Advances in Probabilistic IDSS for the Extreme Precipitation Challenge

Dr. David Novak and many others
Weather Prediction Center

WEATHER PREDICTION CENTER

Our Mission: To synthesize the nation's daily weather story and champion the **operational prediction of rain storms, winter storms, and extreme temperature events** for the protection of life and property.

The Nation's Big-Picture Weather Story

With a Focus On:

Rain Storms

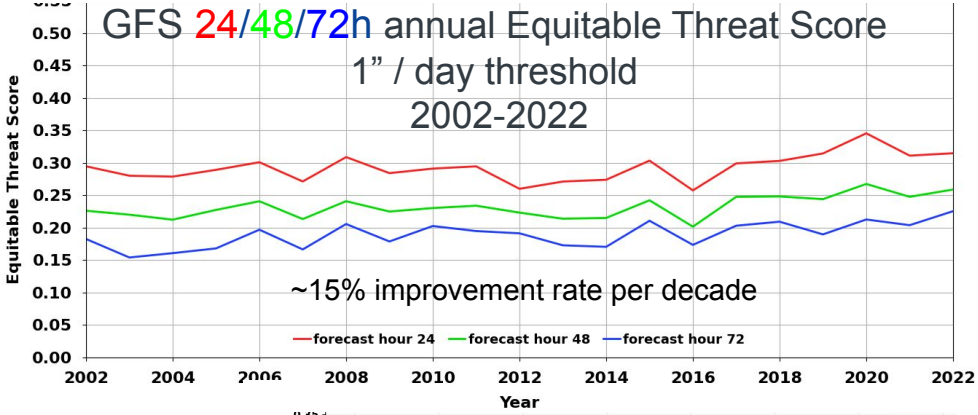
Winter Storms

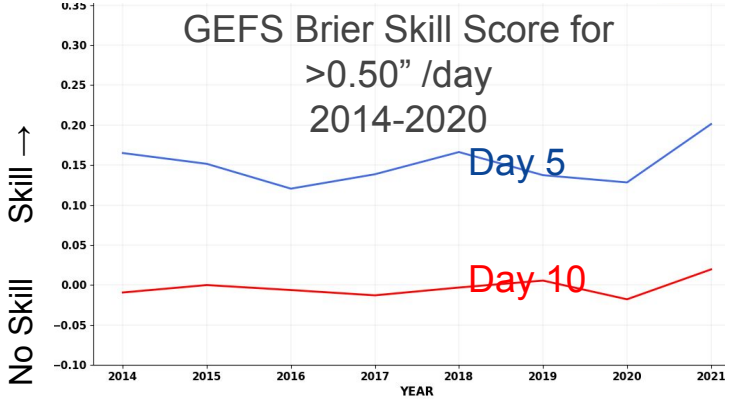
Temperature Extremes

Imperative for accurate, understandable forecasts

Precipitation Forecasts are Challenging!

Painfully slow improvement in past ....





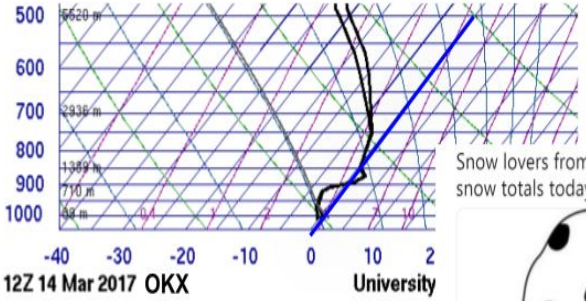
Priorities for Weather Research Report

"Unfortunately, precipitation forecast skill has not improved substantially over decades and remains one of the major technical challenges in atmospheric sciences.

Poor prediction skill for flood and drought has an inordinate impact on disadvantaged communities"

Precipitation Forecasts are Challenging!

March 14, 2017



METRO

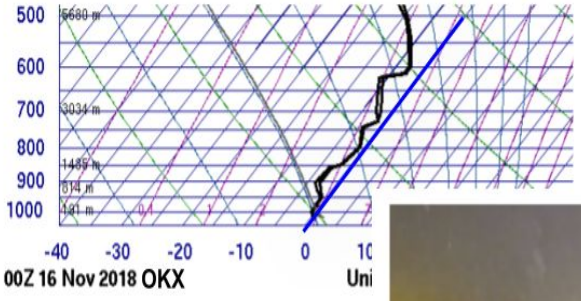
NYC blizzard is a dud

By Danielle Furfaro and Yaron Steinbuch

It's not exactly the snowpocalypse.

Snow lovers from DC to NYC reporting their snow totals today.

November 15, 2018



Outrage after a few inches of snow brings NYC to a halt

By Ben Feuerherd

November 15, 2018 | 11:09pm | Updated

Ensemble Underdispersion

What do you do when the models agree on an extreme event, but not the location?

St. Louis hit with "catastrophic" rainfall, flash flooding prompts rescues

Axios

Jacob Knutson

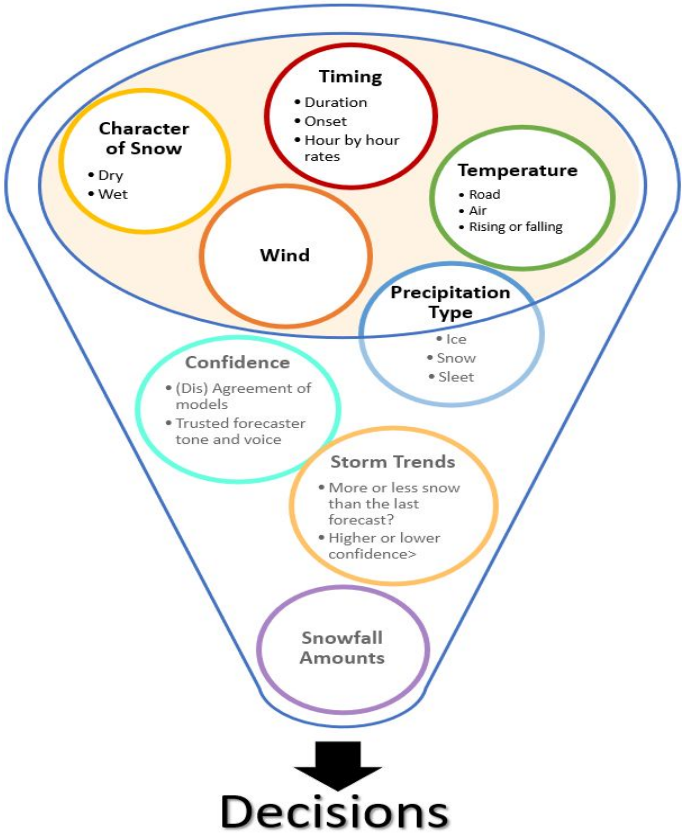
NWS St. Louis
@NWSStLouis · Follow

All Time Daily Rainfall Record at St. Louis Shattered

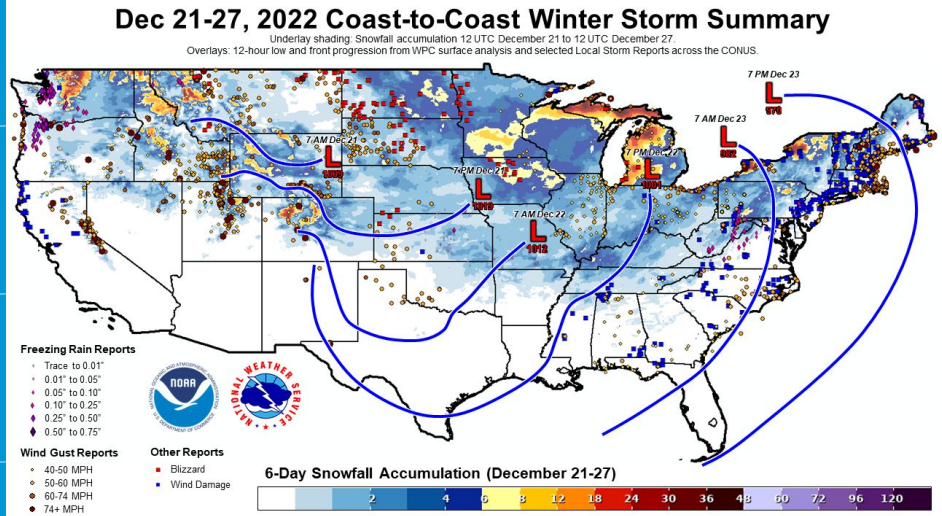
Bruce Veenhuis - Wednesday AM Session 5a

Jimmy Correia - Wednesday PM Session 7a

Complex Decision Environments



And the Stakes are HIGH



"This was a very, very bad night in our community"

Mark Poloncarz, Erie County executive

News // Bay Area & State

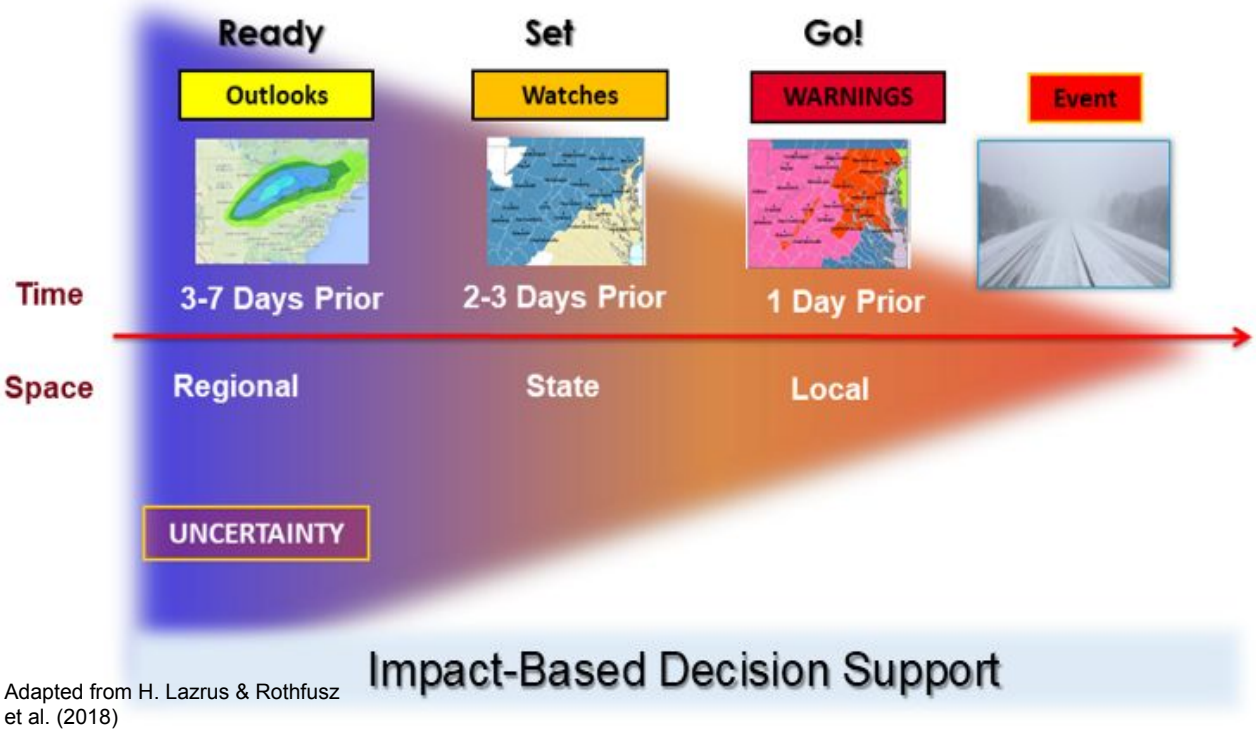
Pleas for help, daring rescues after snowstorm shocks California

Katie Dowd, SFGATE

March 5, 2023 | Updated: March 5, 2023 9:57 a.m.

Approach to the Challenge

Use Probabilistic Impact Information to Drive Messaging



Adapted from H. Lazrus & Rothfusz et al. (2018)

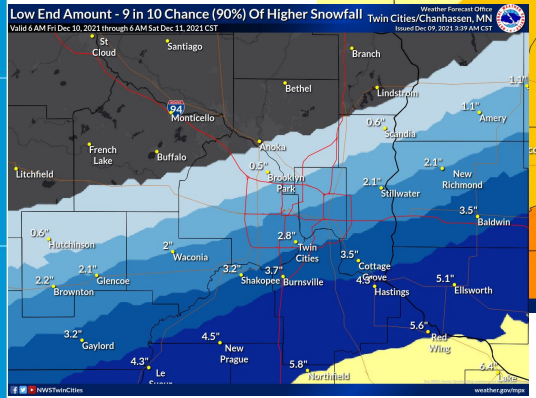
As the certainty of an event increases, the urgency & specificity of forecast information increases

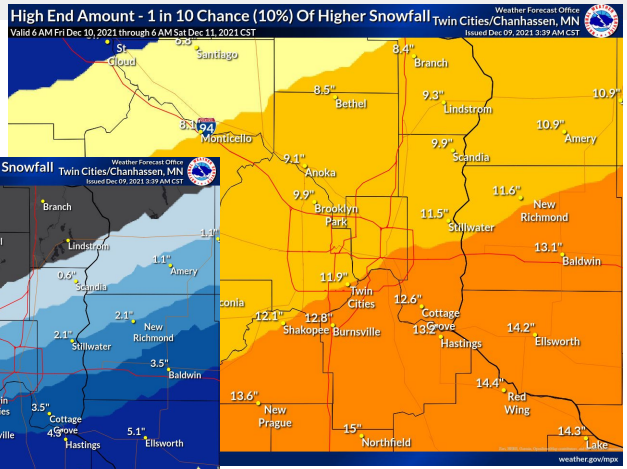
Gilbert, Waldstreicher, Jeglum - Tuesday PM Session 3

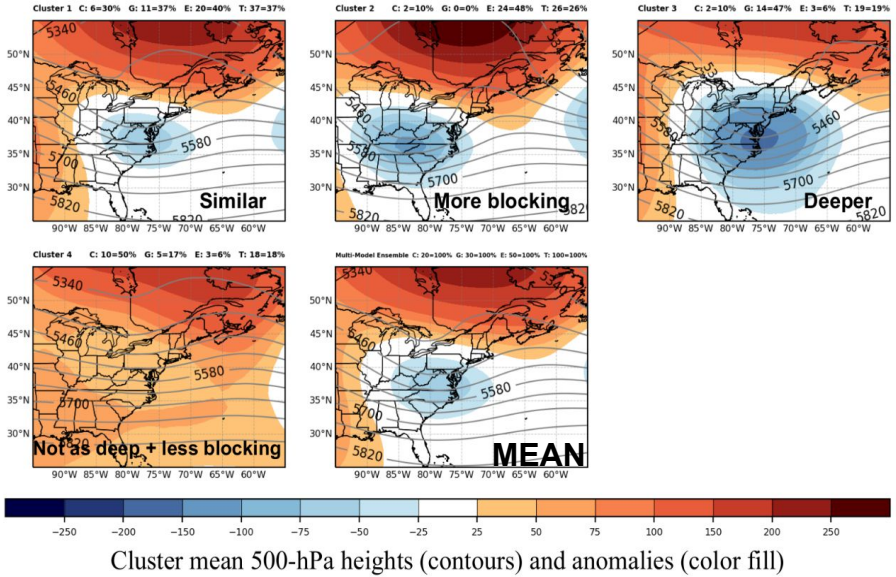
Empower Forecasters with Tools

Extract information from the full ensemble distribution - such as alternative scenarios

"These studies generally agree that ensemble/simulation representations (that highlight alternative possibilities) promote risk comprehension and awareness of unlikely (but possible) outcomes…" Ripberger et al. 2022



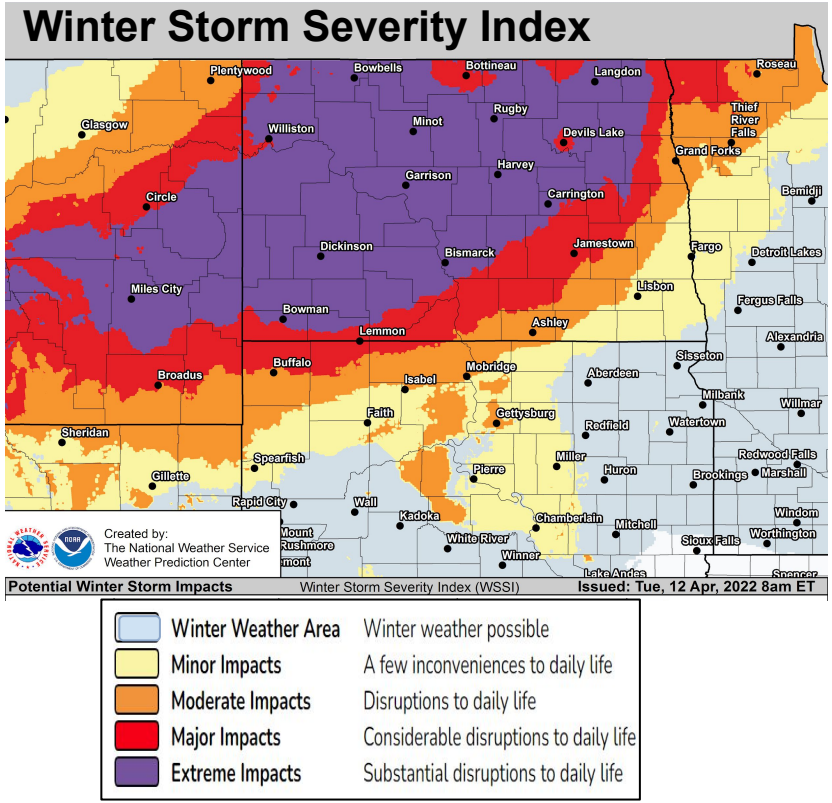


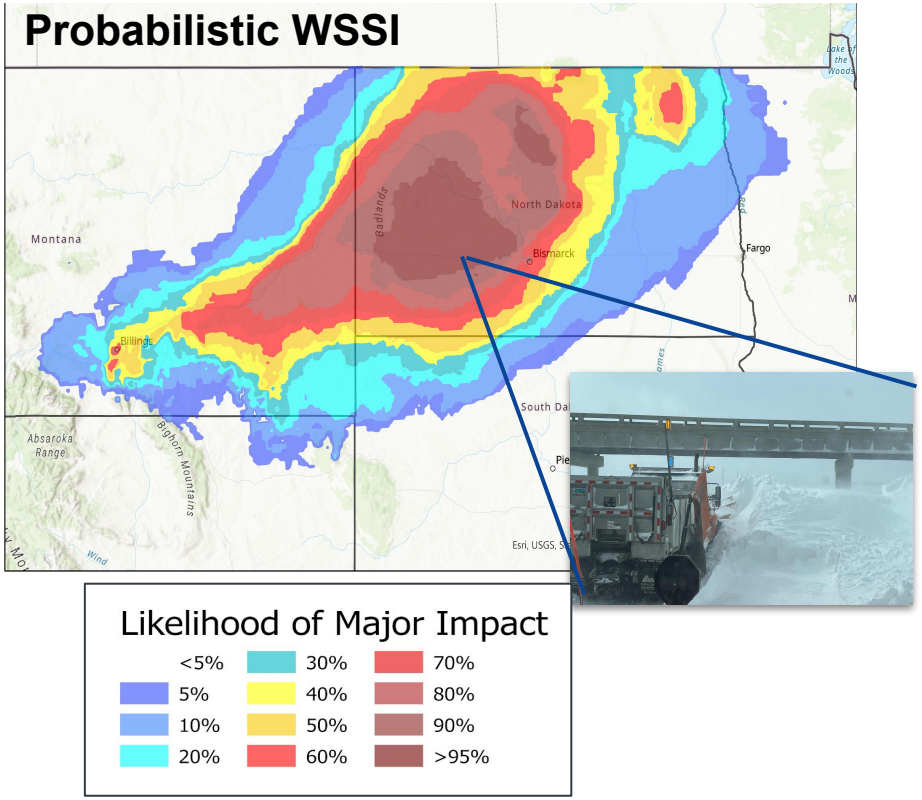


Cluster mean 500-hPa heights (contours) and anomalies (color fill)

Austin Coleman - Wednesday AM Session 5a

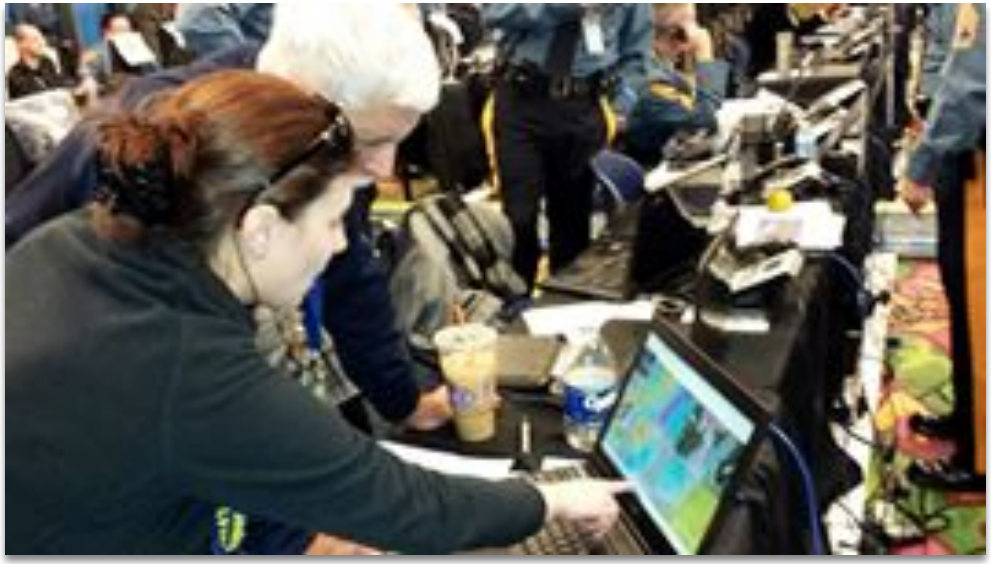
Translate to Impacts

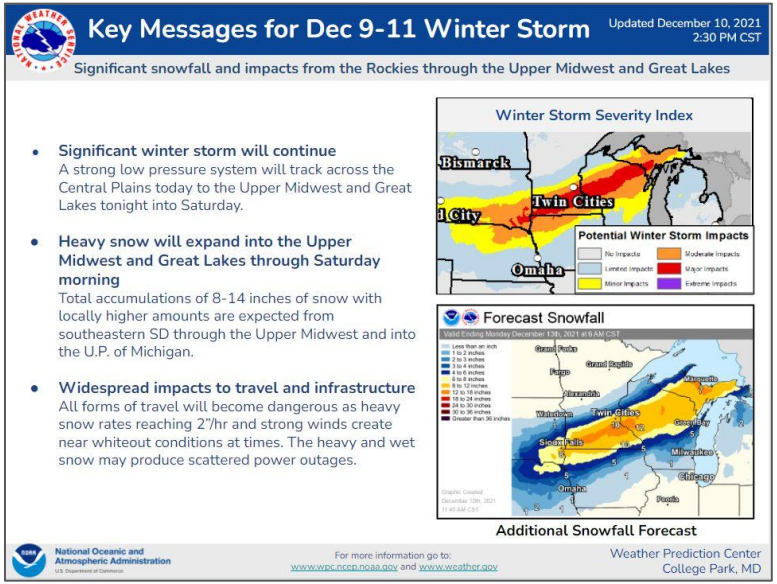




And then Effectively Communicate

Continue to expand Federal, State, & Local partnerships to ensure public safety & mitigate damages.

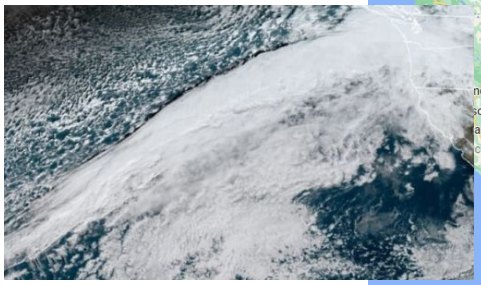




The Precipitation Extremes Are Not Going To Stop

National damages exceeding $1T a year are not out of the question.

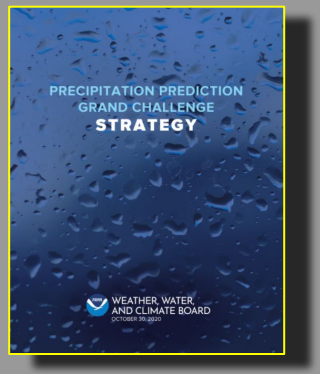
Are we ready?



Accurate Prediction is Essential to Resilience & Mitigation

PPGC Strategic Goal:

Provide more accurate, reliable, and timely precipitation forecasts across timescales, from hours to decades, through the development and application of a seamless, fully coupled Earth System prediction model.



[NOAA Precipitation Prediction Grand Challenge Strategy]

6 Strategic Objectives:

Summary

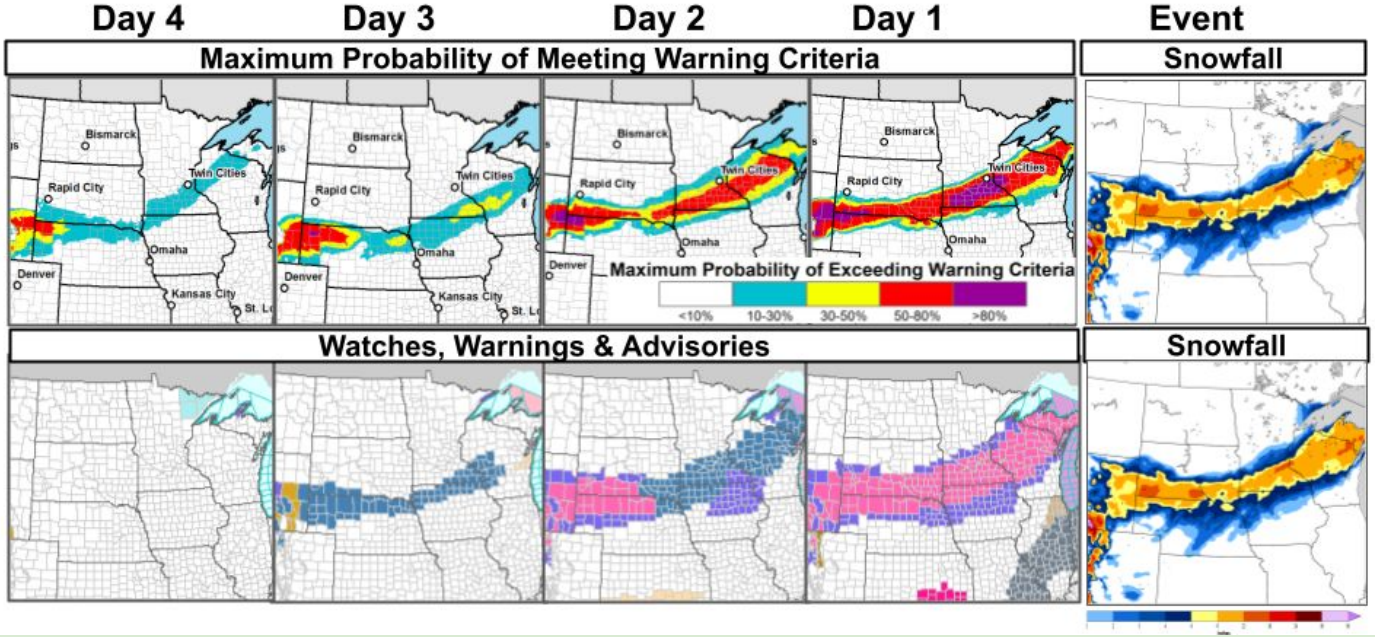
We are embracing a probabilistic framework with a vision of **providing community decision makers skillful and quantitative information on the likelihood of impacts from extreme precipitation**

TO ACHIEVE THIS VISION:

- Fundamentally **improve model forecast precipitation** accuracy
- **Improve ensemble underdispersion**
- **Extend probabilistic service**s further out in time
- Redouble efforts on **characterizing the mesoscale aspects** of storms
- Establish a rigorous and consistent **database of observed impacts** to support impact verification and the development of impact-based tools.
- Develop **probabilistic *impact* information** with decision maker thresholds.
- Expand support for **SBES research** with a range of users (forecasters, core partners, public)

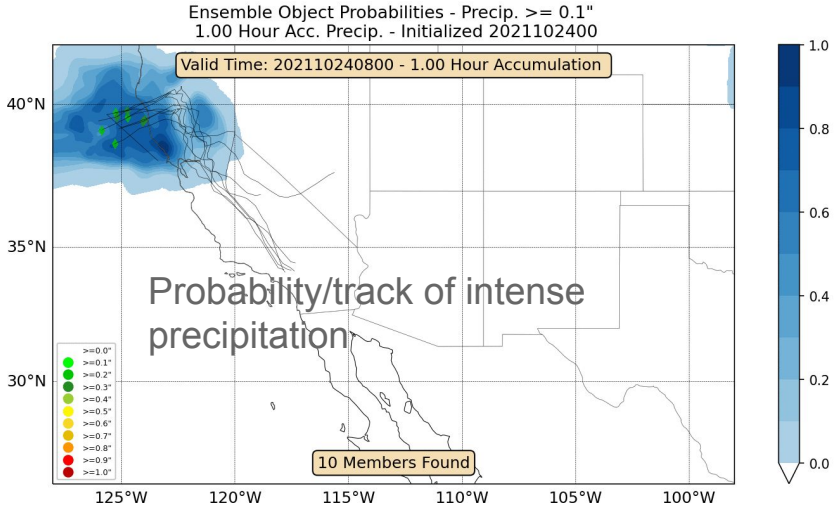
Winter Probabilistic Hazard Information

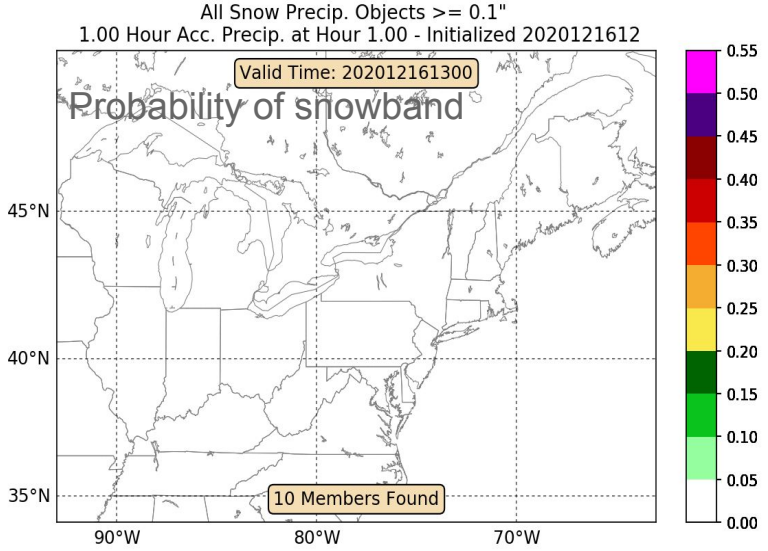
The era of objective probabilistic winter hazard information has arrived.



Community debate as to *the degree* to which IDSS should be based on objective probabilistic information versus subjective impact information.

Empower Forecasters with Tools





Data mining and data visualization of ensemble data and extensive training to:

1) Make a better forecast
2) Communicate risks and impacts (ultimately, probability of an impact)