

# The NWS National Winter Program



## Winter Weather Experiment Seminar Series February 20, 2024

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*Severe, Fire, Public, and Winter Weather Services Branch (AFS21)*

*Analyze, Forecast, and Support Office (AFS)*

*National Weather Service Headquarters*



# Winter Program Staff



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Winter Program Coordinator for R2O and Training



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Winter Program Coordinator for Evolving Service and Outreach



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Winter Program LANTERN - Snow squall study and collaborative winter watch verification



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Winter Program LANTERN - National Avalanche support

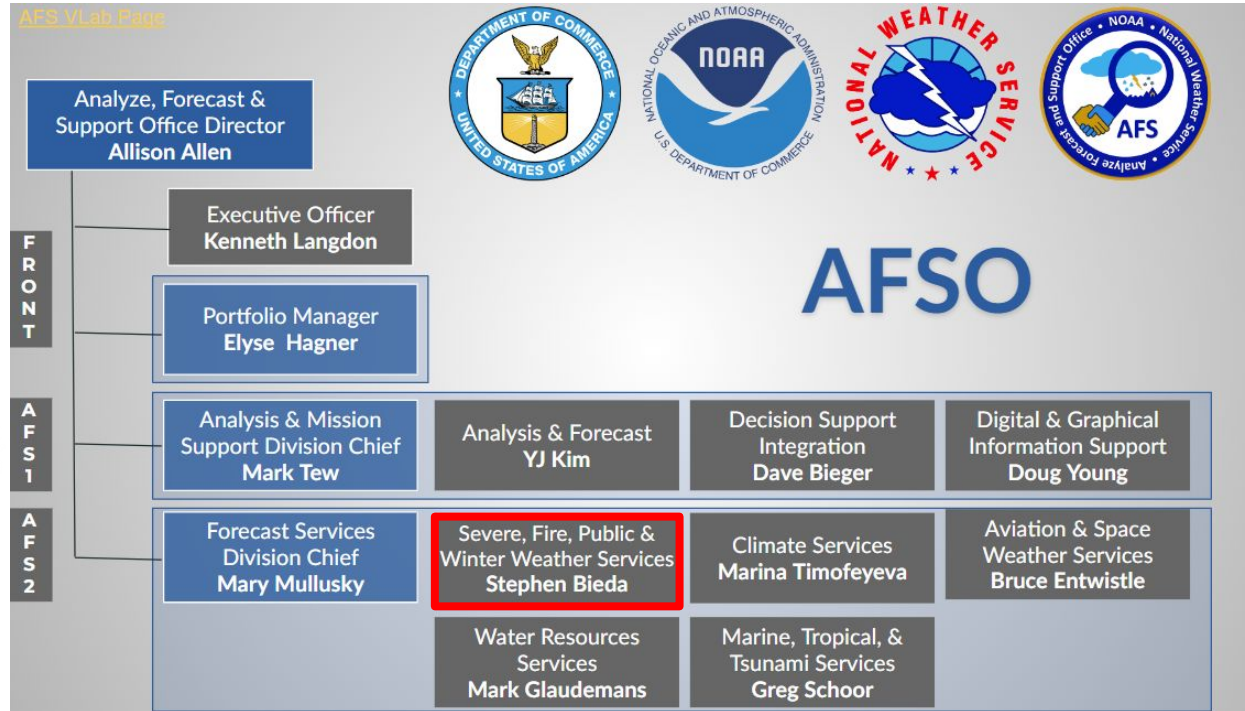
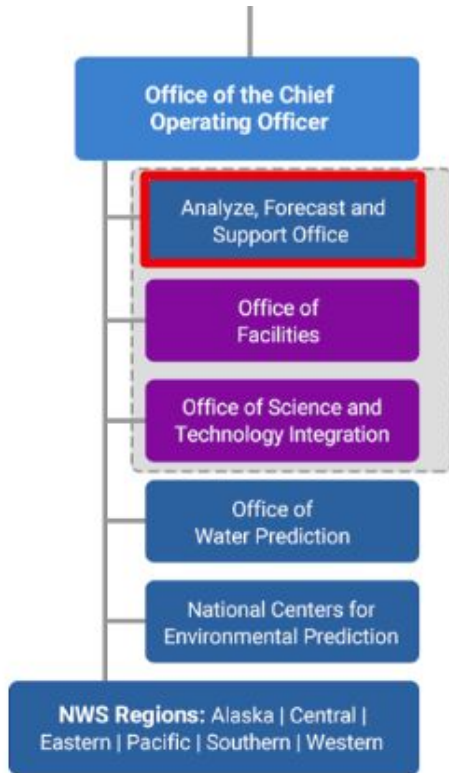


**Nicholas Carletta**

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Winter Program LANTERN - enhanced Winter Watch language and WSSI ice study

# Where Does the Winter Program Sit?



# What Does the Winter Program Do?

- The winter program is responsible for **policy** related to NWS winter products and services provided by both WFOs and National Centers. This is accomplished by working with the **Winter Service Program Team (SPT)**, made up of representatives from each NWS Region and NCEP.
- The Winter SPT is essentially the **governing body** of all things winter at the NWS.
- The Winter Program works to improve winter products and services through the **evaluation of new experimental products, collaboration initiatives** (especially between National Centers and WFOs), **working with other NWS Headquarters Portfolios**, and by **leading teams and working groups** to address current issues with NWS winter products, services, and policy.

## Winter Program Vision

The delivery of winter forecast services that are collaborative, probabilistic, and impact-based.



# Winter Program Research to Operations

How does the Winter Program improve NWS operations?

- Work closely with the NWS Office of the Chief Learning Officer (OCLO), the Office of Science and Technology Integration (STI), National Centers, Regions, and WFOs, and NOAA's Office of Atmospheric Research (OAR)
- We work with academic, science, technical, and operational NWS partners (both internal and external)
- Work to develop techniques, tools, and applications that improve forecasting and associated messaging
- AFS Winter Program paves the way by ensuring proper testing, evaluation, training, and policy development



# The Winter Probabilistic Framework:

## Following Winter Hazards Probabilistically Through Space and Time

Forecast Lead Time Prior to Winter Event

7 Days

1-3 Days

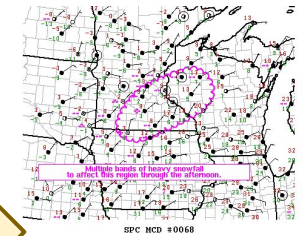
Hours

Day 4-7 Probabilistic Winter Weather Outlook & Day 1-7 Probabilistic Winter Storm Severity Index

Day 1-4 Probabilistic Winter Storm Outlook

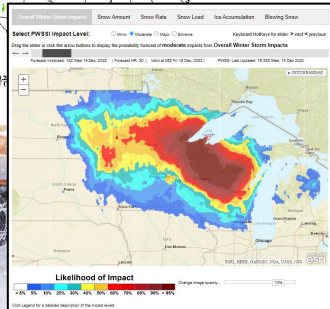
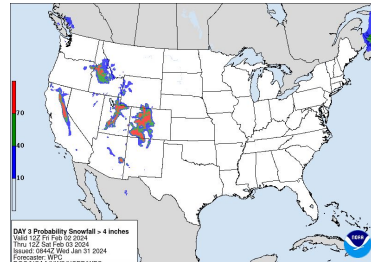
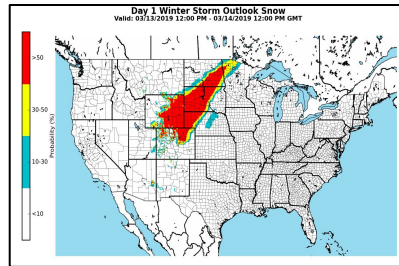
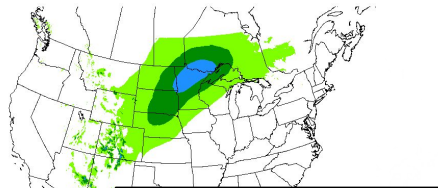
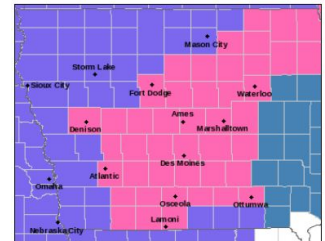
Day 1-3 Probabilistic Snowfall

Mesoscale Snowfall Discussion



Informs

Winter Watches / Warnings



# The Probabilistic IDSS Team

- One of “Ken’s 10” Priorities and Action Strategies for the Future
- A successful implementation of Probabilistic IDSS provides **effective probabilistic-based guidance through our products and services** for our partners and the public to make **informed risk-based decisions based on their unique circumstances, risk tolerances, and decision thresholds** for all time scales from minutes to months.



Courtesy of the ProbidSS Team

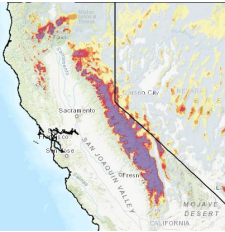
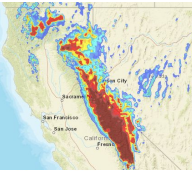
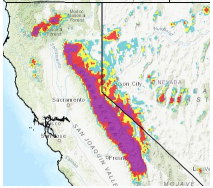
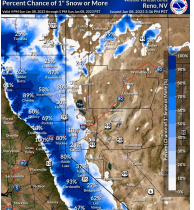


The Past



With Decision Support

# Winter Research to Operations Product Examples

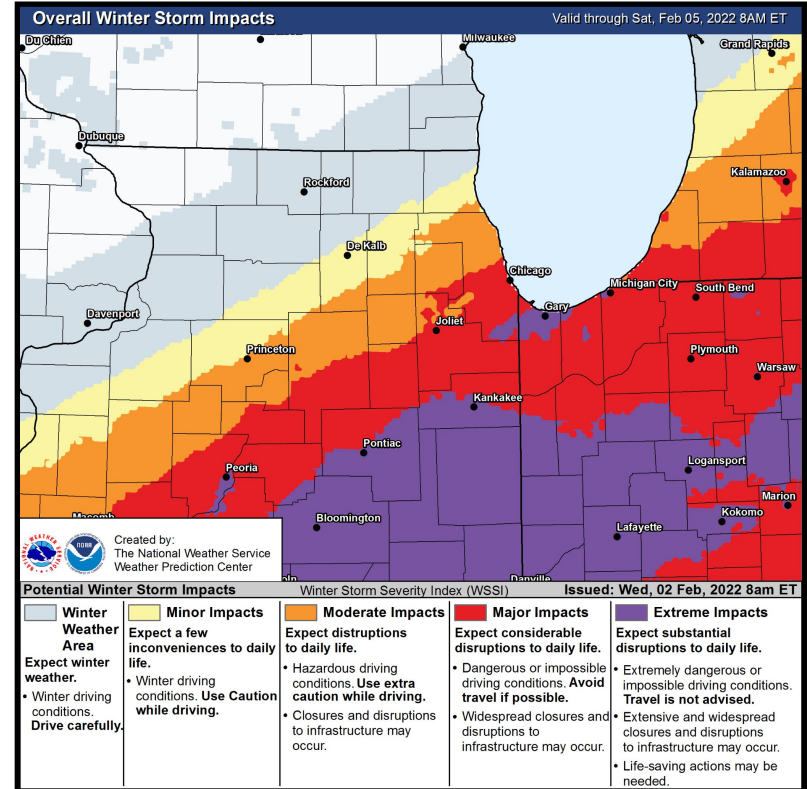
<p><b>Product</b></p>	<p><b>Winter Storm Severity Index (WSSI)</b></p> 	<p><b>Probabilistic WSSI (WSSI-P)</b></p>  <p>Likelihood of Impact</p> <p>&lt; 5% 5% 10% 20% 30% 40% 50% 60% 70% 80% 90% &gt; 95%</p>	<p><b>Winter Storm Outlook (WSO)</b></p>  <p>Maximum Probability of Exceeding Warning Criteria</p> <p>&lt;10% 10-30% 30-50% 50-80% &gt;80%</p>	<p><b>Probabilistic Winter Precipitation Forecast (PWPF)</b></p>  <p>Percent Chance of 1" Snow or More</p>
<p><b>Status</b></p>	<p>Operational (research and improvements continue)</p>	<p><b>Newly Operational</b> (research and improvements continue)</p>	<p>Experimental (External) <b>(SBES work leading to future changes)</b></p>	<p>Experimental (External) <b>(transitioning to new platform this year)</b></p>
<p><b>Source</b></p>	<p>NDFD Forecasts, GIS data, Climatology  (snow load, snow amount, ice accumulation, ground blizzard, flash freeze, blowing snow)</p>	<p>61 member ensemble, GIS data, Climatology  (snow load, snow amount, snow rate, ice accumulation, blowing snow)</p>	<p>61 member ensemble  (calculated using new Winter Storm Watch / Warning criteria)</p>	<p>61 member ensemble  (ensemble mode is the WFO "expected snow amount" forecast)</p>
<p><b>Output</b></p>	<p>Impact categories for Days 1-3 forecast period:  Winter Weather Area, Minor, Moderate, Major, Extreme</p>	<p>Probability of impact categories for Days 1-7 forecast period:  Winter Weather Area, Minor, Moderate, Major, Extreme</p>	<p>Probability of exceeding Winter Storm Watch / Warning criteria for Days 1-4 forecast period</p>	<ul style="list-style-type: none"> <li>• 10th percentile (high-end snow amount)</li> <li>• 90th percentile (low-end snow amount)</li> <li>• Mode (expected snow amount)</li> <li>• Probability of exceedance of</li> </ul>



# Winter Storm Severity Index (WSSI)

## Deterministic WSSI Updates

- **Goal:** Forecast the **severity** of community impacts from winter storms throughout the continental United States, including tree damage, property damage, transportation impacts, and disruptions to daily life
- The WSSI provides output for Days 1-3 (and also in 24 hour intervals) using meteorological & non-meteorological factors
- The WSSI is updated every two hours
- Summary graphic is a composite of the maximum impact from any of the six components
- **New this year:**
  - Flash Freeze & Ground Blizzard extended to 72 hours
  - Introduction of an ice climatology
  - Ice accumulation improvements
  - Updated ice and wind impact methodology
  - Impact-level threshold changes
  - Introduction of a snow load climatology



Available here: [www.weather.gov/wssi](http://www.weather.gov/wssi)

# WSSI - Components & Scale



## Ground Blizzard

Indicates the potential travel-related impacts of strong winds interacting with pre-existing snow cover



## Flash Freeze

Indicates the potential of flash freezing during or after precipitation events.



## Blowing Snow

Indicates the potential disruption due to blowing and drifting snow



## Ice Accumulation

Indicates potential infrastructure impacts due to combined effects and severity of ice and wind



## Snow Load

Indicates potential infrastructure impacts due to the weight of snow



## Snow Amount

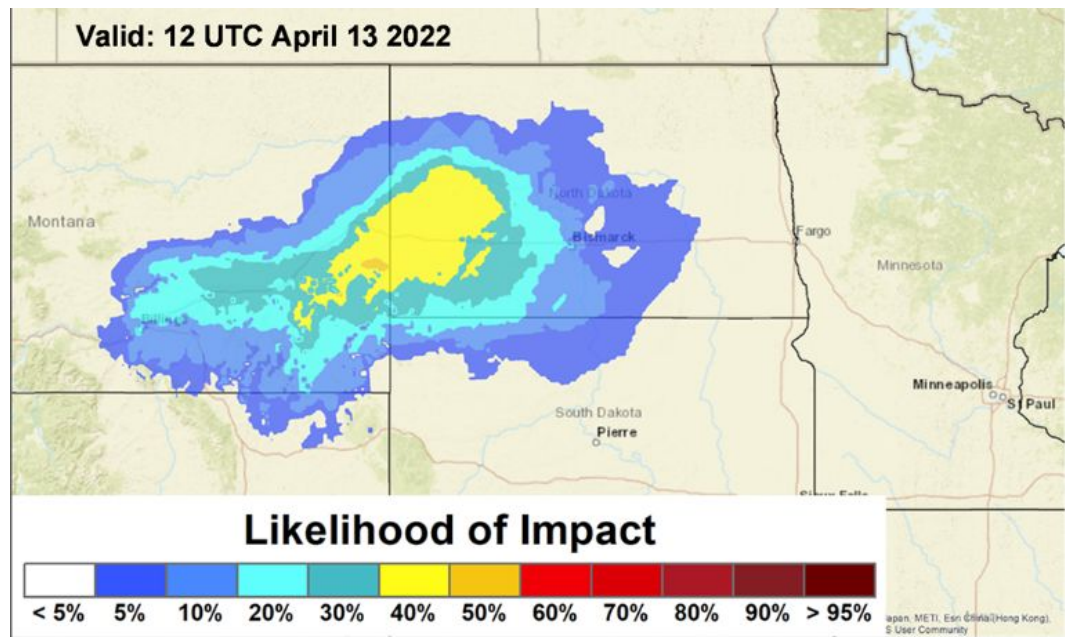
Indicates potential impacts due to the total amount of snow or snow accumulation rate

Potential Winter Storm Impacts	
	<b>Winter Weather Area</b> <b>Expect Winter Weather.</b> <ul style="list-style-type: none"> <li>• Winter driving conditions. <b>Drive carefully.</b></li> </ul>
	<b>Minor Impacts</b> <b>Expect a few inconveniences to daily life.</b> <ul style="list-style-type: none"> <li>• Winter driving conditions. <b>Use caution while driving.</b></li> </ul>
	<b>Moderate Impacts</b> <b>Expect disruptions to daily life.</b> <ul style="list-style-type: none"> <li>• Hazardous driving conditions. <b>Use extra caution while driving.</b></li> <li>• Closures and disruptions to infrastructure may occur.</li> </ul>
	<b>Major Impacts</b> <b>Expect considerable disruptions to daily life.</b> <ul style="list-style-type: none"> <li>• Dangerous or impossible driving conditions. <b>Avoid travel if possible.</b></li> <li>• Widespread closures and disruptions to infrastructure may occur.</li> </ul>
	<b>Extreme Impacts</b> <b>Expect substantial disruptions to daily life.</b> <ul style="list-style-type: none"> <li>• Extremely dangerous or impossible driving conditions. <b>Travel is not advised.</b></li> <li>• Extensive and widespread closures and disruptions to infrastructure may occur.</li> <li>• Life-saving actions may be needed.</li> </ul>

**Updated impact definitions**

# Probabilistic Winter Storm Severity Index (WSSI-P)

- **Goal:** Forecast the *probability* of reaching community impact from winter storms throughout the continental United States using the WSSI impact thresholds
- This product is **NEWLY** operational as of December 2023
- Produces five different levels of impact probabilities for Snow Amount, Snow Rate, Snow Load (heaviness), Ice Accumulation, and Blowing Snow
- The WSSI-P provides output for Days 1-7 in six hour intervals and is updated four times a day

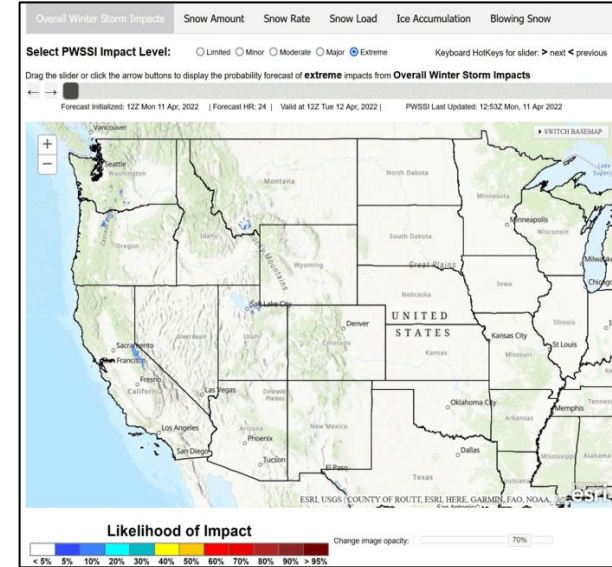
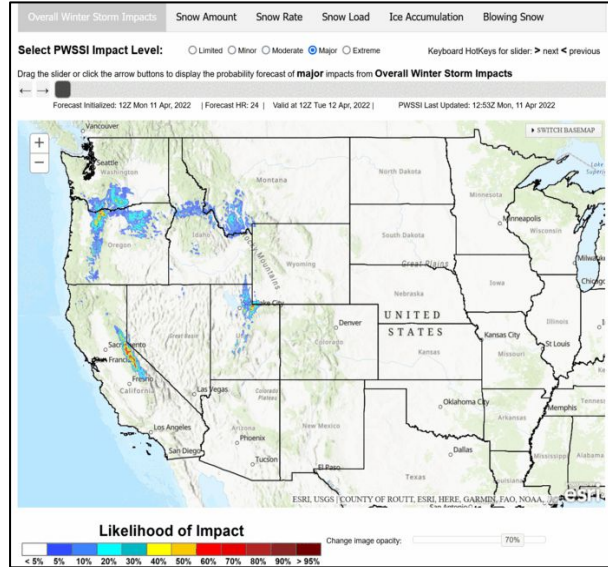
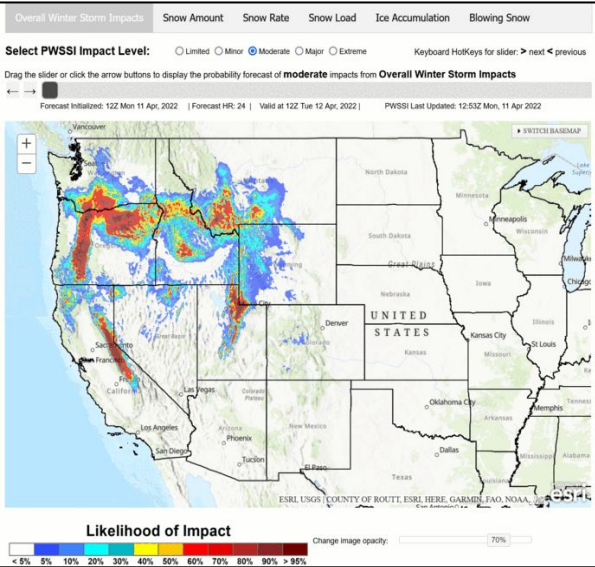


*High Probabilities of Minor provide an envelope of expected impacts*

Available here:

<https://www.weather.gov/wssi-p>

# Example of WSSI-P Impact Probability Differences for a Winter Storm

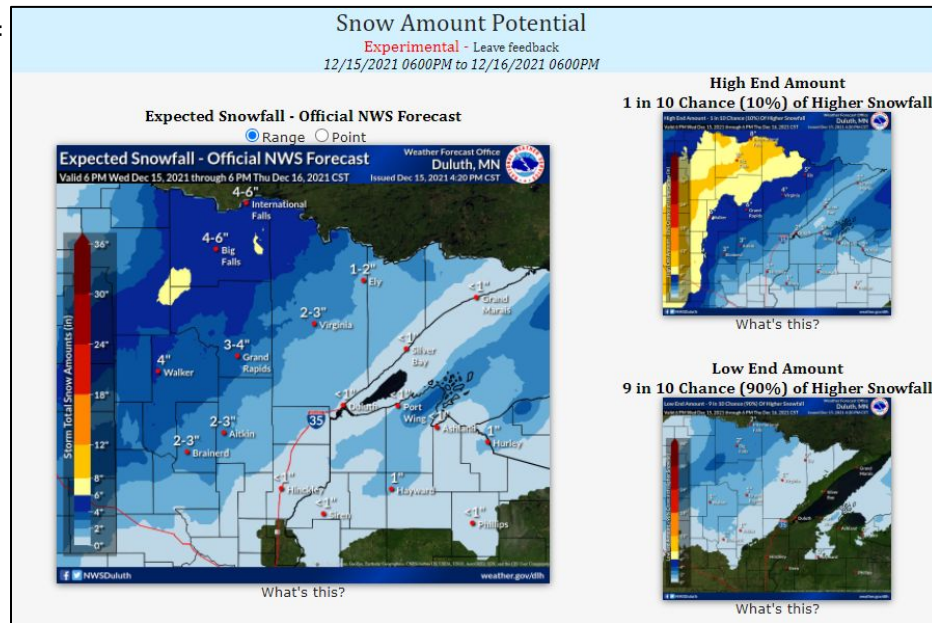


*High Probabilities of Moderate show where there is likely to be disruptions to daily life*

*High Probabilities of Major or Extreme depict where the most severe impacts are likeliest to occur*

# WFO Probabilistic Winter Precipitation Forecast (PWPF)

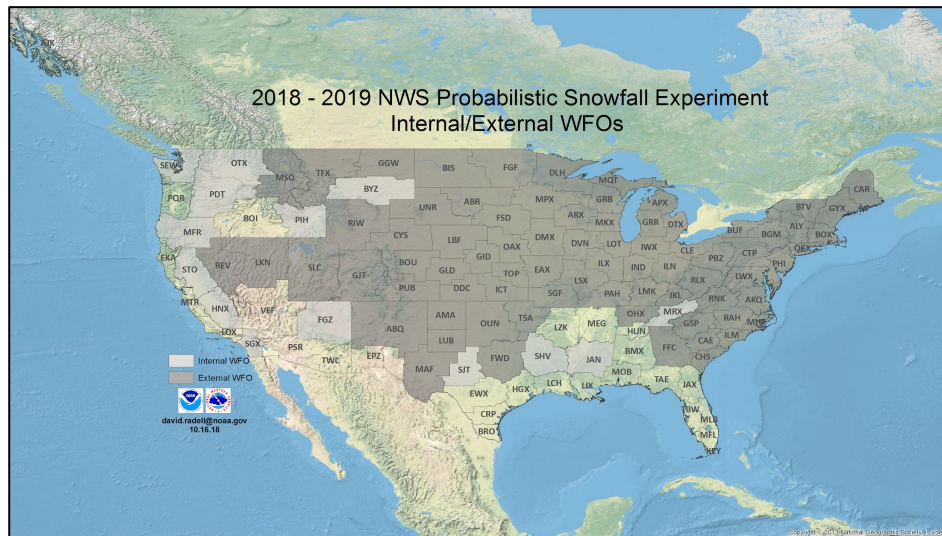
- **Goal:** Provide customers and partners a range of snowfall amounts to better communicate forecast uncertainty during winter weather events on a local level.
- 61-member ensemble of forecast models
  - Expert starting point provided by WPC
  - WFOs add local knowledge
- Significant model diversity contributes to a range of possible outcomes
  - Experimental 10th and 90th percentile graphics are available on the National Digital Forecast Database ([NDFD](#)).



**Local office Experimental PWPF page:**  
<https://www.weather.gov/btv/winter>

# WFOs Participating in PWPF Experiment

- Number of sites remains frozen as a centralized operational prototype is in development.
- We are internally testing and evaluating the prototype this upcoming season for its ability to generate and disseminate these products.
  - A national GIS/Web-based prototype solution is now being developed (next slide)



Provide feedback:

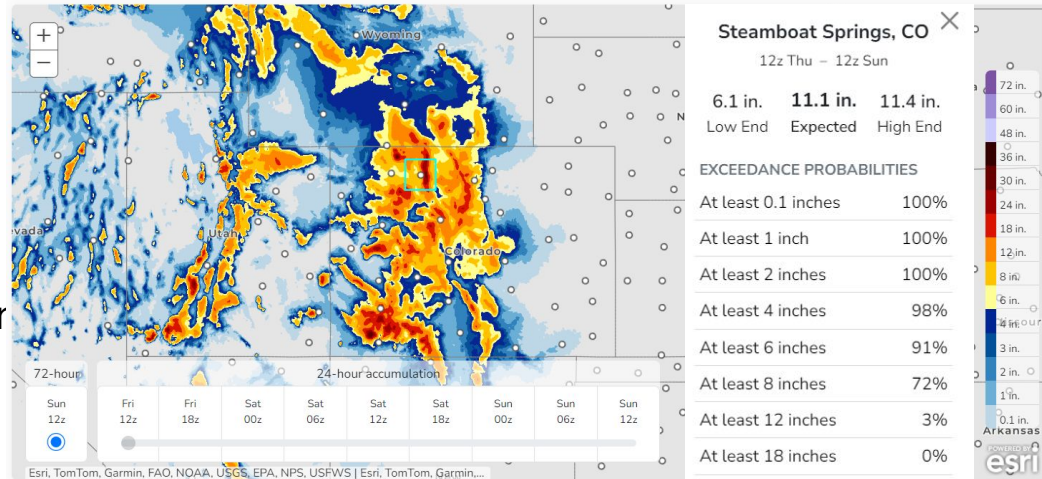
<https://www.surveymonkey.com/r/ProbWinterExp>

# The Probabilistic Precipitation Portal

- The NWS is evaluating an **internal prototype** that displays the PWPF and PQPF (and eventually probabilistic ice forecasts).
- Collaborated probabilistic precipitation forecasts provides consistencies between WPC and among the WFOs
- This will become the centralized location for the creation of the PWPF and PQPF graphics displayed on local WFO webpages
  - **New:** This prototype is expected to reach experimental status and become public-facing by the end of June 2024.

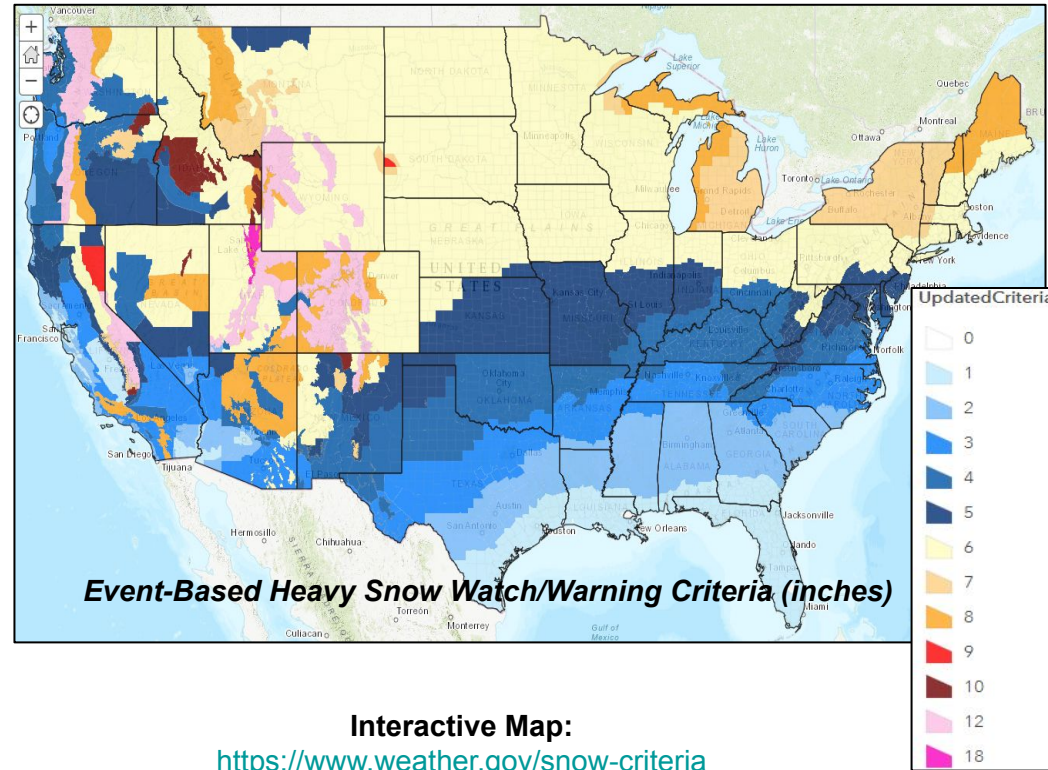
Expected Amount of Snowfall

72-hour accumulation: 12z Thu, Feb 1 to 12z Sun, Feb 4



# NEW: Modernized Heavy Snow Watch/Warning Criteria

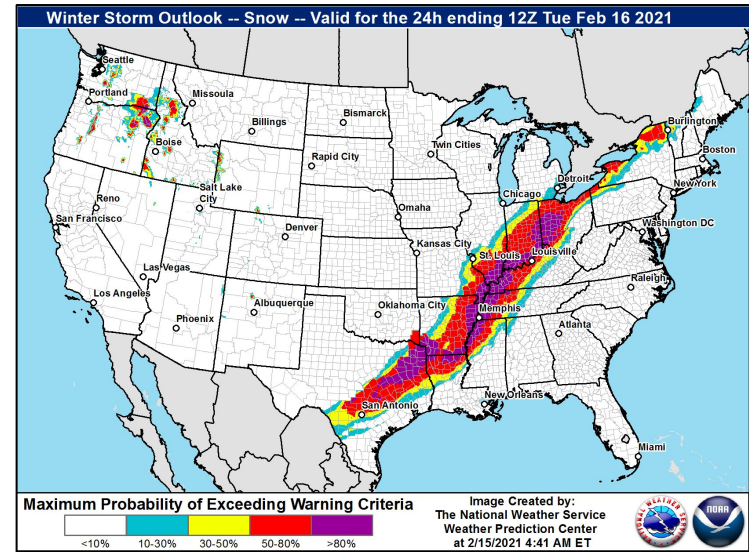
- **Goal:** Improve consistency in Winter Storm Watch/Warning issuance and public messaging
- Our NWS Regional representatives created local teams that worked internally as well as with external partners to establish the changes to the heavy snow winter watch/warning criteria
- The vast majority of zones only results in a 1 or 2 inch change, but with this small change, we remove many non-meteorological boundaries and move toward a more science-based set of criteria!
- This new criteria was **implemented this winter!** WFOs continue to collect feedback from core partners and have the opportunity to modify their thresholds quarterly.





# Experimental Winter Storm Outlook (WSO)

- **Goal:** Display the probability of realizing hazardous snow/ice accumulations using WFO-specific Watch/Warning criteria as a proxy threshold.
- Provides a Days 1-4 “Outlook” product in the Winter Program, serving to unify both external messaging and internal collaboration for consistent and collaborative Winter Storm Watch issuance.
- **New this year:** The WSO will use the aforementioned newly-established, event-based heavy snow watch/warning criteria as part of the evaluation. Please provide feedback via the survey link!
- **In Work:** Physical and Social Science evaluations of the Winter Storm Outlook are underway with the Winter Program to determine future changes to this product, possibly incorporating WSSI-P output to create a true Days 1-7 Outlook.



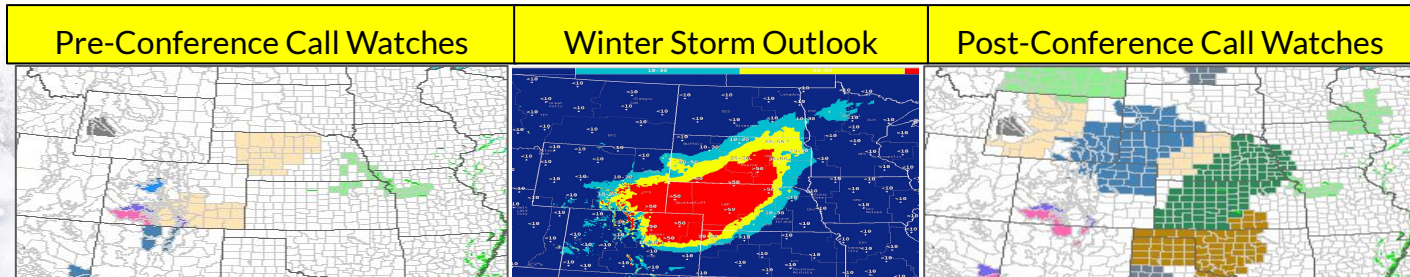
<https://www.wpc.ncep.noaa.gov/wwd/wso>

Provide Feedback:

[https://www.surveymonkey.com/r/ExpWinterStormOutlook\\_2023-2024](https://www.surveymonkey.com/r/ExpWinterStormOutlook_2023-2024)

# Collaborated Winter Watch Experiment

- Collaborated Winter Watches is an effort begun in 2015 to enhance consistency in Winter Watch issuance and messaging. NWS WFOs will issue watches after collaborating with the WPC Winter Weather Desk (WWD) and neighboring WFOs. WPC will send via AWIPS a suggested watch grid.
- Three “Pods” of 8-9 WFOs participating for ~1 month each.
- **Stakeholder benefits:** Consistency in watch issuance times/spatial coverage for decision makers (DOT, Emergency Management); consistency among national and local messaging
- **NWS benefits:** Better utilization of winter weather expertise & forecast guidance from WPC WWD; improved coordination with surrounding offices; improved decision support services; no change to WFO operational responsibility
- **New this year:** The experiment continues due to a low number of test cases last season, preliminary results from 2022-2023 show a nearly **5% improvement in Probability of Detection** for the Pod offices when compared to offices not in the Pod.



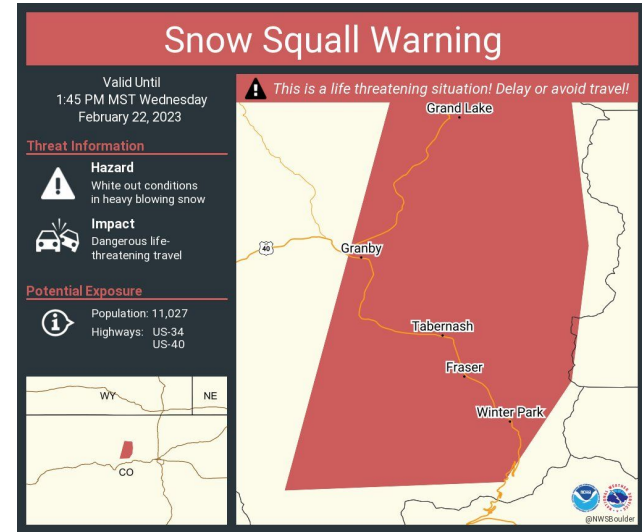
# Snow Squall Warnings and IBW Tags

Snow Squall Warnings were implemented in 2018 and gained WEA access in 2019. Effort to improve SQWs and associated WEAs began in 2021 with **Impact Based Warning (IBW) tags & Wireless Emergency Alerts (WEA) changes** for select offices in 2022 & nationwide in 2023.

## Why make these changes:

- Improve public response to Snow Squall Warnings
- Allow for overnight issuance of Snow Squall Warnings to activate highway message boards & notify partners/public without WEA activation
- Mitigate WEA over-alerting by ensuring WEA activation is reserved for high-impact events

*This process represents a successful implementation of a change based on both internal & external feedback.*



## What This Means

Before: All Snow Squall Warnings activate WEA

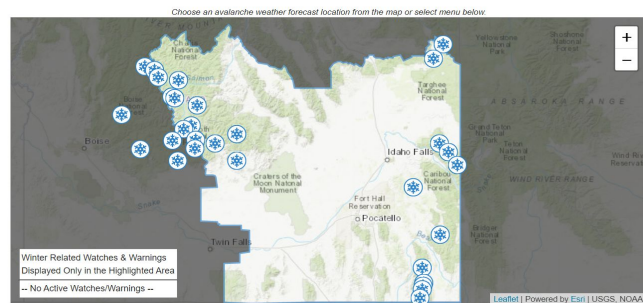
Now: WEA will only activate for high-end events with the SIGNIFICANT tag

# Avalanche Weather Support

- NWS provides forecast weather information critical to USFS Avalanche Centers & other partners & disseminates avalanche warning information from these Centers (Avalanche Warnings and Special Avalanche Bulletins)
- **Avalanche Weather Guidance** product provides partners & public with forecast weather parameters critical to prediction of avalanche conditions, risk, mitigation, & recovery.
- 18 WFOs are participating with **Experimental Avalanche Weather Web Pages**, which contain critical sources of information, including NWS weather alerts, Avalanche Center avalanche alerts, clickable points or polygons, relevant weather discussion, precipitation summary tables, a tabular & graphical forecast, & a local content section

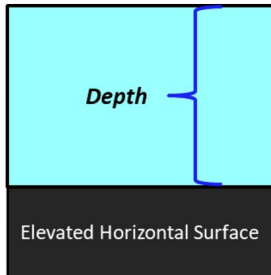
...Mount St. Helens...

Date	Friday 09/23								Saturday 09/24							
Time (LT)	06	09	12	15	18	21	00	03	06	09	12	15	06	09	12	15
	6a	9a	12	3p	6p	9p	12	3a	6a	9a	12	3p	6a	9a	12	3p
Cloud Cover	SC	FW	SC	SC	SC	SC	SC	SC	FW	SC	SC	SC	SC	SC	SC	SC
Cloud Cover (%)	40	15	30	30	40	40	35	30	25	25	30	30	30	30	30	30
Temperature	40	44	49	51	49	45	45	44	44	49	55	57				
Max/Min Temp					51				44							
Wind Dir	W	NW	W	W	NW	W	NW	NW	NW	NW	S	SW				
Wind (mph)	8	4	4	6	5	5	8	8	5	2	3	4				
Wind Gust (mph)	20			16			19	17								
Precip Prob (%)	10	5	10	10	10	10	10	10	10	5	5	0				
Precip Type																
12 Hour QPF									0.00				0.00			
12 Hour Snow									0.0				0.0			
Low End Snow									0.0				0.0			
High End Snow									0.0				0.0			
12 Hour Ice									0.00				0.00			
Snow Level (kft)	8.5	8.5	9.5	10.0	10.0	10.0	10.0	10.0	9.6	10.5	11.0	11.0				



# Winter Program Ice Initiatives: Freezing Rain & Ice Team

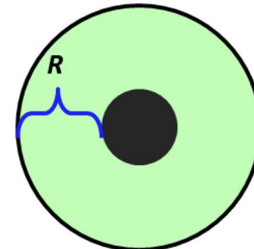
- NWS team chartered in July 2023, made up of WFO SOOs, WCMs, WPC, and the National Winter Program
- FRAIT has several tasks, including:
  - Recommendation on official NWS forecasting and reporting policy of either elevated flat ice, radial ice, or both (currently NWS **only reports** elevated flat ice)
  - Best practices for IDSS **ice messaging** to partners and public
  - Recommendations for ice reporting from Storm Spotters
  - Training changes for NWS staff



radial ice =  $0.394 * \text{flat ice}$

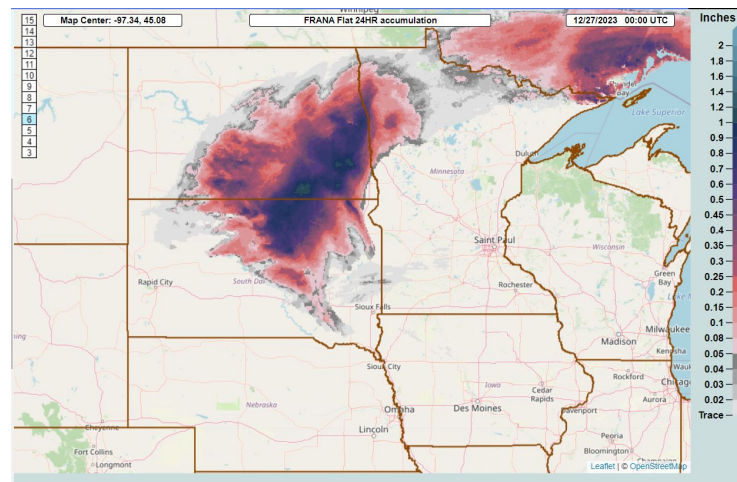
or

flat ice =  $\frac{\text{radial ice}}{0.394}$



# Freezing Rain Accumulation National Analysis

- An experimental Multi-Radar/Multi-Sensor (MRMS) product called the Freezing Rain Accumulation National Analysis (FRANA) is currently being evaluated by WFOs via their Regional Local Data Manager (LDM)
- FRANA uses the Freezing Rain Accumulation Model (FRAM) and other MRMS data to calculate ice accumulation (both flat and radial), at 1,3,6,12, and 24 hour intervals for the CONUS in real time
- The Cooperative Institute for Severe and High-Impact Weather Research and Operations (CIWRO) is collecting feedback from NWS forecasters to improve the product for possible operational implementation in the future



**FRANA-derived flat ice (in)**

# Winter Program Ice Initiatives: COOP Ice Measurements

- The NWS Cooperative Observer Program (COOP) has ~8,000 volunteers reporting daily weather conditions
- COOP has been recognized as “the most definitive source of information on U.S. climate trends for temperature and precipitation.”
- However, COOP sites do **NOT** officially report freezing rain ice accretion!
- The Observations Program Leads (OPLs) at seven WFOs have found volunteers amongst their COOP observers to record ice accretion from freezing rain when it occurs
- 22 COOP sites at seven WFOs have been recruited so far. This will help assess the possibility of observers measuring ice in the future



# Winter Program Ice Initiatives: Freezing Rain Training

- The 2023-2024 Winter Season saw the creation of three NWS training modules by the Warning Decision Training Division that specifically address freezing rain:
  - [Forecasting Freezing Rain](#)
  - [Freezing Rain Impacts and Messaging](#)
  - [Freezing Rain Observations](#)
- These trainings are required for **ALL** NWS new hires as part of their enrollment in the Winter Warning Operations Course
- These trainings are also required as part of the Winter Seasonal Readiness Training course, and have been advertised across the agency as highly recommended for all forecasters





# Winter Program Future Efforts

- Continued R2O collaboration with STI and WPC
- Exploration of “Enhanced Language” for high-end Winter Warning Events
- WSSI ice accumulation improvement study
- Annual Winter Program Meeting - June 2024
- Winter Program Annual Partners Meeting - Fall 2024
- Probabilistic Precipitation Portal - experimental by end of June 2024
- Winter Storm Outlook reconstitution
- Expansion of additional winter services to OCONUS
- Hazard Services Winter Implementation
- Hazard Simplification - Plain Language Headlines
- Community Centric Warnings - Polygons





# Update on Winter Weather Initiatives



## Contributors:

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Jim Nelson  
Alex Lamers  
Josh Kastman  
Tony Fracasso  
Jeff Waldstreicher  
Bruce Veenhuis  
Dana Tobin

## Links:

**WPC PWWF page:**

[https://www.wpc.ncep.noaa.gov/pwvf/wwd\\_accum\\_probs.php](https://www.wpc.ncep.noaa.gov/pwvf/wwd_accum_probs.php)

**Local office Experimental PWWF page:**

<https://www.weather.gov/btv/winter>

**Operational WSSI:**

[www.weather.gov/wssi](http://www.weather.gov/wssi)

**Operational WSSI-P:**

[www.weather.gov/wssi-p](http://www.weather.gov/wssi-p)

**Experimental WSO:**

<https://www.wpc.ncep.noaa.gov/wwd/wso>

Have Questions? [Eric.Guillot@noaa.gov](mailto:Eric.Guillot@noaa.gov)

