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Using machine learning to advance next-day probabilistic convective hazard prediction with convection-allowing models: Initial results and future plans

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Convection-allowing models (CAMs) provide forecasters with potentially valuable depictions of convective mode and intensity. However, present-day CAM diagnostics, including widely-used updraft helicity (UH) fields, do not sufficiently discriminate between convective morphologies. Thus, using CAMs to identify the range of possible modes within a given forecast period is typically accomplished by subjectively interrogating CAM output, such as simulated reflectivity. Although objective automated approaches to identify distinct convective modes have been successfully applied to observed storms, they have not been applied to simulated storms in CAM output. Yet, as the size and update-frequency of CAM ensembles increases, the need for objective techniques to quickly synthesize forecasts of mode from CAMs will become paramount.

Here, we report on initial results to develop an objective convective mode identification system for usage with CAM ensembles. The mode identification system will be tested with multiple state-of-the-art machine learning approaches of various complexity, including random forests and convolutional neural networks, that are well-suited to image classification. These algorithms require a large set of hand-classified simulated storms over a diverse collection of events to reduce the likelihood of overfitting and improving generalization on future events. This presentation will focus on efforts to obtain a robust set of classifications for training, beginning with supercells and mesoscale convective systems, using several large (> 500 forecast) retrospective CAM datasets and initial results from algorithm testing. The development of CAM convective mode guidance and examples of how mode information will be incorporated into existing approaches for producing severe hazard guidance (e.g., using surrogate diagnostics) will also be discussed. The utility of the mode identification system and derived guidance will be evaluated in the NOAA Hazardous Weather Testbed (HWT) between 2020-2022; example of planned comparisons using forecasts from the 2019 NOAA HWT will be presented.