BAMS
Meeting Summary

The First Hybrid NOAA Hazardous Weather Testbed Spring Forecasting Experiment for Advancing Severe Weather Prediction

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The 2023 NOAA Hazardous Weather Testbed Spring Forecasting Experiment

What: Within a hybrid framework of in-person and virtual participation, over 125 forecasters and researchers engaged in real-time, experimental severe weather forecasting activities and model evaluations, which included 1) the Rapid Refresh Forecast System, 2) the Model for Prediction Across Scales, 3) the Warn-on-Forecast System, and 4) innovative postprocessing strategies.

When: 1 May–2 June 2023

Where: Norman, Oklahoma, and Online

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After three years of fully virtual experiments, the 2023 NOAA Hazardous Weather Testbed Spring Forecasting Experiment (SFE 2023) resumed in a hybrid format, with 50 of 127 participants contributing remotely. The hybrid format is ideal because virtual participation engages those unable to attend physically, while in-person participation enables science-based discussions and establishing new collaborations, thus expanding the SFE scope in the number and diversity of participants. SFEs, co-led by the NWS/Storm Prediction Center (SPC) and OAR/National Severe Storm Laboratory (NSSL), aim to accelerate research-to-operations (R2O) by testing new prediction capabilities, studying how end-users apply and interpret severe weather guidance, and conducting numerous model evaluations. SFE 2023 results have particular importance as NOAA's Unified Forecast System (UFS) initiative moves forward with the Rapid Refresh Forecast System (RRFS), NOAA's first formally designed convection-allowing model (CAM) ensemble, which is scheduled for operational implementation in 2025.

SFE 2023 forecasting activities included issuing experimental 1) severe weather outlooks for days 1–4 and 2) short-term mesoscale discussions using NSSL's Warn-on-Forecast System (WoFS). Model evaluations used the 41-member Community Leveraged Unified Ensemble (CLUE; Clark et al. 2018), which included deterministic and ensemble components of RRFS, medium-range CAM ensembles with 7-day forecasts, the Model for Prediction Across Scales (MPAS), and a 1-km Weather Research and Forecasting Model configuration for tornado and severe wind forecasting. Other evaluations explored mesoscale analyses and machine learning (ML) approaches for generating severe weather guidance from CAMs and the Global Ensemble Forecast System (GEFS).

Some highlights of the 2023 SFE

In detailed blind (i.e., model labels were hidden) subjective and objective assessments, the RRFS had inferior performance relative to its operational deterministic and ensemble counterparts, the High-Resolution Rapid Refresh (HRRR) and High-Resolution Ensemble Forecast System (HREF), respectively. Participants noted issues with overforecast storm intensity and spurious convection, which tests at NSSL have shown are directly related to characteristics of the Finite Volume Cubed Sphere (FV3) model core used in RRFS. While similar performance was found between HRRR and RRFS in SFE 2022, the 2023 results were likely impacted by implementation of radar data assimilation in 2023, which introduced the problems with

storm intensity and spurious convection near initialization time that were linked to errors at later hours in the forecast. These storm intensity issues were also present in 2022, but not fully manifest until the first diurnal convective maximum, so that errors had not had a chance to grow and significantly impact the day 1 forecast. Furthermore, 2023 results were likely affected by a relatively quiet weather regime with weakly forced events in which the RRFS issues are more apparent.

Because of irreconcilable issues NSSL identified with FV3 for rapid data assimilation and prediction at convection-allowing scales (i.e., grid spacing ≤ 3 km), NSSL began testing MPAS in early 2023 as a replacement for WRF in its next-generation WoFS. The tests consisted of three regional, CONUS-domain MPAS configurations to assess whether MPAS could simulate storms with the same fidelity as WRF. After this short development period, SFE 2023 evaluations indicated MPAS configurations performed very well. MPAS runs initialized from RRFS performed better than the RRFS itself, and MPAS performance was competitive with the HRRR. NOAA is in the process of leveraging these results to improve future versions of RRFS.

SFE 2023 included assessment of 10-member FV3-based and 5-member MPAS ensembles with forecasts to 7 and 5 days, respectively. In comparisons of FV3-based and MPAS five-member ensembles at day 3–5 lead times, the MPAS ensemble received significantly higher mean subjective ratings. Nonetheless, at times, forecast value was noted in the FV3-based CAM ensembles out to day 7.

More information on the 2023 SFE

In this first hybrid SFE, progress was made in key areas to accelerate R2O and assist evidence-based decision-making for models and tools that improve operational severe weather forecasts. The full 2023 SFE Summary Report is at https://hwt.nssl.noaa.gov/sfe/2023/docs/HWT_SFE_2023_Prelim_Findings_v1.pdf.

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Reference

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