Probabilistic Forecasting of Severe Convection through Data Fusion

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Abstract

Hazards from severe convective storms annually cause property losses in the U.S. exceeding $1 billion and the loss of human lives. Accurate short-term forecasts of these storms are vital to the protection of life and property. The National Weather Service (NWS) already uses many data sources to aid with the forecast of severe storms (e.g., radiosondes, satellites, radar, numerical weather prediction models [NWP], surface stations, lightning detection networks). Each type of data has its own strengths and limitations. This project exploits the advantages of Geostationary Operational Environmental Satellites (GOES), radar, and NWP information in an observation-driven, object-centric manner, by extracting and condensing pertinent information in the torrent of data currently at the forecasters' disposal. An empirical model uses this information to make probabilistic forecasts of severe weather occurrence (within the next 60 min) for a given storm. Furthermore, this probabilistic warning guidance will be displayed using an unobtrusive method, whereby forecasters may view the probability in their normal warning operations mode to quickly ascertain the severe potential, based on a storm's satellite and radar characteristics, and the environment it developed in. This overlaid data will be able to be toggled on and off at the forecaster's discretion.

This project already builds upon recent research in the field of severe convective forecasting, by incorporating the University of Wisconsin Cloud-Top Cooling concept, GOES-derived cloud-top properties, Multi-Radar Multi-Sensor derived products, and high-resolution NWP-derived fields. New datasets with the potential to improve severe weather prediction (e.g., GOES-R Geostationary Lightning Mapper, GOES-R super-rapid scan operation, polarimetric radar data, High-Resolution Rapid Refresh NWP) will be incorporated into the model and evaluated at national proving ground experiments and local NWS offices. Probabilities of specific hazards (e.g., tornado, large hail, high wind) will be a future output of this model. More innovative techniques to display and convey the information quickly and easily to forecasters in an operational setting will also be developed. This research will harness the most useful information available to forecasters in order to increase the accuracy of and extend lead-time on severe thunderstorm and tornado warnings.