The SPC Storm-Scale Ensemble of Opportunity (SSEO): Overview and Results from the 2012 Hazardous Weather Testbed Spring Experiment

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Introduction
- The Storm Prediction Center (SPC) has developed a 7-member experimental storm-scale ensemble of opportunity (SSEO).
- The SSEO:
  - consists of deterministic storm-scale models already available operationally to SPC.
  - provides a practical alternative to a formal storm-scale ensemble, given limited computing resources in NOAA.
  - contains hourly maximum storm-attribute fields, such as simulated reflectivity, updraft helicity, updraft speed, and 10-m wind speed.
- The SSEO has been utilized in SPC operations for the past year.
- The performance of the SSEO during the 2012 Spring Forecasting Experiment (SFE2012) was compared to other high-res ensembles:
  - SREF perturbations for IC/LBCs
  - AFWA – 10-member single-model (WRF-ARW), multi-physics, multi-initial conditions using global model forecasts for IC/LBCs
  - Objective verification (i.e., CSI at 10% and FSS) was performed for neighborhood probabilities of 1-km AGL simulated reflectivity ≥40 dBZ with the SSEO having the highest objective verification scores accumulated over the 5-week period of the SFE2012.

Examples

<table>
<thead>
<tr>
<th>SSEO</th>
<th>02 March 2012 (12-12Z)</th>
</tr>
</thead>
<tbody>
<tr>
<td>6-hr ensemble max UH</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SSEO</th>
<th>29 June 2012 (12-12Z)</th>
</tr>
</thead>
<tbody>
<tr>
<td>24-hr spaghetti UH ≥25 m/s²</td>
<td></td>
</tr>
</tbody>
</table>

SSEO Membership
- The 00Z SSEO is a multi-model, multi-physics ensemble comprised of 7 members with initial condition diversity from 2 time-lagged members:

<table>
<thead>
<tr>
<th>Grid Spacing</th>
<th>Vert Levels</th>
<th>Time Step</th>
<th>PBL</th>
<th>Micro</th>
</tr>
</thead>
<tbody>
<tr>
<td>NSSL WRF-ARW</td>
<td>4 km</td>
<td>24 s</td>
<td>MYJ</td>
<td>WSM6</td>
</tr>
<tr>
<td>EMC HRW WRF-ARW</td>
<td>5.15 km</td>
<td>35 s</td>
<td>YSU</td>
<td>WSM3</td>
</tr>
<tr>
<td>EMC HRW WRF-ARW*</td>
<td>5.15 km</td>
<td>35 s</td>
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<td>WSM3</td>
</tr>
<tr>
<td>EMC HRW WRF-NMM</td>
<td>4 km</td>
<td>35 s</td>
<td>MYJ</td>
<td>Ferrier</td>
</tr>
<tr>
<td>EMC CONUS WRF-NMM</td>
<td>4 km</td>
<td>35 s</td>
<td>MYJ</td>
<td>Ferrier</td>
</tr>
<tr>
<td>EMC CONUS NAM NEST*</td>
<td>4 km</td>
<td>60 s</td>
<td>MYJ</td>
<td>Ferrier</td>
</tr>
</tbody>
</table>

SSEO Hourly Maximum Fields

**Description of Fields:**
- **Simulated Reflectivity** – calculated at 1-km AGL or as composite
- **Uphdraft Helicity (UH)** – representation of rotating updrafts in simulated storms
- **Uphdraft Speed** – maximum upward motion in the lower-to-mid troposphere
- **10-Wind Speed** – examined to identify convective gusts

**Processing Techniques:**
- **Temporal Max** – extract the max value over longer period, e.g., 24 hours
- **Neighborhood Max** – search within 40 km (~25 mi) radius to assign max value

**Display Methods:**
- **Spaghetti** – display members at a given threshold with different colors
- **Ensemble Maximum** – the maximum value for the ensemble at each grid point

SFE2012 Results
- The SSEO was compared to two other storm-scale ensembles during the 2012 HWT Forecasting Experiment (SFE2012) from May 7 – June 8:
  - SREF – 12-member multi-model, multi-physics, multi-initial conditions using SREF perturbations for IC/LBCs
  - AFWA – 10-member single-model (WRF-ARW), multi-physics, multi-initial conditions using global model forecasts for IC/LBCs
- Objective verification (i.e., CSI at 10% and FSS) was performed for neighborhood probabilities of 1-km AGL simulated reflectivity ≥40 dBZ with the SSEO having the highest objective verification scores accumulated over the 5-week period of the SFE2012.

Summary
- The SPC SSEO is a practical approach in generating storm-scale ensemble data and is currently available to SPC forecasters.
- Hourly maximum storm-attribute fields (e.g., UH) are processed in various ways to derive maximum usefulness from the data.
- The SSEO has performed reasonably well in highlighting the threat areas in many of the historic severe weather events over the previous two years.
- Subjective and objective evaluations from SFE2012 indicate the SSEO often performed as well as or better than more formal storm-scale ensembles in forecasting the occurrence of convective and severe weather.

Acknowledgments:
We would like to thank Ming Xue, Fanyou Kong, and Kevin Thomas from OU CAPS for generating and providing SSEF data and Jack Kain and Patrick Marsh of NSSL for making the data available to SPC. Evan Kuchera and Scott Rentschler of AFWA are also thanked for providing AFWA data.

Subjective verification was performed by the SFE2012 participants in rating the usefulness of neighborhood probability forecasts of 1-km AGL simulated reflectivity and updraft helicity with the SSEO most commonly receiving the highest ratings.

Sample Size: 23 days

Accumulated CSI & FSS: 1-km Reflectivity

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