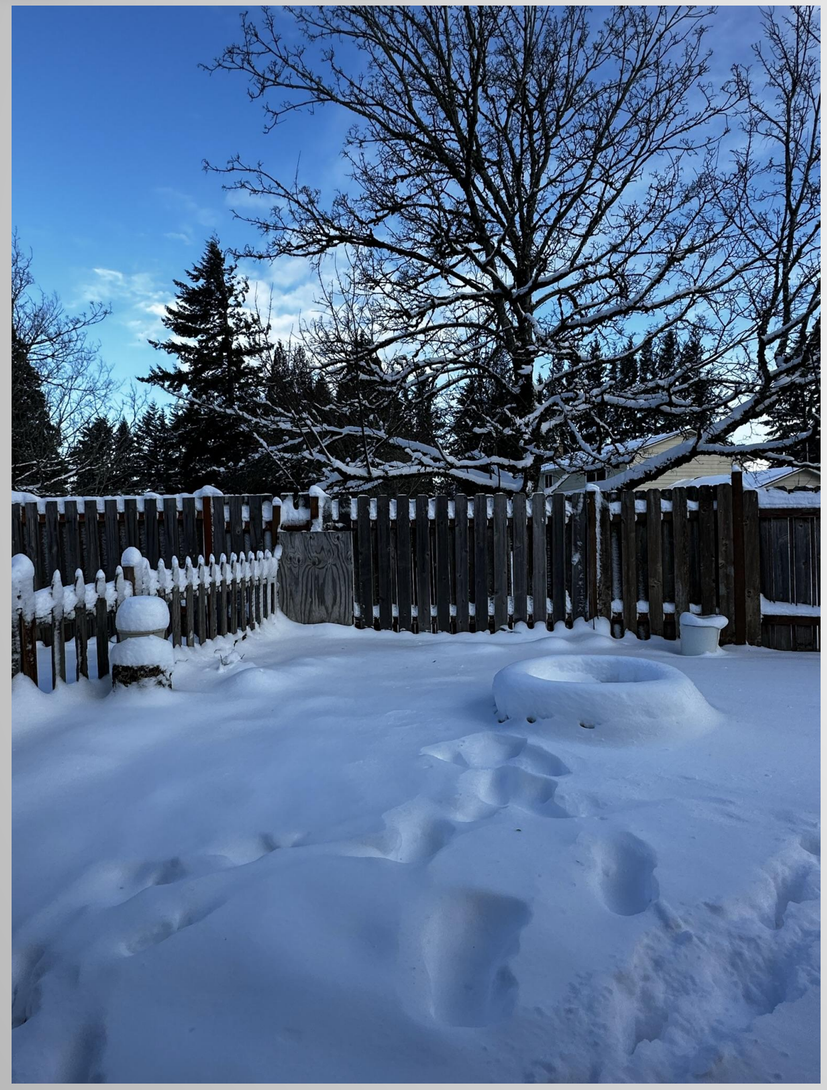
Portland, OR Snowmageddon

February 22-23, 2023

Thursday, March 9

Presenter : Tyler Kranz, Lead Meteorologist, NWS Portland



Courtesy Mick Hangland-Skill

Presentation Outline

- **Event overview**
  - What happened? Impacts?
  - What did observations show?
- **Day 3 model data**
  - Evaluate and discuss NBM v4.1 24-hr deterministic snow amounts and snow probabilities
- **Day 2 model data**
  - Evaluate and discuss NBM v4.1 24-hr deterministic snow amounts and snow probabilities
- **Day 1 model data**
  - Evaluate and discuss NBM v4.1 24-hr deterministic snow amounts and snow probabilities

Event Overview

Courtesy @marydillon - Twitter

- SECOND snowiest day ever recorded in Portland, OR on 2/22/23
  - 10.8” measured at NWS Portland (highest total ever is still 14.4” on Jan. 21, 1943)
- Flash freeze conditions following the snowstorm turned roads into a sheet of ice for days to follow
- Even portions of the Oregon coast recorded 6-12+” of snow due to repetitive heavy snow showers

Event Timeline

Wed, Feb 22

Cold rain in the early morning switched to snow by mid to late morning. Snow became heavy in the afternoon and evening, dumping 8-10" over the eastern Portland metro while people were at work, not expecting much more than an inch or two at best.

Wed night

Snow tapered off in the eastern metro but intensified over the western metro as another band of heavy snow lifted over the area from the south. Temps fell into the 20s with increasing east winds, resulting in a flash freeze. 8-10" fell over the western Portland metro. Hazardous road conditions across the metro due to ice/snow. Many people stuck in traffic through the night or trapped in snow.

Thu, Feb 23

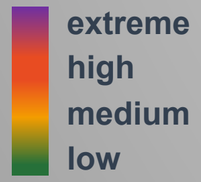
Snow ends, but temps below freezing through the day with gusty east winds. Very icy and hazardous driving conditions continued. Many abandoned vehicles on roads and highways.

Thu night

Cold with temps in the mid 20s. Many roads remained covered in ice and/or snow. Abandoned vehicles still trapped on some roads. Temps finally warmed a few degrees above freezing Friday afternoon, 2/24.

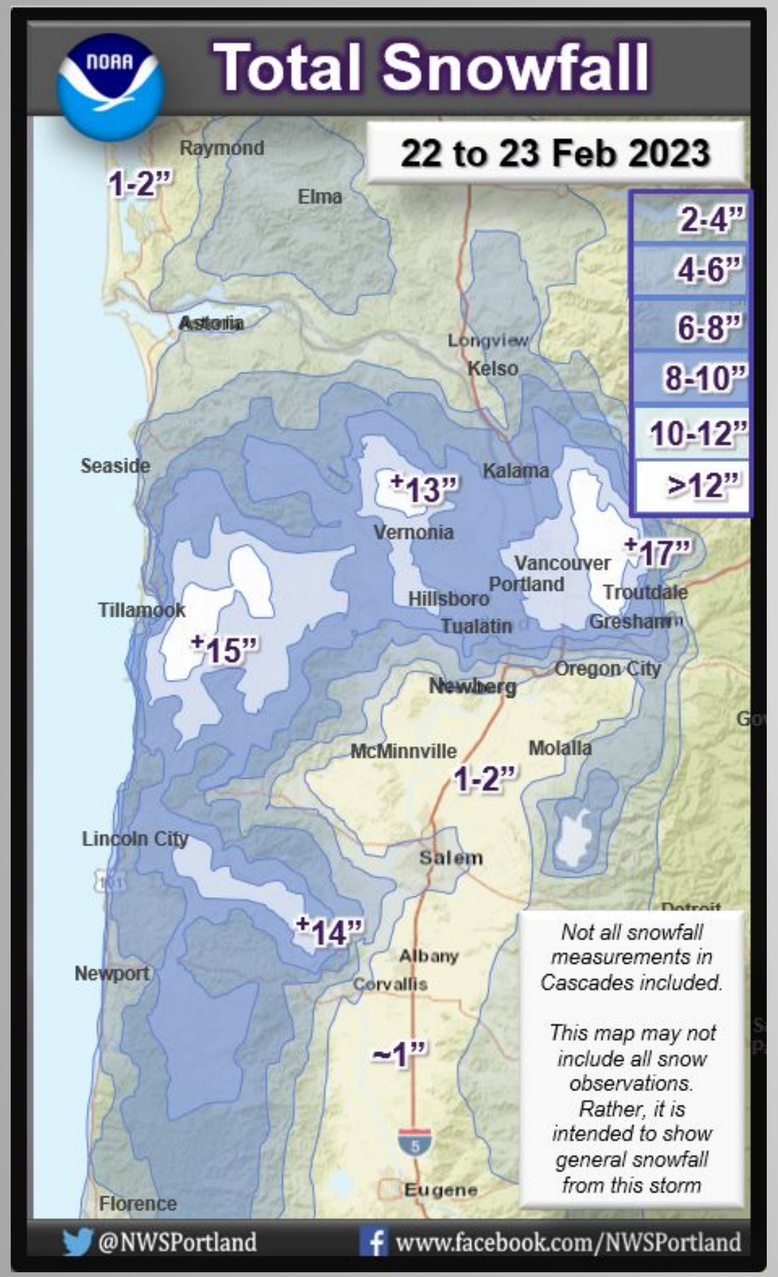
Visibilities at PDX were down to ¼ to ½ mile at times due to heavy snow and blowing snow

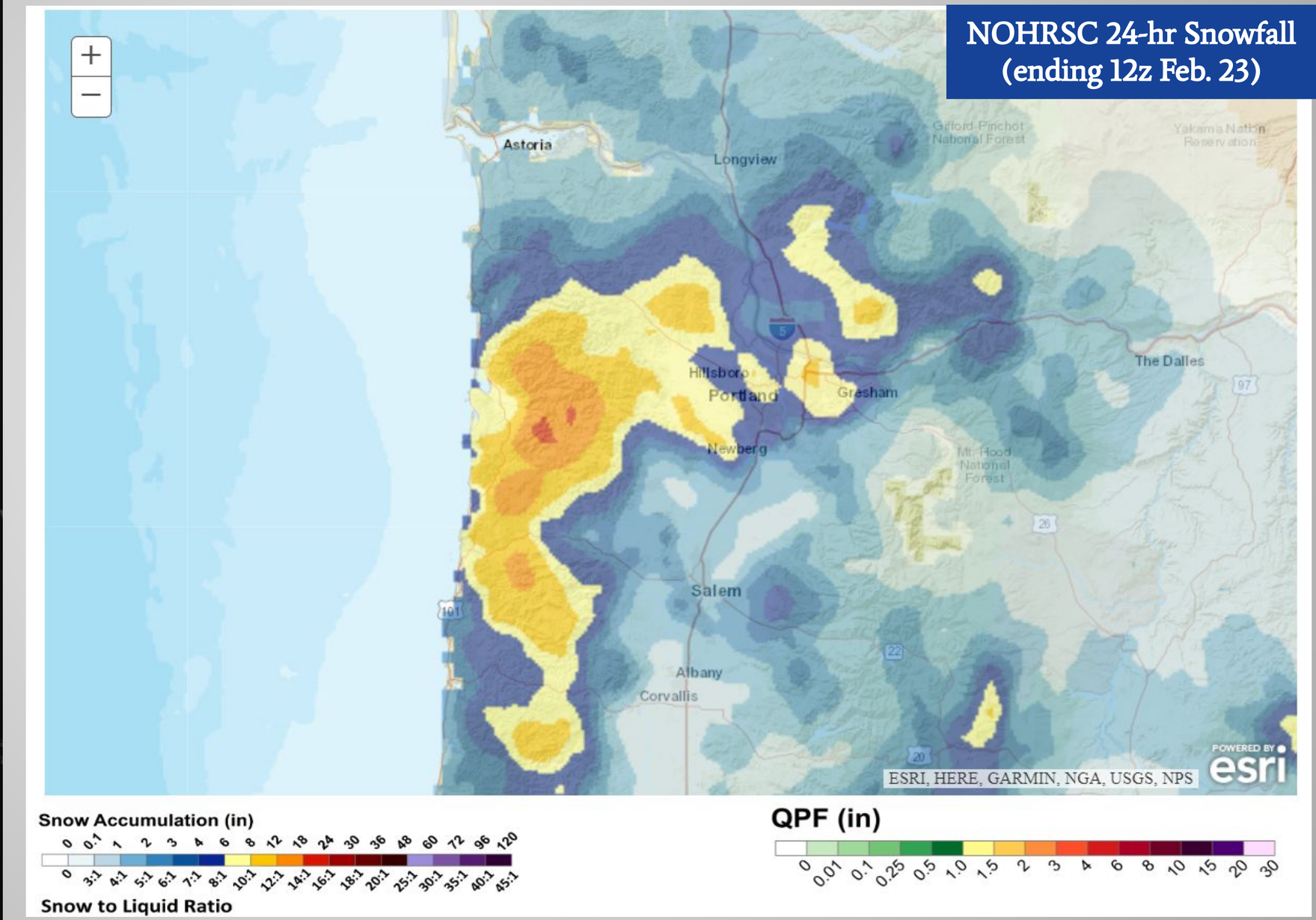
Impact level



Observed Snow Amounts Feb 22-23, 2023

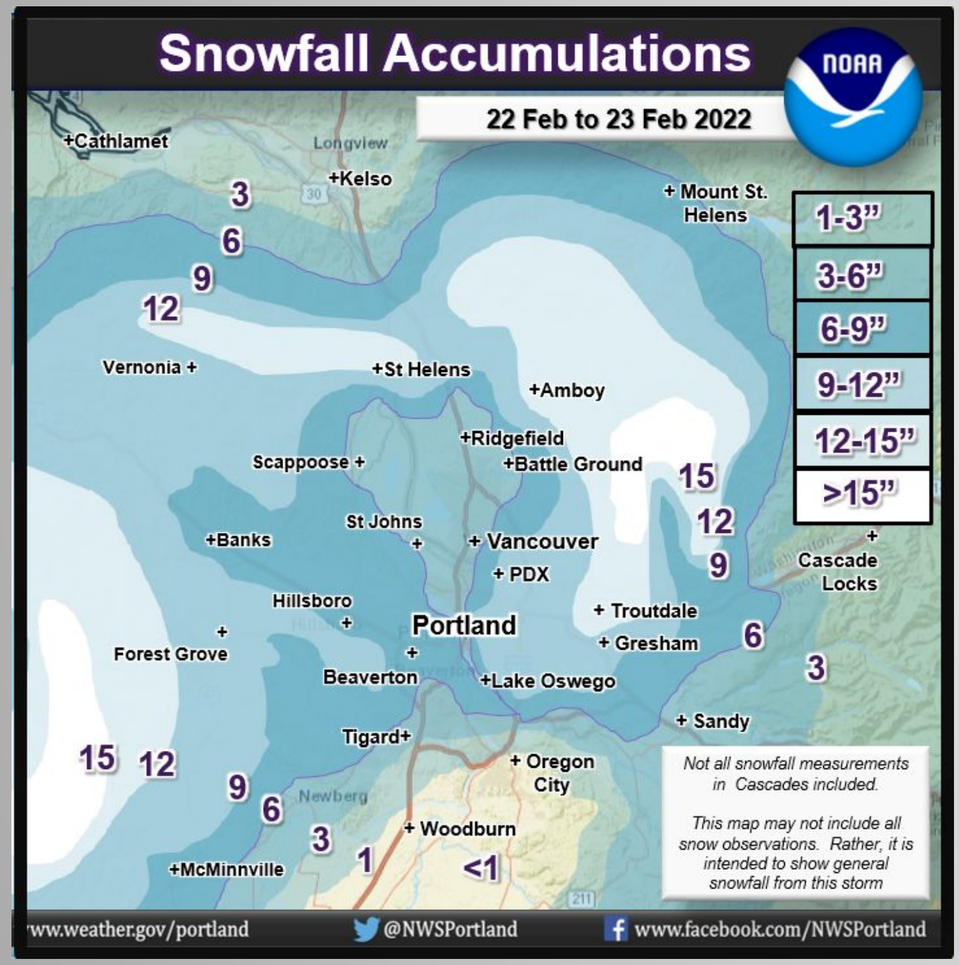
Thursday, March 9





Observed Snow Amounts Feb 22-23, 2023

Thursday, March 9

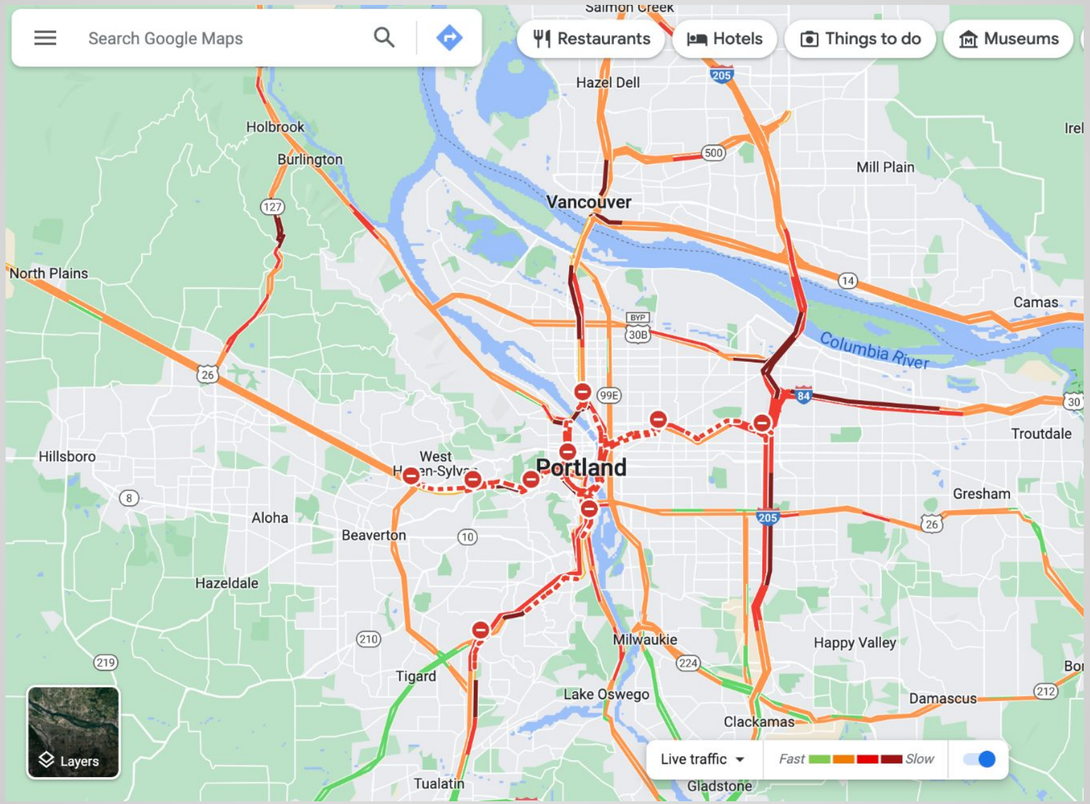


Location	Amount	Lat/Lon/Elev (ft.)
...Western Columbia River Gorge...		
2 WNW Cape Horn	17.0 in	45.58N/122.24W
...South Washington Coast...		
Naselle	3.5 in	46.37N/123.82W
...South Willamette Valley...		
Philomath	5.0 in	44.54N/123.36W
2 WNW Lewisburg	4.2 in	44.64N/123.26W
2 WNW Lewisburg	4.0 in	44.64N/123.28W
1 SSE Sodaville	2.5 in	44.47N/122.86W
Scio	2.5 in	44.71N/122.85W
5 NW Cheshire	1.0 in	44.24N/123.35W
1 SW Lewisburg	1.0 in	44.62N/123.25W/260
3 SE Fern Ridge Reservoir	1.0 in	44.05N/123.25W
Lebanon	1.0 in	44.53N/122.90W
...Northern Oregon Cascade Foothills...		
2 WNW Foster Reservoir	3.3 in	44.42N/122.67W/960
Sandy	2.5 in	45.40N/122.27W
...North Oregon Coast...		
2 E Tillamook	14.6 in	45.45N/123.80W
Tillamook	13.0 in	45.46N/123.84W
Tillamook	10.0 in	45.46N/123.84W
Tillamook	9.5 in	45.46N/123.84W
1 W Pleasant Valley	8.0 in	45.37N/123.84W
Netarts	7.0 in	45.43N/123.94W
Neskowin	7.0 in	45.10N/123.98W
Rockaway Beach	6.0 in	45.62N/123.94W
Astoria	1.5 in	46.19N/123.82W
Cannon Beach	1.2 in	45.88N/123.95W
...Lower Columbia...		
2 W Saint Helens	13.0 in	45.86N/122.85W
1 W Saint Helens	8.0 in	45.86N/122.83W
Mayger	1.0 in	46.17N/123.10W

...Lower Columbia and I - 5 Corridor in Cowlitz County.		
5 E Stella	2.0 in	46.18N/123.01W
...Greater Vancouver Area...		
2 NE Washougal	18.0 in	45.60N/122.31W
3 NE Washougal	16.0 in	45.61N/122.30W
1 SSW Lacamas Lake	11.5 in	45.60N/122.44W
1 WSW Amboy	11.3 in	45.89N/122.47W
1 S Yacolt	11.0 in	45.85N/122.41W
Camas	9.0 in	45.59N/122.42W
1 SSE Lacamas Lake	9.0 in	45.60N/122.42W
1 SE Vancouver Mall	8.5 in	45.65N/122.57W
2 NNE Ellsworth	7.5 in	45.63N/122.56W
1 ENE Vancouver Mall	7.5 in	45.66N/122.57W
1 E Vancouver Downtown	5.0 in	45.63N/122.64W
Hazel Dell	5.0 in	45.68N/122.65W
Vancouver Downtown	4.9 in	45.63N/122.67W
Hazel Dell	3.0 in	45.68N/122.65W
...Greater Portland Metro Area...		
1 ENE Rockwood	12.0 in	45.52N/122.47W
Gresham	12.0 in	45.50N/122.44W
Fairview	11.5 in	45.54N/122.44W
1 NNE Sylvan	11.0 in	45.52N/122.72W
Gaston	11.0 in	45.44N/123.14W
Cherry Grove	11.0 in	45.45N/123.25W
2 ENE Wilshire Park	11.0 in	45.56N/122.60W
1 SE Hillsboro	10.0 in	45.51N/122.92W
1 NE Powellhurst	10.0 in	45.50N/122.50W
2 S Aloha	10.0 in	45.46N/122.87W
1 ENE Gales Creek	10.0 in	45.59N/123.20W
1 W Forest Grove	10.0 in	45.52N/123.13W
2 WNW Forest Grove	9.8 in	45.53N/123.14W
1 N Mt Tabor	9.5 in	45.53N/122.59W
2 WNW Powellhurst	9.5 in	45.51N/122.55W
Forest Grove	9.0 in	45.52N/123.10W
1 WNW Parkrose	9.0 in	45.56N/122.56W
1 NW Forest Grove	8.5 in	45.53N/123.12W
1 S Swan Island	8.5 in	45.54N/122.71W
Aloha	8.5 in	45.49N/122.87W
1 WSW Dilley	8.5 in	45.48N/123.14W
Cornelius	8.5 in	45.52N/123.05W
1 WNW Rockcreek	8.5 in	45.56N/122.90W
1 SW Wilshire Park	8.2 in	45.54N/122.64W
Aloha	8.0 in	45.49N/122.88W
1 NW Forest Grove	8.0 in	45.53N/123.13W
2 SW Rockcreek	8.0 in	45.53N/122.90W
1 S Forest Grove	7.5 in	45.51N/123.11W

Impacts

Thursday, March 9



Impacts

Western Region
Regional Operations Center

801-524-7907
wr.roc@noaa.gov
weather.gov/wrh

Western Region High Impact Event Report - 02/22/2023

City of Portland at a standstill.

DATE OF EVENT: 02/22/2023 to 02/23/2023

FROM: David A. Bishop - Meteorologist
Bianca Feldkircher - WR ROC Duty Officer

OFFICES: WFO Portland

EVENT TYPE: Winter Weather

LOCATION: Portland/Vancouver Metro area

EVENT DESCRIPTION: Deformation band set up across the Portland/Vancouver Metro area and dropped 6 inches or more and brought the Portland/Vancouver Metro area to a standstill.

DEATHS: None known at this time

INJURIES: 1 known

IMPACTS: All Portland Schools and Vancouver Schools were closed late afternoon on 2/22/2023 for the next day 2/23/2023. PDX Airport shut down around 7 pm on 2/22/2023.Oregon Federal Executive Board initially recommended a two hour delay, and then decided to recommend offices be closed on 2/23/2023. Numerous accidents in and around the Portland Metro area
I-5 and I-84 closed for jackknifed semi-trucks. 6 NWS employees are currently staying in the office as roads are impassable.

- All Portland/Vancouver schools closed 2/23, the day following the snowstorm
- Portland International Airport shut down around 7 PM 2/22
- Accidents all over, cars stuck, at least 600 cars left abandoned on roadways according to PBOT
- I-5 and I-84 closed
- 20 minute commutes took several hours or longer

KRTX Base Reflectivity - Feb. 22, 2023

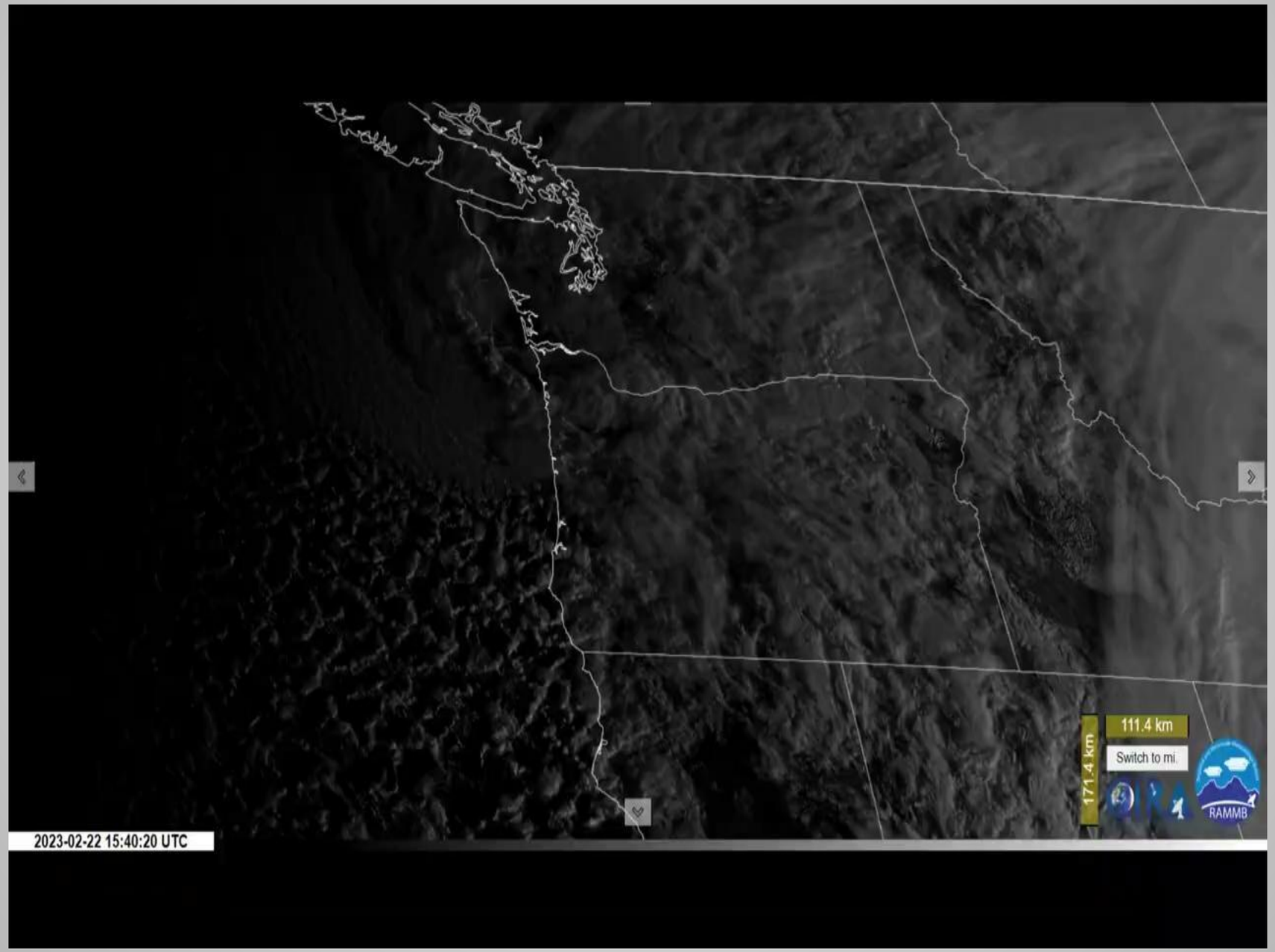
Thursday, March 9

MRMS Composite Reflectivity (0500-0730z Feb. 23)

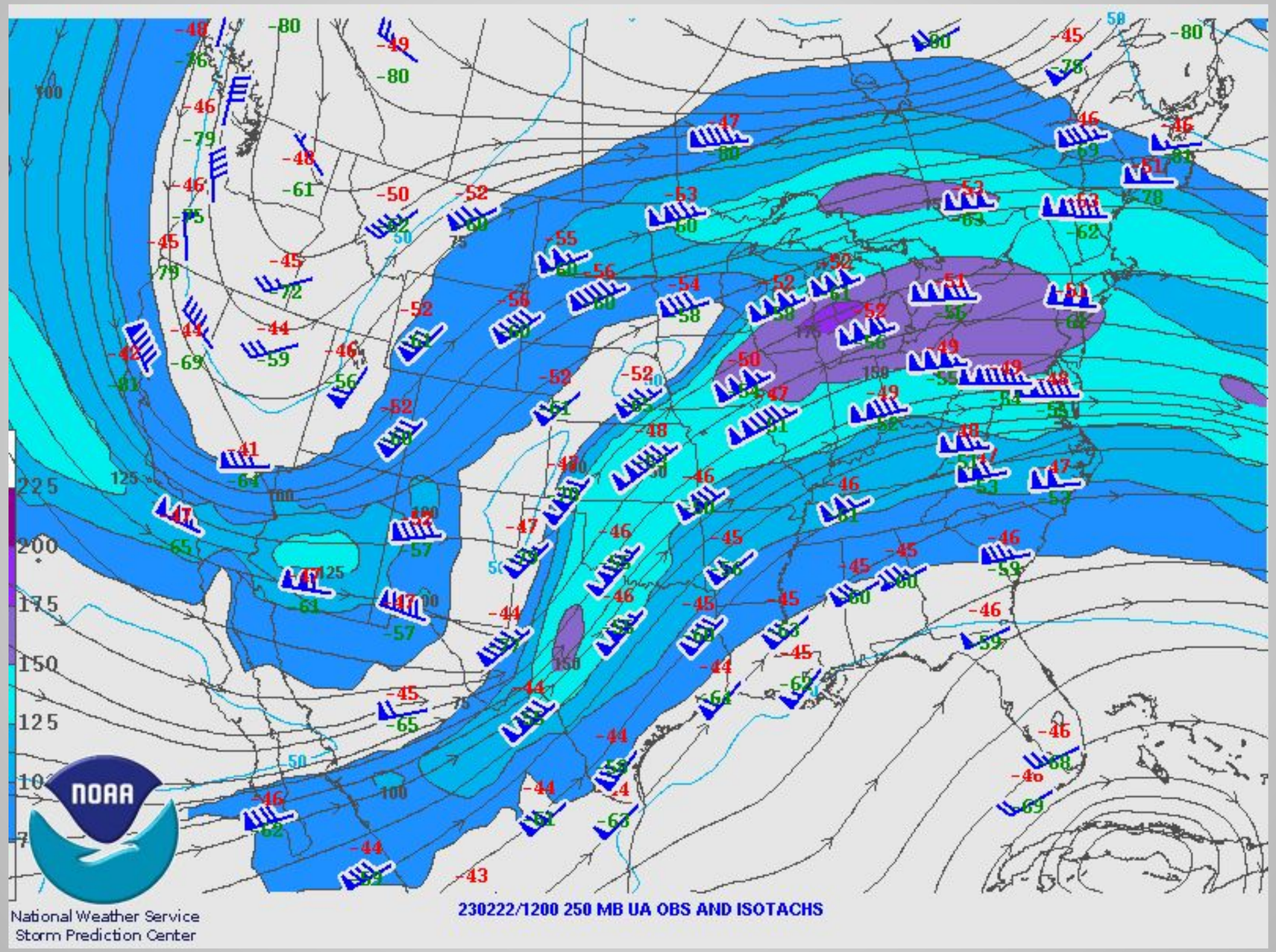
Thursday, March 9

GOES-18 Visible Satellite Imagery

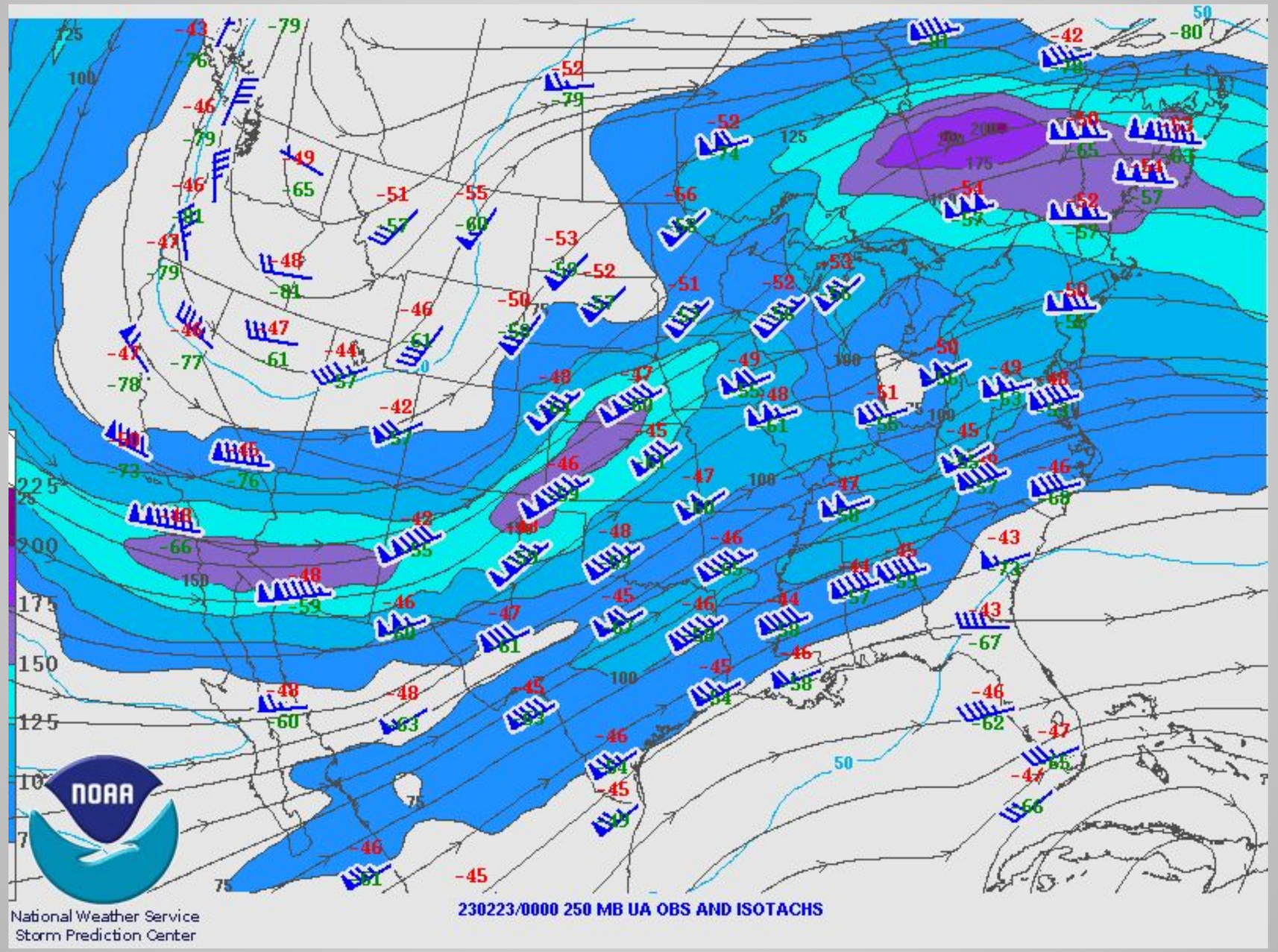
Thursday, March 9



250 mb Analysis - Feb. 22 - 12z

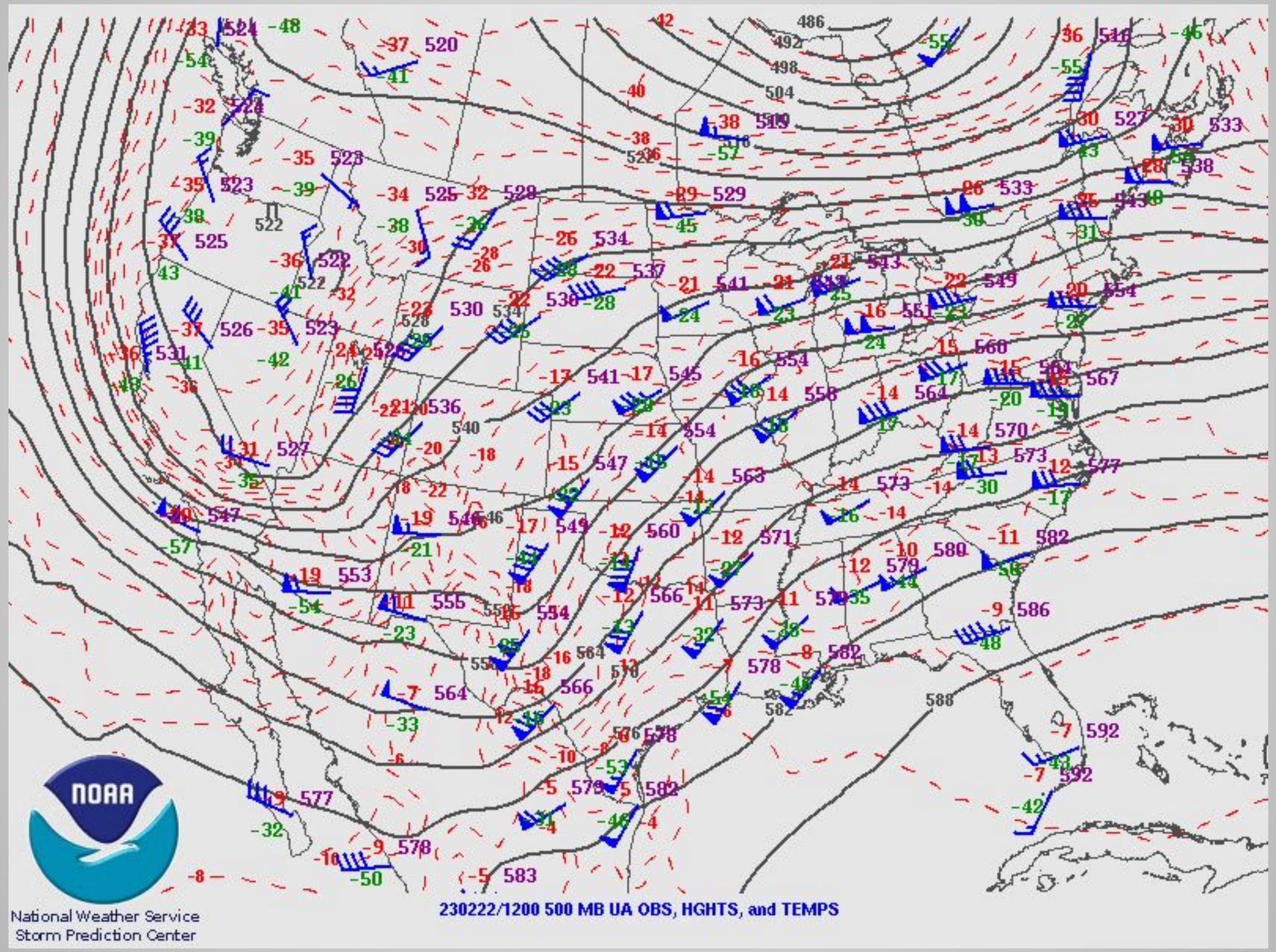


250 mb Analysis - Feb. 23 - 00z



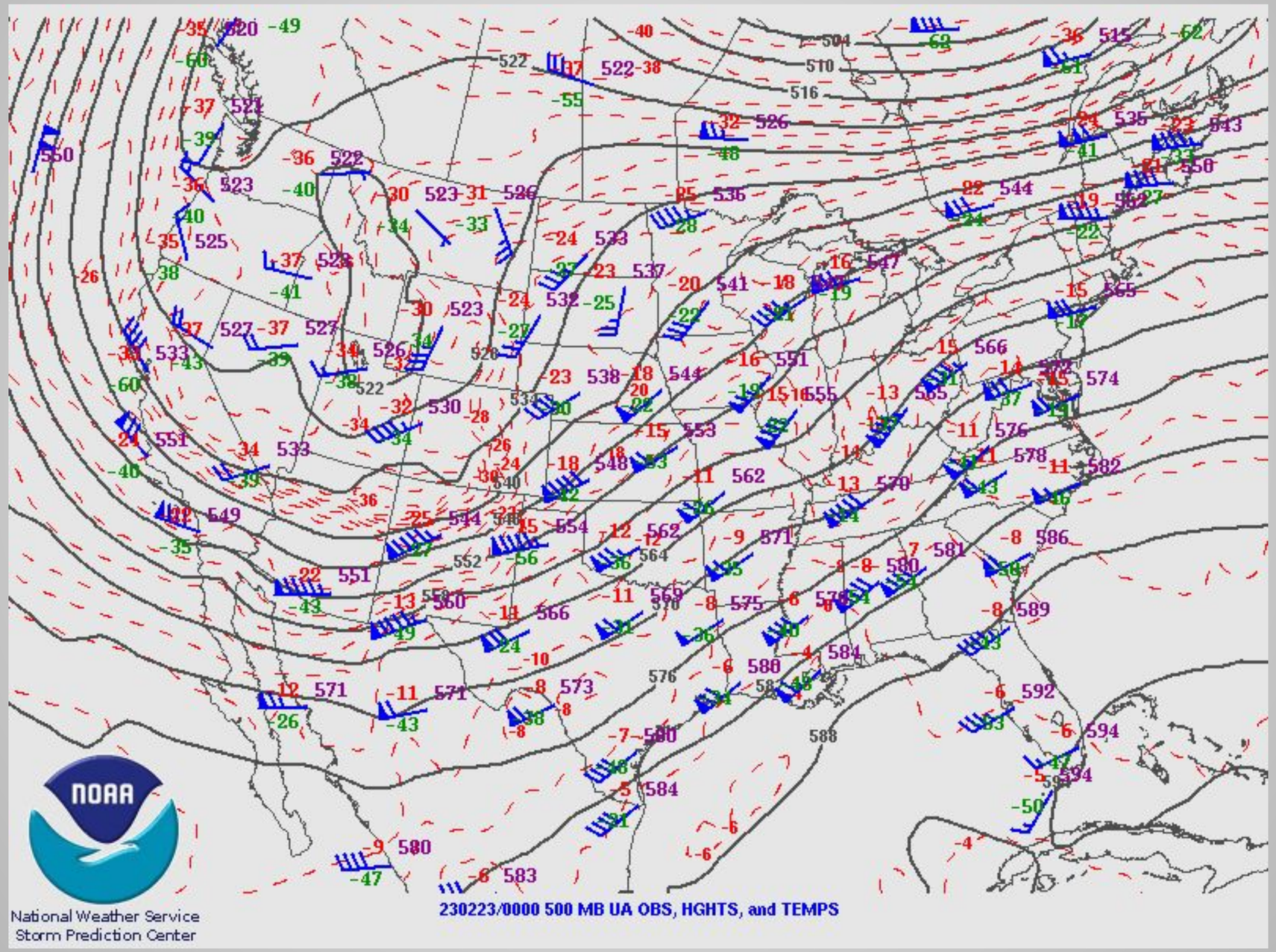
500 mb Analysis - Feb. 22 - 12z

Thursday, March 9



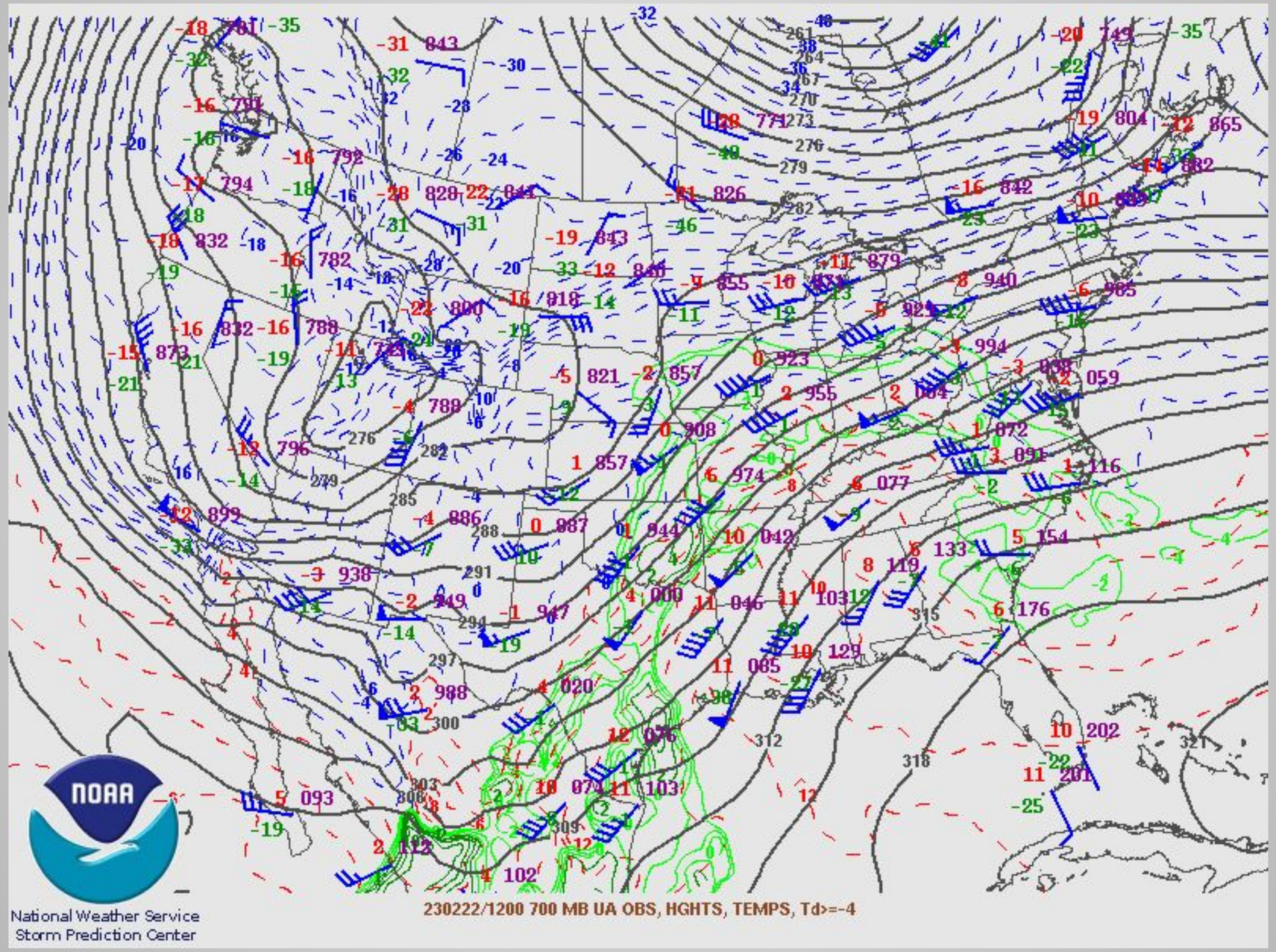
500 mb Analysis - Feb. 23 - 00z

Thursday, March 9

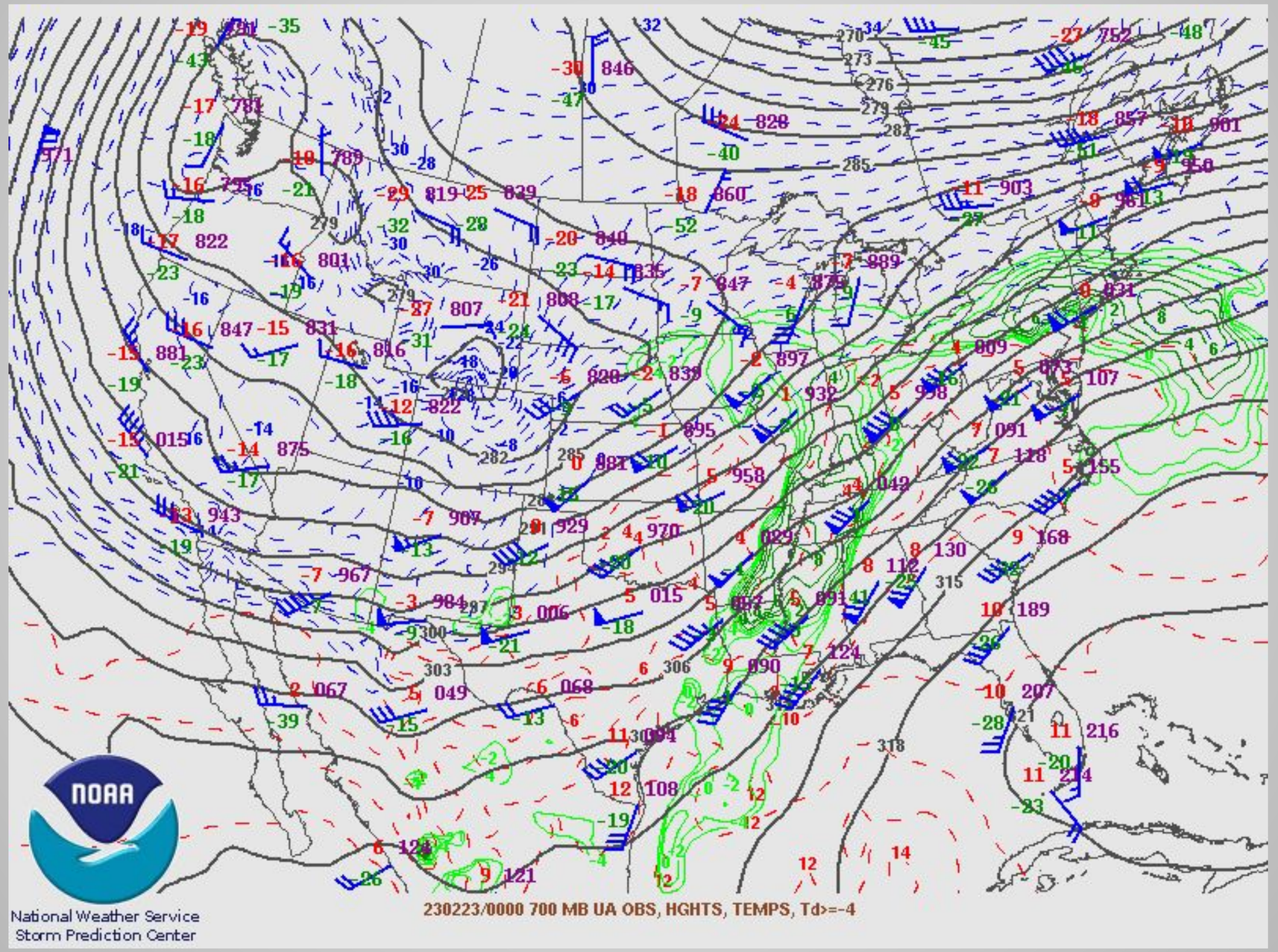


700 mb Analysis (Feb. 22 - 12z)

Thursday, March 9

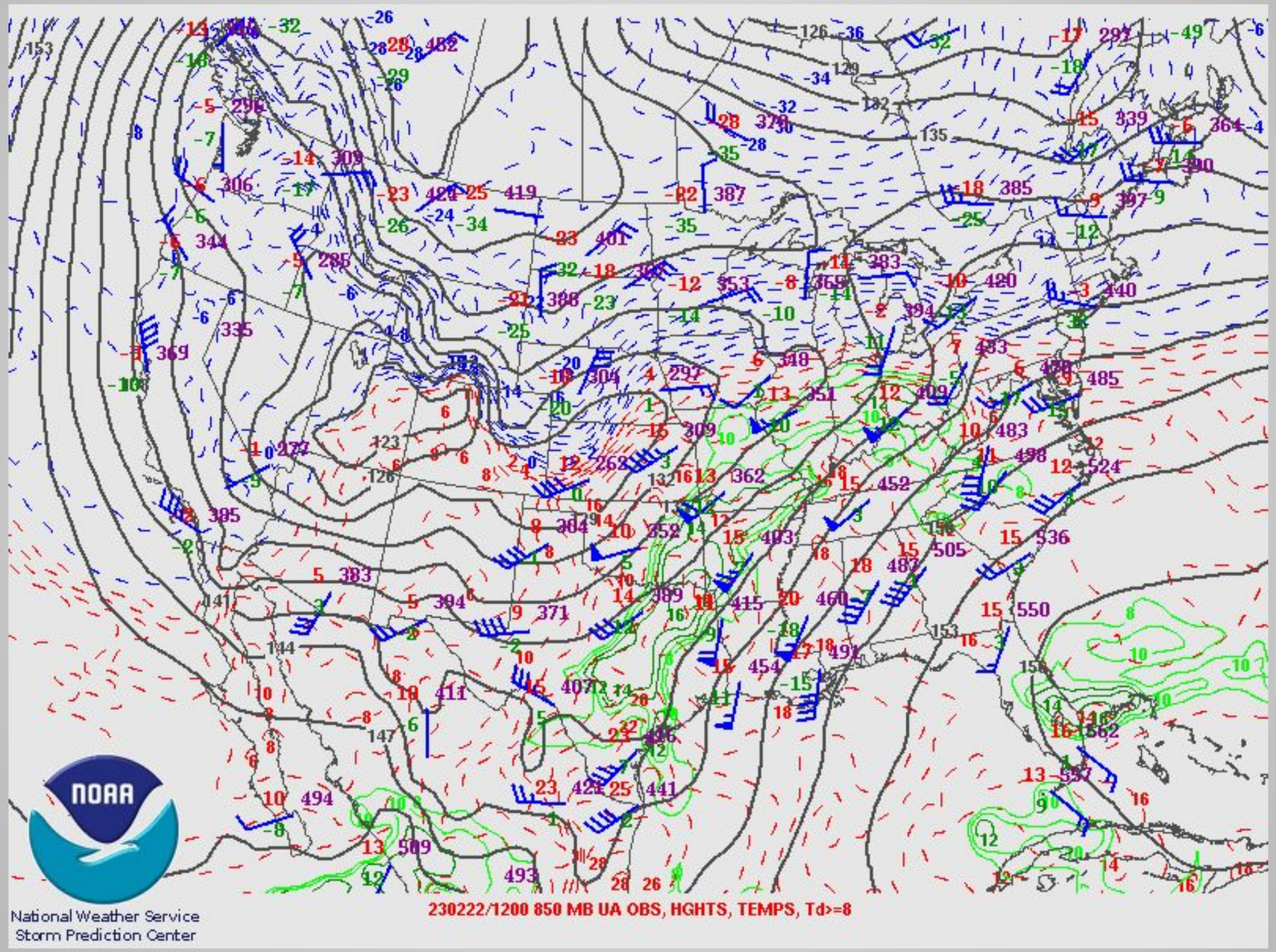


700 mb Analysis (Feb. 23 - 00z)



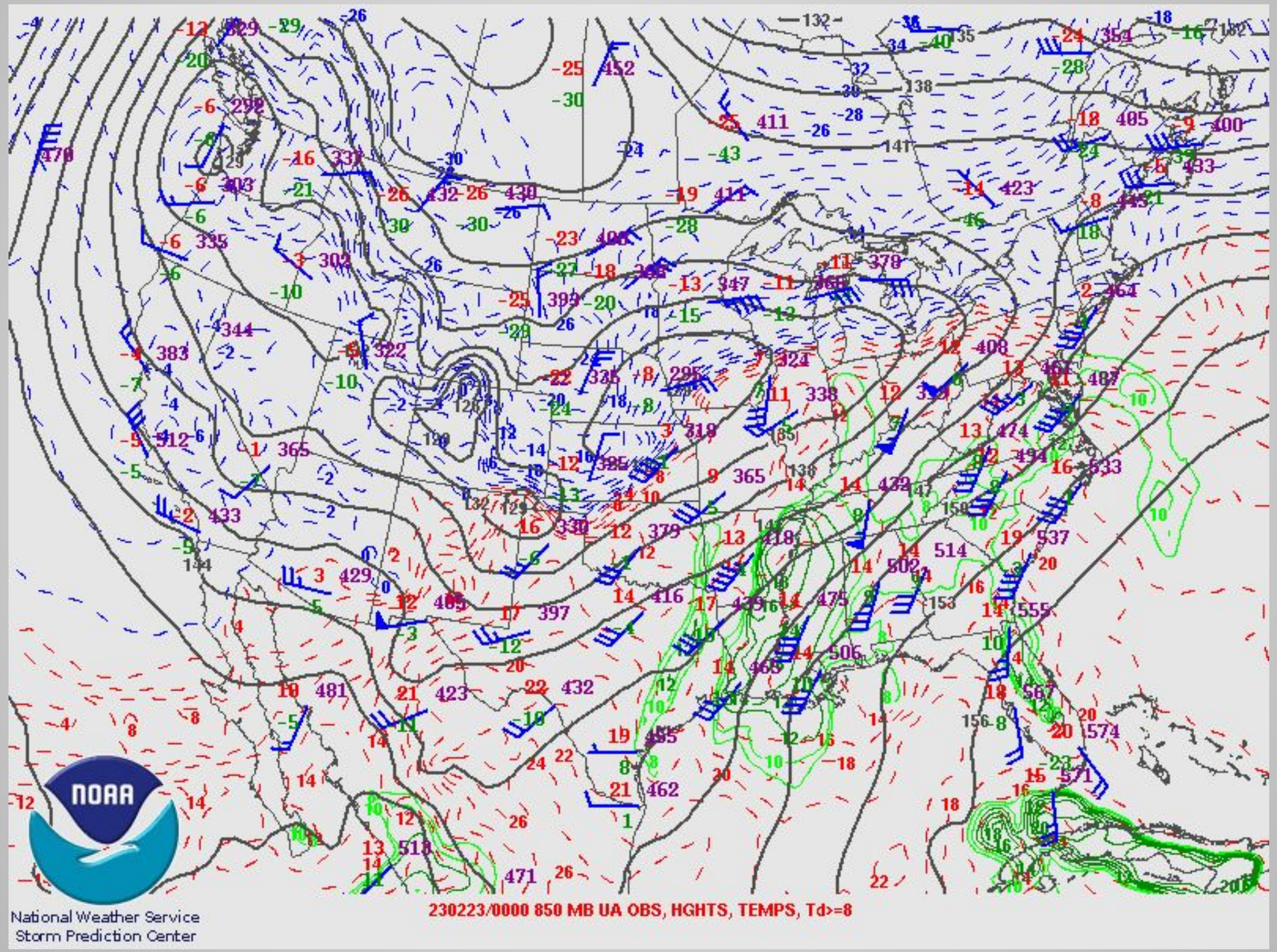
850 mb Analysis (Feb. 22 - 12z)

Thursday, March 9



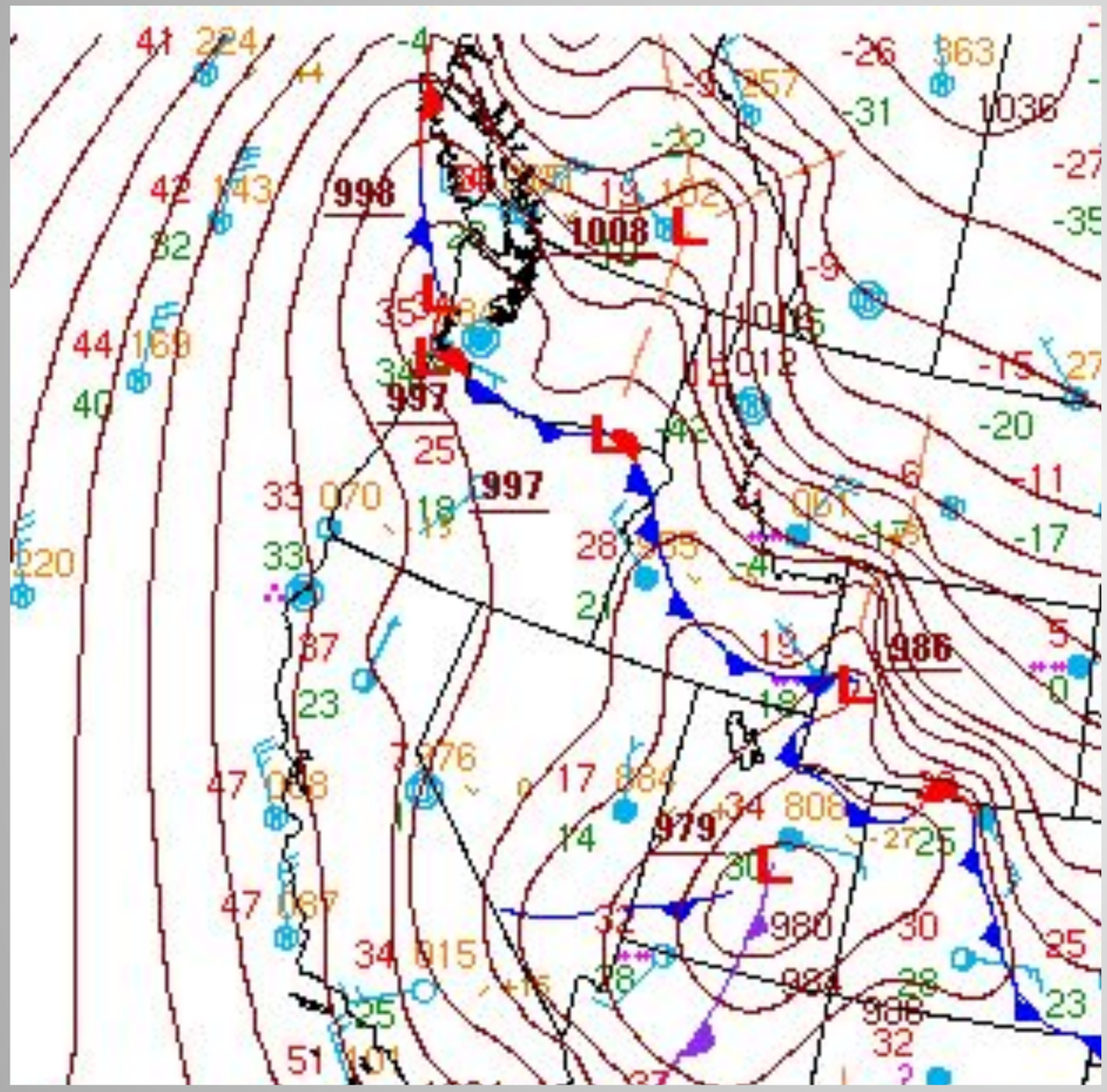
850 mb Analysis (Feb. 23 - 00z)

Thursday, March 9

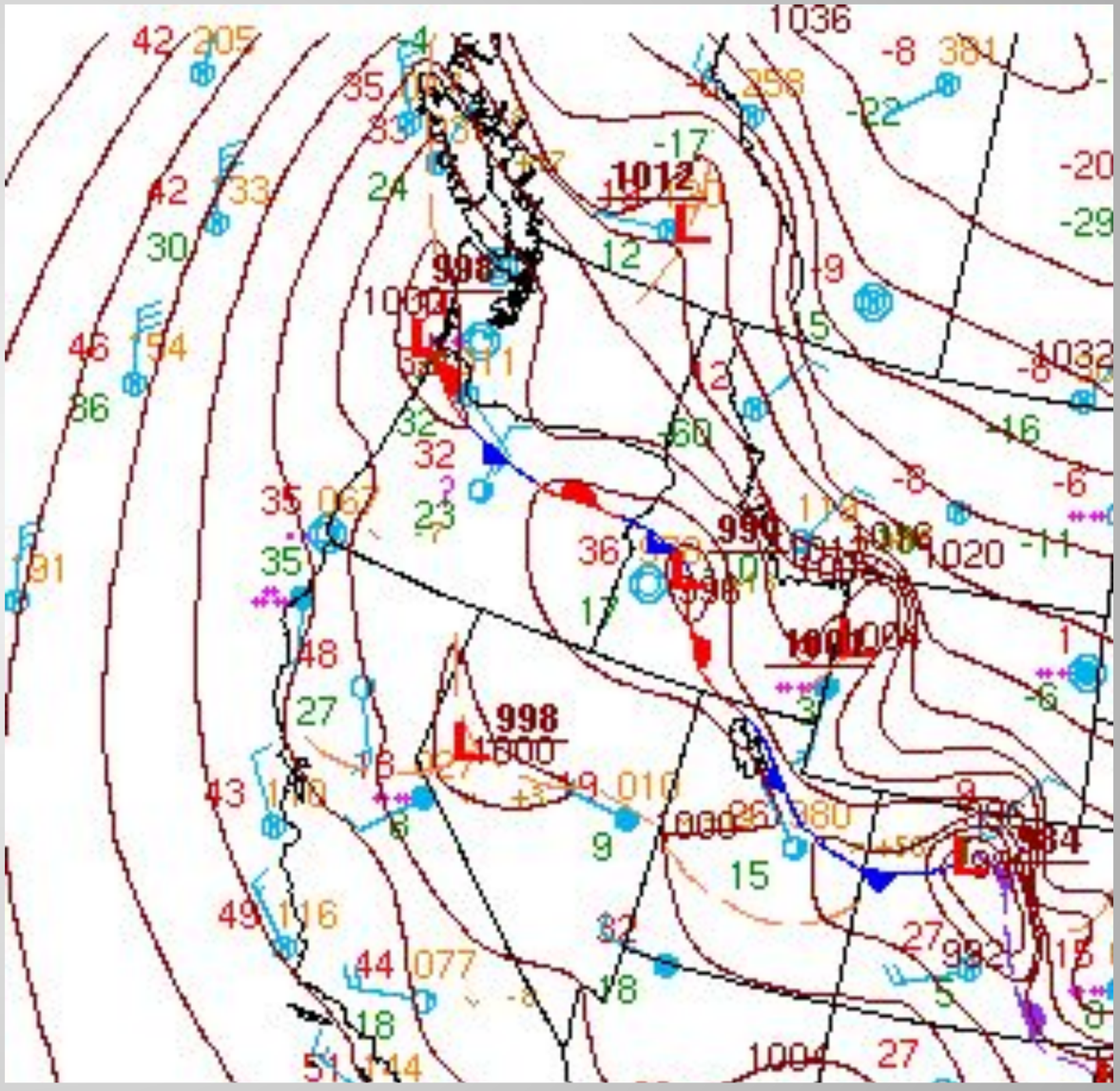


WPC Surface Analysis

Thursday, March 9



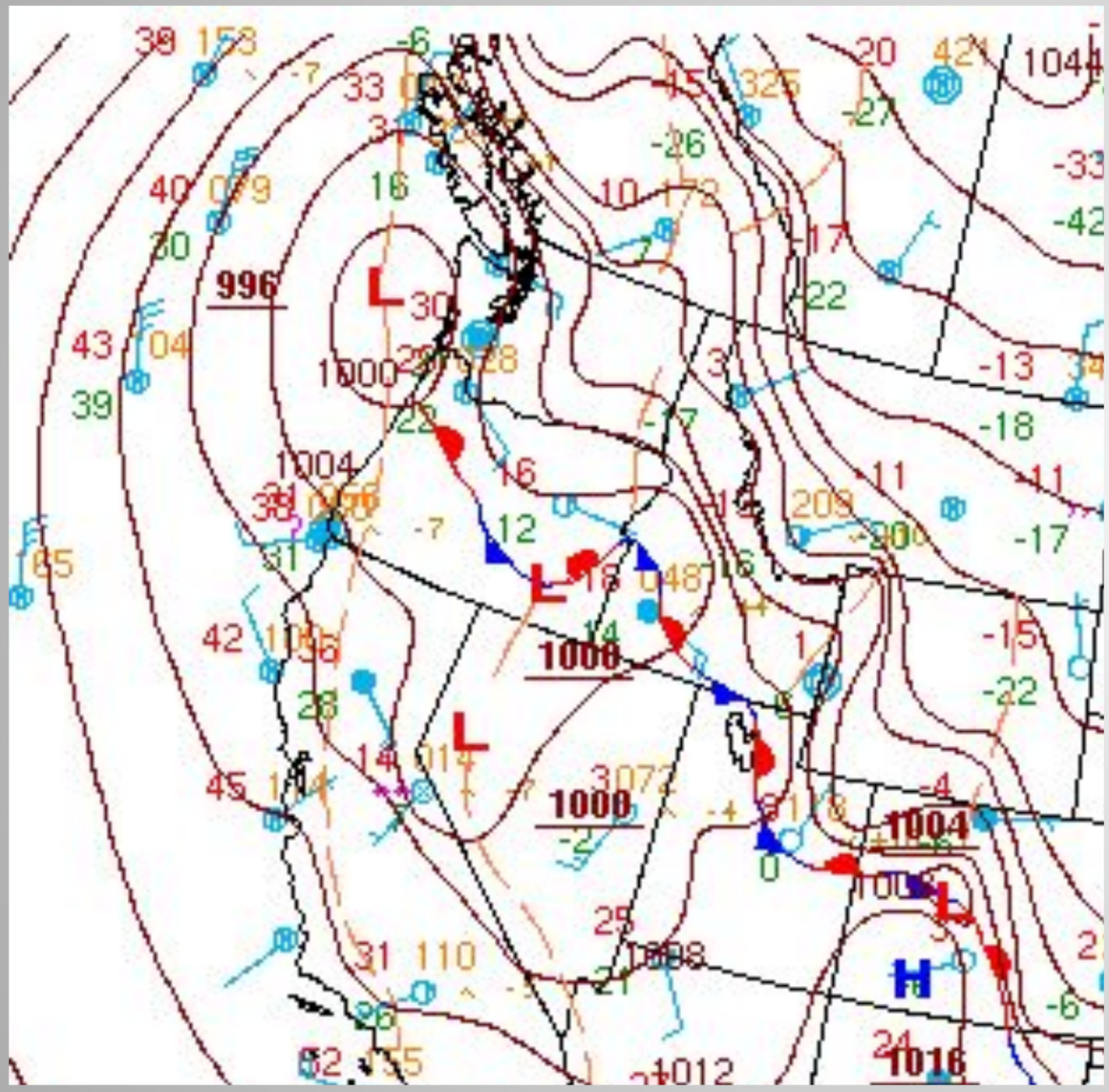
Valid 2/22 12z



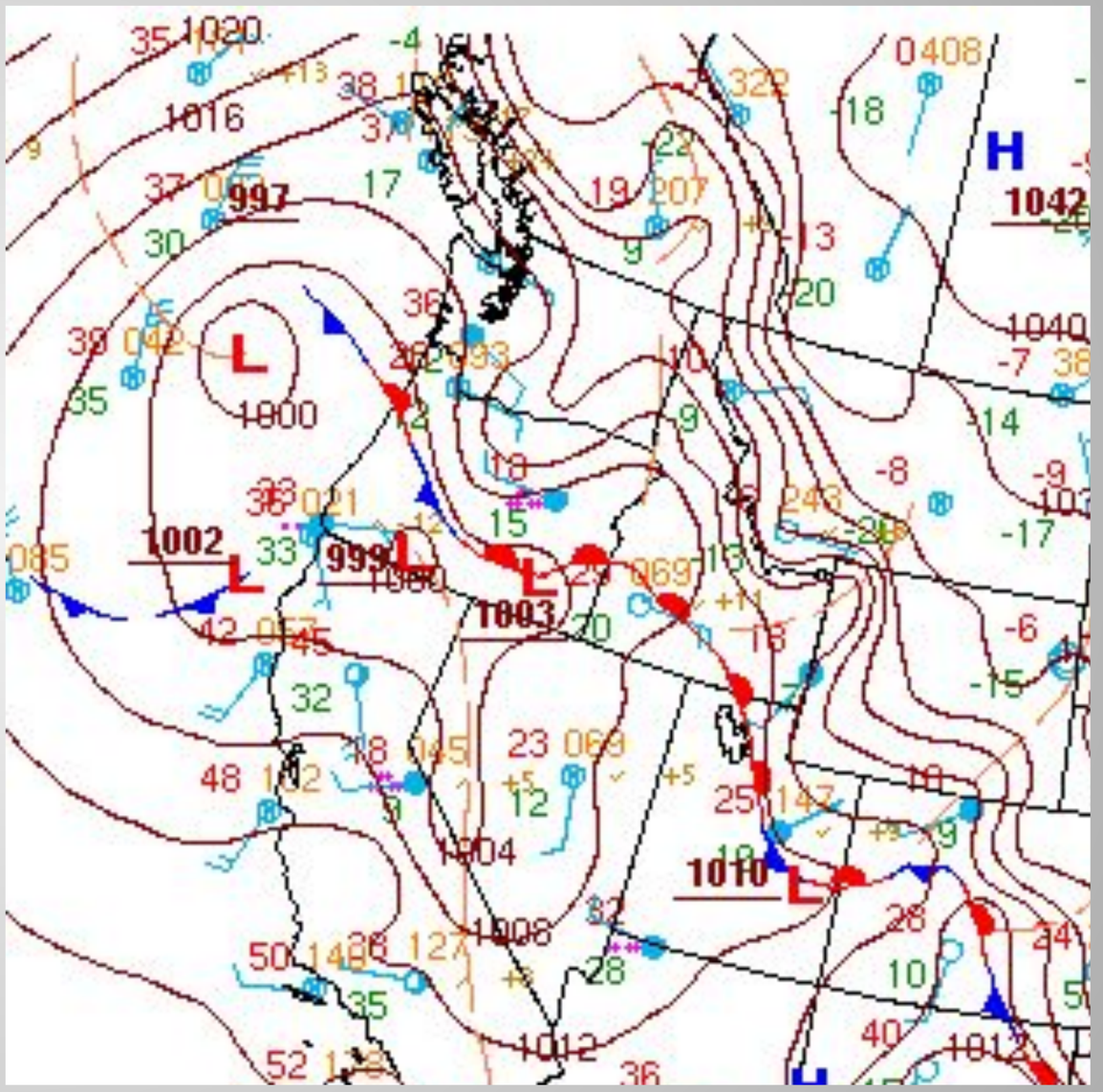
Valid 2/23 00z

WPC Surface Analysis

Thursday, March 9



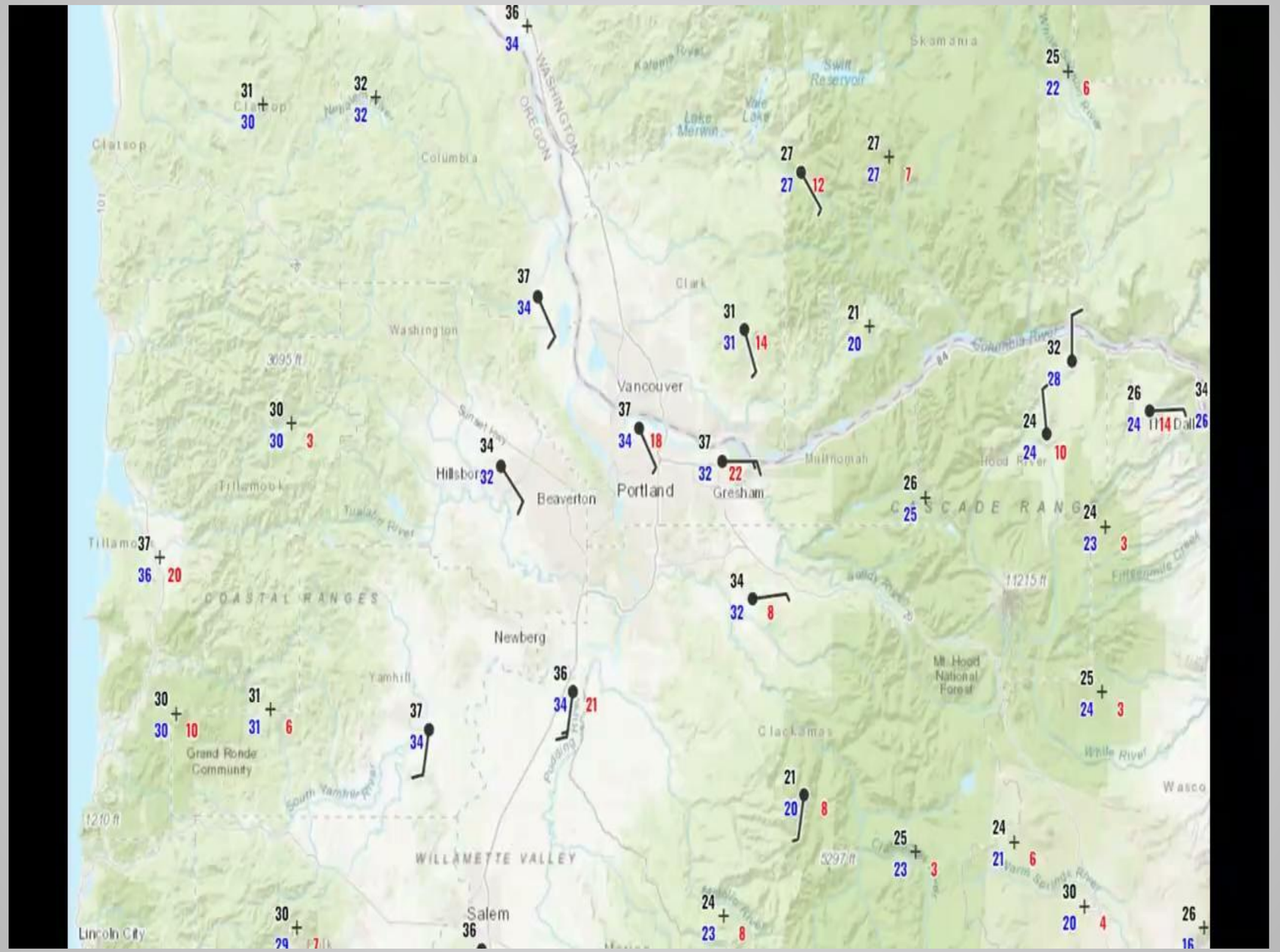
Valid 2/23 12z



Valid 2/24 00z

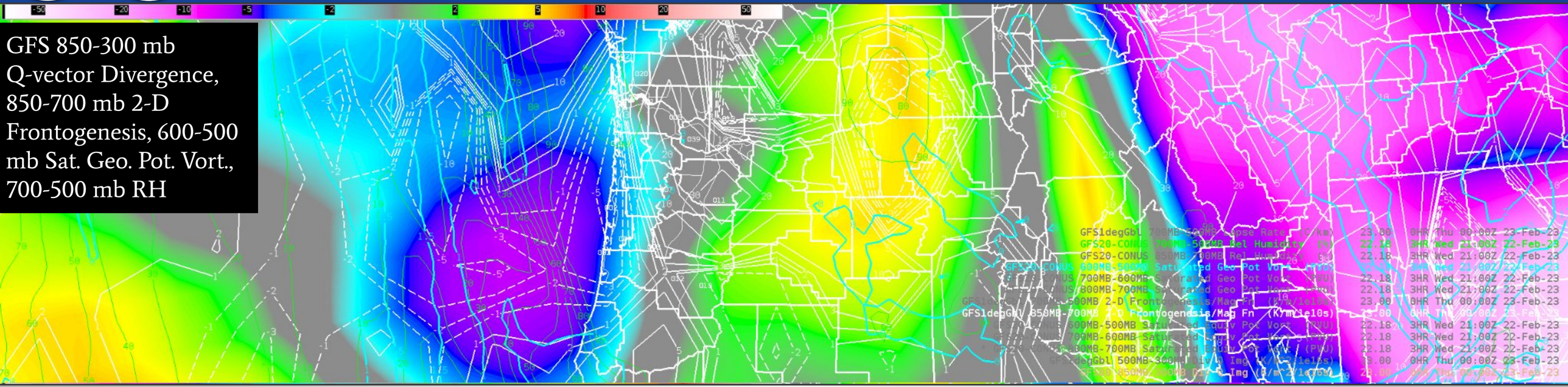
Hourly Surface Observations (17z Feb. 22 - 12z Feb. 23)

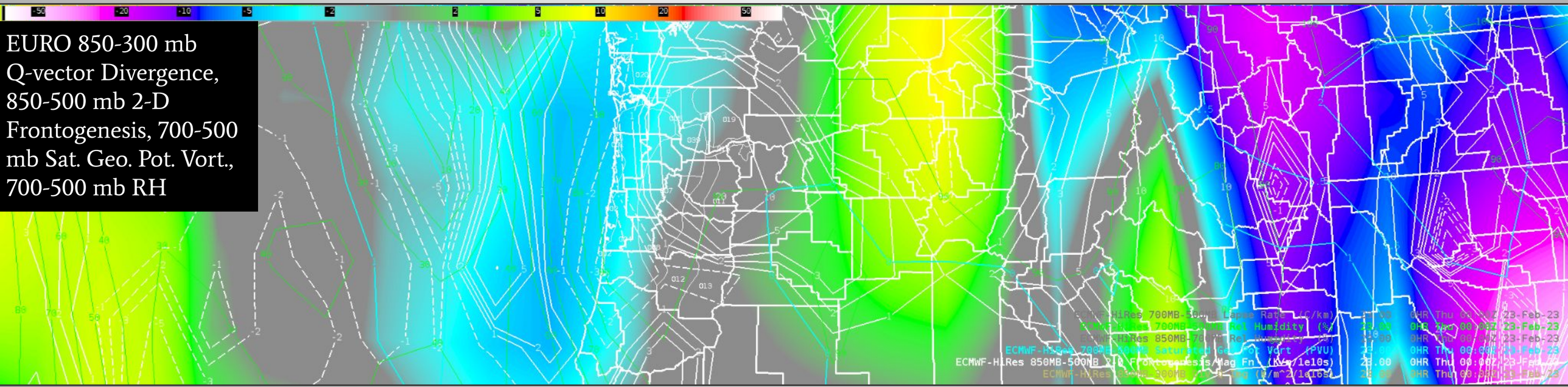
Thursday, March 9



Synoptic and Mesoscale Forcing (GFS/EURO - Initialized/Valid 00z Feb. 23)

Thursday, March 9

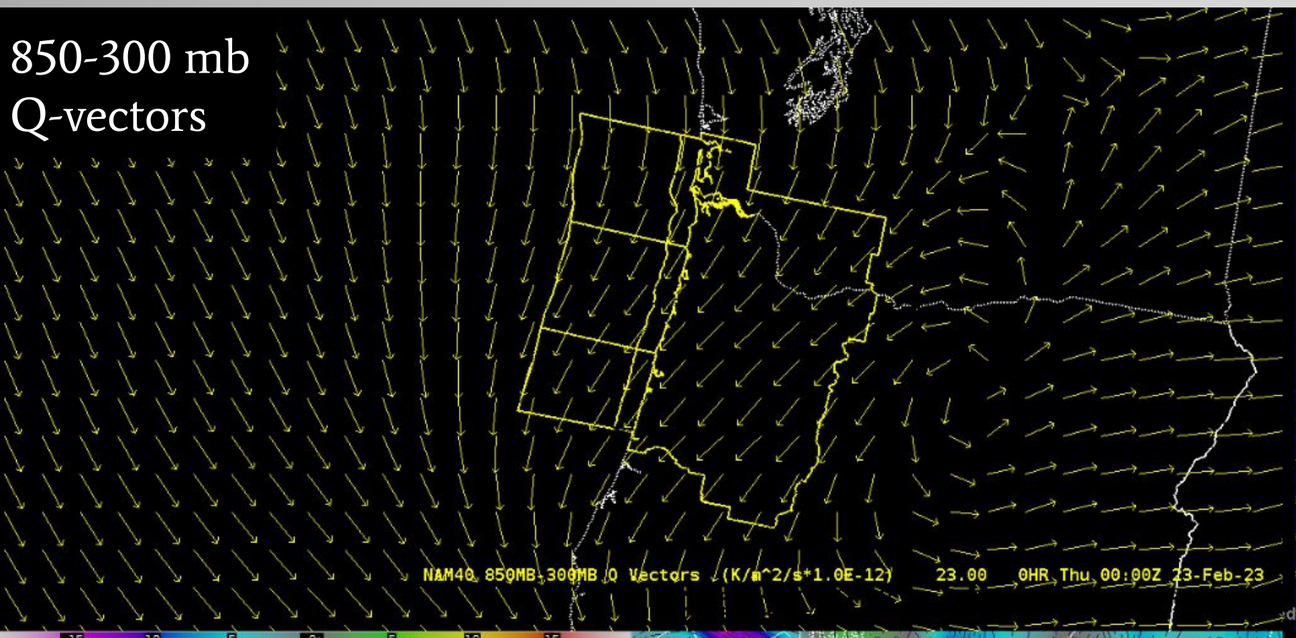




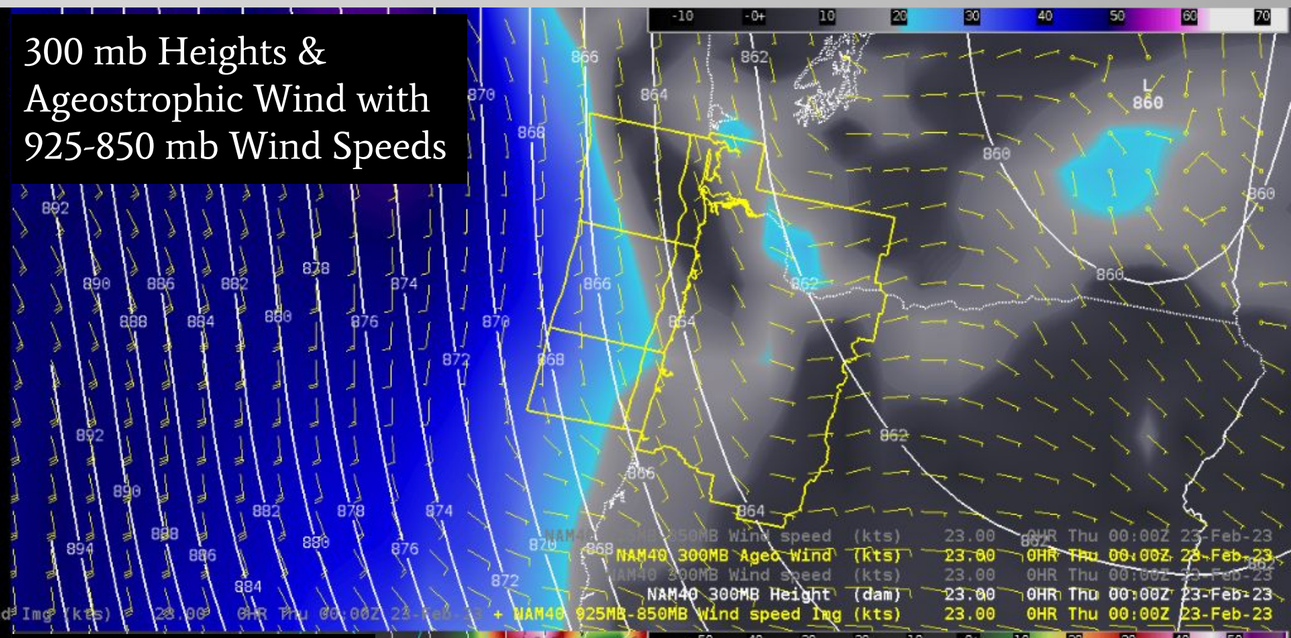
Synoptic and Mesoscale Forcing (NAM - Initialized/Valid 00z Feb. 23)

Thursday, March 9

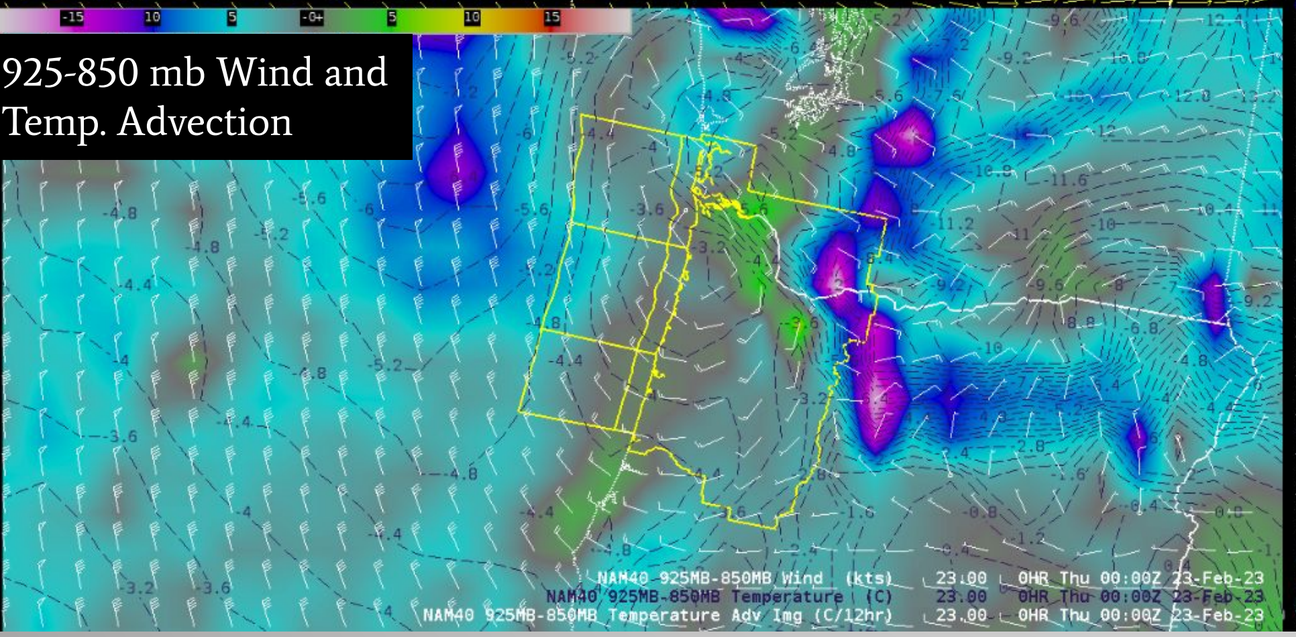
850-300 mb
Q-vectors



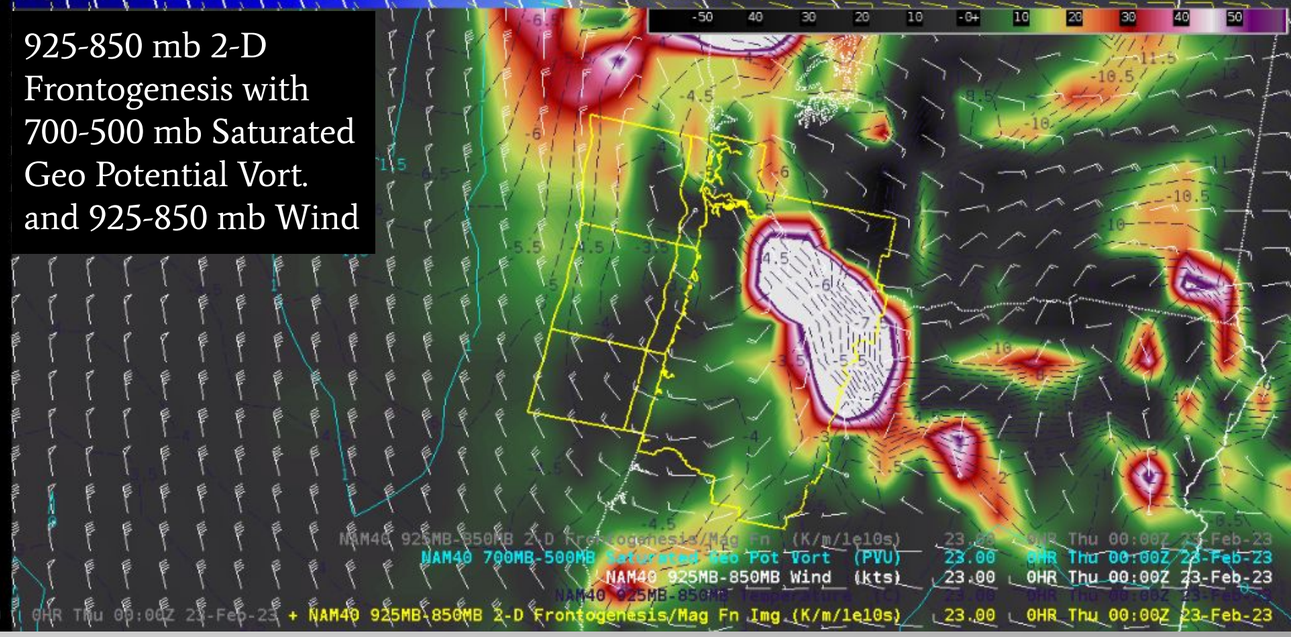
300 mb Heights &
Ageostrophic Wind with
925-850 mb Wind Speeds



925-850 mb Wind and
Temp. Advection



925-850 mb 2-D
Frontogenesis with
700-500 mb Saturated
Geo Potential Vort.
and 925-850 mb Wind



SNOW AMOUNTS… we expected snow, *but not nearly this much!*

- Exact track of surface/mid-level low not handled well by global/hi-res model guidance. Mesolows rotating counter-clockwise around the parent low were also not well handled

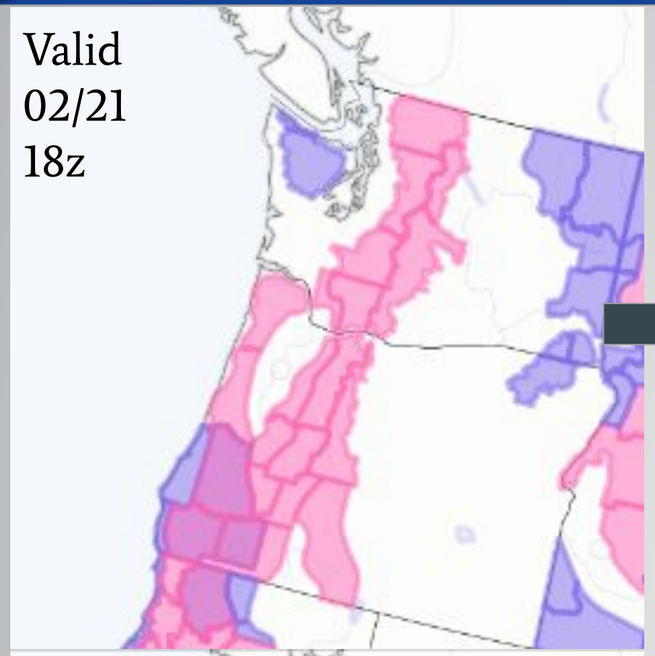
- Model guidance 12-24+ hours in advance generally showed a surface low near Astoria, OR the morning of the 22nd moving slowly southward towards Florence, OR through the day. Models showed precipitation shutting off completely across the Portland metro the morning of the 22nd with relatively dry easterly flow from the Columbia Gorge helping to shut off precipitation as the low shifted south.
  - In reality, the low stalled over Astoria for around 24 hours and precipitation continued through the day in Portland rather than shutting off in the morning like models and their ensembles suggested
  - Temps cooled below freezing due to cold easterly winds, allowing rain to switch over to snow in the morning
  - This had drastic consequences on QPF/snow amounts, which wasn't clear until the event was already unfolding

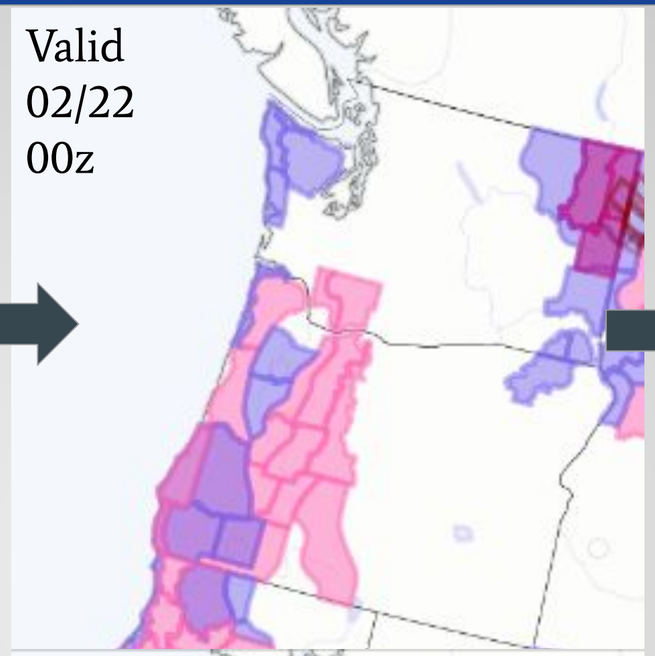
- Uncertainty regarding exact timing of rain switchover to snow
  - Precipitation began as rain with temperatures in the 40s, but temperatures quickly cooled to below freezing in a matter of hours as easterly winds advected a relatively colder air mass into western WA/OR.

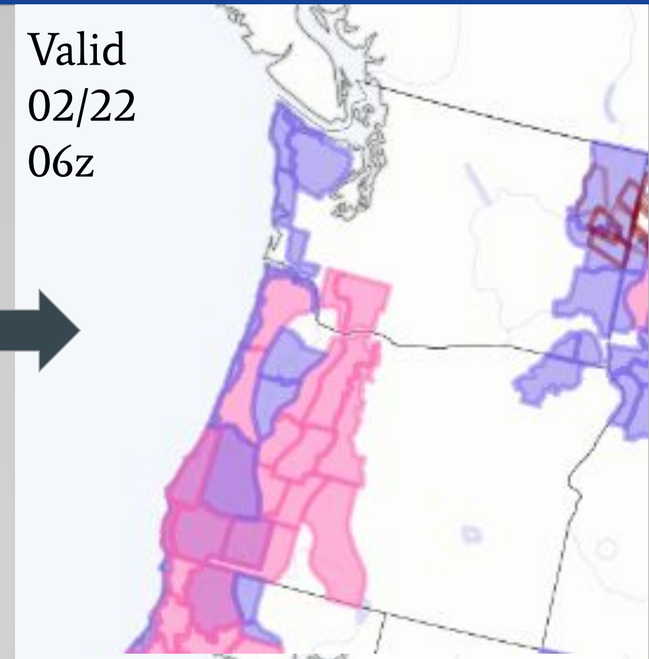
- NBM v4.1 24-hour snow probs 12-24 hours in advance of the event (01z run on Feb. 22nd):
  - 5% or less for snow amounts >= 4”
  - 0-1% for snow amounts >=6”
  - 0% for snow amounts >=10”

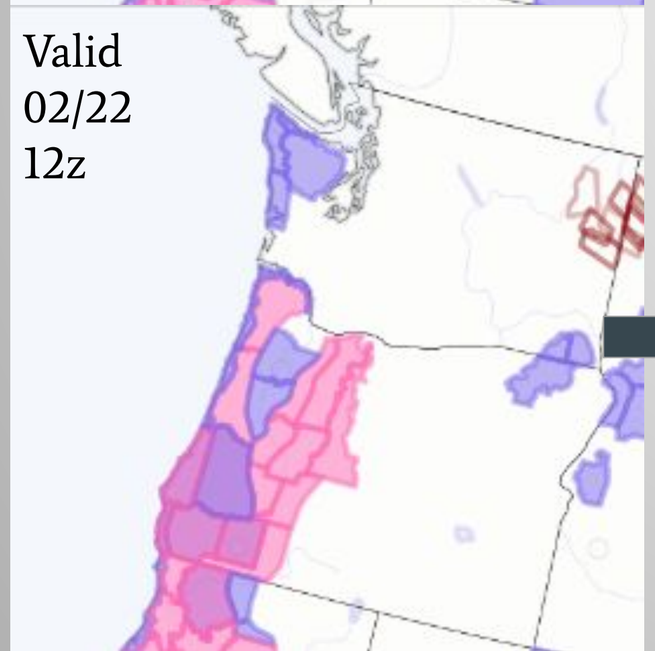
Winter Headlines - Adjusting to Reality

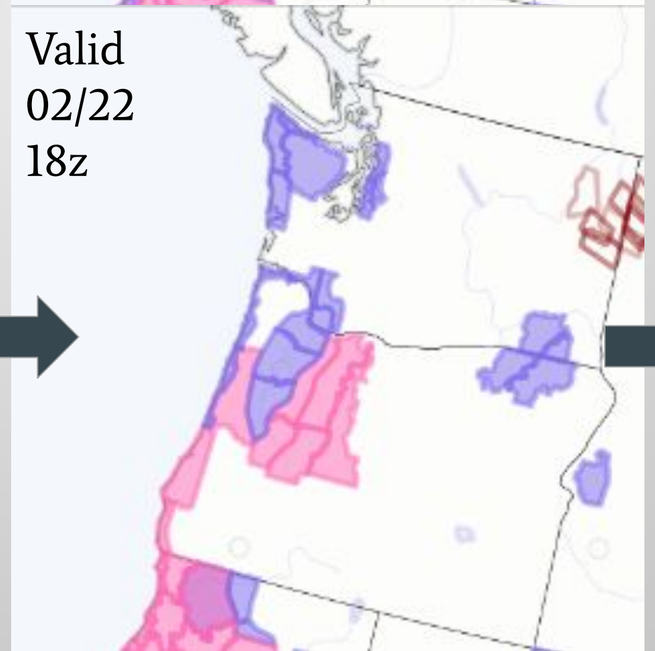
Thursday, March 9

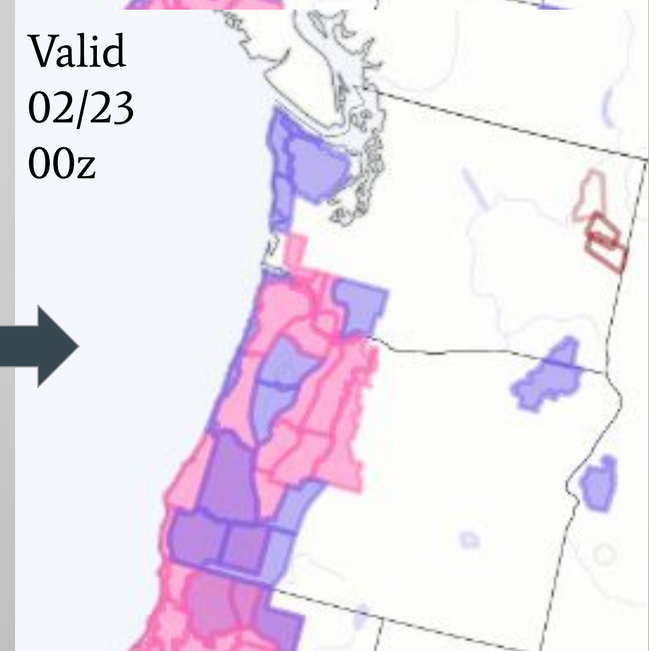












Warn/Adv
- WS.W
- LE.W
- BZ.W
- IS.W
- SQ.W
- LE.Y
- ZR.Y
- WW.Y

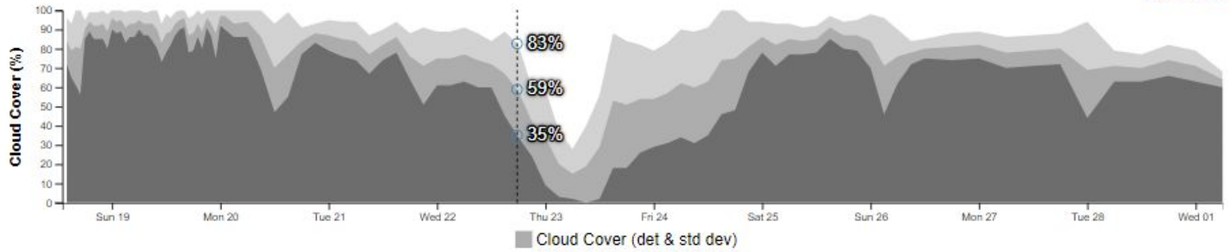
Day 3 Model Data

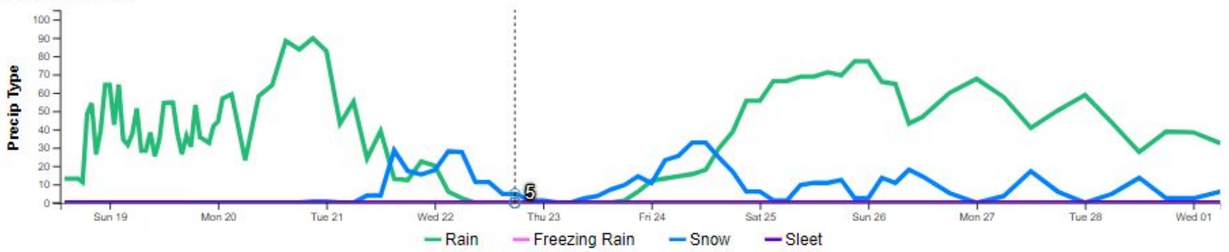
Day 3 - NBM Initialized 13z Feb. 19 - PDX

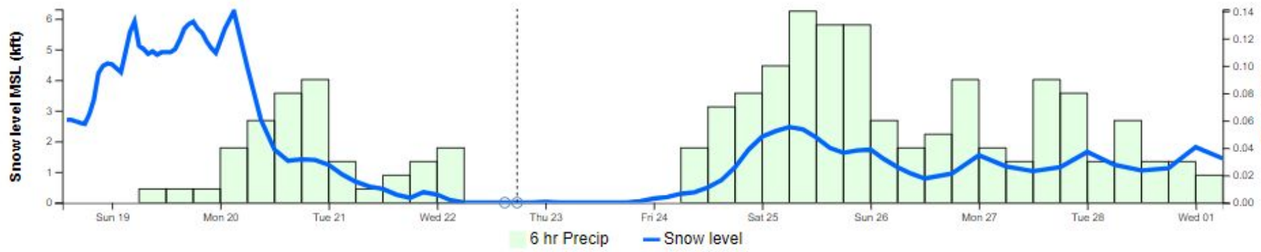
KPDX

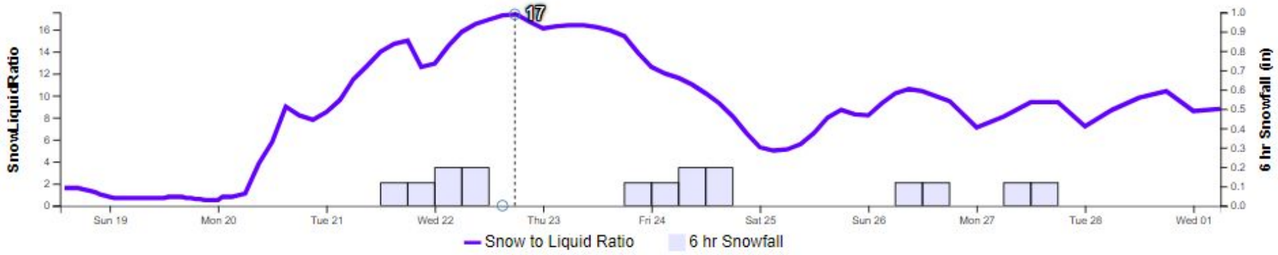
Thursday 09 am PST, February 23, 2023

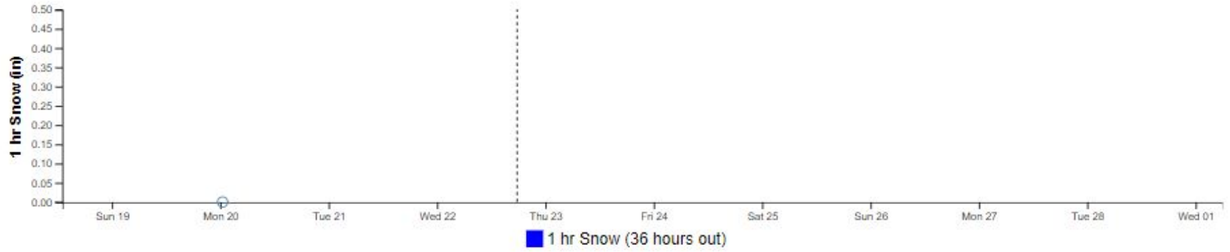
Box whiskers: 10th, 25th, 50th, 75th, & 90th

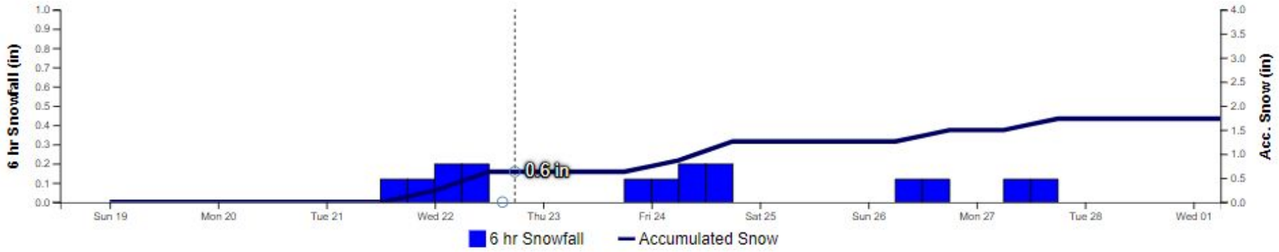


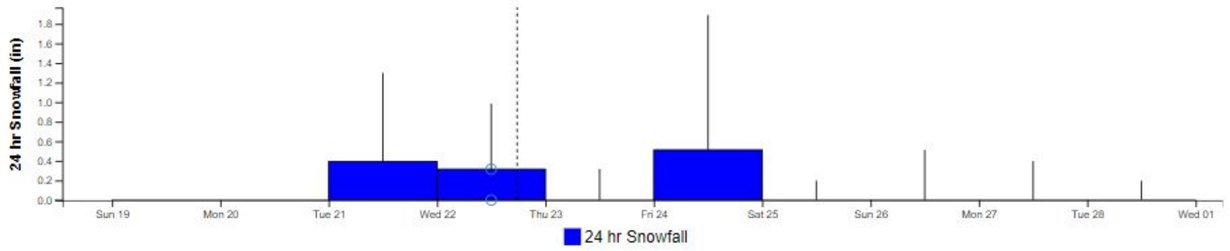


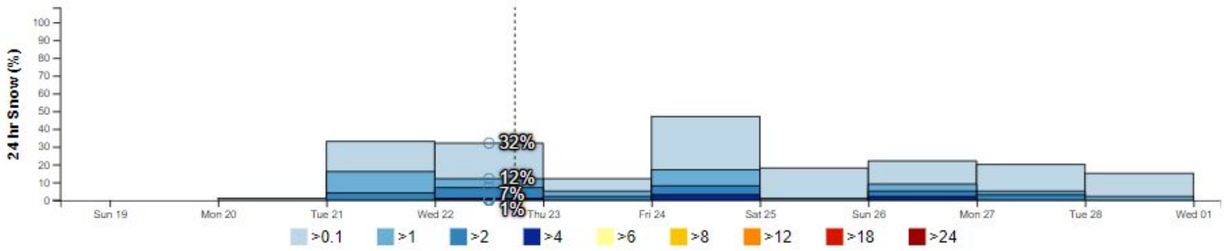






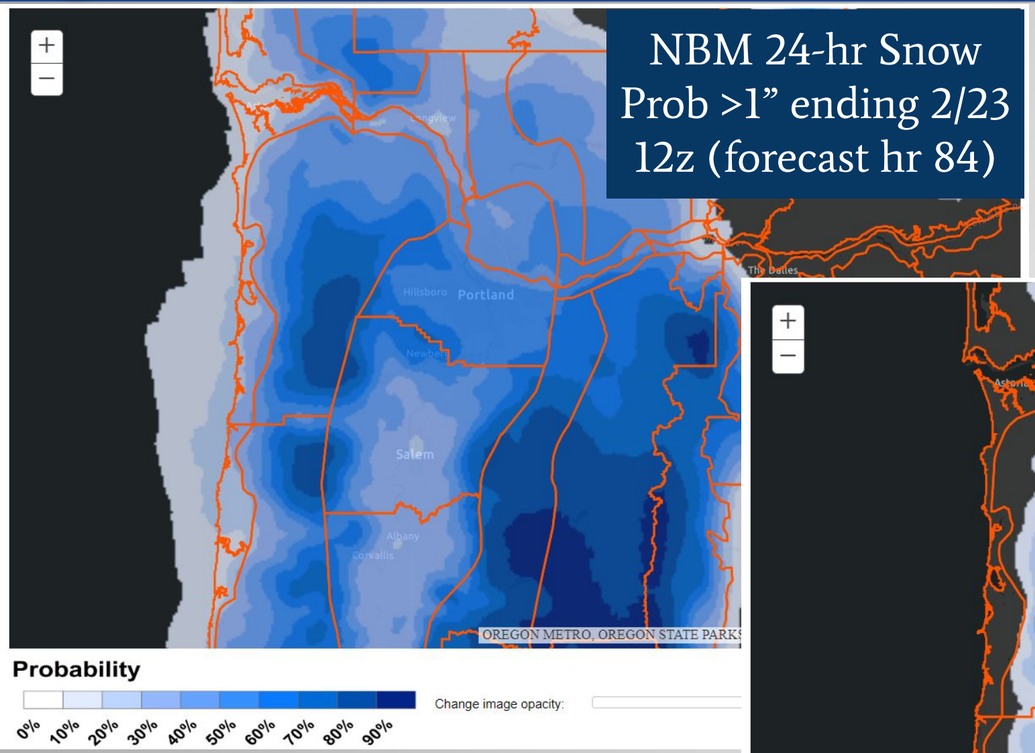


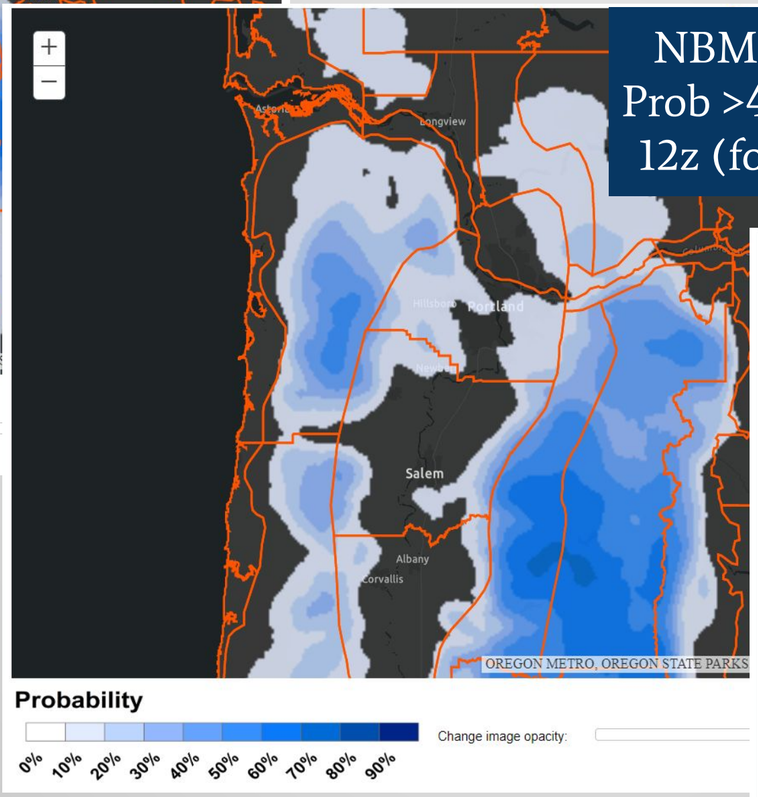


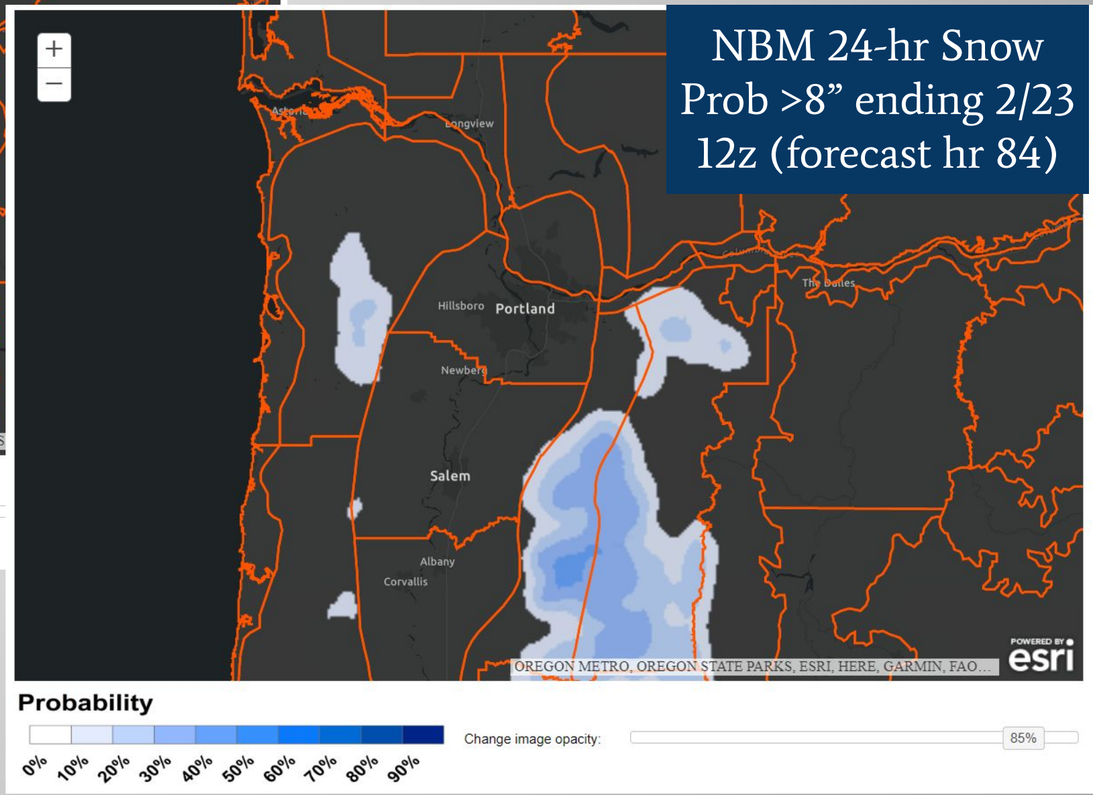


NBM 24-hr Snow Probs (forecast hr 84)

Thursday, March 9



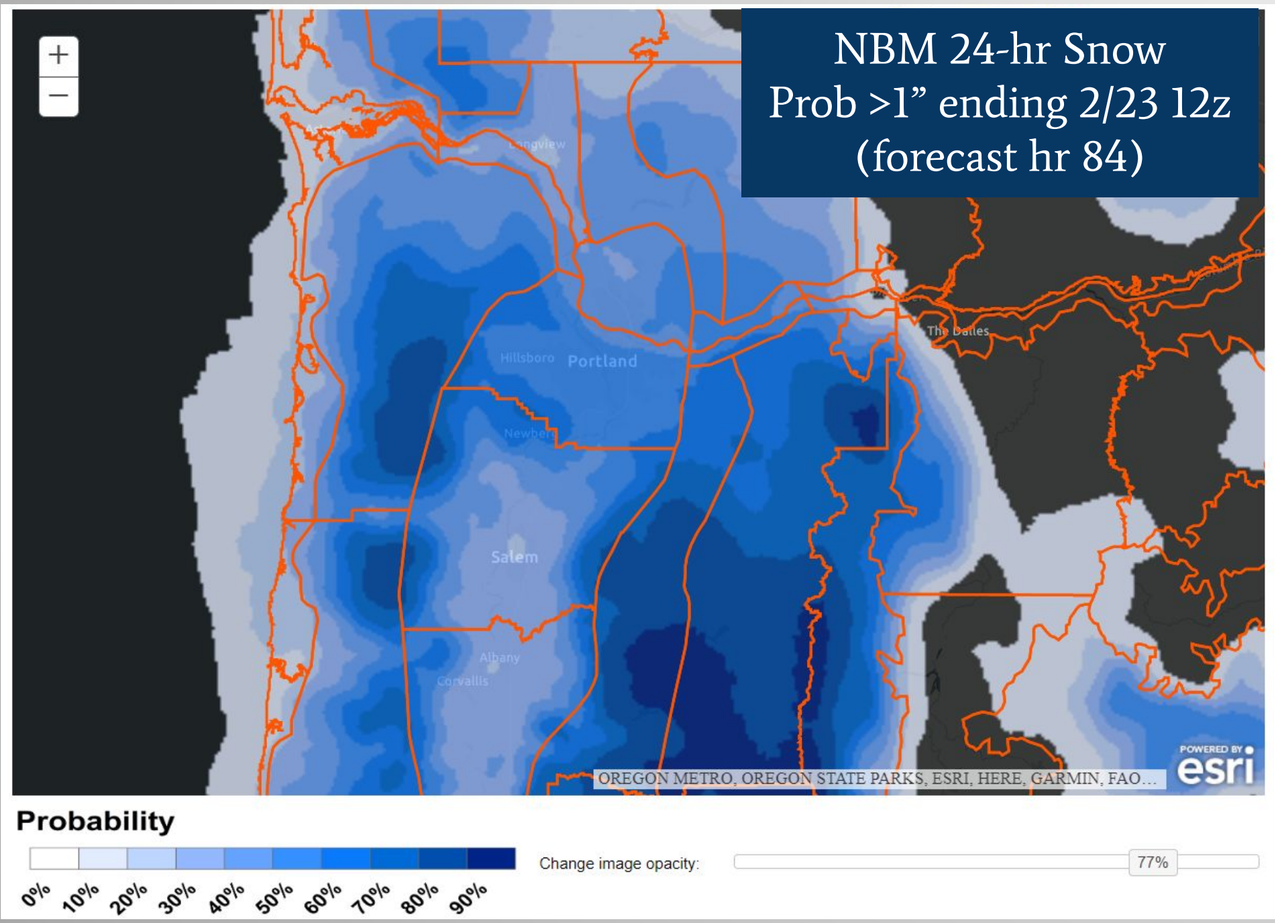


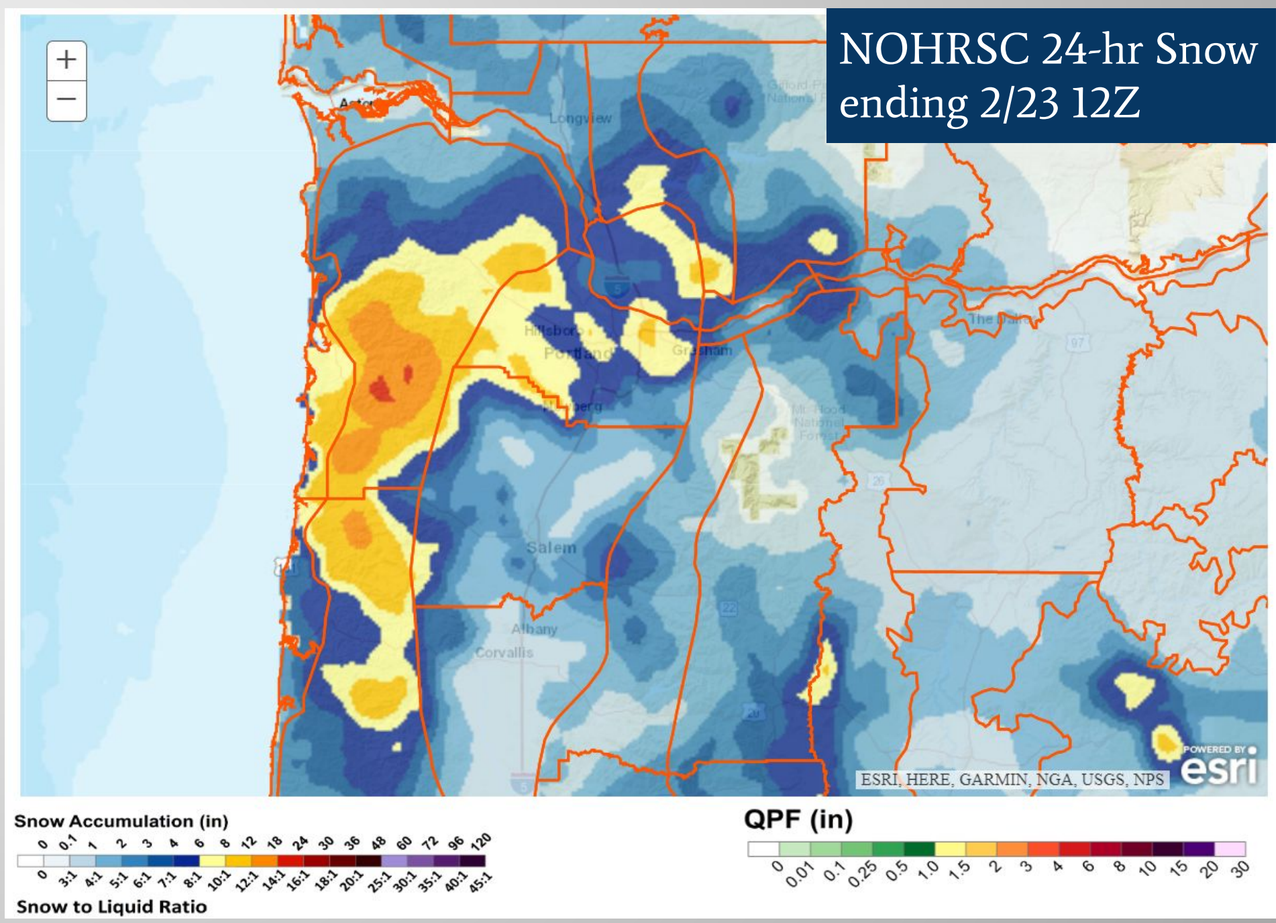


Evaluate and Discuss NBM Snow Probs

Thursday, March 9

- Spend the next 10-15 minutes filling out the Google Form for Day 3
- Answer the questions by comparing NBM 24-hr Deterministic Snow Amts and Snow Probs on Day 3 (forecast hour 84) to NOHRSC 24-hr snow amounts ending at 12z Feb 23

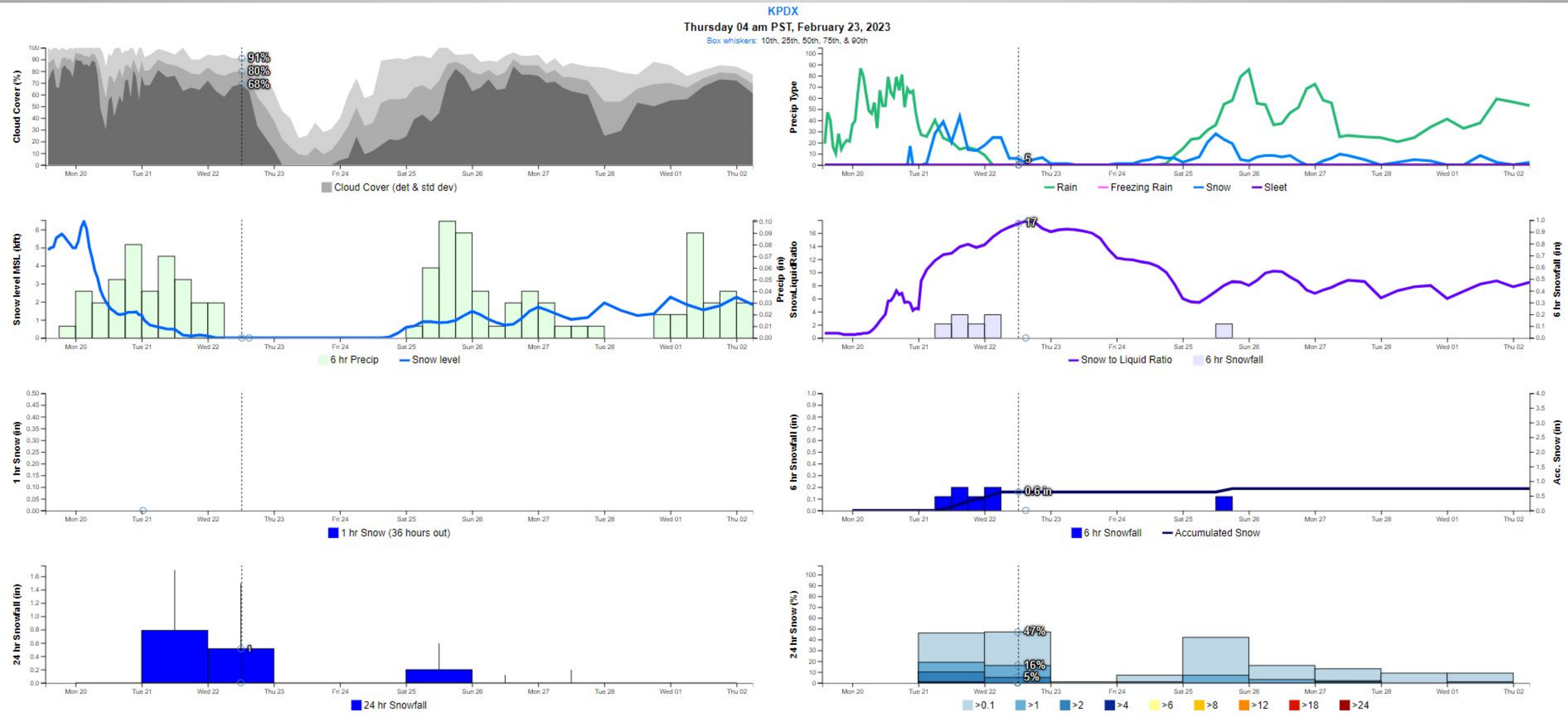




Day 2 Model Data

Day 2 - NBM Initialized 13z Feb. 20 - PDX

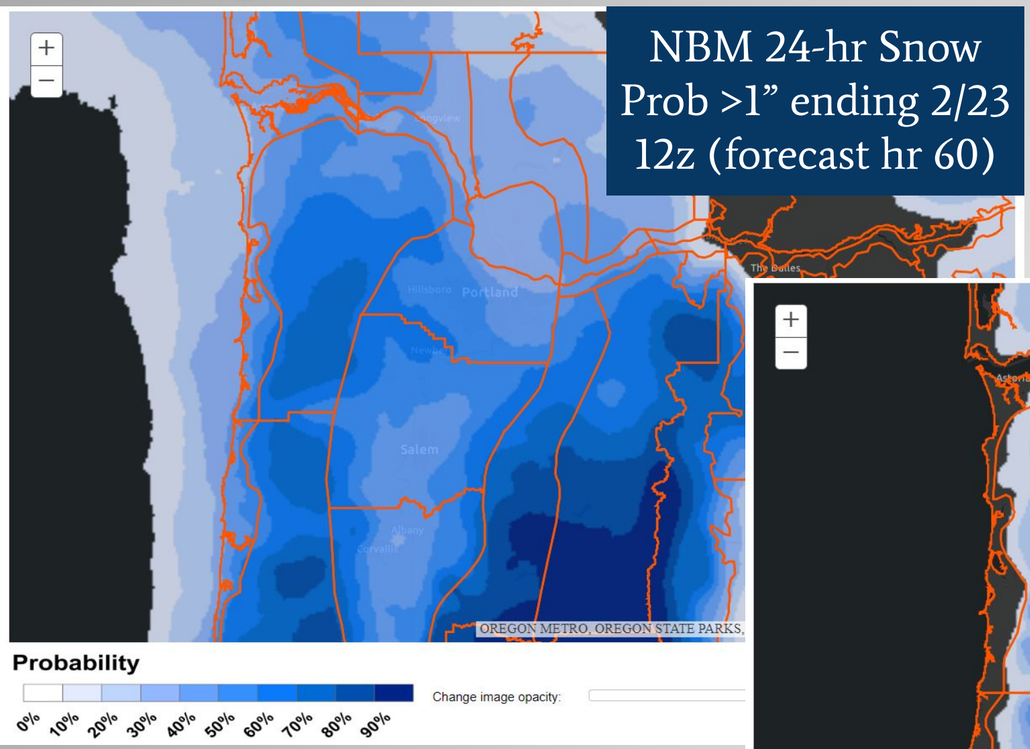
Thursday, March 9



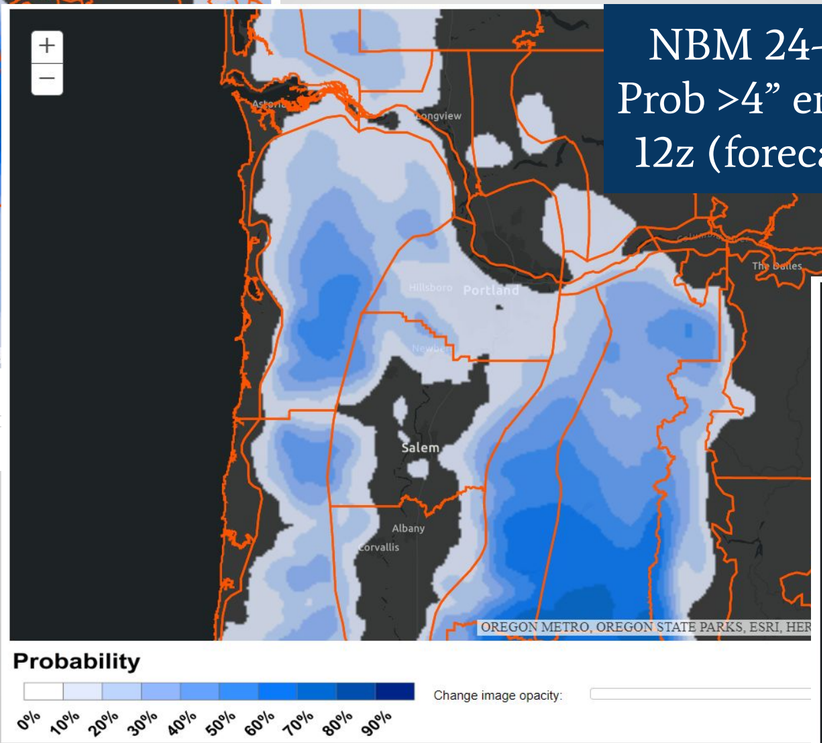
NBM 24-hr Snow Probs (forecast hr 60)

Thursday, March 9

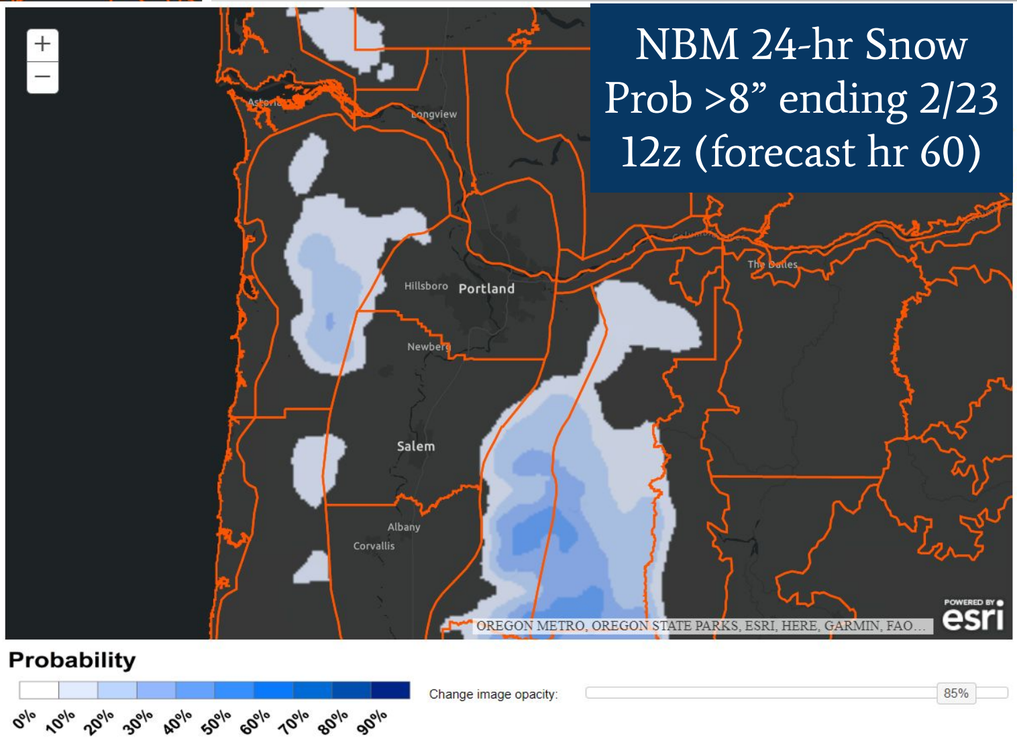
NBM 24-hr Snow Prob >1” ending 2/23 12z (forecast hr 60)



NBM 24-hr Snow Prob >4” ending 2/23 12z (forecast hr 60)



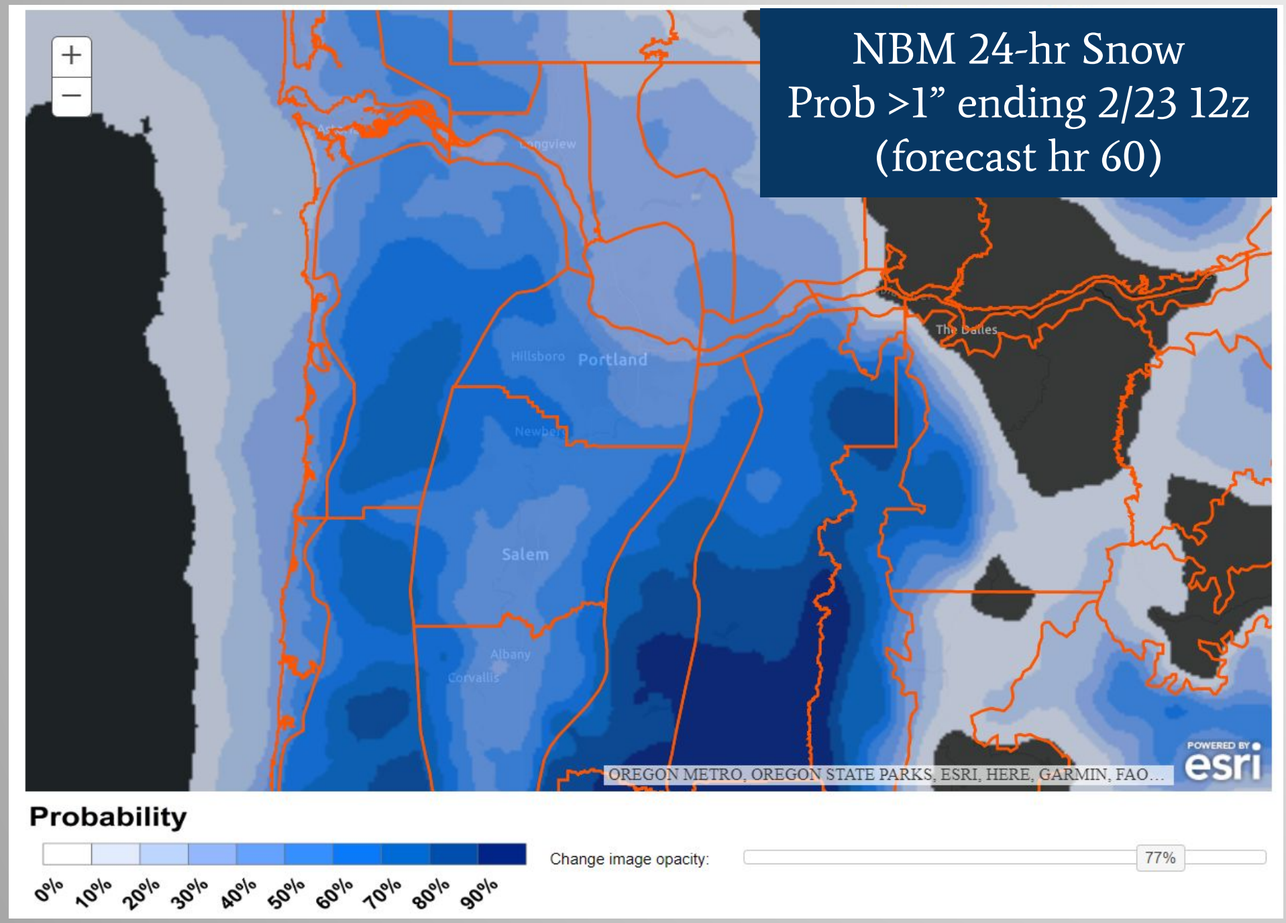
NBM 24-hr Snow Prob >8” ending 2/23 12z (forecast hr 60)

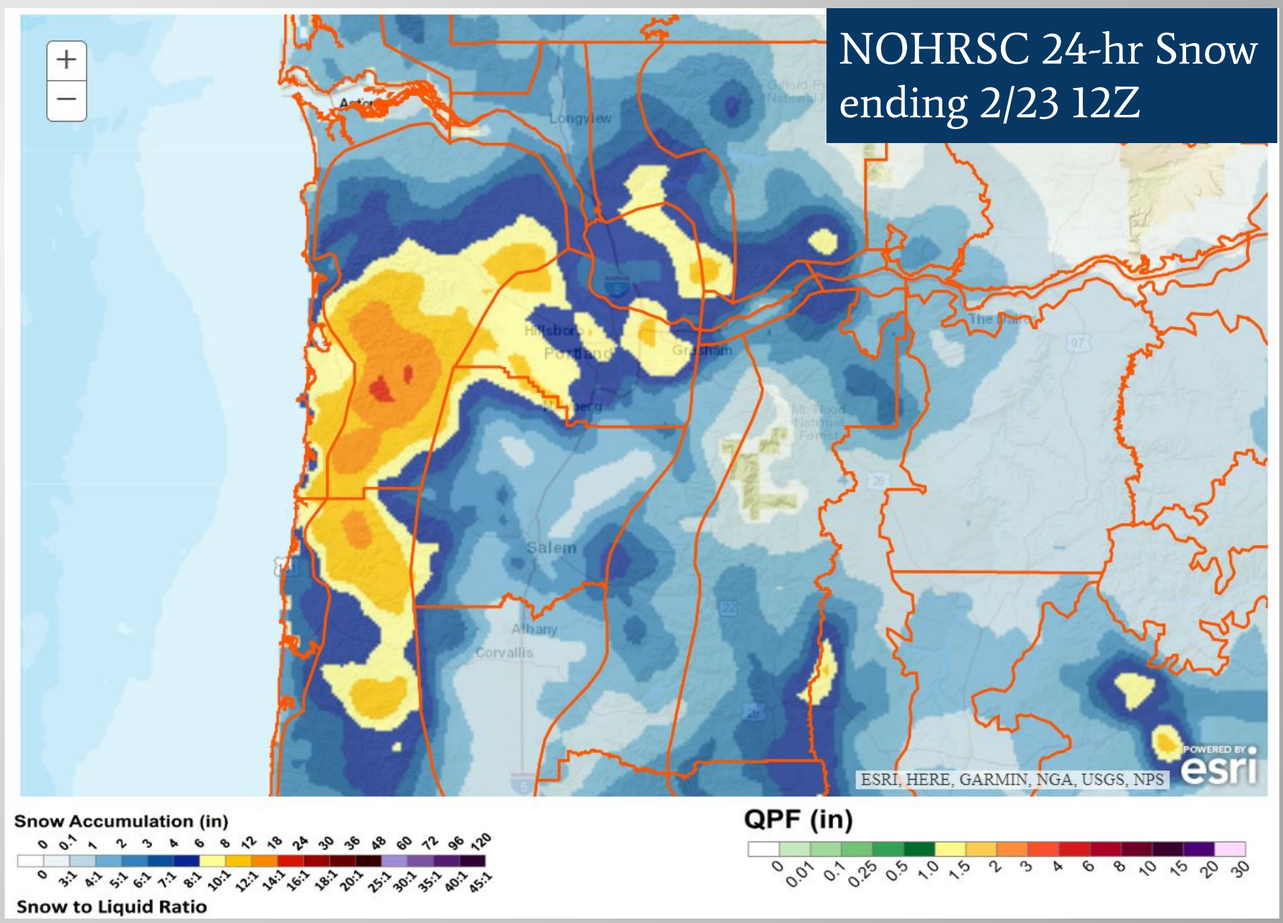


Evaluate and Discuss NBM Snow Probs

Thursday, March 9

- Spend the next 10-15 minutes filling out the Google Form for Day 2
- Answer the questions by comparing NBM 24-hr Deterministic Snow Amts and Snow Probs on Day 2 (forecast hour 60) to NOHRSC 24-hr snow amounts ending at 12z Feb 23

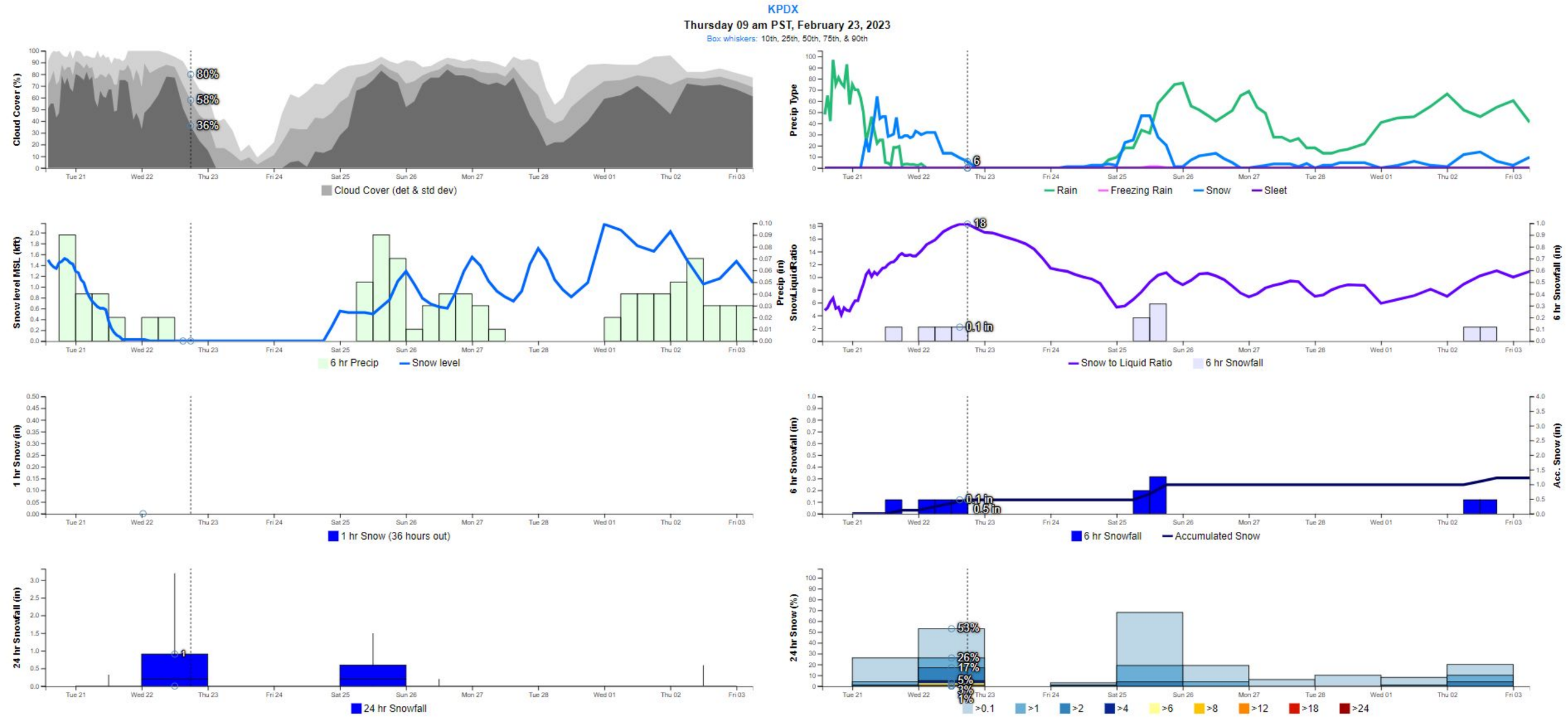




Day 1 Model Data

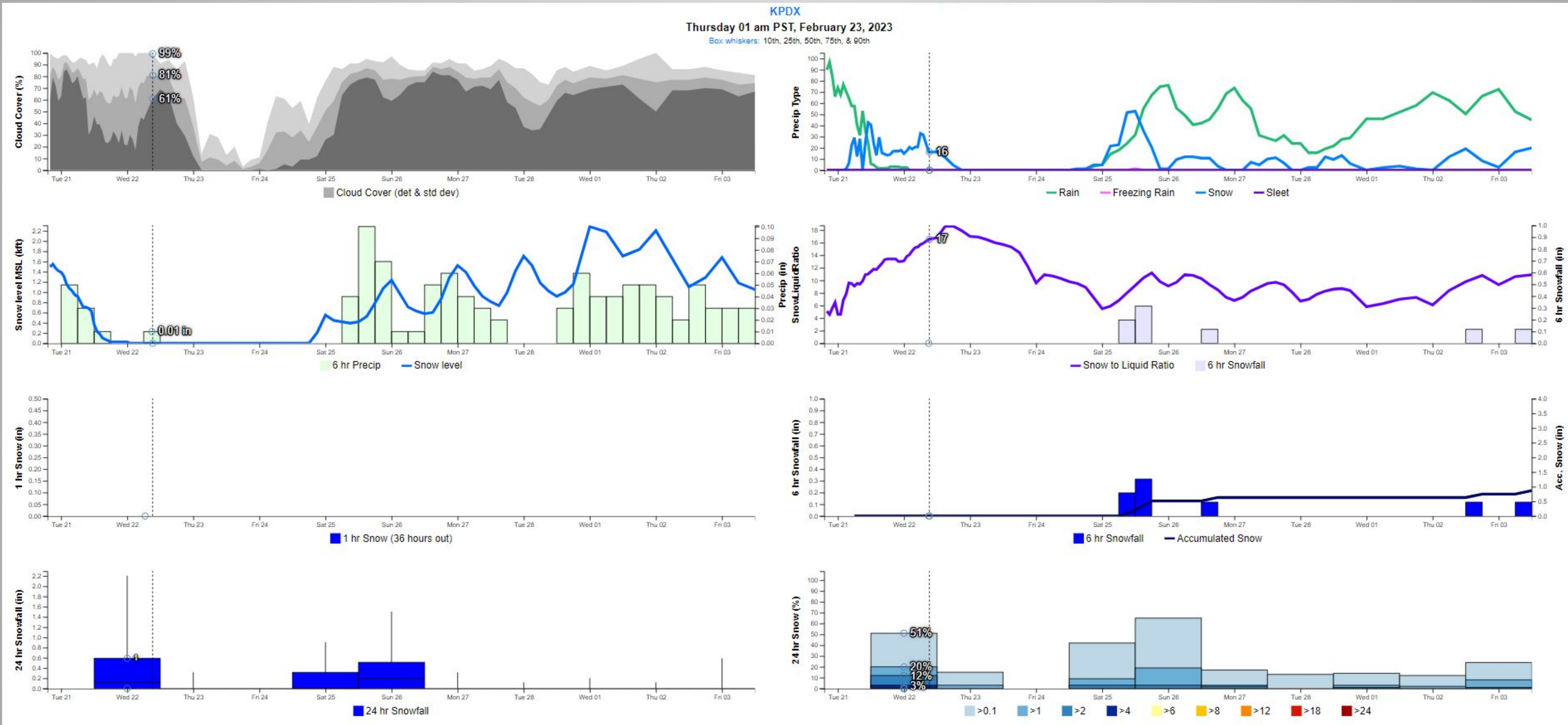
Day 1 - NBM Initialized 13z Feb. 21 - PDX

Thursday, March 9



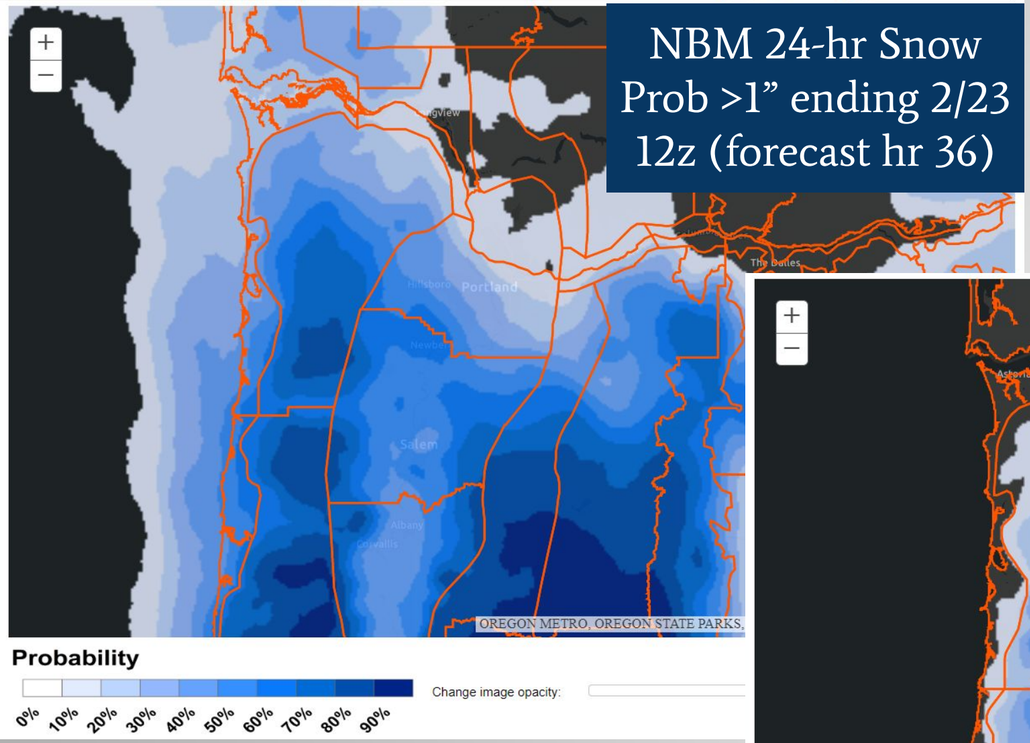
Day 1 - NBM Initialized 19z Feb. 21 - PDX

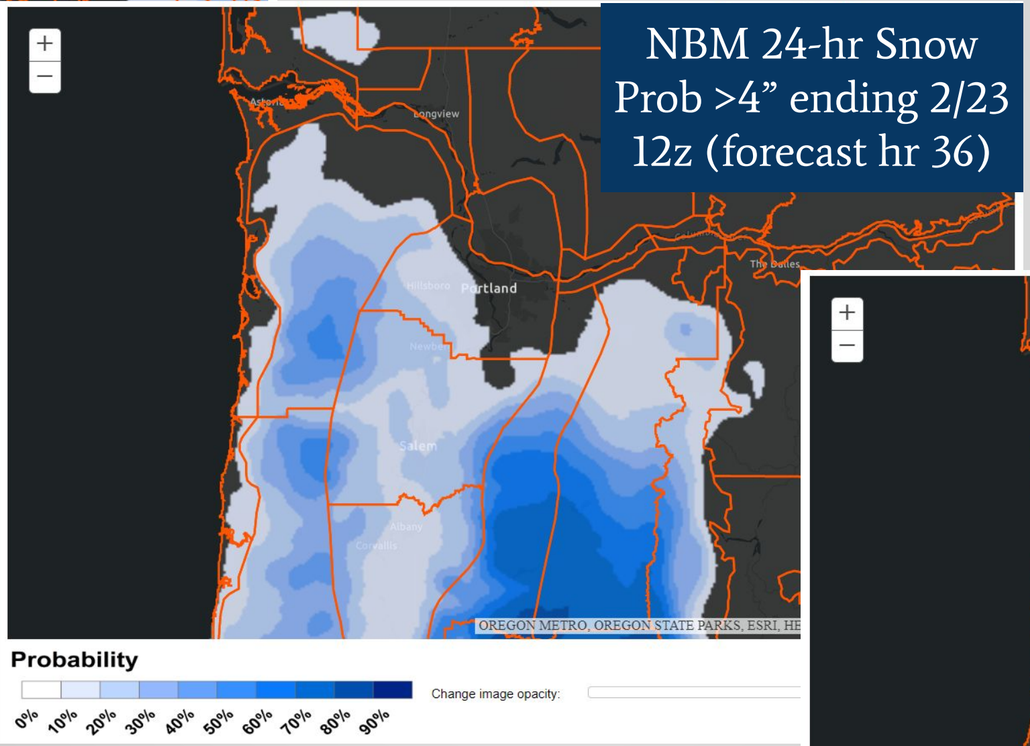
Thursday, March 9

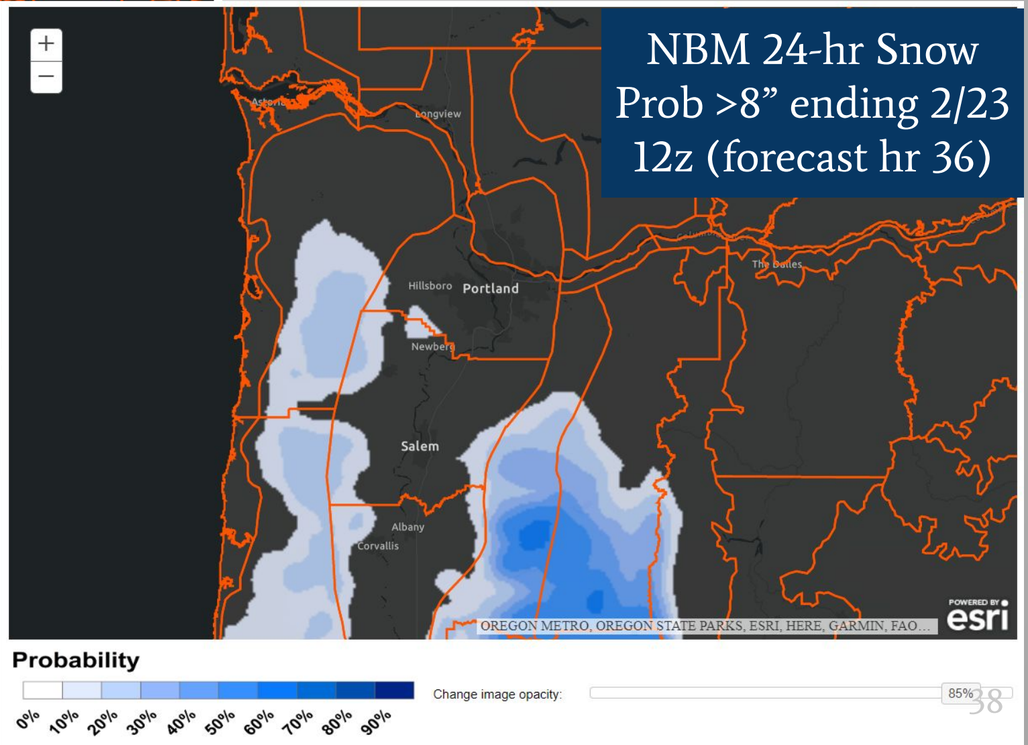


NBM 24-hr Snow Probs (forecast hr 36)

Thursday, March 9



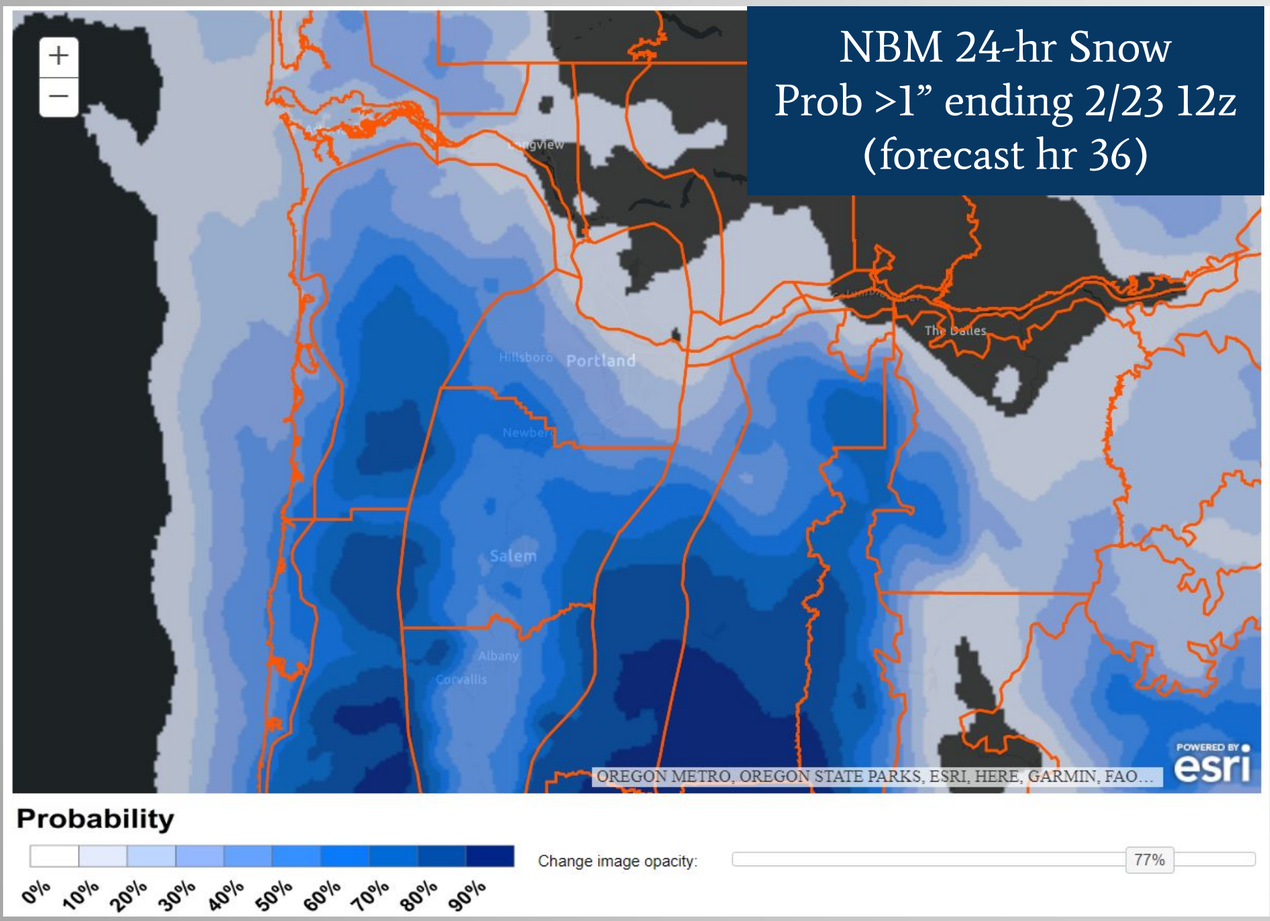


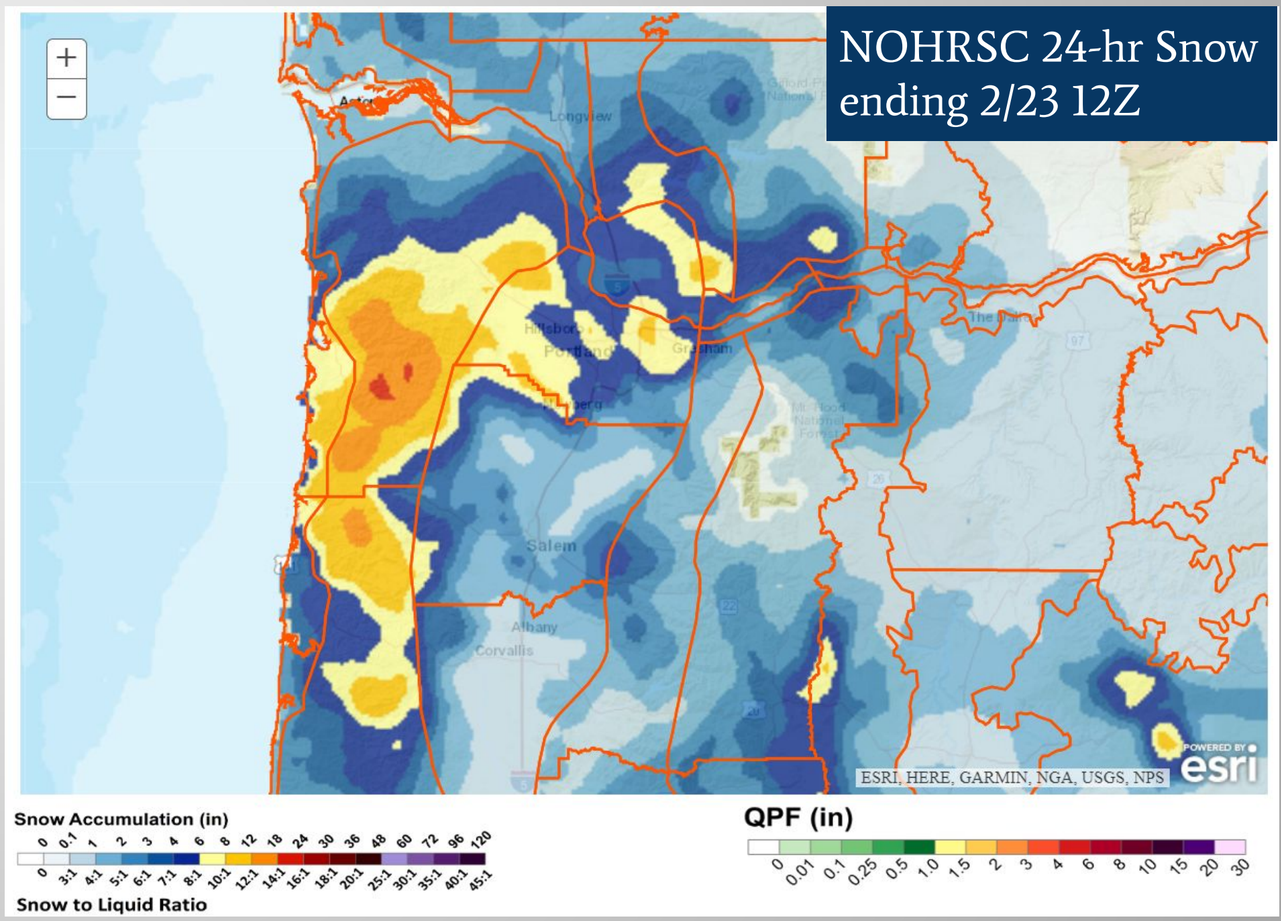


Evaluate and Discuss NBM Snow Probs

Thursday, March 9

- Spend the next 10-15 minutes filling out the Google Form for Day 1
- Answer the questions by comparing NBM 24-hr Deterministic Snow Amts and Snow Probs on Day 1 (forecast hour 36) to NOHRSC 24-hr snow amounts ending at 12z Feb 23

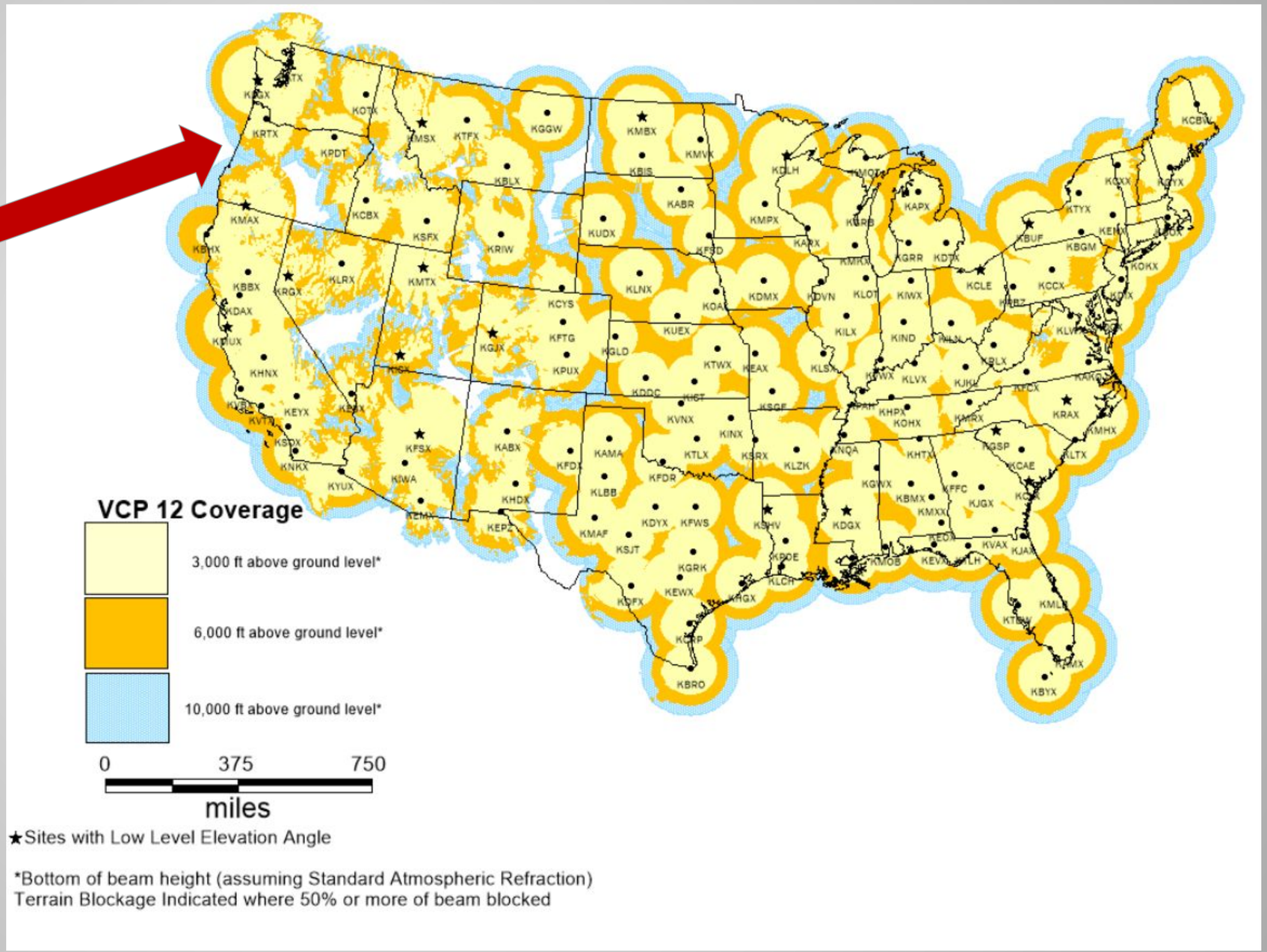




Radar Coverage Gap

- Heavy precipitation occurred along and near the central Oregon coast where there is a large gap in radar coverage

- Could this have negatively affected hi-res model guidance in the near-term? One would argue YES for any model that assimilates radar observations during initialization



Key Takeaways

- People are generally accustomed to having at least 1-3+ days notice for upcoming winter storms, but not every winter storm can be predicted this far in advance

- Some winter storms, such as the Feb 22nd snowstorm, are best handled as short-fused events given the uncertainty involved leading up to the event

- When models and their ensembles fail us, we have no choice but to quickly pivot our forecast, messaging and headlines once observations make it clear that our forecast isn't going as planned

- One huge problem leading up the Feb 22nd snowstorm was our inability to message a foot of snow as the worst case scenario due to a lack of supporting model data

- It's natural to pick apart the NBM for events like this and jump to conclusions and/or begin to no longer trust the NBM. However, this case study makes it clear that the NBM isn't to blame, it's the NBM's model inputs. Garbage in, garbage out!