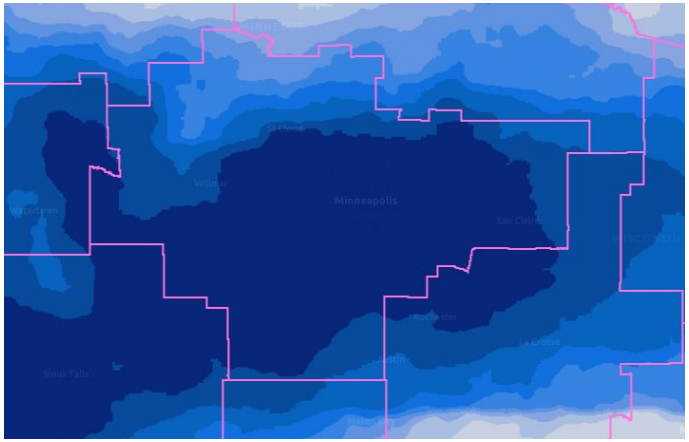
Snow Accumulation (in)

0 0.1 1 2 3 4 6 8 12 18

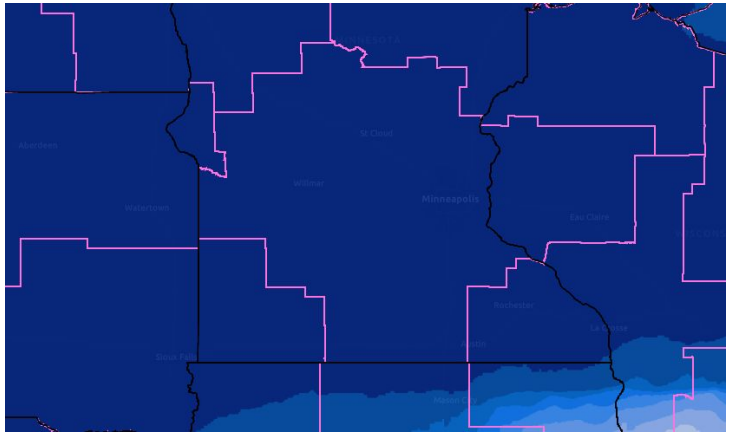
Day 2 to 1 NBM Probabilistic Snow Forecasts



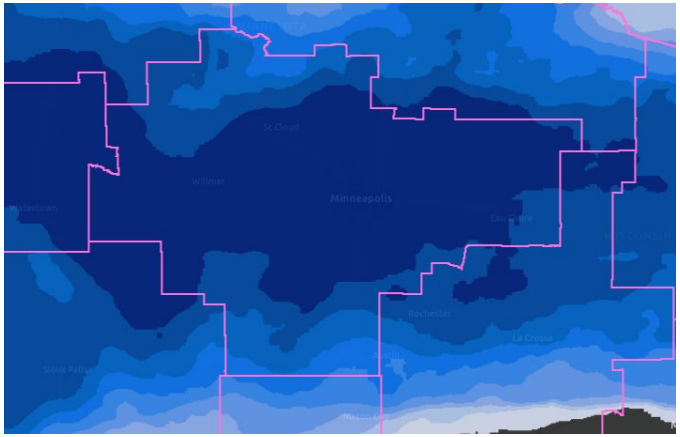
Day 2 1 inch



Day 2 4 inch

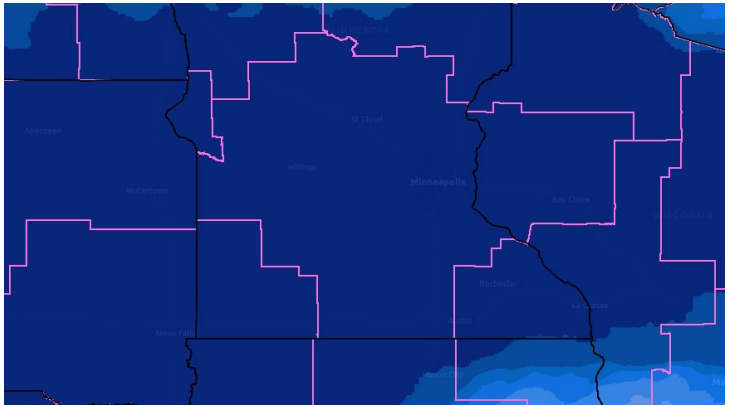


Day 1 1 inch

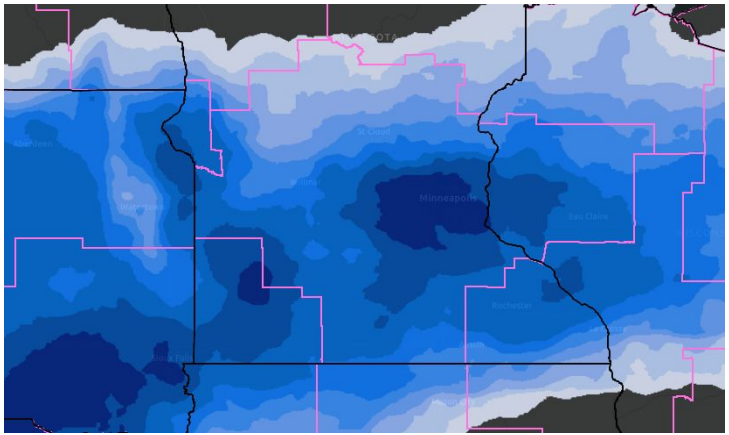


Day 1 4 inch

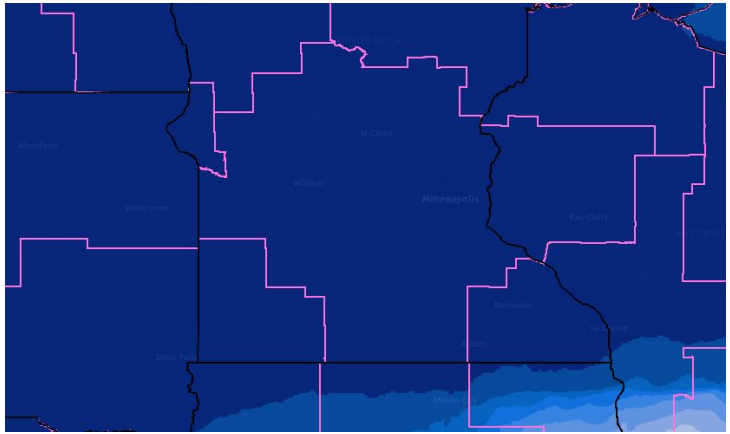
Day 2 to 1 NBM Probabilistic Snow Forecasts



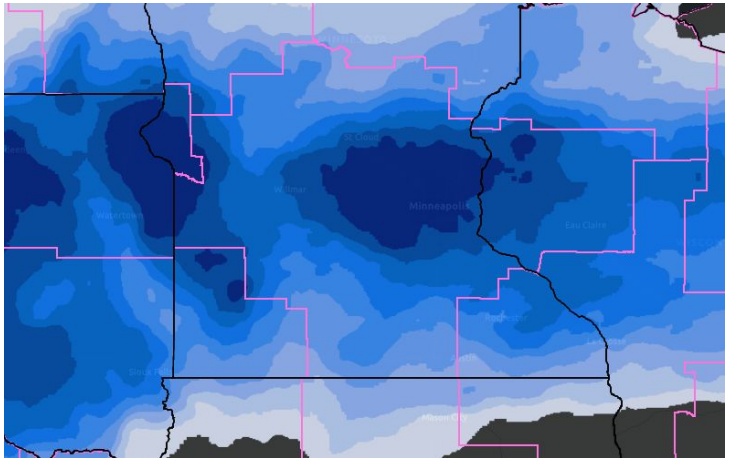
Day 2 1 inch



Day 2 6 inch



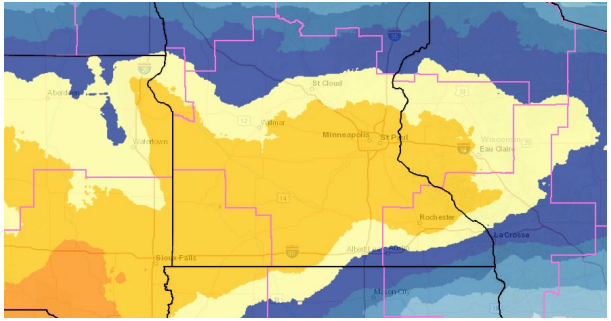
Day 1 1 inch



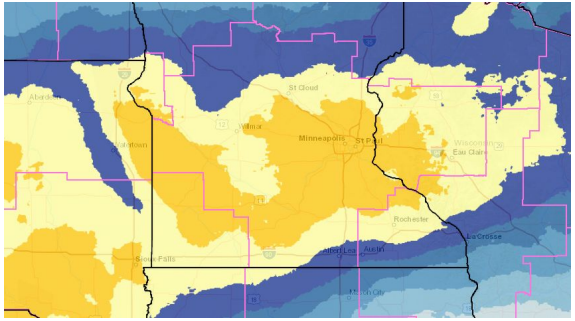
Day 1 6 inch

Day 3 - 2 - 1 NBM Deterministic Snow Forecast

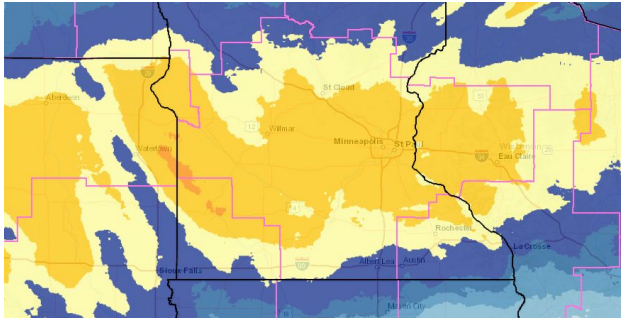
Day 3



Day 2



Day 1



Snow Accumulation (in)

Day 1 Discussion Questions

- Where is it most likely to see more than 6 inches of snow (local winter storm warning criteria)?
- How has the area with the greatest snow totals changed from day 3 to day 1?
- What enhancement did you observe along the Coteau or Buffalo Ridge?
- How has NBM changed as higher resolution data starts to impact it more on day 1?
- What are your thoughts on the consistency in the NBM forecast from earlier days to day 1?

Overall Discussion

- NBM was remarkably consistent for this event throughout much of the week leading up to the event with the main axis of snowfall remaining over the same area with few changes
- This was a two wave event that had high (>80%) NBM probabilities of greater than 6 inches almost a week out
- One of the local challenges was that there were two waves to this event, we have focused on the second wave as it had the larger snow totals, but what is the best way to use NBM probabilities to make decisions and message for events like this?
- If you were a forecaster at ABR, FSD, MPX, ARX, or WPC how would you have handled cross office collaboration?
- The main changes over time were snowfall totals due to changes in QPF location and some areas of enhancement like along the Coteau/Ridge by day 1