RAL/MMM SEMINAR SERIES

Real-Time, High-Resolution Hurricane Prediction with the Model for Prediction Across Scales

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The NOAA Global Systems Laboratory's (GSL's) Grand Challenge is to deliver actionable global storm-scale prediction and environmental information through advanced technologies to serve society. Meeting the prediction aspect of our Grand Challenge requires a robust modeling system, including the dynamical core to solve the primitive equations on a defined grid, physics parameterizations to mimic small-scale and/or computationally expensive physical processes, and data assimilation to provide a reliable representation of the initial atmospheric state.

NOAA's operational thunderstorm-scale to subseasonal-to-seasonal scale modeling activities rely on the Finite Volume on the Cubed Sphere, or FV3, dynamical core at the foundation of the Unified Forecast System (UFS). However, years of development have demonstrated that the FV3 dynamical core suffers from significant positive biases in thunderstorm updraft intensity, thunderstorm counts, and precipitation on thunderstorm- resolving scales. Consequently, GSL has adopted an alternative model and dynamical core, the Model for Prediction Across Scales-Atmosphere (MPAS-Atmosphere), as the foundation for its storm-scale model development activities.

As one of its initial steps toward meeting its Grand Challenge, GSL has been running twice-daily real-time MPAS-Atmosphere forecasts over the North Atlantic Basin as part of NOAA's 2024 Hurricane Forecast Improvement Project. The associated hurricane track forecasts are highly skillful for all storms, with mean absolute errors of comparable magnitude to those from the National Hurricane Center's official forecasts and NOAA's Hurricane Analysis and Forecast System forecasts. Hurricane intensity errors are also highly skillful except for very-short-lead predictions of very-intense hurricanes due to the lack of storm-scale data assimilation to initialize these forecasts. The model is capable of reasonably predicting rapid intensification and internal dynamics such as eyewall replacement cycles and resulting structural evolution. My presentation will characterize MPAS-Atmosphere's performance in predicting hurricane track, intensity, and structure, emphasizing highly impactful Hurricanes Francine, Helene, and Milton, and discuss our plans for future MPAS-Atmosphere modeling system development.