MMM SEMINAR SERIES

Mesoscale & Microscale Meteorology MMM LABORATORY

Improving Predictability of Hazardous Weather through Ensemble Sensitivity Analysis

Austin Coleman

NCAR/MMM

Ensemble sensitivity analysis (ESA) offers a computationally inexpensive way to diagnose sources of high-impact forecast feature uncertainty by relating a localized high-impact forecast phenomenon of interest (response function) back to early forecast conditions. These information-rich diagnostic fields provide ample opportunity both for understanding predictability from a basic science standpoint and for practical operational applications.

From a physical science perspective, developing a climatology of ESA fields allows us to investigate the types of flow regimes that yield high- or low-predictability forecast scenarios. Exploring this question through different formulations of ESA as proxies for intrinsic and practical predictability reveal insights pertaining to the extent in which reduced observational uncertainty improves predictability. Finally, principal component analysis of these fields can yield leading modes of low-predictability (high-sensitivity) scenarios. Preliminary findings in this realm will be discussed.

From a practical perspective, ESA fields provide valuable context to high-impact forecast events but contain too much detail to be used in fast-paced operational scenarios. In direct response to this forecaster sentiment, an ESA-based ensemble subsetting approach was developed. Sensitivity-based ensemble subsetting is a post-processing technique that identifies ensemble members best-equipped for the prediction of some chosen high-impact forecast feature later in the forecast period without the need for additional data assimilation cycles. The flexibility, speed, and customizability of the tool make it well-posed to be used by forecasters to interrogate uncertain ensemble guidance. Subjective assessment from 4 years-worth of real-time experiments in the HWT SFE yielded promising results, with encouraging enthusiasm from forecasters about the usefulness of subset guidance. Furthermore, subsets outperformed their full ensemble counterparts substantially and consistently in objective idealized experiments. However, translating this underlying utility to a practical framework with objective verification statistics has proven challenging. Semi-idealized experiments revealed that the primary obstacle in subset success is due to verification of updraft helicity response functions with local storm reports (two fundamentally different quantities). Mitigating this disconnect has involved developing machine learning algorithms that explicitly predict local storm reports towards the end goal of optimizing the subsetting tool for its eventual transition to operations. These results and their implications will be discussed.

Thursday, 6 October 2022, 2:00pm

Refreshments 1:45pm

Please also join colleagues for refreshments and informal discussion after the seminar until 3:30pm

NCAR-Foothills Laboratory, 3450 Mitchell Lane

FL2-1022, Large Auditorium

Seminar will also be live webcast

https://operations.ucar.edu/live-mmm

Participants may ask questions during the seminar via Slido.

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