Developing and Evaluating First-Guess Watch Guidance Within SPC Operations

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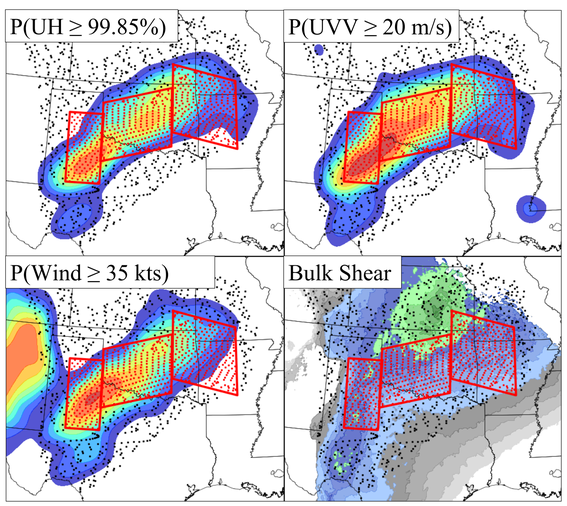
1. Motivation:

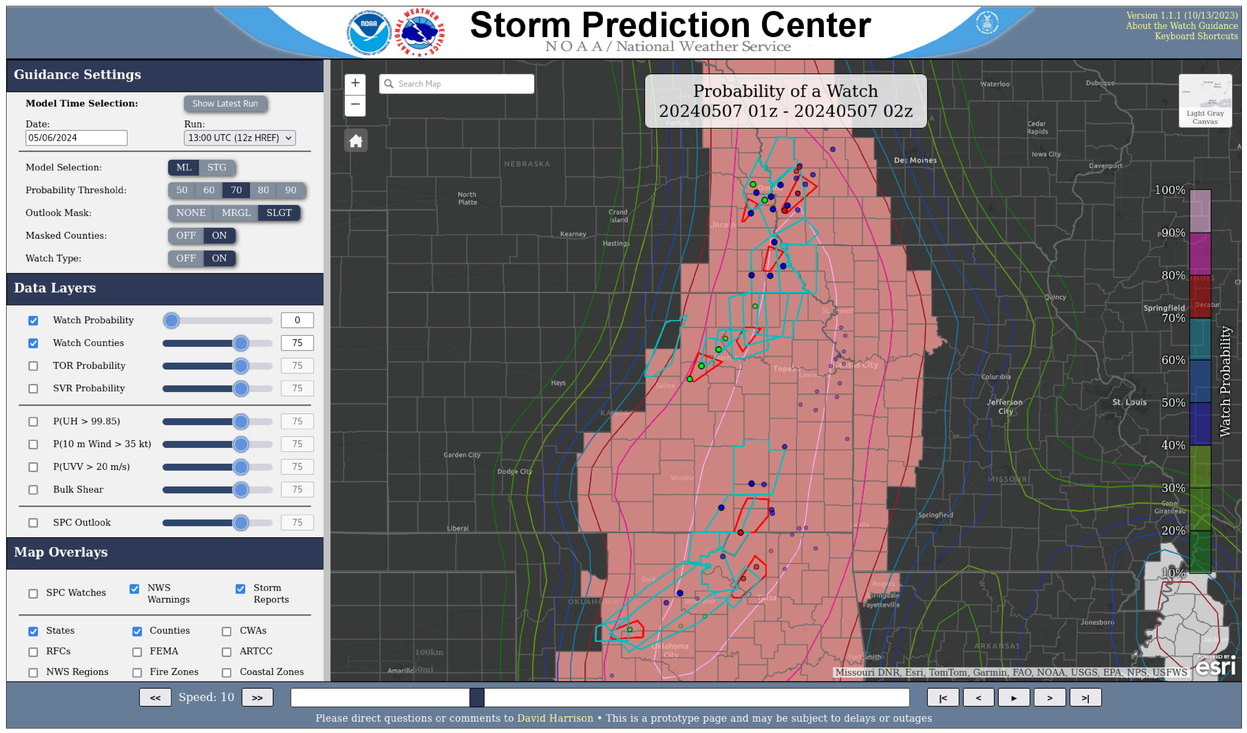
SPC forecasters must start planning where, when, and for how long to issue a convective watch several hours before the first severe storm develops. The placement and timing of the first watch can impact forecaster workload during severe weather operations. Can we use machine learning to provide advanced guidance on where and when watches may be needed?

2. Watch Location/Timing:

A Gradient Boosting Classifier was trained on archived High-Resolution Ensemble Forecast (HREF) prognostic fields to estimate where and when conditions will be favorable for a severe weather watch during a 48-h forecast period. Most important variables identified by the watch location model include:

- Probability of UH ≥ 99.85% of climo
- Probability of 10-m Wind ≥ 35 kt
- Probability of UVV ≥ 20 m/s
- Bulk Shear (sfc – 500 mb)





3. Watch Type:

A second Gradient Boosting Classifier was trained on archived HREF prognostic fields to estimate if conditions favor a Tornado or Severe Thunderstorm watch. Initial inputs were selected by identifying which fields best discriminated between the two watch types via a Kolmogorov-Smirnov test. The model was then trained on HREF forecasts from 2018 – 2020 and tested on data from 2021.

Most important inputs identified by the watch type model include:

- 700 mb wind speed
- 700 mb wind direction
- 0-1 and 0-3 SRH
- MUCAPE
- SBCAPE
- Month
- 2-m dewpoint
- LCL Height
- STP
- MUCINH
- SBCINH
- Bulk Shear

4. A First-Guess Watch:

A county is included within a deterministic first-guess watch at a given forecast hour if:

- The mean watch probability within the county ≥ 70%
- At least part of the county is within an SPC Slight Risk area valid at the forecast hour

A county is shaded red if the predicted mean probability of a Tornado Watch ≥ 50%. Otherwise the county is shaded blue to indicate a recommended Severe Thunderstorm Watch. Clustering algorithms are applied in post processing to ensure type congruity in the recommended watches. All thresholds can be adjusted by forecasters in real-time to tune the first-guess watches to their specific needs.

5. Operational Applications:

The first-guess watch guidance was introduced into SPC operations in early 2023 and forecaster feedback has been largely positive. The guidance has been found particularly useful when planning out Mesoscale Convective Discussions in the hours preceding watch issuance.

While the location and timing predictions are skillful, the watch-type predictions have been found to excessively favor Tornado Watches. Further development of the watch-type model is planned to address this aspect of the guidance

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