Comparison of the HRRRR Time-Lagged Ensemble to Formal CAM Ensembles during the 2018 HWT Spring Forecasting Experiment

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Introduction

Three convection-allowing model (CAM) ensembles were compared to time-lagged ensembles generated from the High Resolution Rapid Refresh (HRRRv3) during the 2018 NOAA HWT Spring Forecasting Experiment (SFE2018) from 30 April – 1 June: the operational High Resolution Ensemble Forecast (HREF) system, the HRRR ensemble (HRRRE), and the National Center for Atmospheric Research (NCAR) ensemble.

These 12Z CAM ensembles were evaluated subjectively on hourly maximum field (HMF) forecasts, e.g., updraft helicity – UH) for severe weather guidance.

12Z CAM Ensembles Evaluated during SFE2018

- HREFv2: 8-member multi-model (WRF-ARW & NMMB); multi-physics; multi-initial conditions (NAM & RAP, four 12-h time-lagged members)
- HRRRE: 9-member single-model (WRF-ARW); single-physics; multi-initial conditions (from 36-member 3-km EnKF data assimilation system with hourly cycling from 03Z initialization)
- NCAR: 10-member single-model (WRF-ARW); single-physics; multi-initial conditions (from 80-member 15-km DART EnKF data assimilation system with continuous hourly cycling)
- HRRR-TL: 4- or 6-member single-model (HRRRv3); single-physics; multi-initial conditions (four 1-h time-lagged members; plus 6- and 12-h time-lagged members for HRRR-TL6)

1 May 2018

22-02Z

Moderate Risk over central KS

HREF focuses highest UH probs over proper region

HRRRE: UH probs are elongated too far to the NE

NCAR forecast is underdispersive

HRRR-TL also overconfident, but UH probs nicely capture reports

15 May 2018

20-00Z

Moderate Risk over Northeast

HREF: UH max slightly displaced, but broadest probs

HRRRE UH prob max is located too far to the north

NCAR forecast lowest UH probs

HRRR-TL generates perhaps the best location of UH probs

Results of Subjective Ensemble Forecast Evaluation

- Ensemble maximum and neighborhood probabilities of HMF fields (typically UH and 10-m wind speed) were subjectively evaluated by SFE2018 participants for correspondence with severe weather reports from 16-03Z and assigned a rating on a scale of 1-10, with 10 being best.

Subjective HMF Ratings for 12Z CAM Ensembles

<table>
<thead>
<tr>
<th>Ensemble</th>
<th>Median</th>
<th>Mean</th>
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<tbody>
<tr>
<td>HREF</td>
<td>7</td>
<td>6</td>
</tr>
<tr>
<td>HRRRE</td>
<td>7</td>
<td>5</td>
</tr>
<tr>
<td>NCAR</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>HRRR-TL4</td>
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<td>2</td>
</tr>
<tr>
<td>HRRR-TL6</td>
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</tbody>
</table>

The HRRR-TL ensembles, fared well in terms of subjective ratings, falling behind the HREF but ahead of the HRRRE and NCAR ensemble

Summary and Conclusions

- Three CAM ensembles were compared for severe weather events to 4- and 6-member HRRR-TL ensembles during the five-week HWT SFE2018: HREF, HRRRE, and NCAR
- The HREF was the highest subjectively rated 12Z ensemble during SFE2018, likely owing to a more diverse ensemble forecast represented by broader probabilistic fields.
- The HRRR-TL ensembles fared well in subjective ratings, commonly outperforming the HRRRE, a formal initial-condition ensemble with ensemble DA, using the same model configuration.
- These results suggest that HRRR-TL ensembles are an underutilized resource in NWS severe weather operations, given that the data (i.e., HRRR output) already exist operationally and are updated on an hourly basis.

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