Title: Improving the watch-to-warning space with Probabilistic Hazard Information and the Warn-on-Forecast System

Abstract:

The period between watch and warning issuance (corresponding to lead times of about 1-4 hours) can be important for decision makers who need longer lead times to take protective actions. However, between watches and warnings, there are no standardized National Weather Service (NWS) products designed for public consumption, no guarantees of consistent messaging between NWS offices, and relatively few forecaster tools that consider both observations and numerical weather prediction (NWP) data.

To help address some of these challenges, the National Severe Storms Laboratory (NSSL) and Cooperative Institute for Severe and High-Impact Weather Research and Operations (CIWRO) have created several probabilistic forecasting tools designed to provide guidance between watches and warnings. Storm-based Probabilistic Hazard Information (PHI) is designed to provide a meaningful quantification of hazard likelihood with additional spatial and temporal precision. Artificial intelligence/machine learning (AI/ML) guidance provides the initial estimates of hazard probabilities for tornadoes, hail, wind, and lightning. PHI plumes are continuously updated to reflect immediate changes in storm motion and intensity. Another AI/ML product, called Warn-on-Forecast System - Probabilistic Hazard Information (WoFS-PHI) blends observation-based information from PHI and NWP forecast data from NSSL’s WoFS to make probabilistic predictions of severe hail, wind, and tornadoes within specified time windows and spatial radii at lead times up to 4 hours.

PHI and WoFS-PHI were evaluated in the 2024 Hazardous Weather Testbed Watch-to-Warning-Experiment (HWT W2WE), which took place over 3 weeks from August - September of 2024. In this experiment, SPC and WFO forecasters used PHI and WoFS-PHI to issue novel probabilistic watch-to-warning products in 4 displaced-real-time severe weather cases. During the final case each week, 3-5 emergency managers (EMs) used forecasters’ products to make decisions in a parallel EM activity.

In surveys from the W2WE, forecasters indicated that WoFS-PHI was helpful for creating probabilistic products, especially non-technical “local discussions” and public graphics. Half of the EMs indicated that forecaster-issued PHI plumes allowed them to make decisions earlier than they otherwise would have been able to. Overall, results suggest that AI/ML products such as PHI and WoFS-PHI can be used to create more effective messaging to end users, leading to better and faster decisions.