Evolving Toward Probabilistic Information as the Foundation for IDSS

Dr. David Novak
Director, Weather Prediction Center

Increasing demand for accurate, consistent forecasts

Increasing Demand

"Is it going to rain tomorrow?"

"How much is it going to rain tomorrow?"
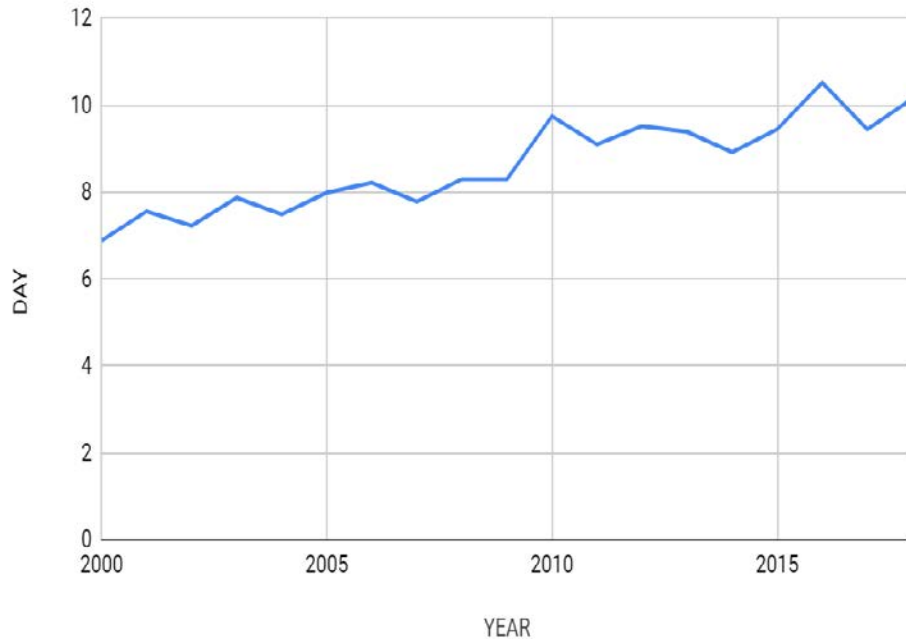
"Will my city be immobilized?"

"Will my city be immobilized next week?"

More skill
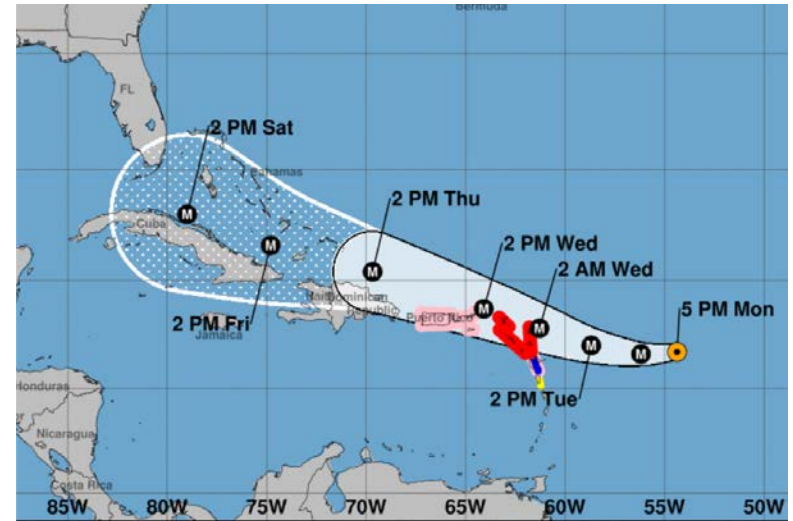
Less Skill

Progress

- Skill is slowly improving
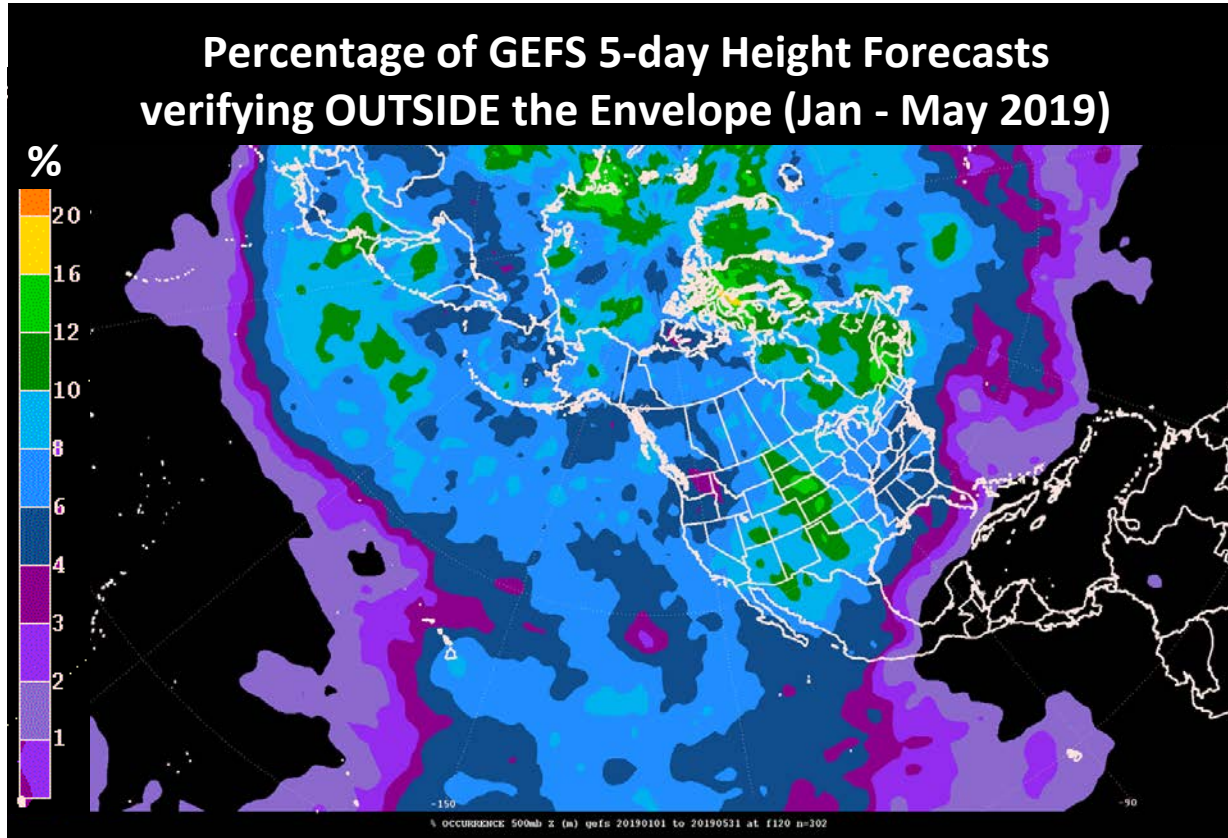
Day at which GEFS forecast loses useful skill (AC = 0.60)

Florida declared a **State of Emergency six days** before Irma's Landfall

Physical Science Challenge

Percentage of GEFS 5-day Height Forecasts verifying OUTSIDE the Envelope (Jan - May 2019)

- Ensemble systems exhibit underdispersion

- Often at coarser resolution than features of interest

Communication Challenge

Weather Forecasts are Inherently Uncertain

- Predictability varies from event-to-event & by scale

- Impacts more difficult to predict than the meteorology

- Results in wide range of lead-time for partner decisions

WEEK   TO   HOURS

Winter storm could impact 75 million people
Residents in at least a half-dozen states are being warned to prepare for potentially damaging winter weather. Expected snow totals »
1 – 5 of 85

NWS Portland
@NWSPortland

Okay. Enough trying to play catch up with our forecast. Someone in the valley will likely see a FOOT of snow by tomorrow morning.

9:59 PM - 10 Jan 2017

194 Retweets   274 Likes
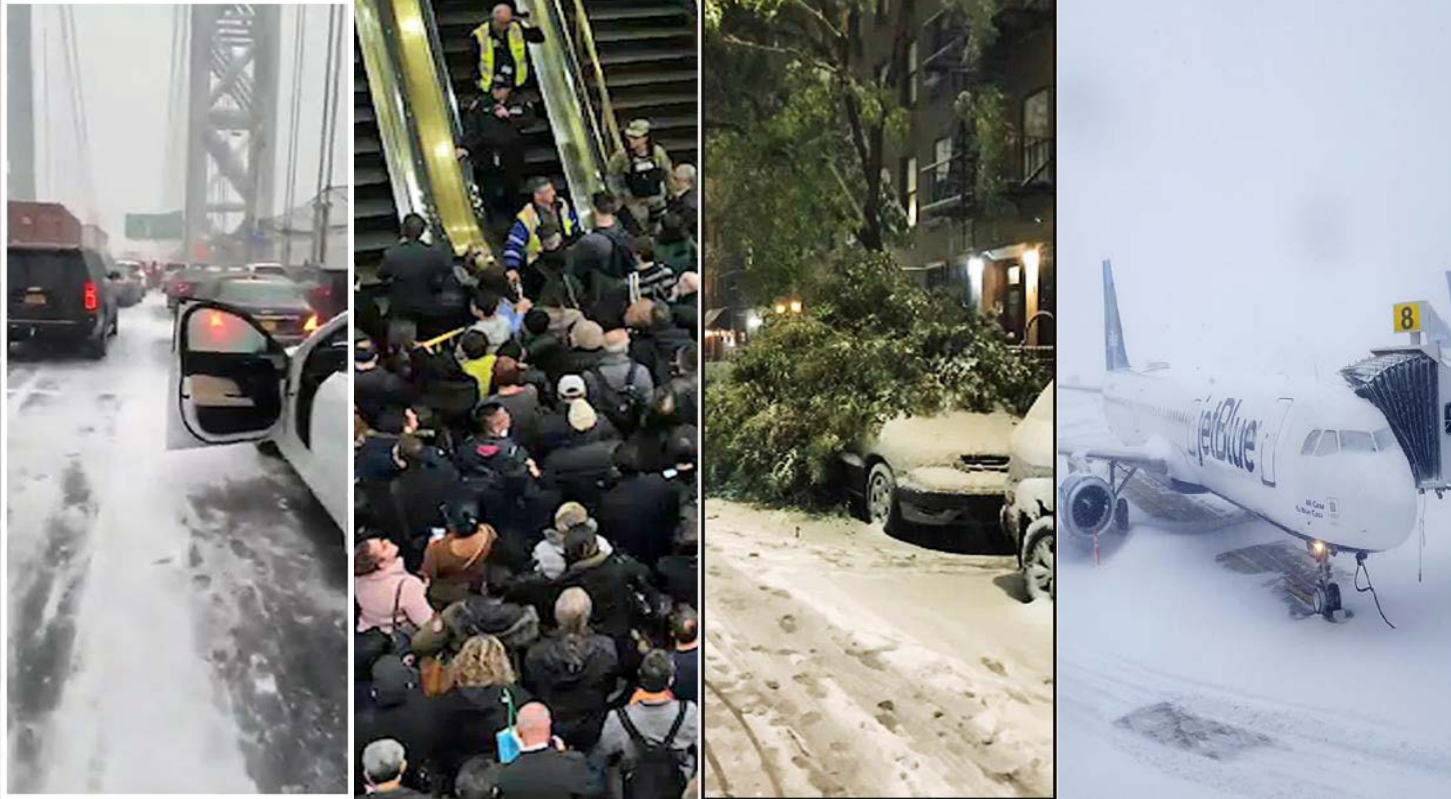
25   194   274
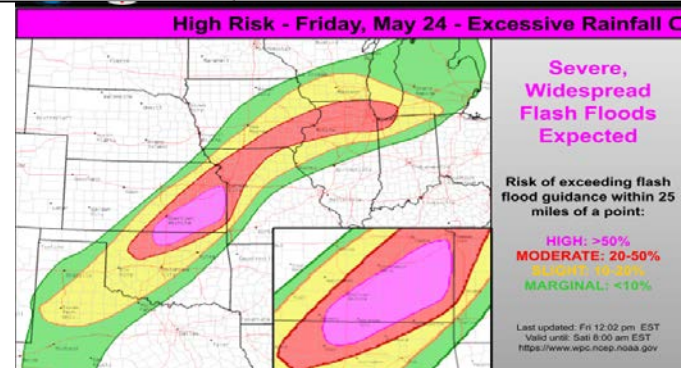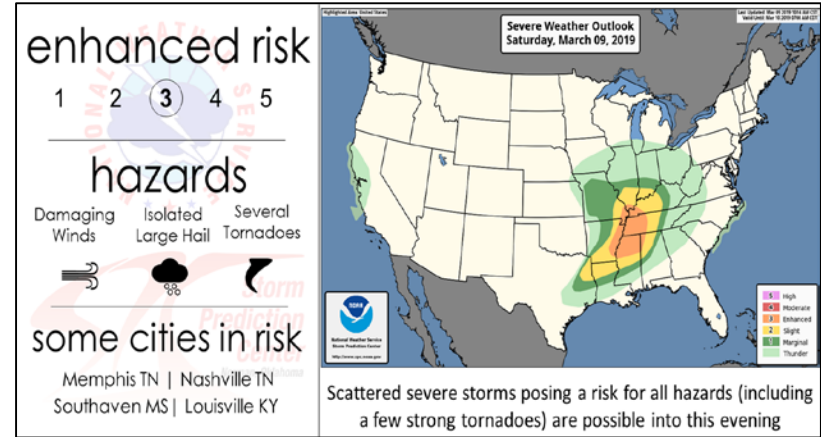
Outside the Envelope Event with Short Lead Time
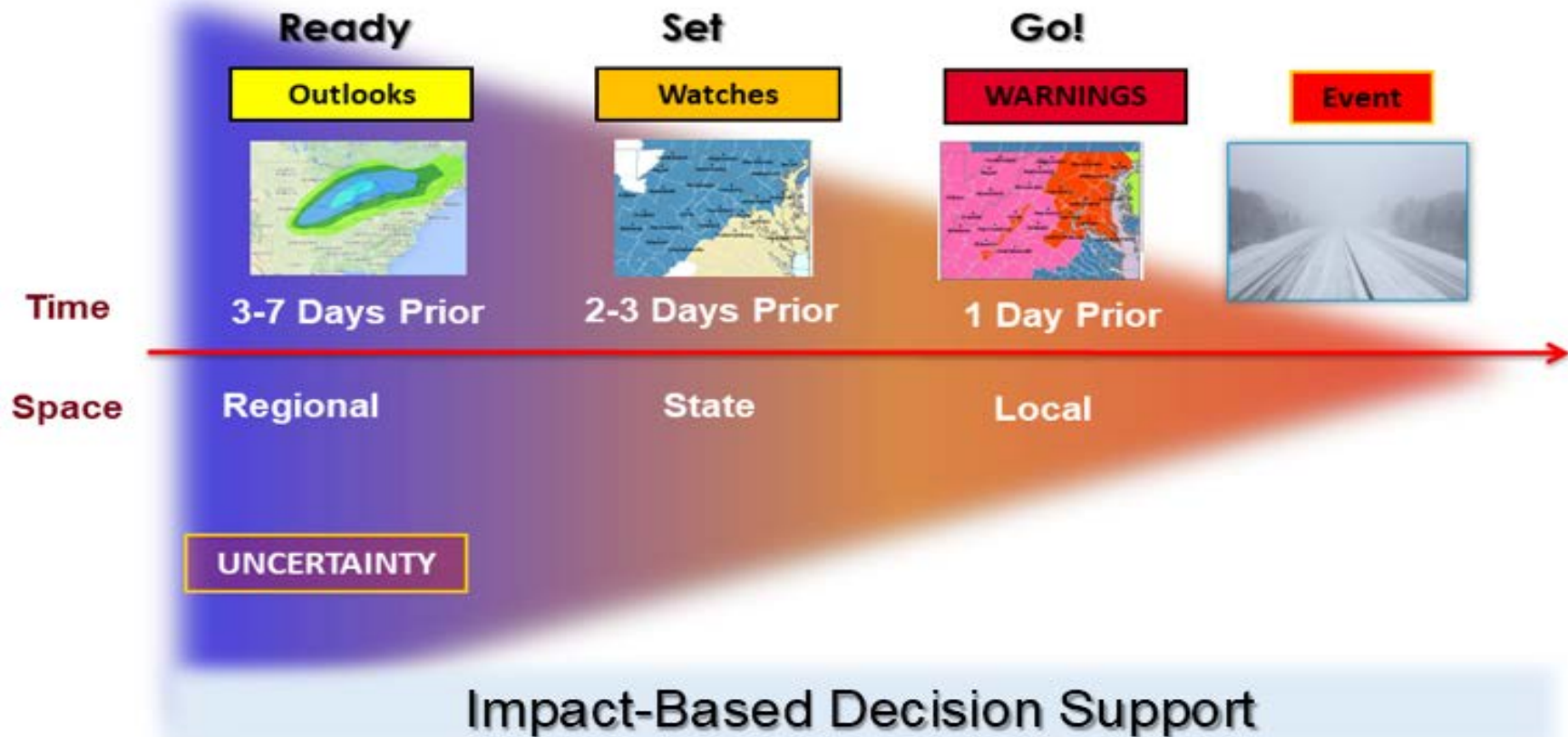
November 15, 2018 in New York City

Probabilistic Hazard Information as Foundation for IDSS
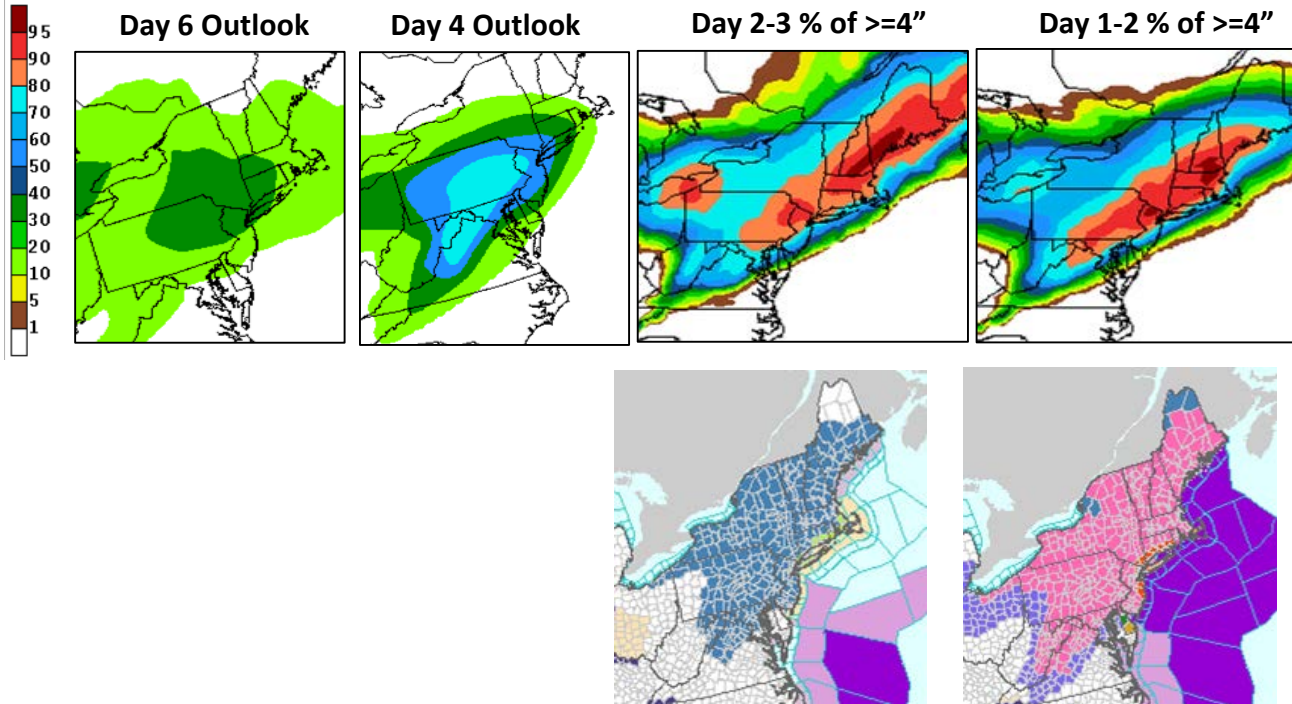
Products/Language triggered by Level of Certainty

Adapted from Lans Rothfusz
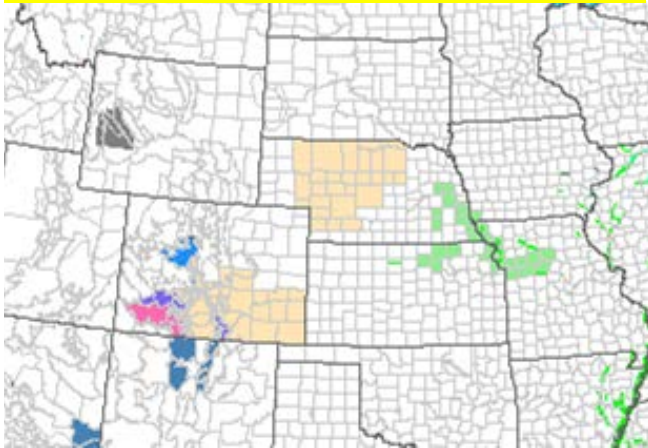
Example: Consistent Probabilistic Framework

Day 6 Outlook

Day 4 Outlook

Day 2-3 % of >=4"

Day 1-2 % of >=4"

95
90
80
70
60
50
40
30
20
10
5
1

Portland, ME

CNN

Binghamton, NY

WSYR
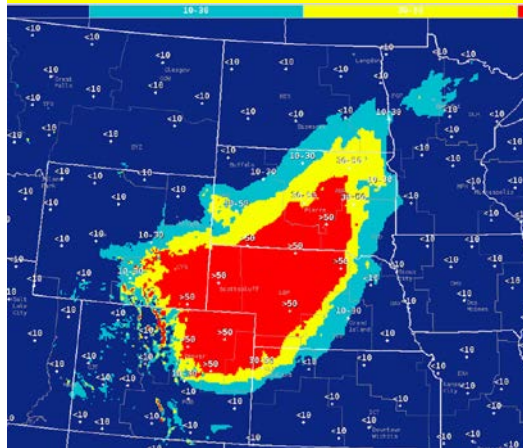
Example: Consistent Probabilistic Framework

- Experimental External Probabilistic Winter Storm Outlook
  - **Displays probability of exceeding WFO warning criteria**
  - >50% triggers AWIPS alert and Watch discussion

Pre-Conference Call Watches

Winter Storm Outlook
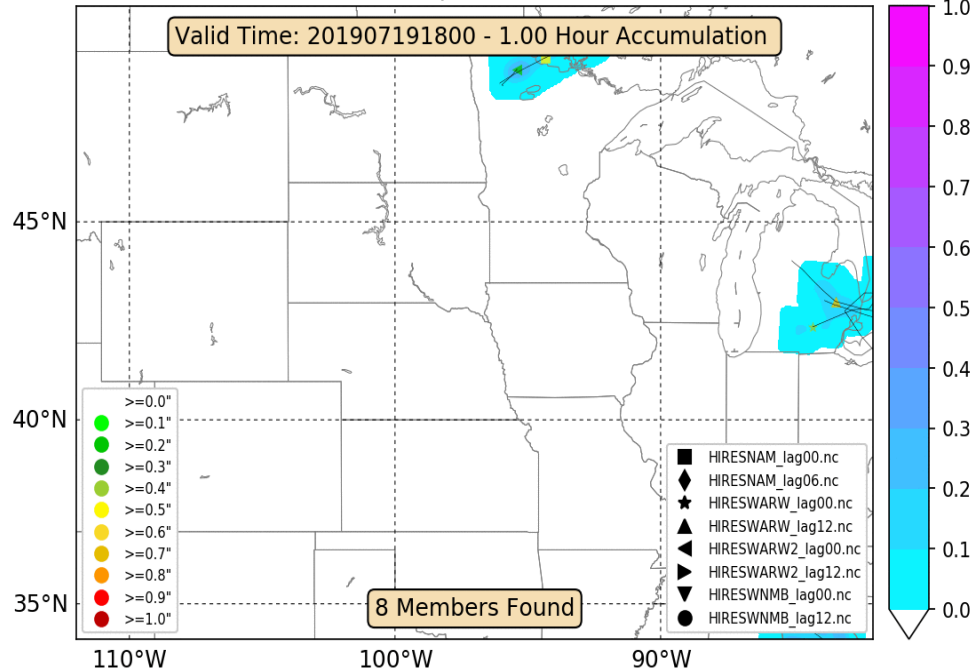
Post-Conference Call Watches

Forecaster's IDSS Informed by Specialized Post-Processing

Specialized Post-Processing for Extreme Events (Rainfall)
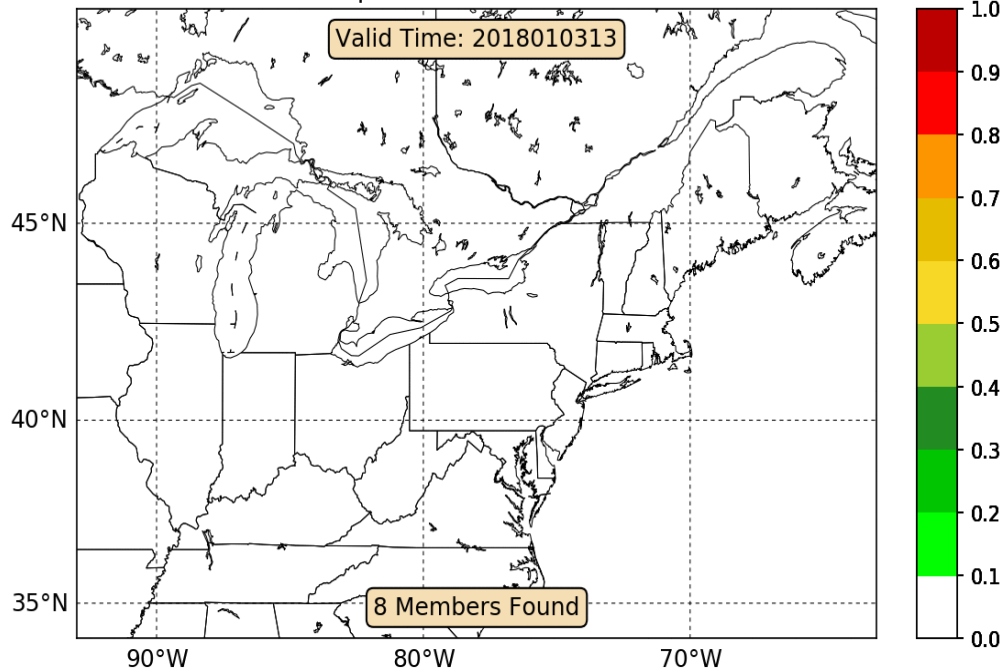
- Probability of being inside a heavy precipitation object (blue shading), object centroid location (marker) and 90th percentile of object intensity (marker color) is displayed.

- User can assess model consistency with regard to placement, intensity and timing.

Specialized Post-Processing for Extreme Events (Snowbands)

HREF
All Snow Precip. Objects >= 0.1"
01 Hour Acc. Precip. at Hour 01 - Initialized 2018010312
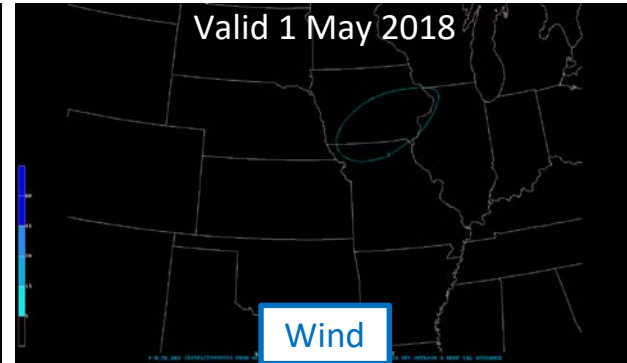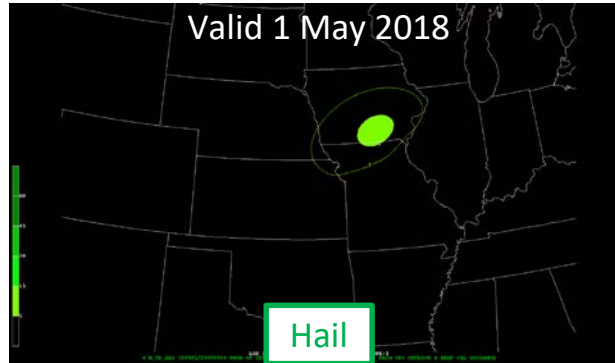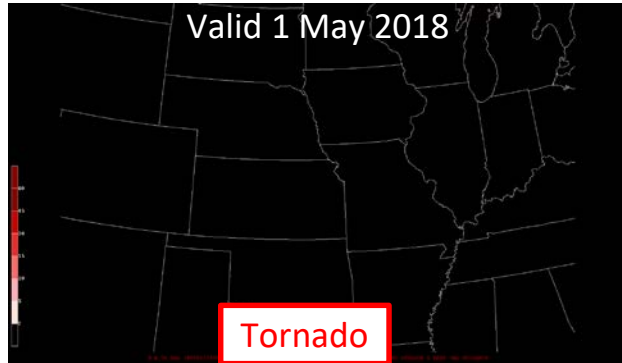
Valid Time: 2018010313

8 Members Found
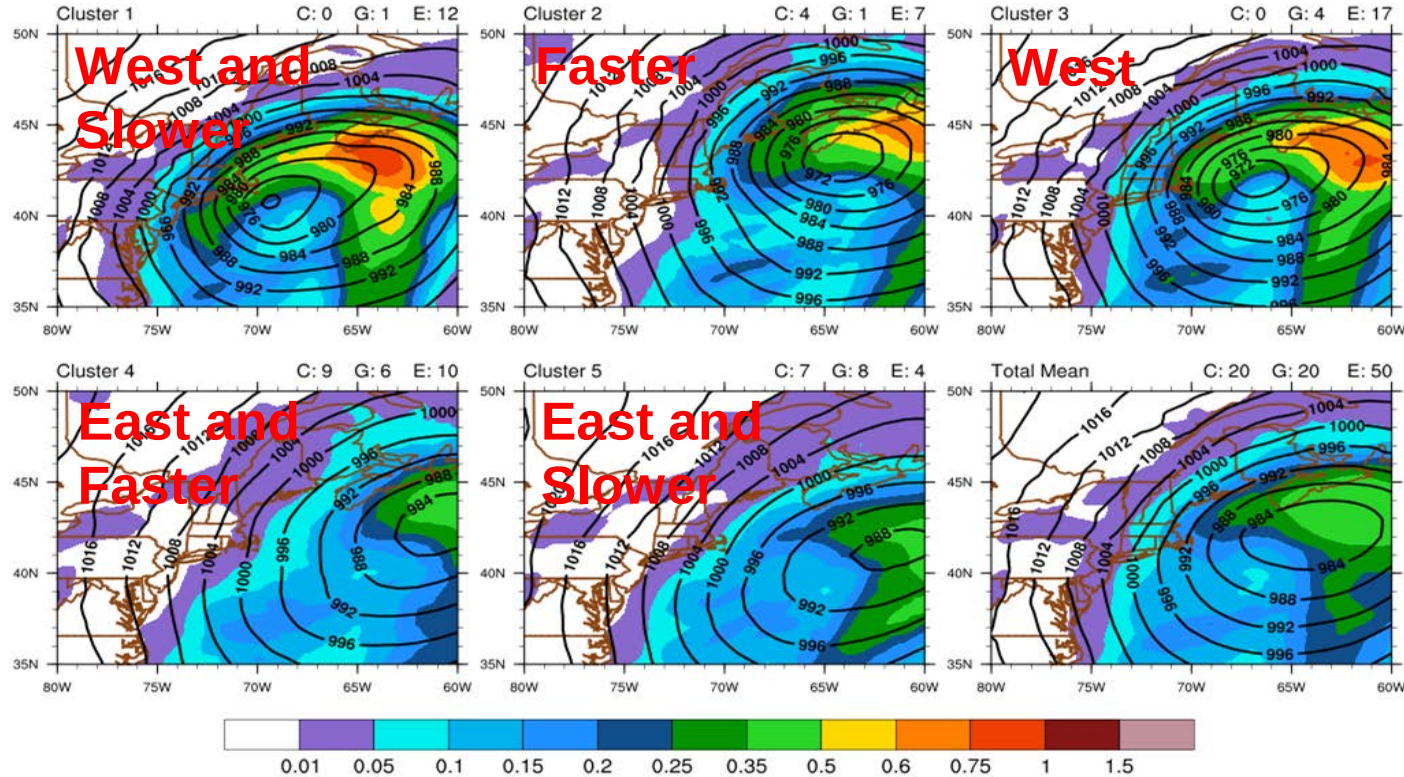
- QPF is masked with the categorical snow field and tracked to generate snowband images.

- The shape of the snowband object is displayed, with the border color representing 90th percentile of object intensity.

Specialized Post-Processing for Extreme Events (Severe Weather Timing)

- Leverage the **HREF** to add temporal information to SPC products regarding the evolution of the severe weather threat that is consistent with the SPC forecaster full-period Day 1 outlook

Specialized Post-Processing for Extreme Events (Nor'easters)
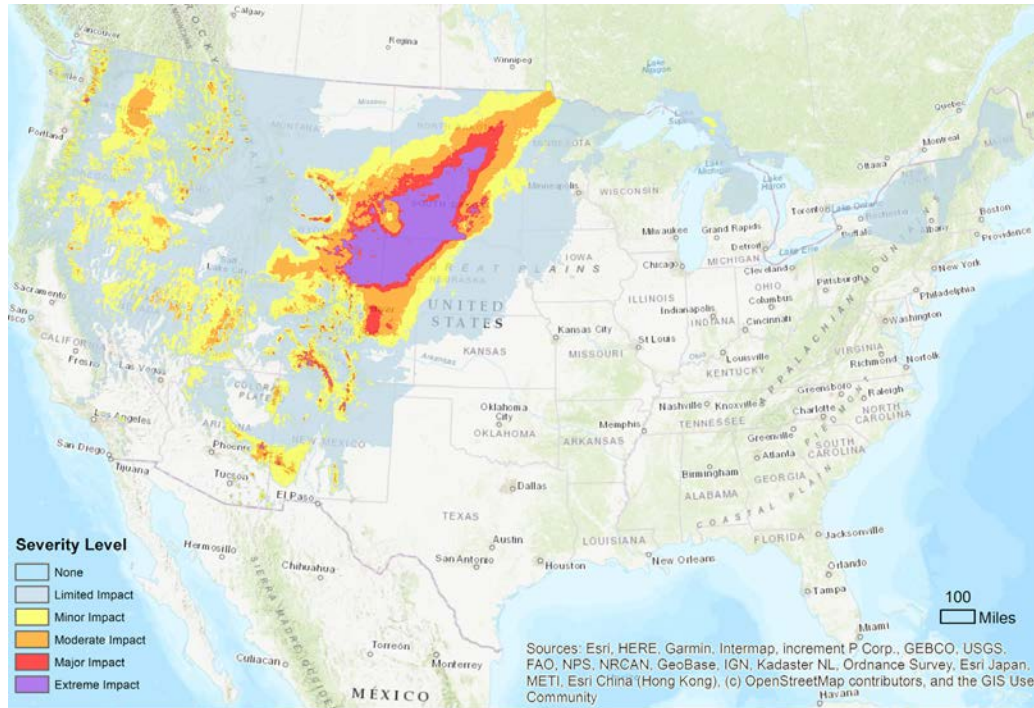
90 Member Multi - Model Ensemble Synthesized to 5 Scenarios

But what about impacts?

Nascent Example: Winter Storm Severity Index

Translates combination of meteorological variables into expected IMPACT
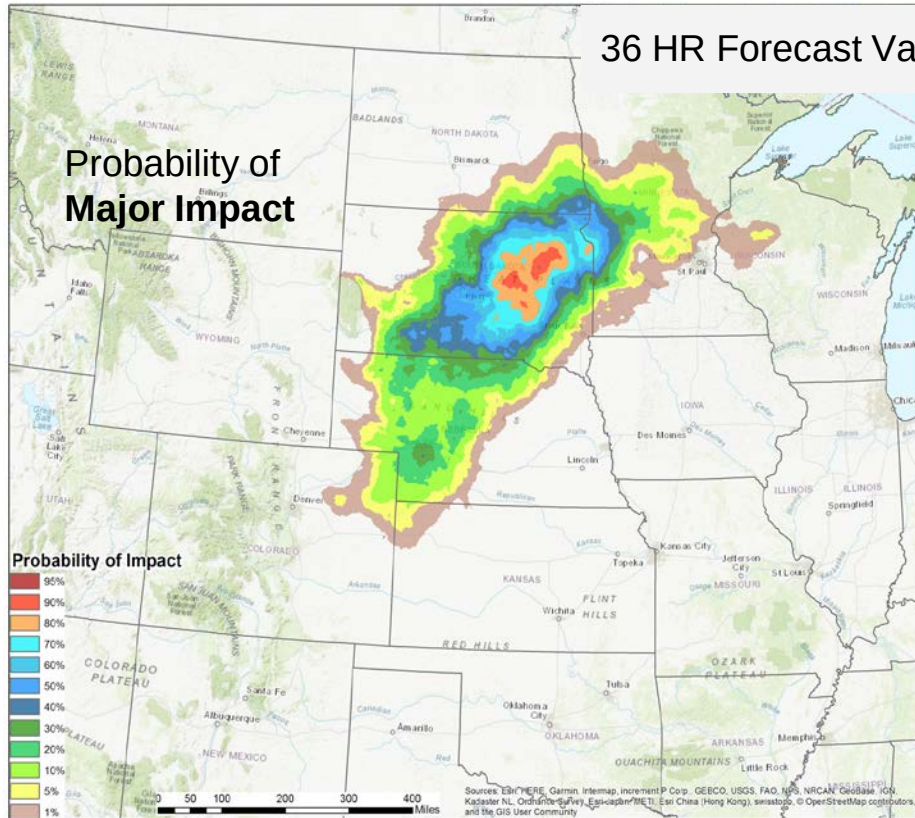
Potential Winter Storm Impacts

No Impacts
Impacts not expected.

Limited Impacts
Rarely a direct threat to life and property. Typically results in little inconveniences.

Minor Impacts
Rarely a direct threat to life and property. Typically results in an inconvenience to daily life.

Moderate Impacts
Often threatening to life and property, some damage unavoidable. Typically results in disruptions to daily life.

Major Impacts
Extensive property damage likely, life saving actions needed. Will likely result in major disruptions to daily life.

Extreme Impacts
Extensive and widespread severe property damage, life saving actions will be needed. Results in extreme disruptions to daily life.
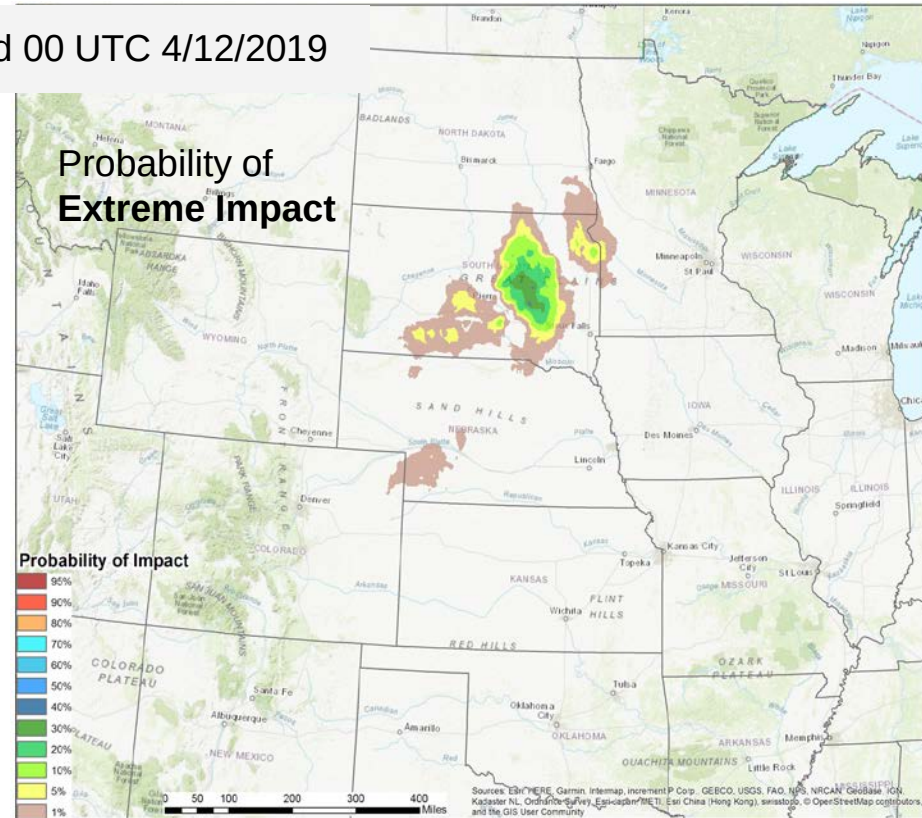
Probability of IMPACT

36 HR Forecast Valid 00 UTC 4/12/2019
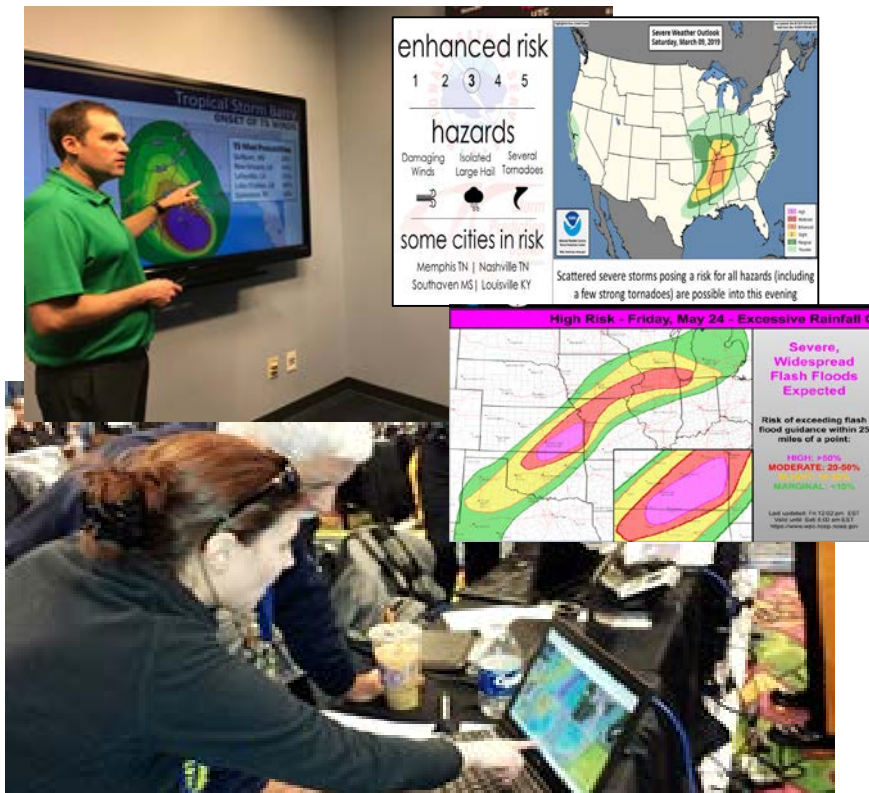
Probability of **Major Impact**

Probability of **Extreme Impact**

Probability of Impact
- 95%
- 90%
- 80%
- 70%
- 60%
- 50%
- 40%
- 30%
- 20%
- 10%
- 5%
- 1%

Evolving Toward Probabilistic Hazard Information as the Foundation for IDSS

Requires continued investments in:
- Improved Observations
- High Performance Computing
- Ensemble development and improvement
  - Calibration & Resolution
  - Reforecasts
- Forecaster tools & visualizations
- Risk communication science
- Partner engagement
- Forecaster training

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