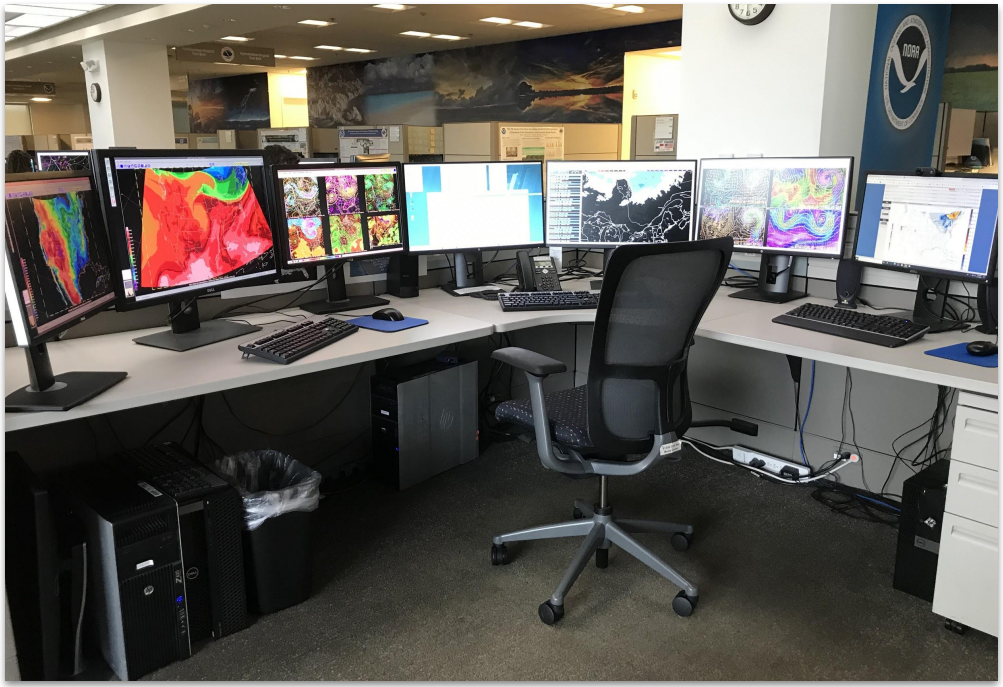
WEATHER PREDICTION CENTER

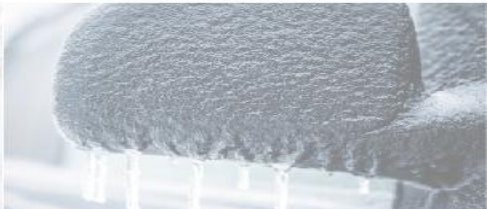
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

Weather-Ready Nation

"Digging Out: Understanding WPC's Winter Weather Desk"

Josh in 2011: not always just a winter forecaster!





What is NCEP/WPC?

The Overview:

Historical Roots:

- **March 16, 1942** - **Analysis Center** as the **Forecast Operations Branch (FOB)** of National Weather Bureau located downtown Washington, DC
  - Meteorological services for the War Department
  - Produced CONUS Analysis and Forecast Products (1 to 3 days)

- **January 1958** - Merged with Joint Numerical Weather Prediction Unit (Suitland, MD)
  - Named **National Meteorological Center (NMC)**

- **October 3, 1970** - Weather Bureau becomes National Weather Service (NOAA created)
- **January 1975** - Moved to World Weather Building in Camp Springs MD
  - 1 remaining employee (just retired this week!)

- **October 1, 1995** - NMC was reorganized into **National Centers for Environmental Prediction (NCEP)**
  - **HPC (Hydrometeorological Prediction Center)** is a subunit
  - Includes: **AWC, CPC, EMC, NHC/TAFB, OPC, SPC, SWPC, and Central Operations**

NOAA Center for Weather and Climate Prediction - NCWCP

College Park, Maryland (M Square @ Univ. of Maryland)

August 2012

- **March 5, 2013 - Renamed Weather Prediction Center**

World Weather Building
1975-2012

March 2020

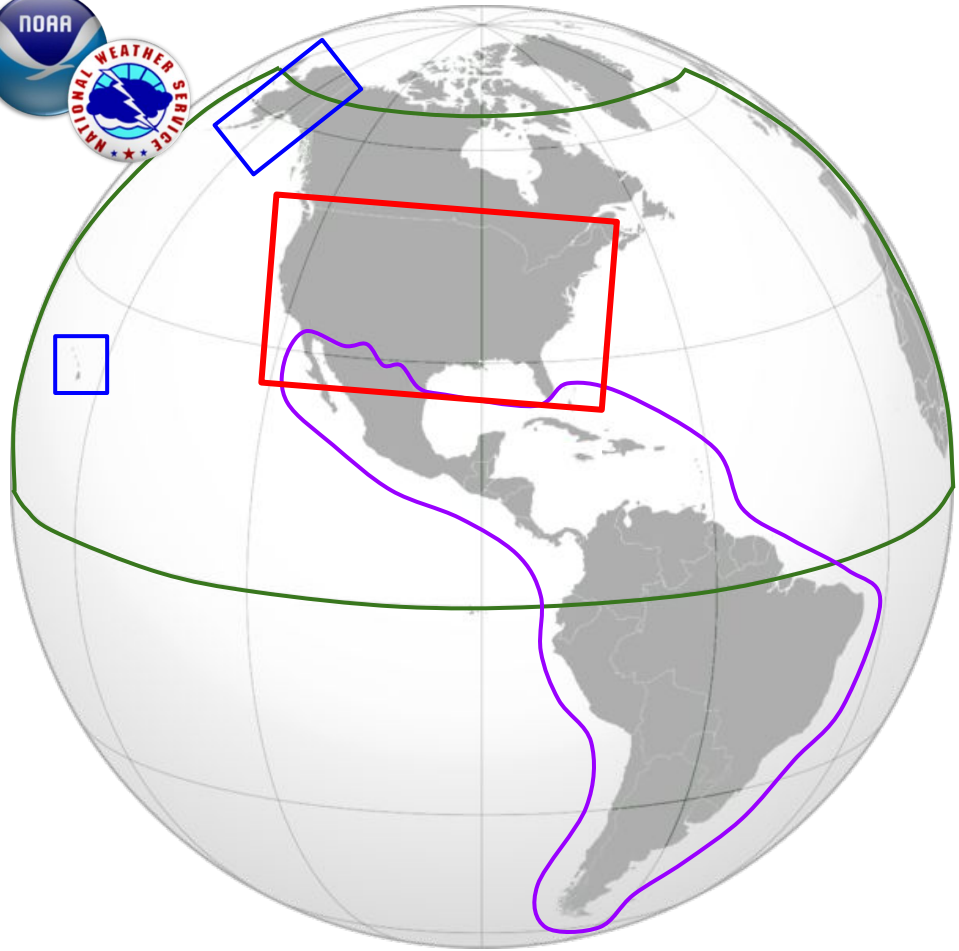
National Centers for Environmental Prediction (NCEP):

Provide specialized overview with daily national-level expertise

WPC's expertise being broader: Model Preference, Heavy Rain, Winter Weather, Pressures/Fronts
Hence : ***WEATHER*** Prediction Center (even though every other Center is Predicting Weather)

WPC has a total of 9 specialized desks staffed at any given time, plus the International Desks, Developers, as well as, backup responsibilities to the National Hurricane Center.

32 Forecasters, 2 International Experts, 6 Managers, 3 Admin, 15 Developers (incl. contracts), 1 MetTech



Large Domain

- CONUS: multitude of forecasts
  *winter forecasts
- OCONUS: Alaska medium range grids and Hawaii forecast discussion
- Tropical cyclone rainfall statements with NHC and CPHC
- International Desk trains forecasters from Central and South America and the Caribbean

WPC Mission

National situational awareness and readiness for hazardous weather.
Providing actionable information that is scientific, probabilistic, & impact-based.

Routine/Event driven products produced by WPC

Analysis

Unified Surface Analysis
Social Media
Storm Summaries
CONUS High/Low
Day 1-3 Hazards

Short Range
Days 1-3
6 to 84 hrs

Fronts/Press. & Discussion
Precipitation(QPF) → Winter Weather
Excessive Rainfall Outlook
Metwatch - Mesoscale Precip Discussion
National Media Phone Calls
Rainfall Statements for TCs
Service Backup for NHC in the Atlantic
Advisories for Inland Depressions (CONUS)

Medium Range
Day 3-8
72 to 204 hrs

Days 3-7 Fronts/Pressures
Max/Min Temps,
QPF, Precip Prob,
Cloud Cover, Wx Type
Tropical Coordination - VTC
Day 3-8 Hazards Chart

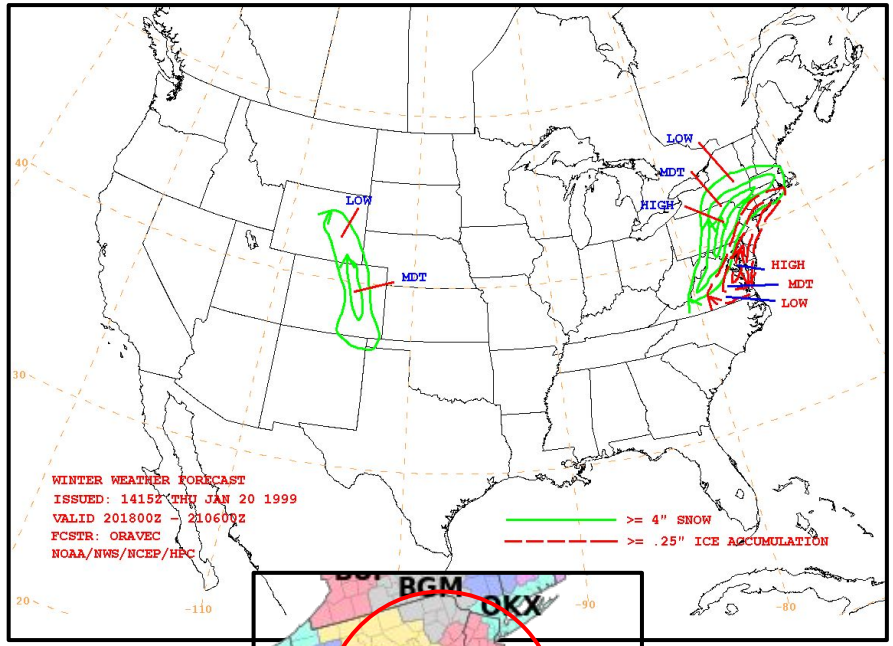
WPC Winter Weather Desk (WWD)

- Seasonal desk with rotation of 4 forecasters
- Typically operates late September into May
  - Available for support for late/early season events (eg. Sep 2020, May 2020)
- **How did we get here?**

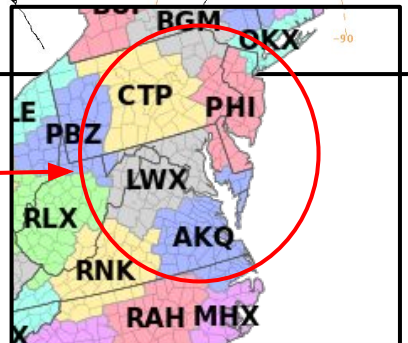
"There isn't enough winter weather to fill this desk."

WPC WWD - History

- 1999-2001: WPC (then HPC) begins producing categorical probabilities for deterministic snow and ice accumulations
  - The snow accumulation probabilities are for greater than 4”
  - The ice accumulation (accretion) probabilities are for greater than 0.25”



- These initial forecasts were for only a small region of the Mid-Atlantic (CTP/PHI/LWX/AKQ)

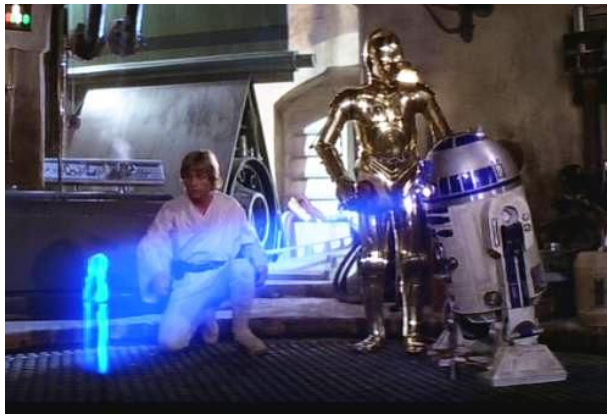


WPC WWD - History

- IN 2001, WPC management collaborated with the local Weather Forecast Offices (WFOs) and NWS HQ to determine how WPC can best assist the winter forecasts

NWS Winter Weather Desk

- Goals of 4 year experiment from 2001- 2004:
  - Improve Winter Weather Services to the public through coordination of the winter weather watches/warnings with National guidance products
  - Test short range ensemble for their applications to winter weather forecasting
- Motivation:
  - Jan 24-25, 2000; December 30, 2000: March 4-6, 2001



"Help me WPC, you're my only hope"

WPC WWD - History

For the next 3 seasons (2001-2004) the first “Winter Weather Experiment” began between WPC and the NWS local WFOs.

- Forecasts:
  - Probability of 4, 8, and 12 inches of snow & deterministic snow forecast
  - Probability of 0.25” of ice & deterministic ice forecast

- Verification:
  - Probability of Detection (POD)
  - False Alarm Rate (FAR)
  - Critical Success Index (CSI)
  - Lead Time (LT)

WPC WWD - History

ER	WWE1 (01-02')	WWE2 (02-03')	WWE3 (03-04')	WWD (04-05')
# WFOs	8	23	23	ALL
POD	.89	.90	.92	.92
FAR	.33	.30	.32	.30
CSI	.62	.65	M	.66
LT–Warn	13	15	18	21

CR	WWE2 (02-03')	WWE3 (03-04')	WWD* (04-05')
# WFOs	8	33	ALL
POD	.90	.88	.92
FAR	.40	.45	.32
CSI	.57	.51	.65
LT–Warn	13	13	17

WR	NonWWE3 (03-04')	WWE3 (03-04')	WWD* (04-05')
# WFOs	12	10	ALL
POD	.86	.88	.88
FAR	.26	.27	.30
CSI	.66	.67	.64
LT–Warn	12	14	16

SR	NonWWE3 (03-04')	WWE3 (03-04')	WWD (04-05')
# WFOs	4	11	ALL
POD	.84	.92	.90
FAR	.37	.38	.39
CSI	.57	.59	.57
LT–Warn	5	9	9

2001: 8 WFOs, 2002: 31 WFOs, 2003: 77 WFOs, 2004: ALL WFOs

WPC WWD - History

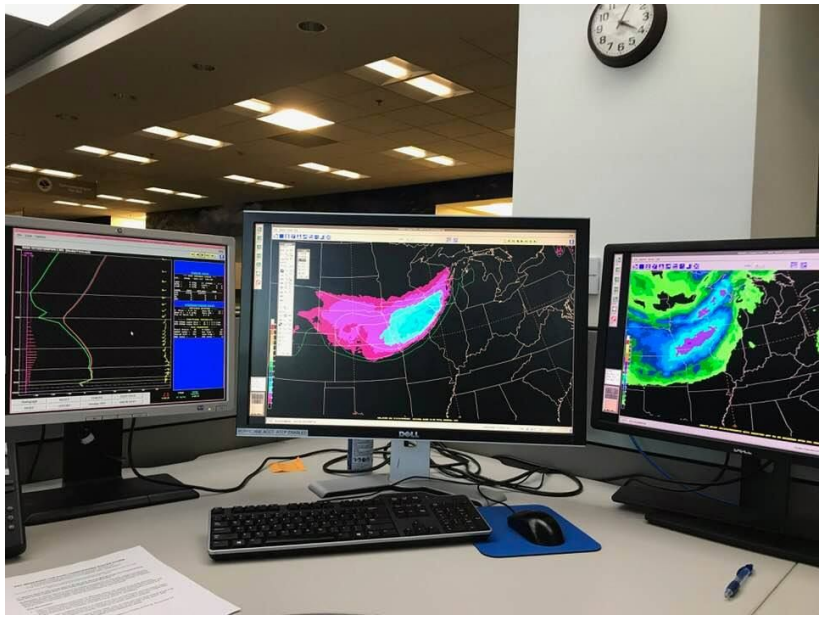
The Winter Weather Desk goes “operational” as WWD on Sep 15, 2004

WPC will provide probabilistic and deterministic expertise for all heavy snow and icing events across the CONUS

“Now, witness the power of this fully operational
WPC Winter Weather Desk.”

WPC: The operational WWD

- WPC WWD products:
  - Deterministic snow and ice (D1-3)
    - Internal to NWS
  - Probabilistic snow and ice (D1-3)
  - Winter Storm Outlook (D1-4)
  - Winter Weather Outlook (D4-7)
  - Winter Storm Severity Index
  - Low Tracks Graphic
  - Heavy Snow/Ice Discussion
  - Winter Storm Key Messages

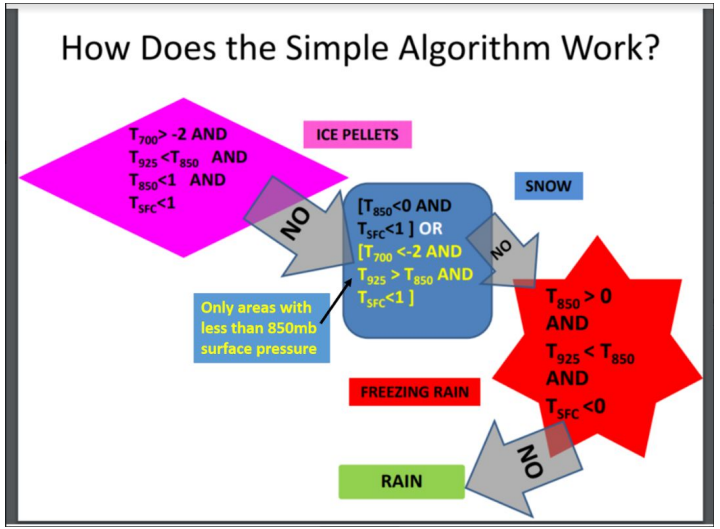


WWD Products: Snow and Ice (D1-3)

- Through 2019: WWD created through NMAP (NAWIPS)
- 2019-2020 Season: Transition to AWIPS (GFE)
  - Better resolution (~40km → 5km)
  - Better verification (improved forecast skill scores)
  - Easier to assist WFOs
- Snow:
  - QPF * PoWT * SLR
    - (Quantitative Precipitation Forecast * Probability of Weather Type * Snow Liquid Ratio
- Ice:
  - QPF * PoWT * ILR

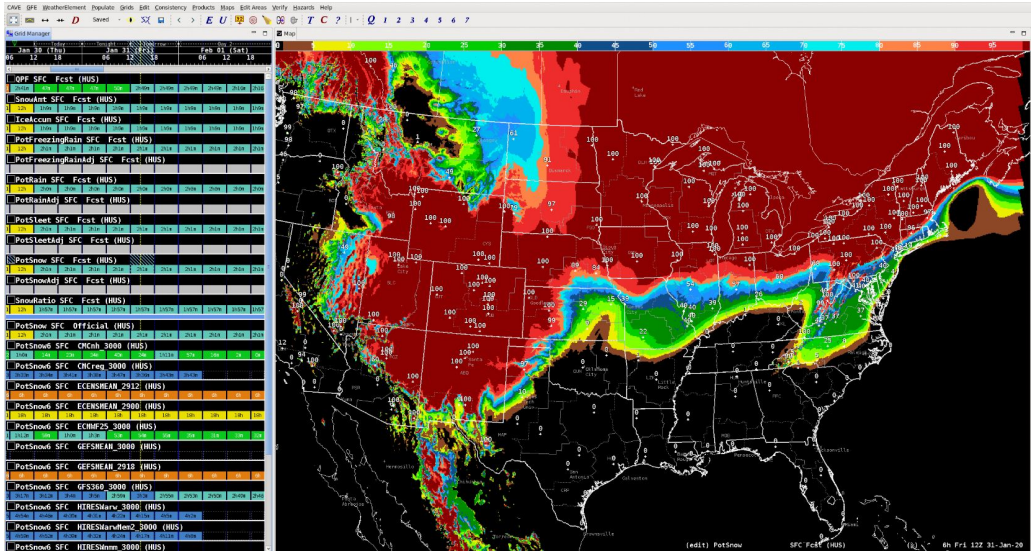
WWD Products: Snow and Ice (D1-3)

- Snow: QPF * PoWT * SLR
  - QPF: Quantitative Precipitation Forecast
  - PoWT: Probability of Weather Type
  - WPC "Decision Tree" algorithm:
    - Determines one precip type for each grid: Snow, Rain, Sleet, or Freezing Rain. There are 937,227 5km grid points!
    - Based on thermal structure (SFC, 925mb, 850mb, 700mb)
    - Decision tree algorithm determines precip type



WWD Products: Snow and Ice (D1-3)

- Procedure:
  - PoWT grids are initialized using a GFE procedure with the “first guess” 100% 00Z (12Z) ECENS on night (day) shift
  - Forecaster can blend model guidance to produce targeted improvements based off thermal and mass field preferences
- Probability of Weather Type grids are normalized to 100



WWD Products: Snow and Ice (D1-3)

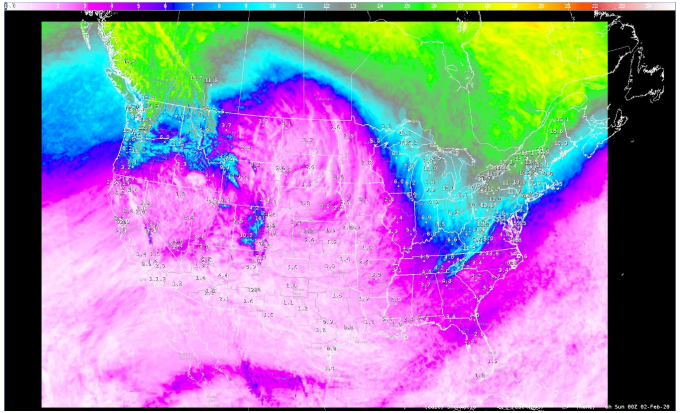
- Snow: QPF * PoWT * SLR
  - QPF: Quantitative Precipitation Forecast
  - PoWT: Probability of Weather Type

  - SLR: Snow-Liquid Ratio:
    - Pre-2019: WPC Legacy SLR blend
    - 2019+: Modified NBM SLR

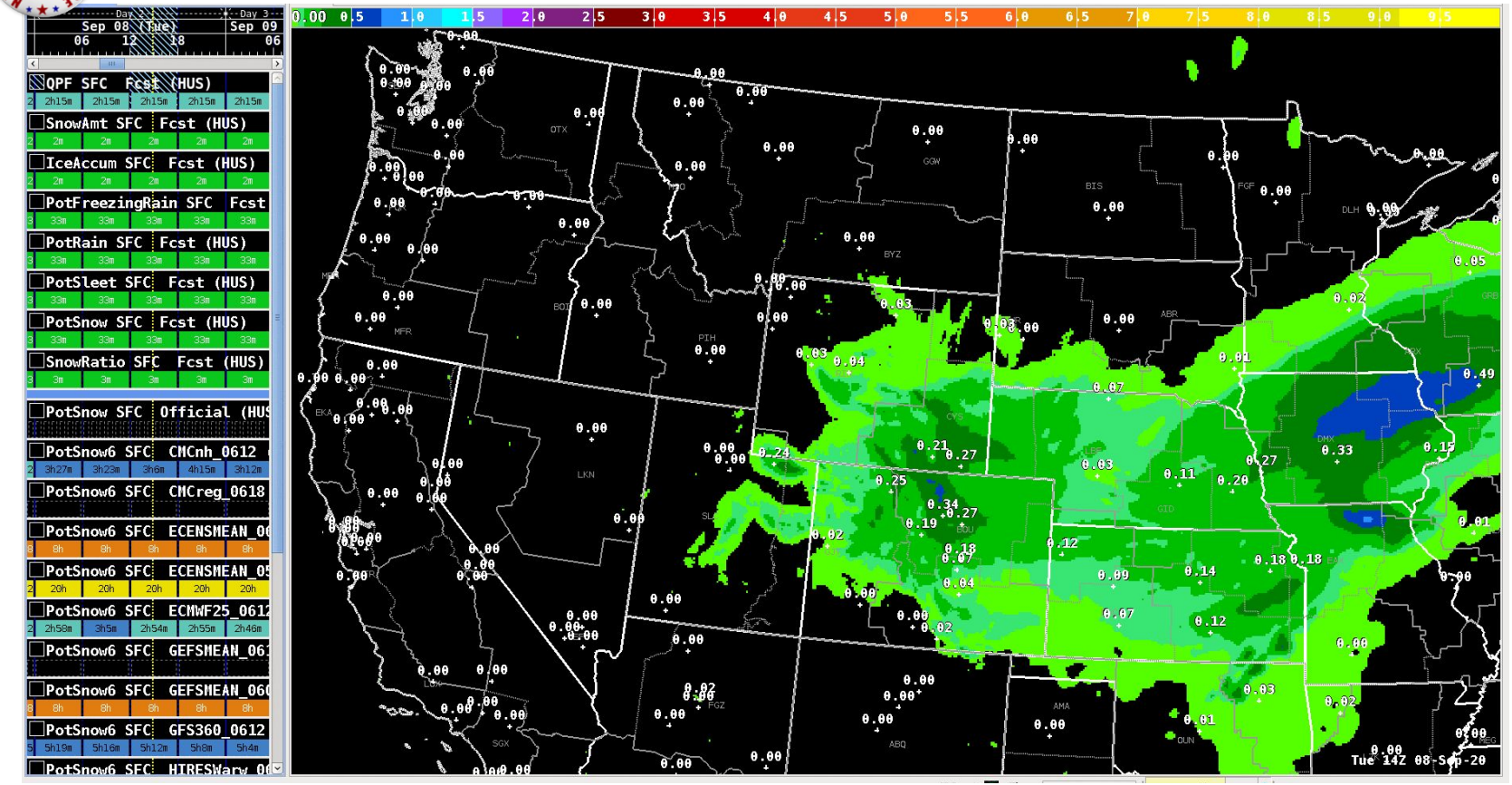
Pre-2019:

"These are not the SLR you are looking for"

2019+: 1.13x NBM v3.2



WWD Products: Snow and Ice (D1-3)



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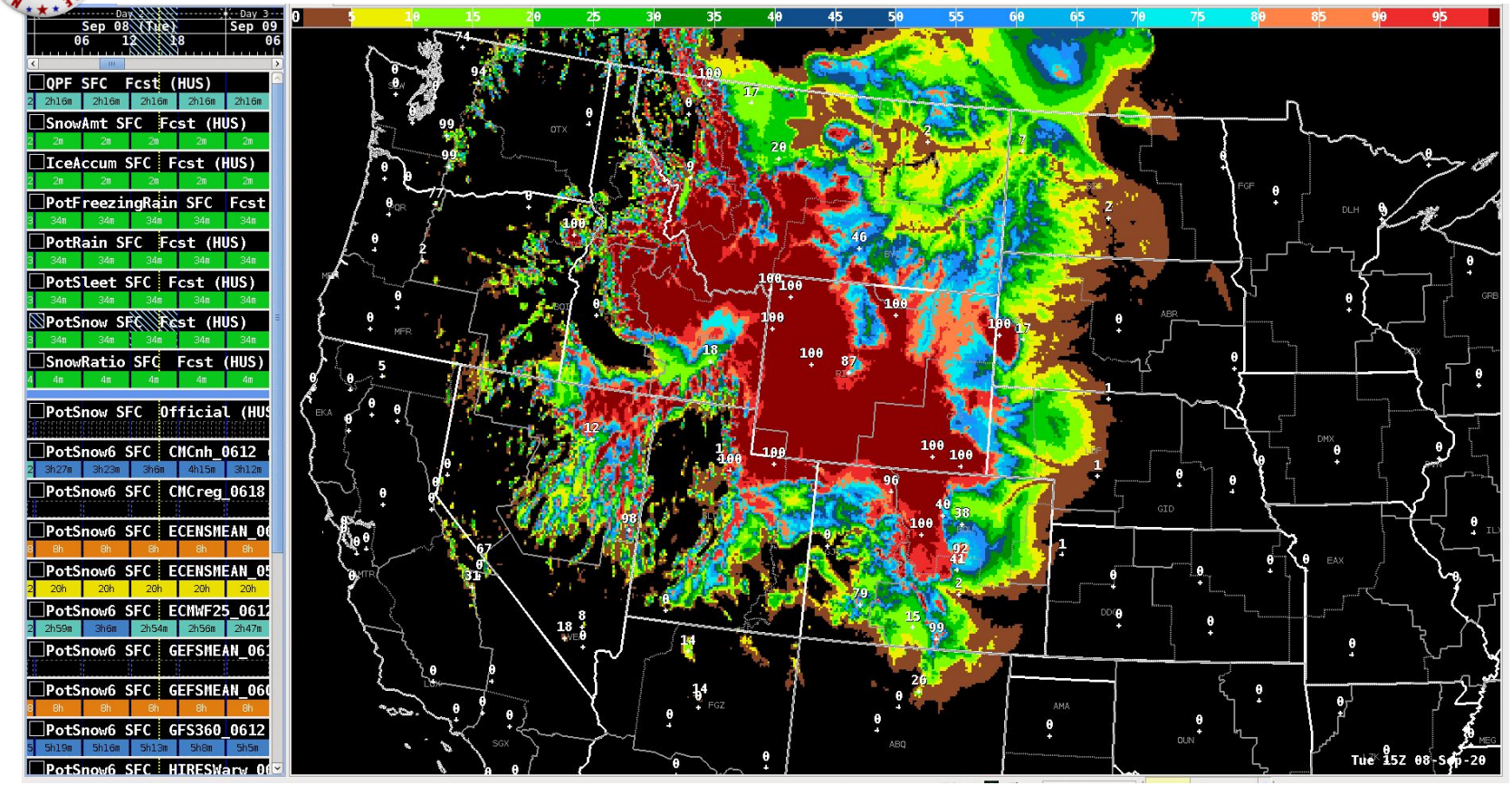
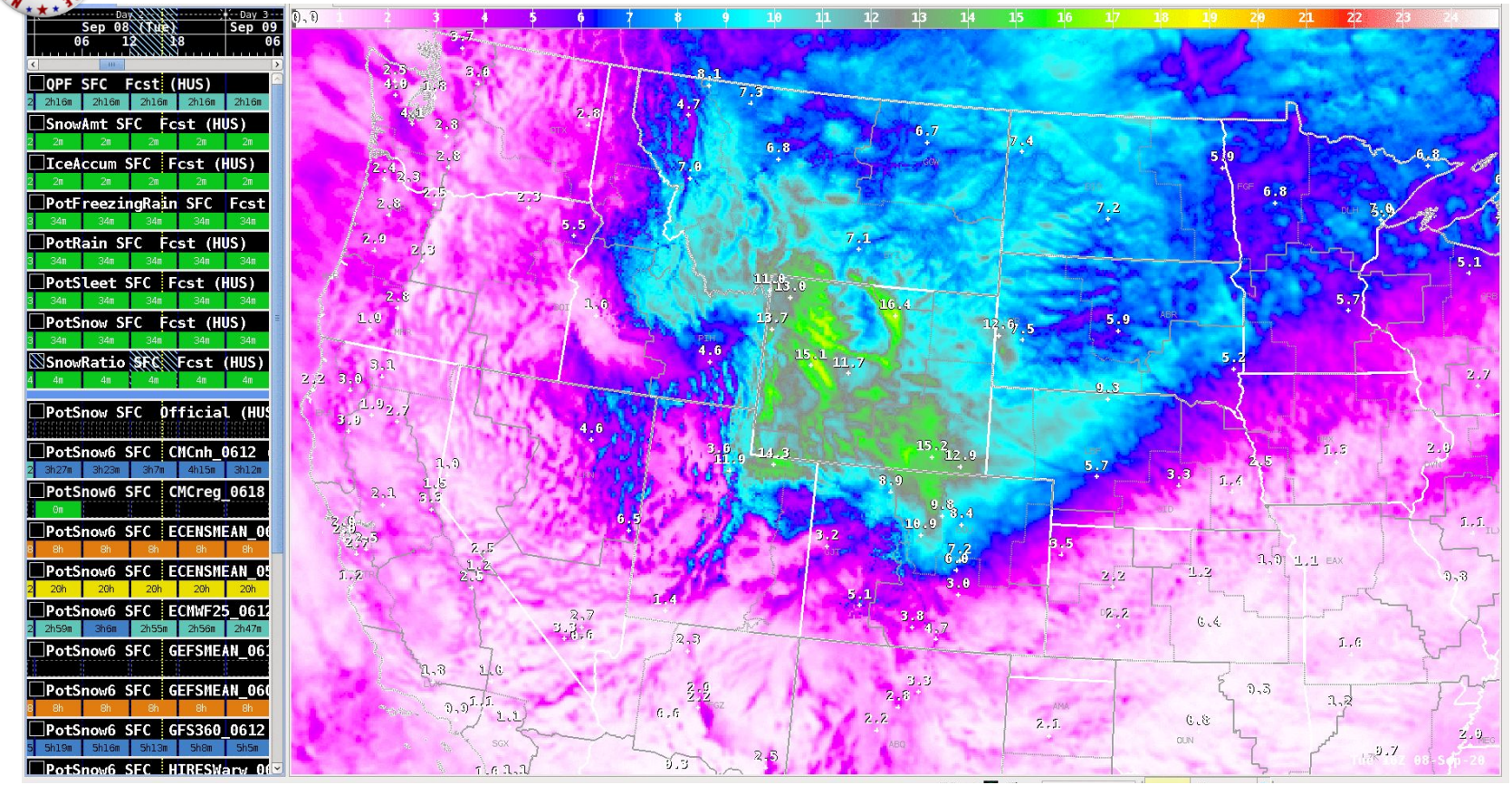
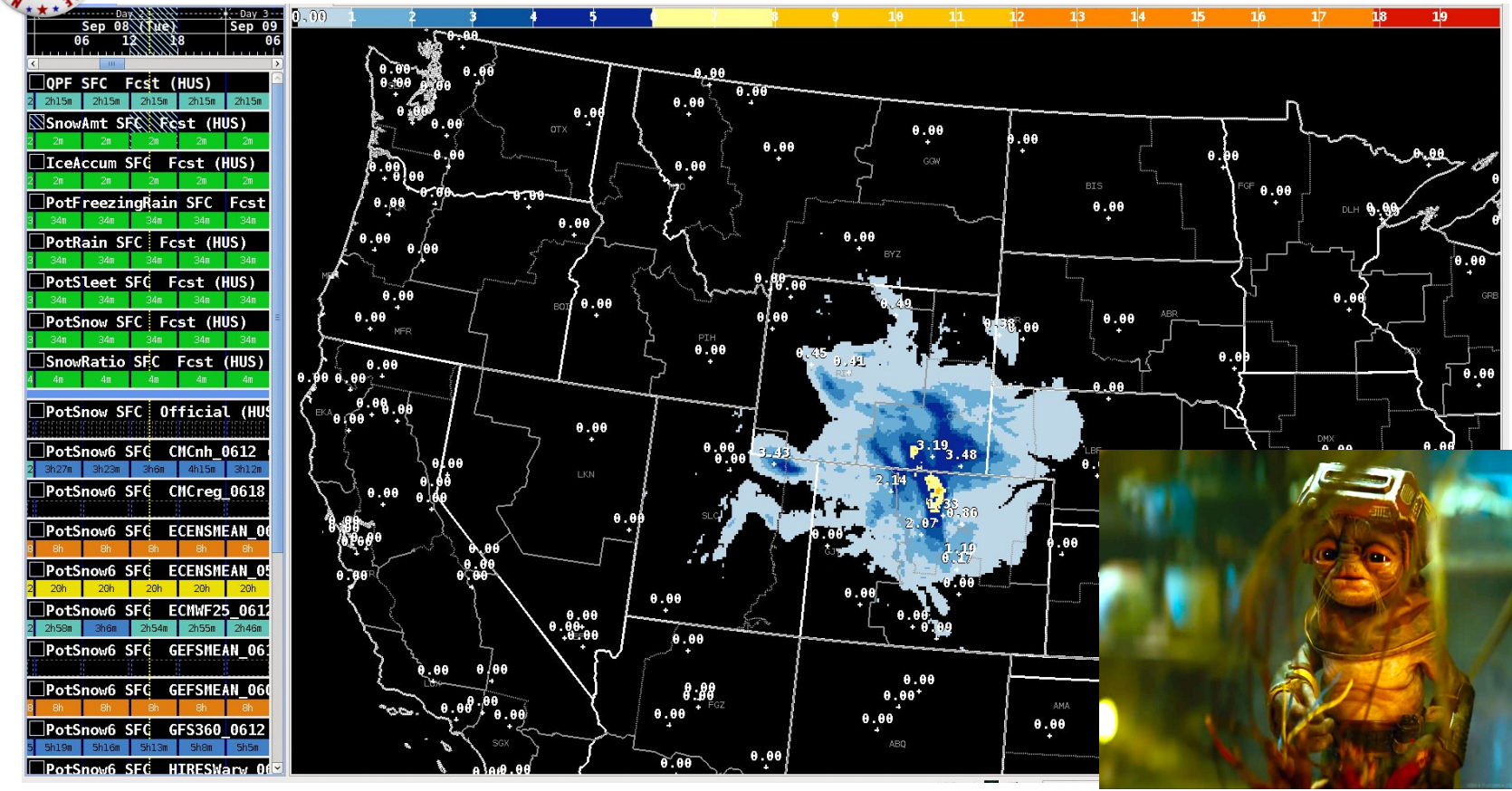


WWD Products: Snow and Ice (D1-3)

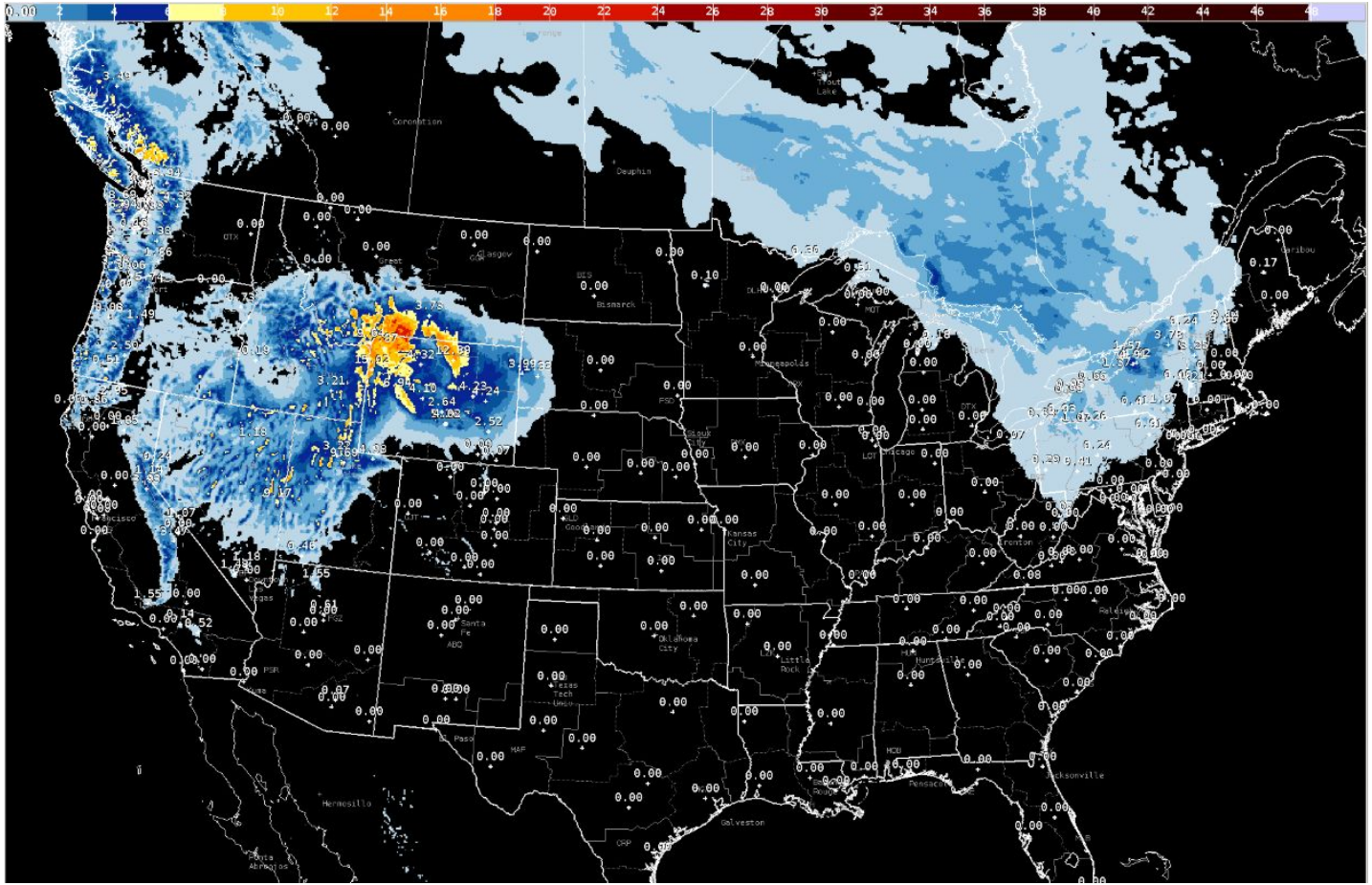


WWD Products: Snow and Ice (D1-3)



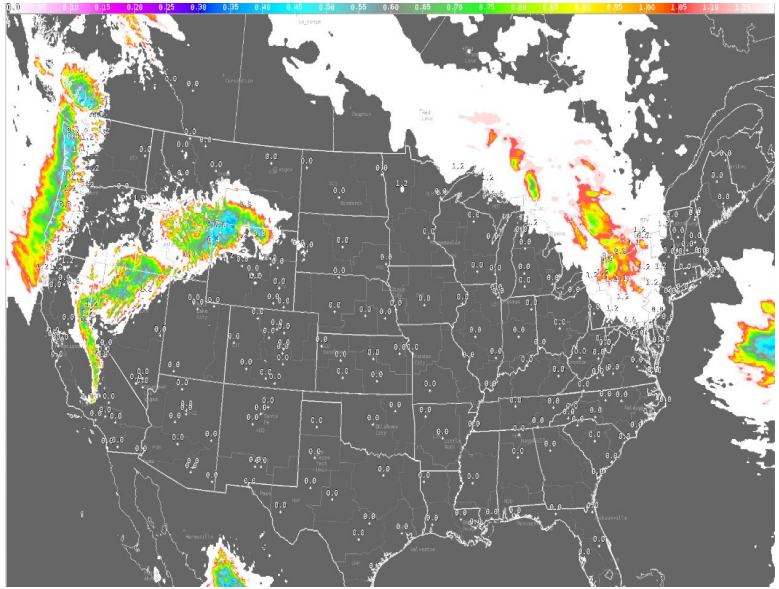
"WWD is Ready!"

WWD Products: Snow and Ice (D1-3)



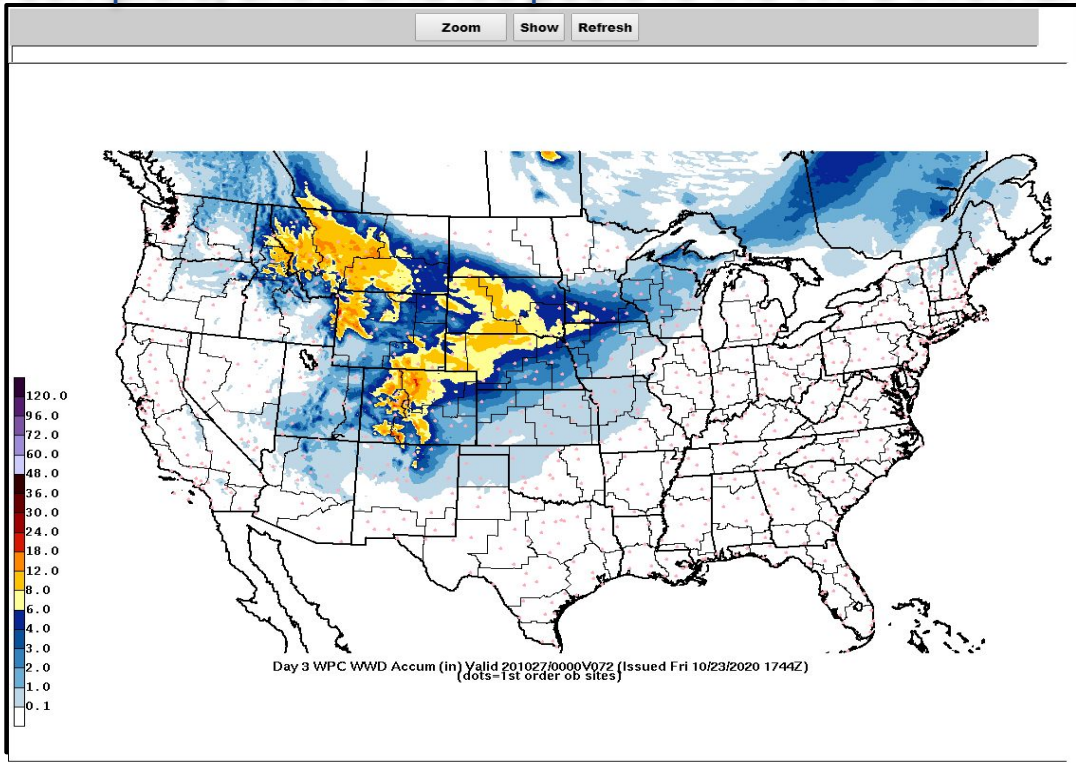
WWD Products: Snow and Ice (D1-3)

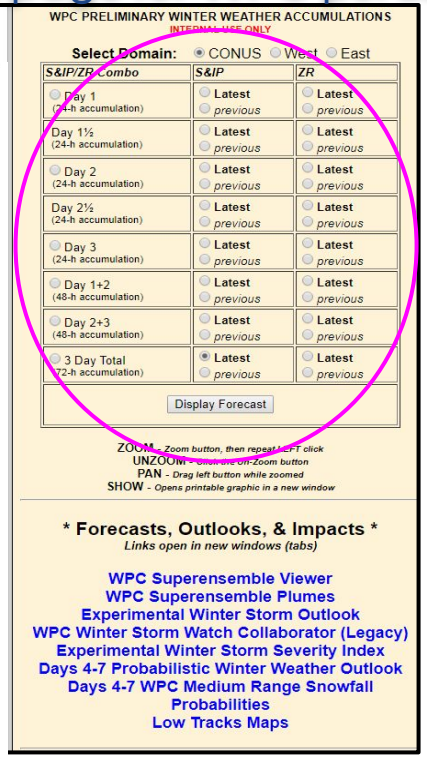
- Ice: QPF * PoWT * ILR
  - QPF: Quantitative Precipitation Forecast
  - PoWT: Probability of Weather Type
  - ILR: Ice-Liquid Ratio:
    - Freezing Rain Accumulation Model (FRAM)



WWD Products: Snow and Ice (D1-3)

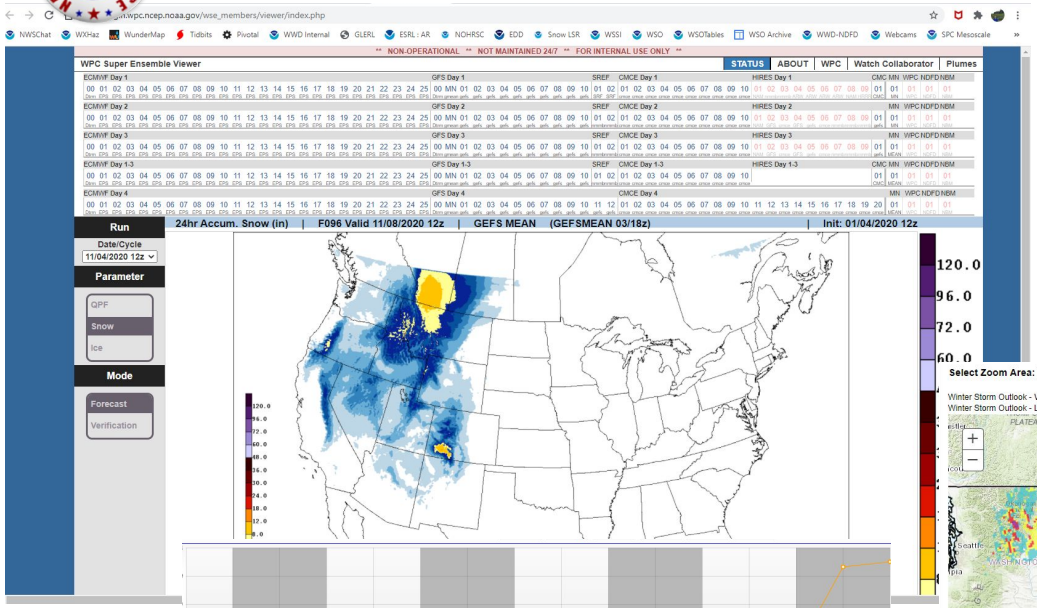
Once complete, snow and ice posts to the WPC internal page for WFO perusal

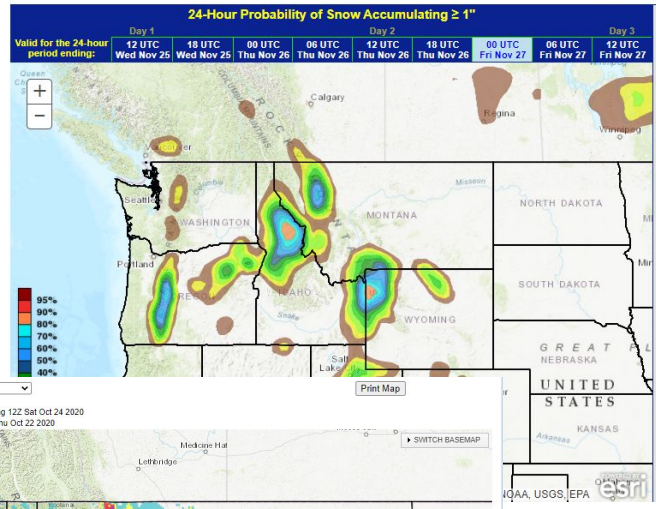


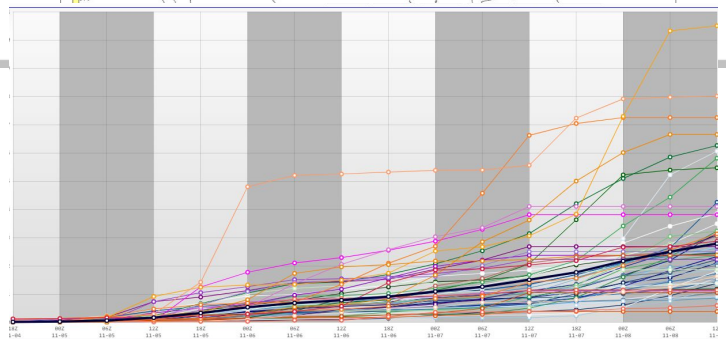


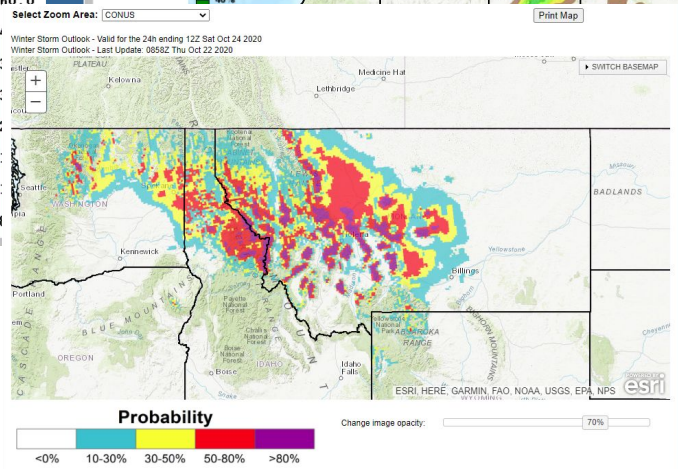
However, Probabilistic information is available to everyone!

WWD Products: Probabilistic winter (D1-3)









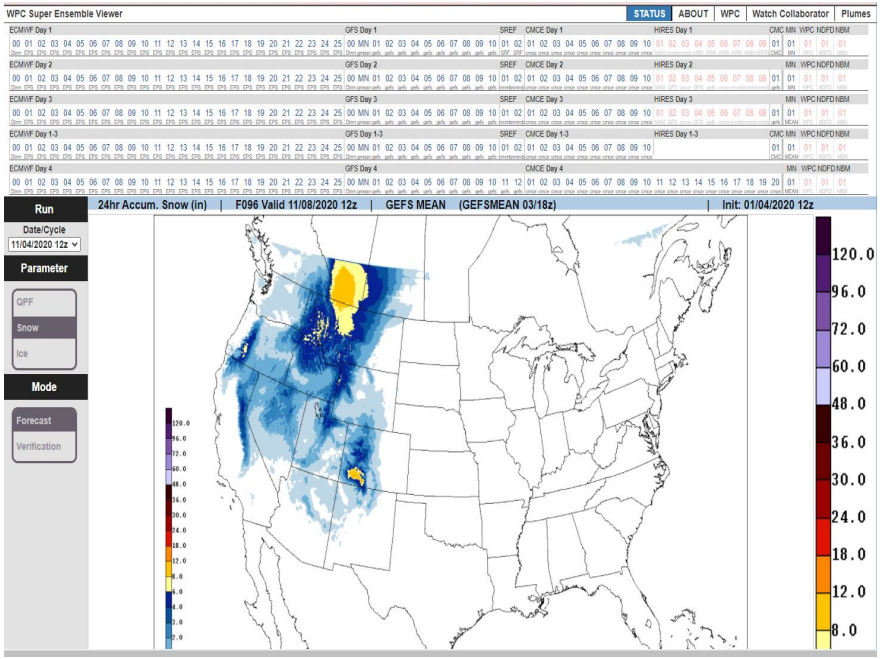
WWD Products: Probabilistic winter (D1-3)

- WPC Probabilistic Winter Forecasts:
  - Leverage all models using an ensemble approach to produce the most representative winter forecast
  - Accounts for outliers and high-end event potential
  - Provides a “reasonable worst case” forecast for decision makers
  - Encompasses more solutions to reduce the potential of a “missed event”

- Probabilistic Products:
  - Winter Storm Ensemble (WSE) & plumes, PWPF graphics, Winter Storm Outlook (WSO), Winter Weather Outlook (WWO)

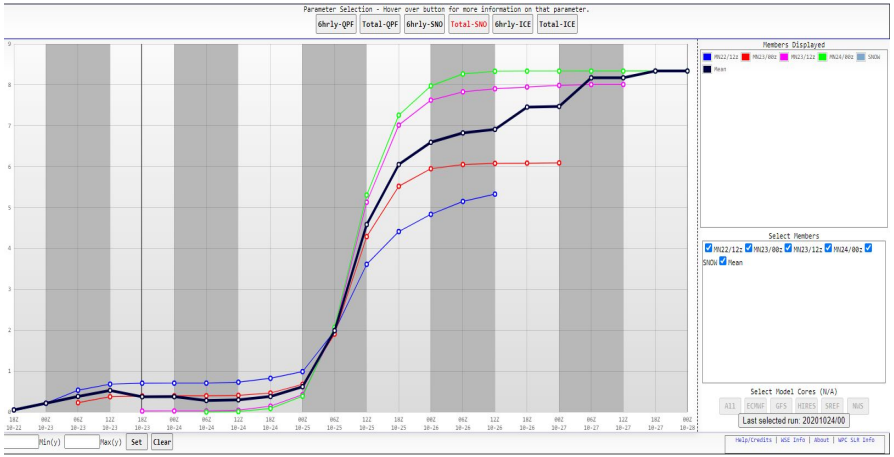
WWD Products: Probabilistic winter (D1-3)

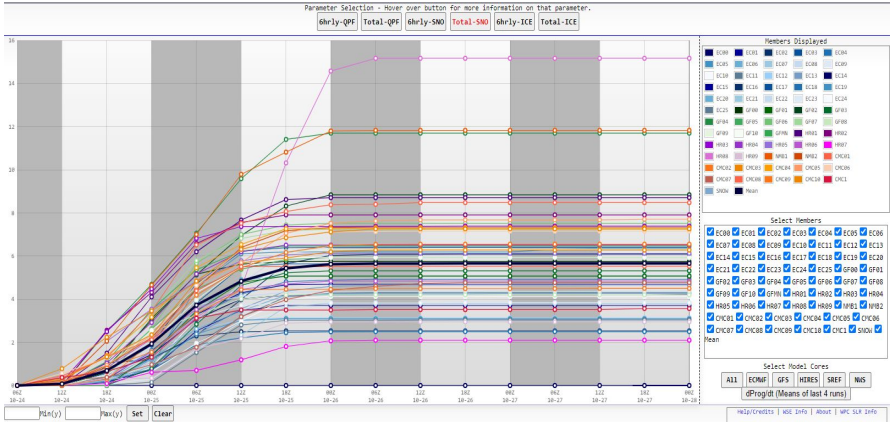
- WSE Viewer:
  - Has output for QPF, Snow, and Ice from a selection of:
    - 25 ECENS members
    - 10 GEFS members
    - 10 CMCE members
    - 10 high-res
    - All deterministic guidance
  - Allows forecasters to see the range of possibilities for different events
  - Internal to NWS only



WWD Products: Probabilistic winter (D1-3)

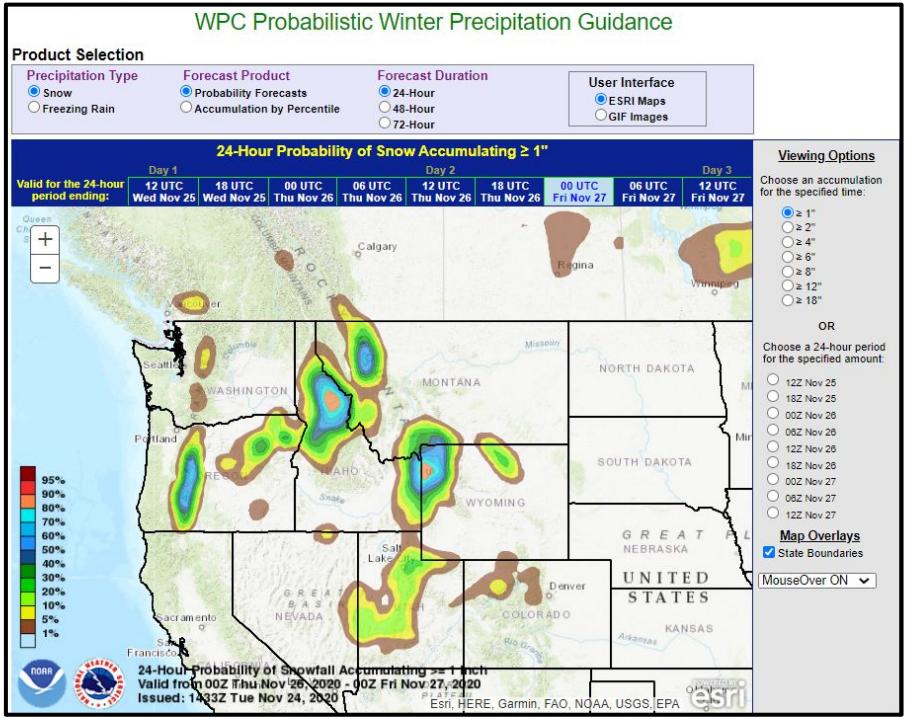
- WSE Plumes:
  - Shows all 63 ensemble members and the evolution of rain/snow/ice
  - Can show storm total or 6-hr accumulations
  - Allows forecasters to see the range of possibilities
    - Focus on “clustering”
    - Estimate percentiles
    - Show outliers
    - Dprog/Dt of means
  - Can help guide messaging (IDSS)
  - Internal to NWS only





WWD Products: Probabilistic winter (D1-3)

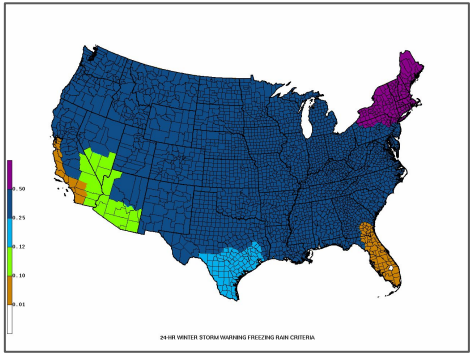
- Probabilistic Winter Precipitation Forecast (PWPF) viewer
  - Public facing product
  - Provides probabilities and percentiles of exceeding thresholds in 6, 24, 48, or 72 hr intervals
  - Can help with forecast confidence in amounts and spatial distribution
  - Used to message best and worst case scenarios

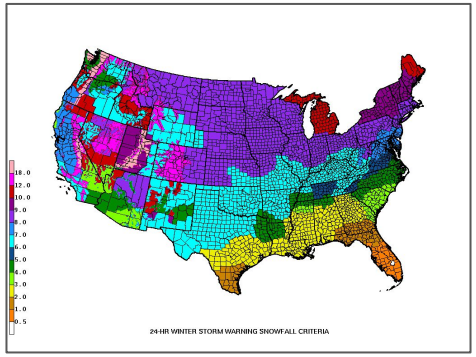


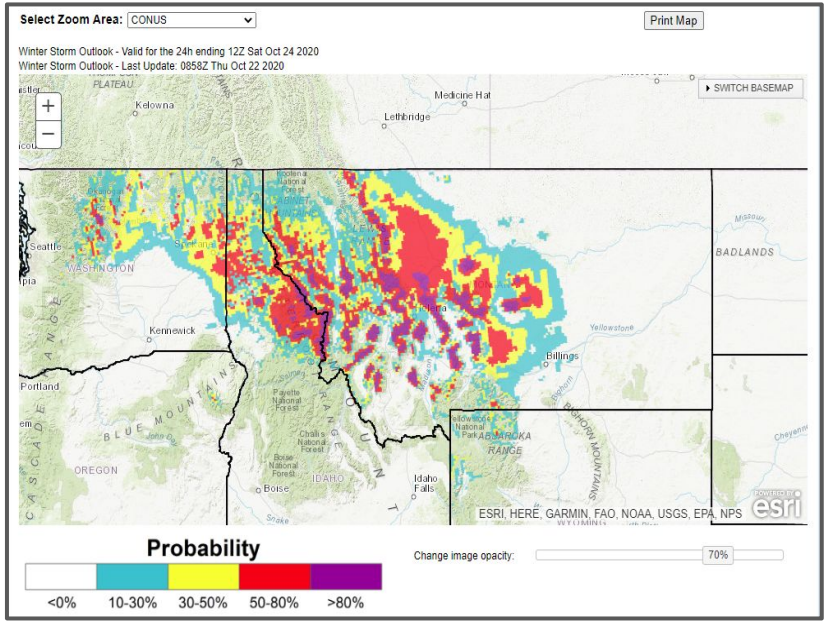
View Here:
https://www.wpc.ncep.noaa.gov/wwd/winter_wx.shtml

WWD Products: Winter Storm Outlook

- Winter Storm Outlook: The probability of exceeding locally defined winter storm warning thresholds
  - 12h/24h/event criteria
  - Probabilities from <10, 10-30, 30-50, 50-80, >80 through Day 4

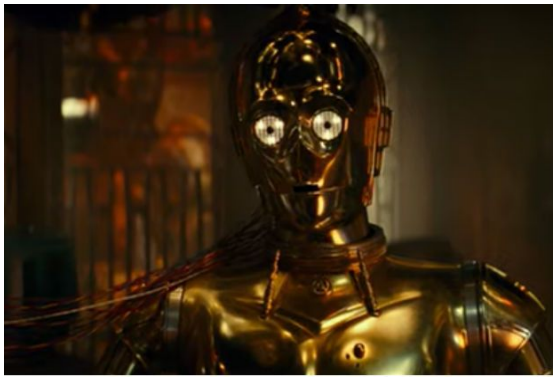




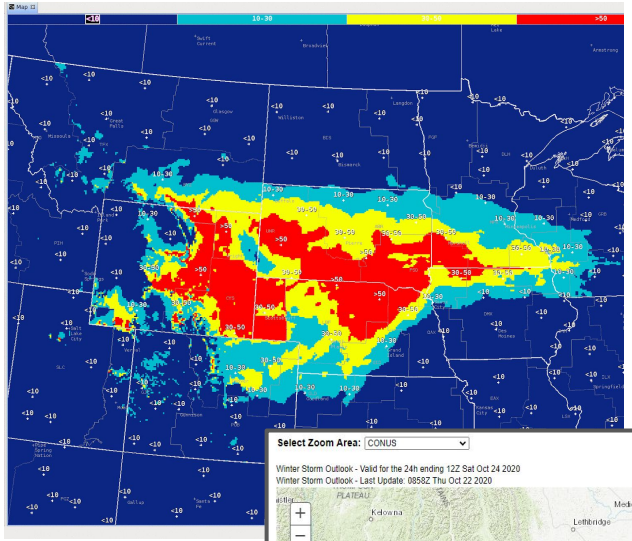


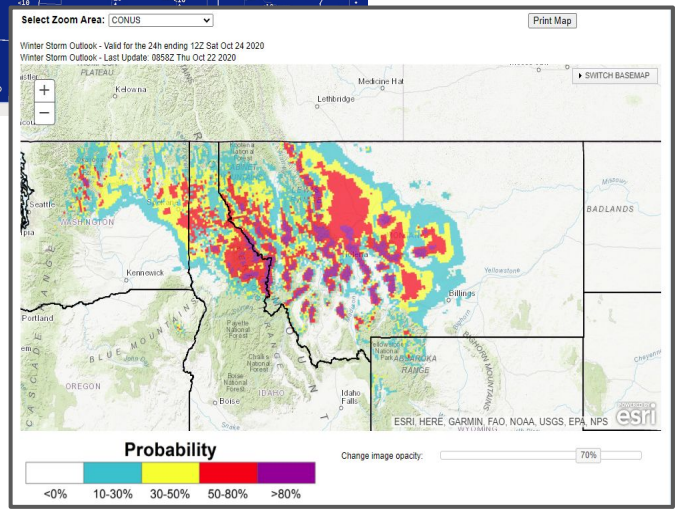
WWD Products: Winter Storm Outlook

- Winter Storm Outlook:
  - Is available in GFE and the *new* operational website
  - Aids the WFO in watch/warning decisions for winter storms



"Sir, the possibility of warning criteria snow is as low as 2:1!"

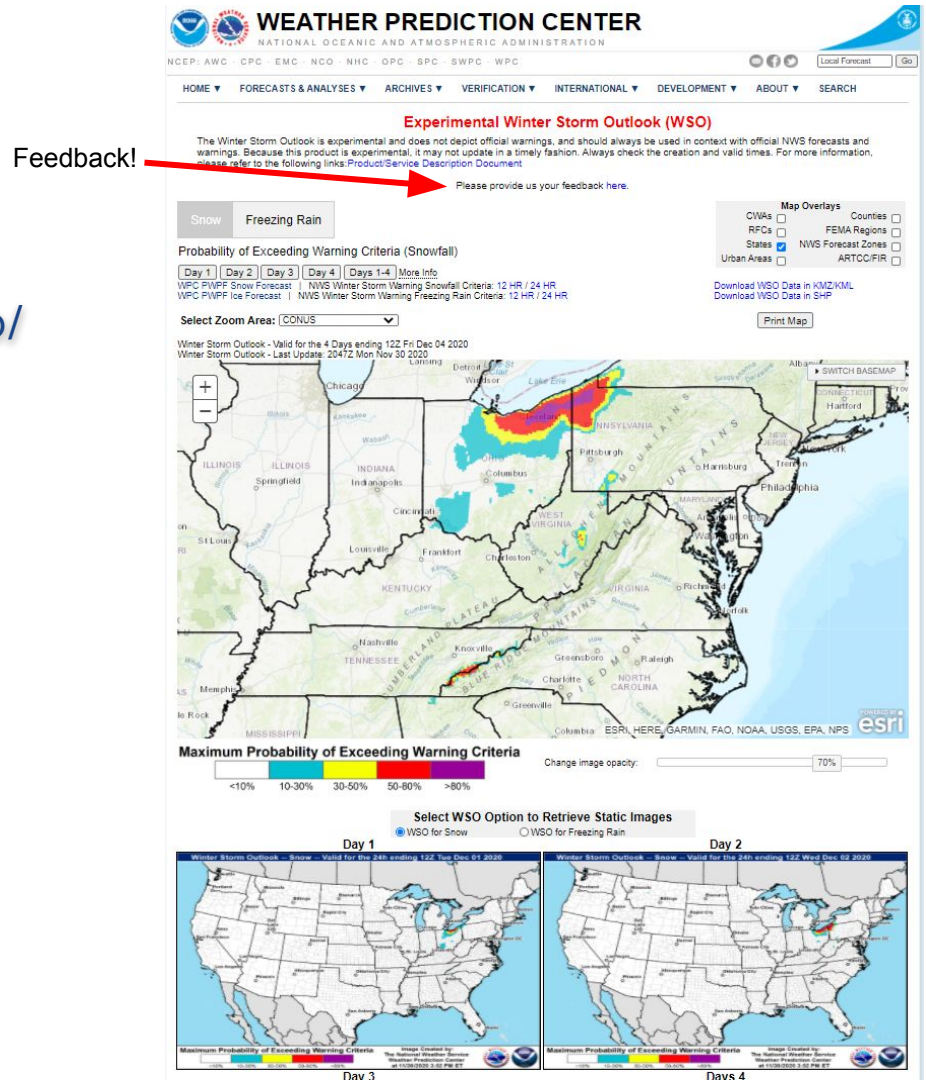




WSO Website

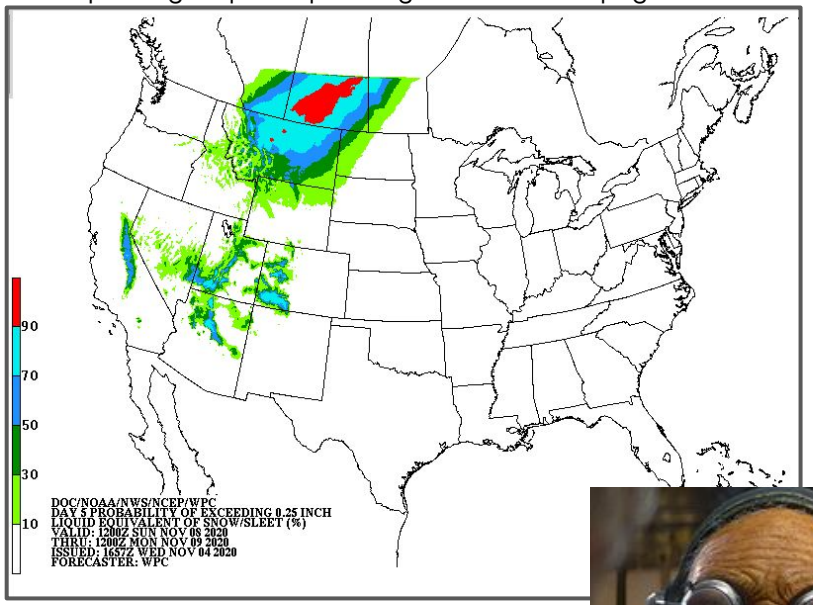
www.wpc.ncep.noaa.gov/wwd/wso/

- Clickable tabs
  - Loads WSO for Snow/Ice
  - Day 1-4 tabs
- Dynamic Display
  - Can adjust transparency
  - Multiple basemap options
  - Many zoom areas
- Map Overlays
- Print Image Options



WWD Products: Winter Weather Outlook

https://origin.wpc.ncep.noaa.gov/index.shtml#page=wwx



- Winter Weather Outlook:
  - Probability of 0.25” liquid precipitation falling as snow
  - 2-4” of snow

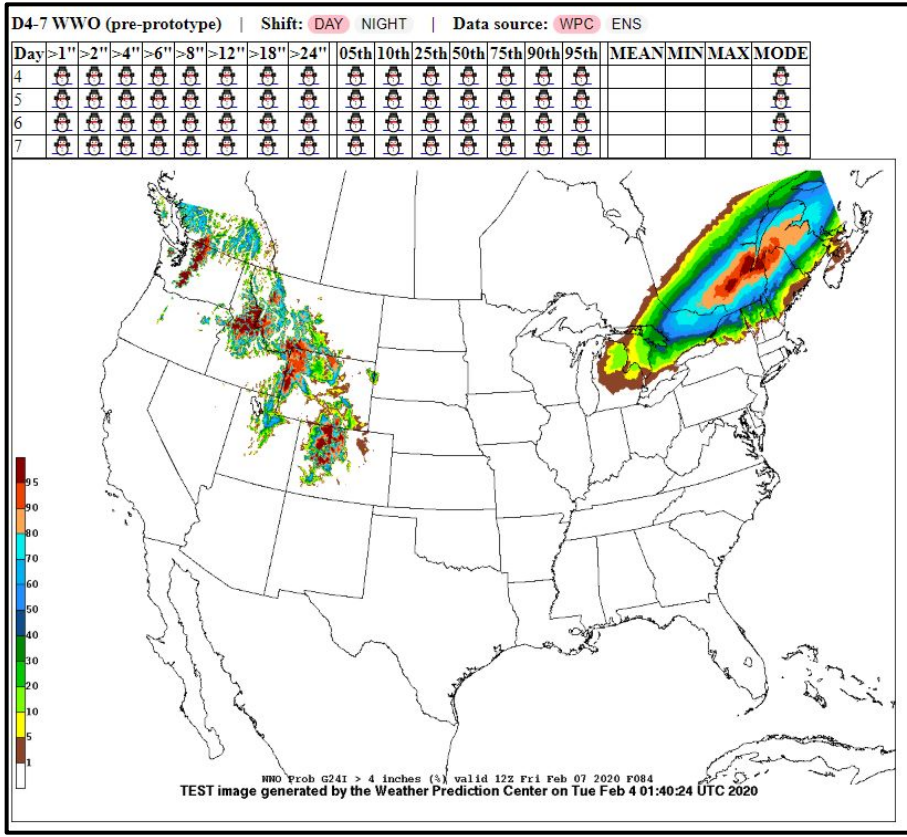
- Ensemble produced via all ECENS, GEFS, and CMCE members
- Helps improve early messaging for significant winter storm potential

“The forecast you seek is not behind you. It is in front of you”

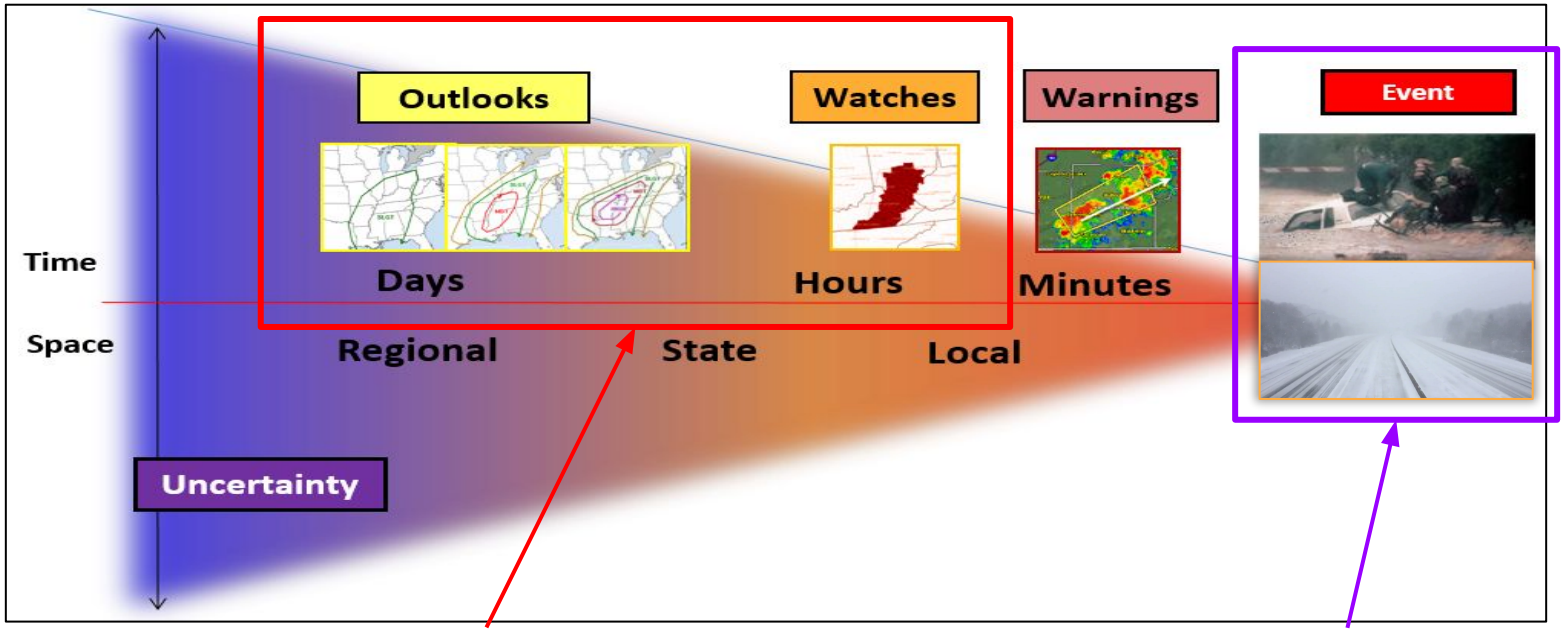
WWD Products: Winter Weather Outlook

- Experimental Winter Weather Outlook:
  - PWPF for Days 4-7
  - Probabilities for snowfall between 1 and 24”, along with percentiles
  - Uses all 103 ensemble members from the ECENS, GEFS, CMCE

- In testing! Could help improve lead times for winter storm watches beyond D3



WWD Products: Shifting towards Impacts



Currently: Winter Storm Outlook (WSO) informs the Winter Storm Watch creation through collaboration with Weather Forecast Offices (WFOs)

What about events that do not reach criteria?

WWD Products: Shifting towards impacts

Georgia, 2014

Ontario, 2014

Washington, D.C., 2016

Pennsylvania, 2016

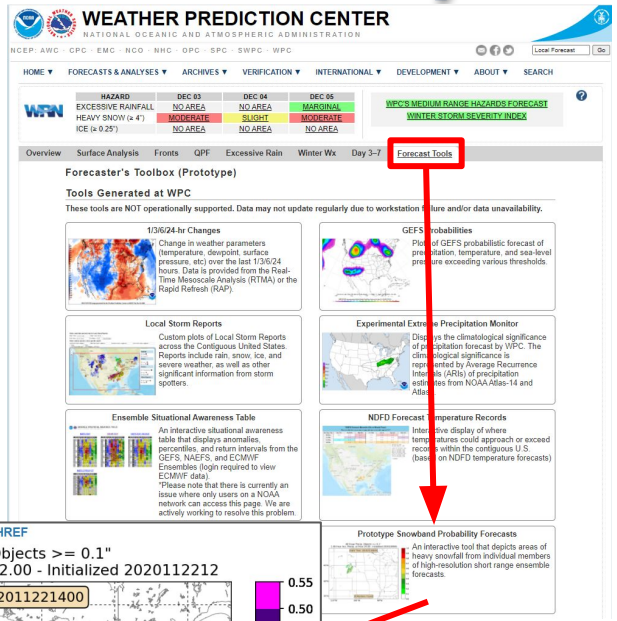
Hoth, 3665

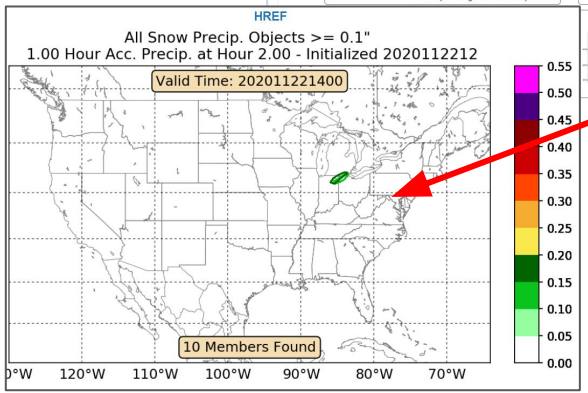
WWD Products: Snowband Probability

- WPC Snowband Prototype tool
  - Indicates the potential for mesoscale snow banding from the HREF
  - Shows the intensity (snow rate) for each of the ensemble members
  - The higher the rate and greater number of members, the better the snowband potential

- Can help diagnose intense snow rates and "over-performing" snow accumulations

- Can be used in conjunction with SPC HREF probability tool:
  - https://www.spc.noaa.gov/exper/href/

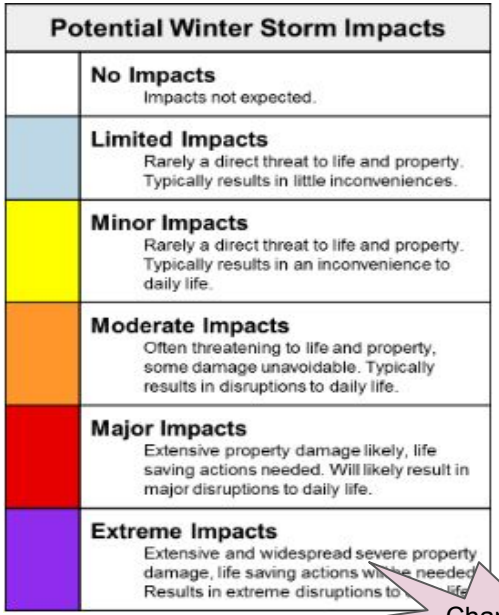




https://www.wpc.ncep.noaa.gov/snowbands/view.php

WWD Products: Winter Storm Severity Index

- Winter Storm Severity Index (WSSI)
- Goal: Impacts Based Hazards
  - Summarize multiple winter weather impacts into an easily consumable graphics
  - 3-day forecast broken into 24-hr segments
  - Data comes from the National Digital Forecast Database (NWS NDFD)
- Highlights areas of significantly impactful winter weather, regardless of snow or ice amounts



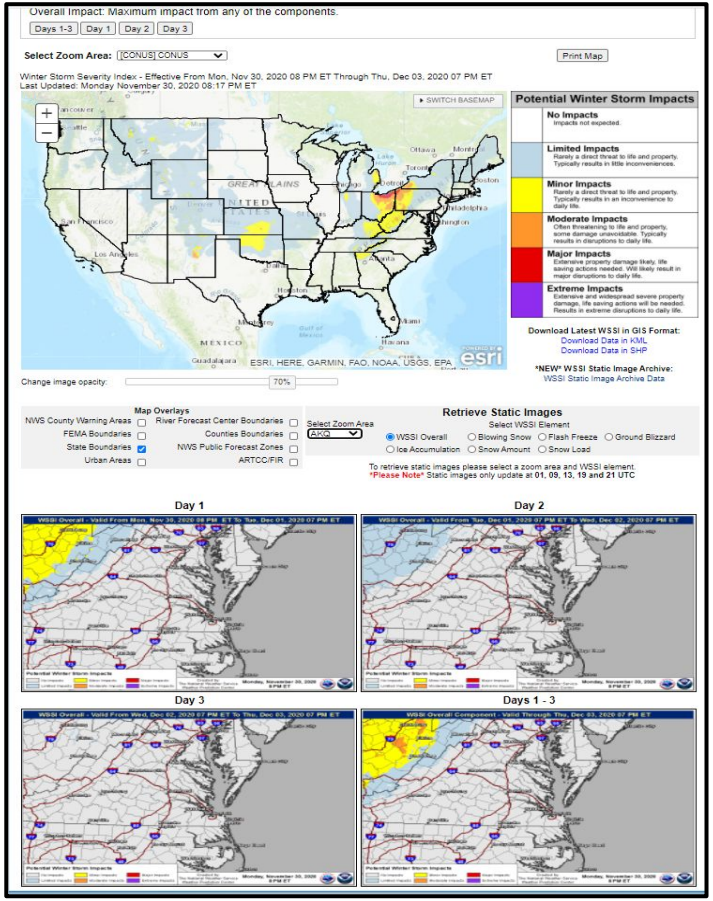
Components:

Snow Amount
Snow Load
Ice Accumulation
Blowing Snow
Ground Blizzard
Flash Freeze

Changes coming?

WWD Products: Winter Storm Severity Index

- WSSI is now operational (2020) and is available to the public
- On the website:
  - Retrieve Static Images
  - Change Zoom level
  - Adjust WSSI Element
  - Download static images (updated at 01Z, 09Z, 13Z, 19Z, 21Z)

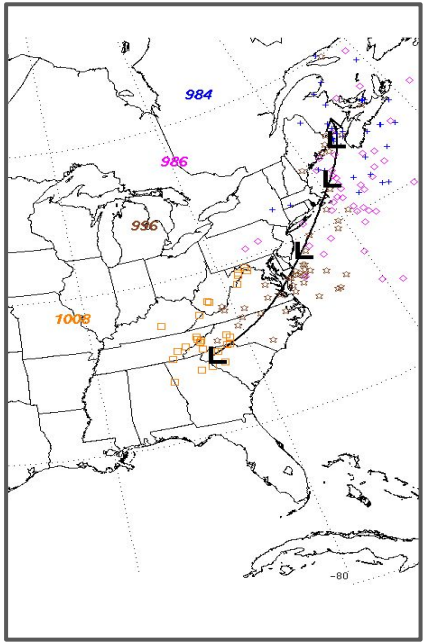


https://www.wpc.ncep.noaa.gov/wwd/wssi/wssi.php

WWD Products: Low Tracks and Discussion

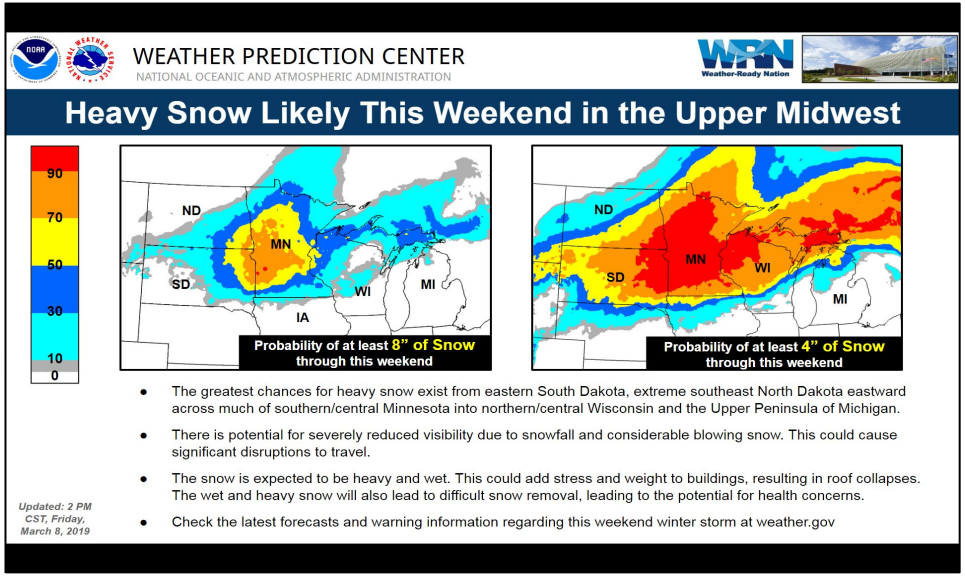
- WWD produces a graphic of low tracks and ensemble clusters associated with significant winter storms
  - The ensemble points can help gauge the confidence in the low positions

- A “heavy snow discussion” is also produced outlining the areas of most significant snow and ice during the next 3 days, while highlighting the meteorological reasoning for the forecast



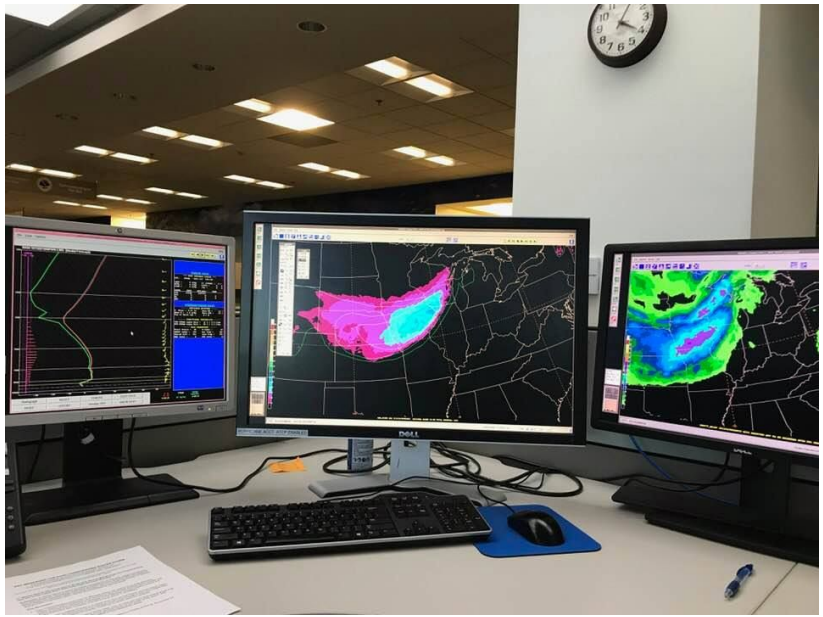
WPC WWD: Key Messages

- WPC Coordinates "Key Messages" for significant winter events:
  - **When:** Large scale impactful snow or ice
  - **Who:** WPC, National Centers, Regional Centers, Forecast Offices
  - **Why:** Galvanize partners and media around consistent, coordinated, impacts messaging
  - **How:** Social Media Platforms and NWS distribution lists



WPC: The operational WWD

- WPC WWD methodology:
  - Forecasts created through the NWS Graphical Forecast Editor
  - NAWIPS/AWIPS
  - Collaboration chat
  - NWSChat
  - Phone calls
  - Conference calls (Now using Google Meet!)



WPC: The operational WWD

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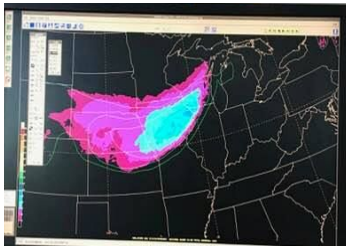
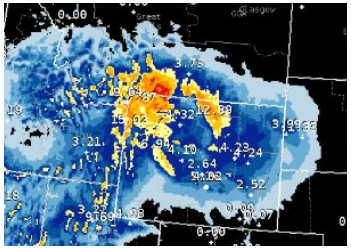
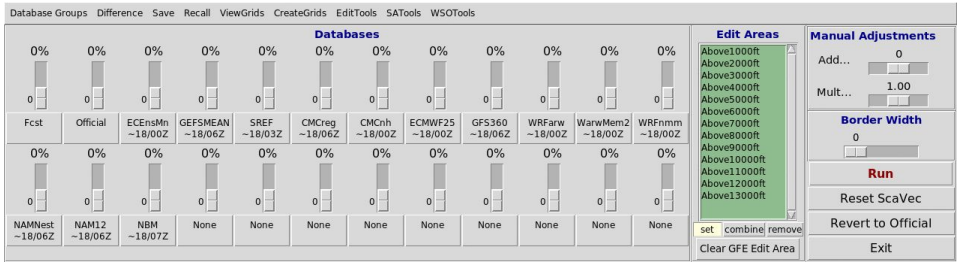


NMAP: 40km resolution, hand drawn contours



GFE: 5km resolution, computer generated, 937,227 grid points!



NMAP

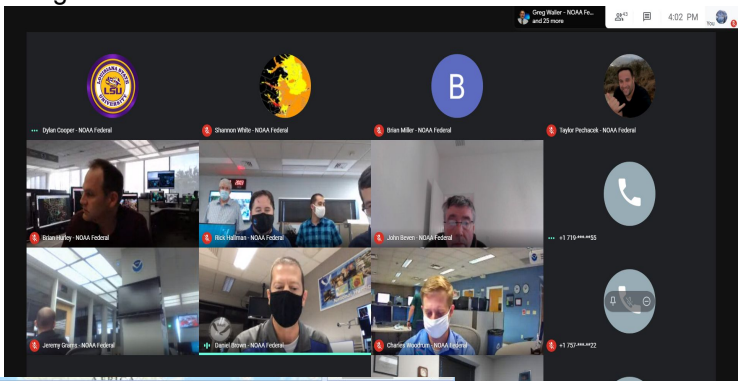
GFE

WPC: The operational WWD

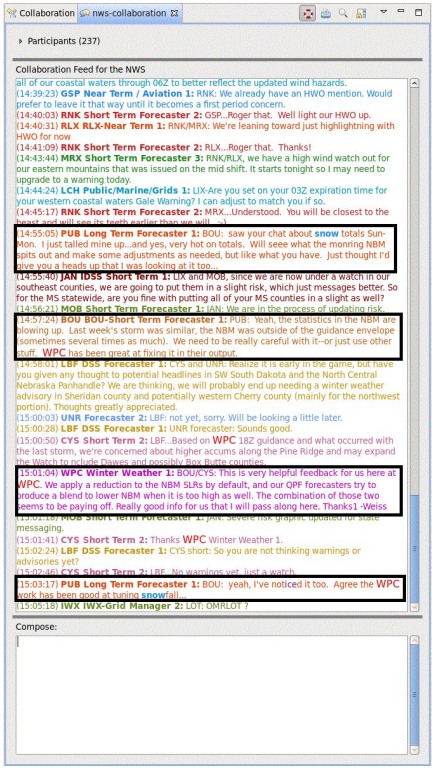
WPC WWD methodology:

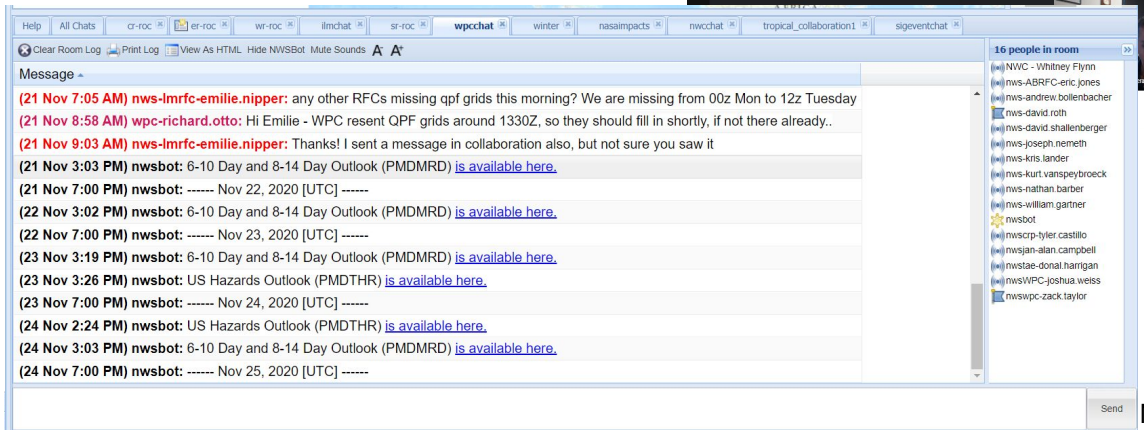
Direct phone calls

Google Meet



Collaboration Chat

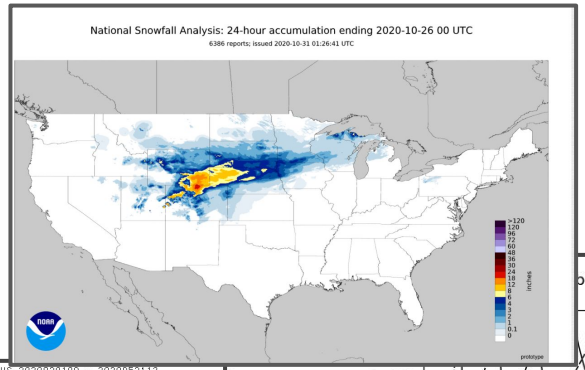


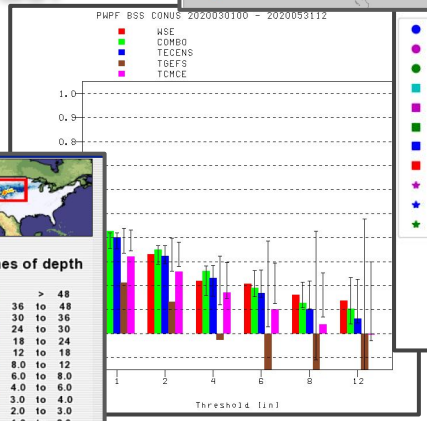


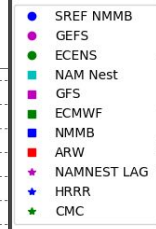
NWS Chat

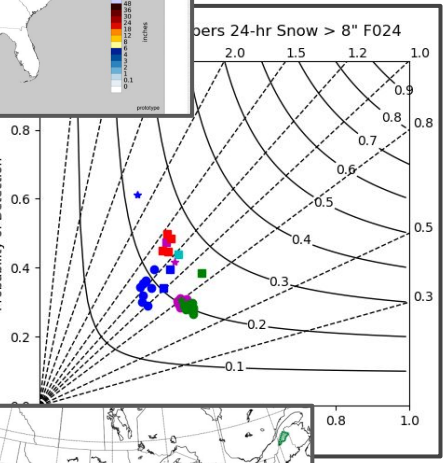
WPC WWD: Verification

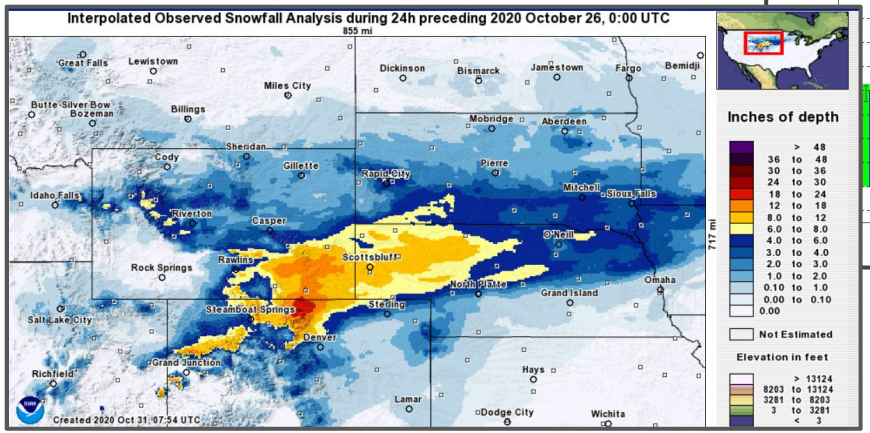
- Verification is conducted both subjectively and objectively
- Improves pattern recognition and forecast skill
- Allows for improvements in forecast tools
- Constantly being updated

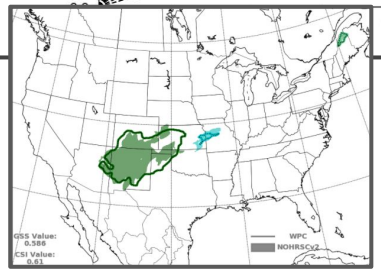






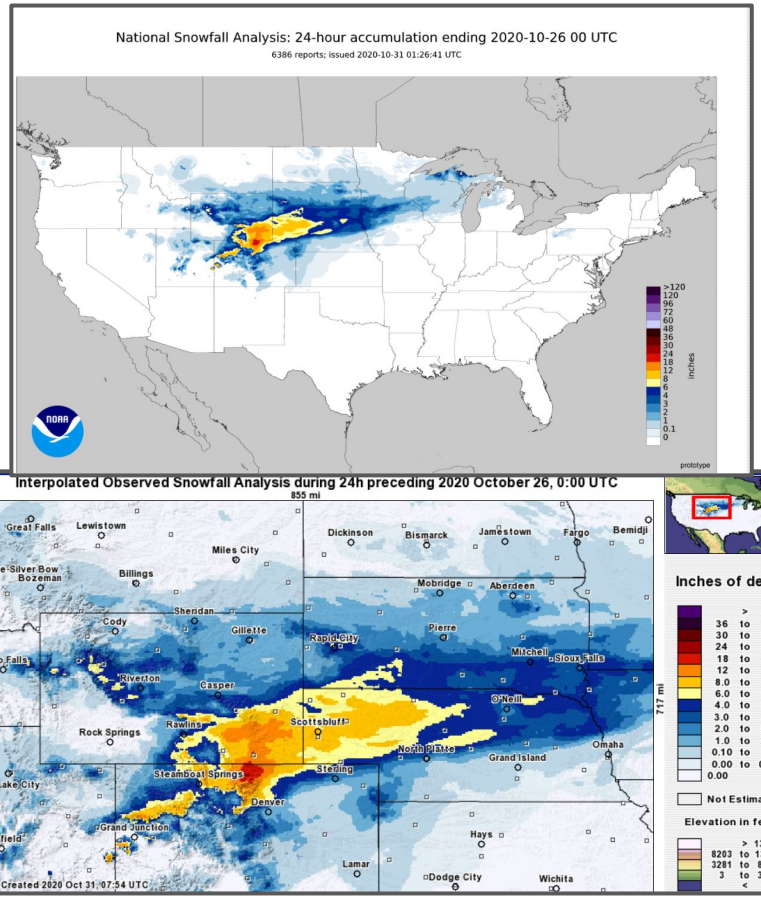






WPC WWD: Verification

- NOHRSC: National Operational Hydrologic Remote Sensing Center
  - Allows for both subjective and objective verification of snow events
  - Updated 4x/day at 1330, 1530, 1830, 2130 (Z) and uses all methods of reports and the HRRR thermals
  - Can be used to develop seasonal climatologies and departures



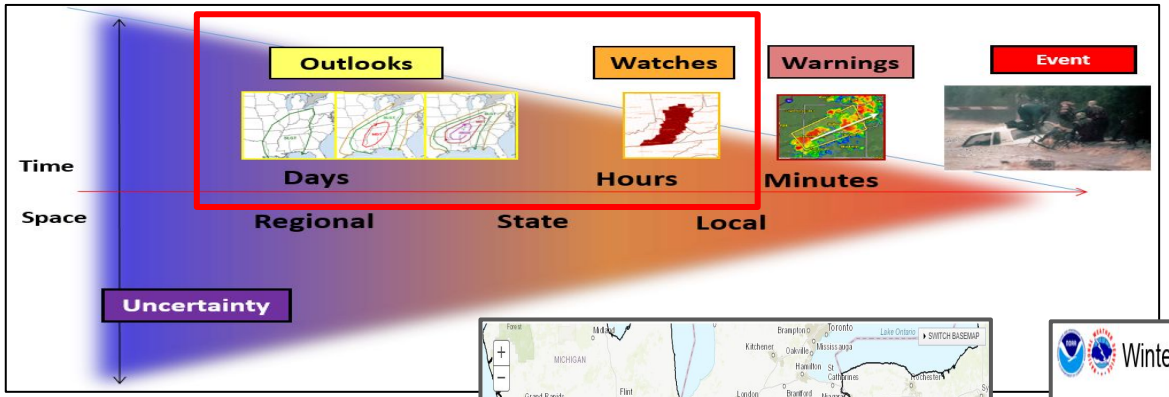
WPC WWD: The Future

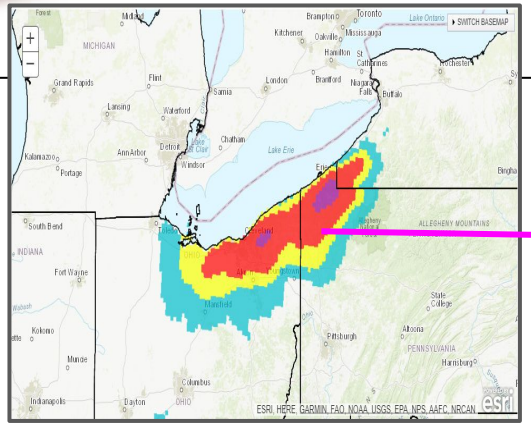
- WPC, especially the Winter Weather Desk, is always trying to improve and plan for the future
  - Winter Storm Watches
  - Improved and updated model guidance
  - More efficient coordination

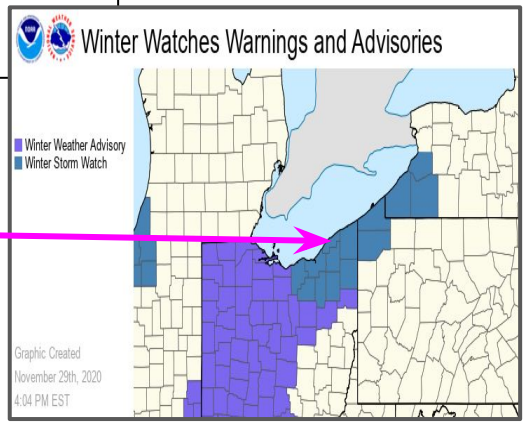
"Always in motion, the future is."

WPC WWD: The Future

- Winter Storm Watches:







Current: WSO informs Winter Storm Watch Decisions

Future: WSO used to explicitly define Winter Storm Watches

WPC WWD: The Future

- Improved Guidance and Coordination
  - Improved NBM calibration
  - Extended high-res guidance
    - FV3, CMC, HRRR
  - Faster and more efficient coordination
    - ISC

"The WWD made it to the WFOs in less than 12 parsecs."

Thank you for listening!
Questions?

joshua.weiss@noaa.gov

"The Globe of WPC's Winter Weather Desk"