Evaluation of RAMS in the Eastern Range Dispersion Assessment System

Jonathan L. Case
John Manobianco
Mark M. Wheeler
Allan V. Dianic
NASA Kennedy Space Center/Applied Meteorology Unit/ENSCO, Inc.
Carlton R. Parks
ACTA, Inc.
Dewey E. Harms
45th Weather Squadron, USAF
Presentation Outline

- ERDAS RAMS Configuration
- Model Evaluation
  - Objective and Subjective Components
- Objective Results
- Subjective Results
- Summary
ERDAS RAMS Configuration

- 4 nested grids (2-way interactive on grids 2, 3, 4)
- Full microphysics on grids 1-4
- Kuo-type cumulus parameterization on grids 1-3
- 3D non-hydrostatic
- Mellor-Yamada TKE
- Chen and Cotton radiative parameterization
- Vegetation temperature / moisture model (11 soil layers - fixed initial soil moisture)
- Lateral BC: nudged by 12-36 h Eta forecasts
<table>
<thead>
<tr>
<th>Grid</th>
<th>NX</th>
<th>NY</th>
<th>NZ</th>
<th>ΔX (km)</th>
<th>ΔT (s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>36</td>
<td>40</td>
<td>33</td>
<td>60</td>
<td>90</td>
</tr>
<tr>
<td>2</td>
<td>38</td>
<td>46</td>
<td>33</td>
<td>15</td>
<td>45</td>
</tr>
<tr>
<td>3</td>
<td>41</td>
<td>50</td>
<td>36</td>
<td>5</td>
<td>22.5</td>
</tr>
<tr>
<td>4</td>
<td>74</td>
<td>90</td>
<td>36</td>
<td>1.25</td>
<td>7.5</td>
</tr>
</tbody>
</table>

RAMS Nested Grid Configuration
RAMS Initialization and Forecast

- Data obtained at 0000 and 1200 UTC
  - 12-h forecast from Eta
  - Rawinsondes
  - Surface stations & buoys
  - Local wind towers
  - 5 local 915 MHz & 1 local 50 MHz profilers

- Isentropic analysis using Barnes

- Cold start (no 4DDA or cycling with RAMS forecasts)

- 24-h RAMS forecasts generated

- Hourly forecast output available
Objective component

- Point verification (automated real-time archive)
  - Bias, RMS in T, T_d, u, v, Wind direction & Speed
  - 13 selected local wind towers on grid 4
  - Land, buoy, tower, profiler, & raob sites on grids 1-4
  - Eta benchmark

- Grid verification (difference fields on grid 4)

- Limited sensitivity / case studies
  - Soil moisture
  - Horizontal resolution
  - Parameterization schemes

- May through August 1999
Subjective Component (real-time evaluation)

- Central Florida east coast sea breeze (grid 4 only)
  - Identify occurrence (WSR-88D & 1-km visible satellite data)
  - Onset & propagation (13 local towers)
  - Compare with model forecasts at 13 towers

- Precipitation on grid 4

- Low-level Temperature inversions

- May through August 1999
Objective Verif. (May–Aug, 0000 UTC only)

Wind Direction (°)

Bias (systematic error)

RMS Error (total error)

Forecast Hour

Temperature (°C)

Forecast Hour
### TABLE 1. Contingency table of sea breeze occurrence.

<table>
<thead>
<tr>
<th>Forecast Sea Breeze</th>
<th>Observed Sea Breeze</th>
<th>No Observed Sea Breeze</th>
</tr>
</thead>
<tbody>
<tr>
<td>Observed Sea Breeze</td>
<td>110</td>
<td>3</td>
</tr>
<tr>
<td>Sea Breeze Not Forecast</td>
<td>6</td>
<td>16</td>
</tr>
</tbody>
</table>

- Probability of Detection: 0.95
- False Alarm Ratio: 0.03
- Critical Success Index: 0.92
- Heidke Skill Score: 0.74

### TABLE 2. Sea-breeze timing error statistics for May–August 1999.

<table>
<thead>
<tr>
<th></th>
<th>0000 UTC</th>
<th>1200 UTC</th>
<th>All</th>
</tr>
</thead>
<tbody>
<tr>
<td>MAE (h)</td>
<td>0.9</td>
<td>0.9</td>
<td>0.9</td>
</tr>
<tr>
<td>RMS (h)</td>
<td>1.3</td>
<td>1.3</td>
<td>1.3</td>
</tr>
<tr>
<td>SD (h)</td>
<td>1.3</td>
<td>1.3</td>
<td>1.3</td>
</tr>
<tr>
<td>Bias (h)</td>
<td>-0.2</td>
<td>0.1</td>
<td>0.0</td>
</tr>
</tbody>
</table>
Summary

- **Wind Dir:** Unbiased, 50-70° non-systematic error
  - Largest during nighttime hours (light wind regimes)
  - 15-23° composed of observational variability (Merceret 1995)
  - 35-50° remaining model error → cannot resolve obs features

- **Temperature:** Cool daytime bias (up to 4 °C)

- **RAMS:** Excellent in forecasting onset and movement of central FL ECSB
  - Occurrence
  - Timing at each wind tower (within 1 h)

- **AMU Quarterly reports:**
  [http://technology.ksc.nasa.gov/WWWaccess/AMU](http://technology.ksc.nasa.gov/WWWaccess/AMU)
St. Dev. vs. RMS (May-Aug, 0000 UTC)

Wind Direction (°)

RMS Error (total error)

St. Dev. (non-sys. error)

Forecast Hour

Temperature (°C)

Forecast Hour
RAMS Operational Cycle

- RAMS run on (3) HP-K460 (11 processors total)
- Prognostic data still available for 1-cycle failure