Introduction to NCEP's time lagged North American Rapid Refresh Ensemble Forecast System (NARRE-TL)

Binbin Zhou¹,², Jun Du², Geoff Manikin² & Geoff DiMego²

1. I.M. System Group
2. EMC/NCEP/NWS/NOAA

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Background

RR will be implemented at NCEP in fall of 2011 to replace RUC

RR: same purpose for aviation, same hourly cycles, same 18 forecast hours, and same resolution as RUC (13km), but with more advanced WRF-ARW model and GSI analysis system, covers larger N.A. domains plus Alaska

NCEP and GSD agreement: 3 WRF-ARW and 3 WRF-NMMB members will be combined to generate N.A. RR Ensemble (6 member NARRE)

Before 6-membered NARRE emerging, first build a Time-lagged NARRE system based on current RR and operational NAM. Benefits:

(1) Fully utilize existing hourly output RR data
(2) Replace VSREF to provide probabilistic guidance to aviation weather
(3) Very low computing resource demand (just post processing)
(4) Provide a baseline to future NARRE/HRRRE development/evaluation
### Configuration

10 weighted time-lagged members collected:
- 6 NCEP’s parallel RR members
  (9 months parallel RR: March ~ Nov 2011)
- 4 operational NAM members

Output grids:
- Grid#130 over CONUS (same as RUC/VSREF)
- Grid#242 over Alaska

Forecast hours:
- 12 hours (same as VSREF)
Member Weighting = 1 - forecast age (hr)/30:

1 for current fcst and 0 for 30hr-old fcst

(NAM always older than RR → gives more weight to RR members)
RR’s first 6 hr forecasts are used up for time-lag
Example for 06Z cycle’s NARRE-TL:
Ensemble product generation (post processing)

Member 1 | Member 2 | Member 3 | Member 4 | Member 5 | Member 6 | Member 7 | Member 8 | Member 9 | Member 10

Unified ensemble product generator

User defined product list table

Product 1 | Product 2 | Product 3 | Product 4 | Product 5 | Product 6
<table>
<thead>
<tr>
<th>Product</th>
<th>Ensemble</th>
<th>VSREF</th>
<th>NARRE-TL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Icing</td>
<td>Occurrence prob on 8 FL</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Turbulence (CAT)</td>
<td>3 severity occurrence Prob on 9 FL</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Ceiling (cloud base)</td>
<td>Mean/spread/prob of 4 ranges</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Visibility</td>
<td>Mean/spread/prob of 4 ranges</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Low level Wind shear</td>
<td>Mean/spread/occurrence prob</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Jet stream</td>
<td>Prob on 3 levels</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Fog (light/dense)</td>
<td>Mean/spread/prob (Zhou &amp; Ferrier)</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Convection</td>
<td>Prob of occurrence (Steve W.)</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Reflectivity</td>
<td>Prob of 4 thresholds (Ferrier)</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Freezing height</td>
<td>Mean/spread</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Precipitation type</td>
<td>Prob of rain and snow types</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Accumulate Precip</td>
<td>Prob of 3 and 6hr acc. precip</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Lightning</td>
<td>Prob of occurrence (D. Bright)</td>
<td>N</td>
<td>Y</td>
</tr>
<tr>
<td>Severe thunderstorm</td>
<td>Prob of occurrence (D. Bright)</td>
<td>N</td>
<td>Y</td>
</tr>
</tbody>
</table>
Alaska Experimental NARRE Time-Lag System

NARRE—Alaska: Probability of Icing at FL180 01H FCST
3hr. Accu. Prcp > 0.25 inch (6.35 mm) probability
6hr forecast, validated 15Z, Jun 22, 2011

VSREF

NARRE-TL

Stage4 Analysis

ST4 03h Accum (mm) Ending 2011062215
Reflectivity >30 dBZ  Probability
6hr forecast, Jun 22, 2011
Icing probability 6hr forecast at FL240, Jun 22, 2011

VSREF: Probability of Icing at FL240 06H FCST from 09z Jun 22 2011, Verified Time: 15z 06/22/2011

NARRE: Probability of Icing at FL240 06H FCST from 09z Jun 22 2011, Verified Time: 15z 06/22/2011
Severe CAT probability 6hr forecast at FL300, Jun 22, 2011
Ceiling < 1000 feet probability 6hr forecast, Jun 22, 2011

VSREF: Probability of Cloud Base < 1000 feet 06H FCST from 09z Jun 22 2011, Verified Time: 15z 06/22/2011

NARRE: Probability of Cloud Base < 1000 feet 06H FCST from 09z Jun 22 2011, Verified Time: 15z 06/22/2011
Vis < 1 mile probability 6hr forecast, Jun 22, 2011

VSREF

VSREF: Probability of visibility < 1 mile 06H FCST from 09z Jun 22 2011. Verified Time: 15z 06/22/2011

NARRE

NARRE: Probability of visibility < 1 mile 06H FCST from 09z Jun 22 2011. Verified Time: 15z 06/22/2011
Low level wind shear occurrence prob 6hr forecast, Jun 22, 2011


Convection occurrence probability 6hr forecast, Jun 22, 2011
(both use Steve W. method)


Probabilistic verification example (accumulated Apr 28 ~ Jun 29, 2011)

Icing probability forecasts of NARRE-TL and VSREF against ADDS-CIP

Icing Reliability at FL090 (725mb)
Against ADDS-CIP

Icing Reliability at FL180 (500mb)
Against ADDS-CIP
Next Steps

• Keep NARRE-TL running and data flow after RR operational

• More verifications

• HRRRE-TL over CONUS (Geoff D. Suggested)

  4km NAM-nest, 4km HRW-ARW, 4km HRW-NMM, 4km Pyle (for SPC runs), 3km HRRR (GSD runs)
Summary

- Based on NAM and NCEP’s parallel RR runs, a 10-member time-lagged ensemble system NARRE-TL was first experimentally developed.

- NARRE-TL has similar configuration in file structure and timing as VSREF, similar aviation products, but added 2 more products (lightning and severe thunderstorm probabilities).

- After parallel RR transits to operational RR in Nov 2011, NARRE-TL will continue run but VSREF will be stopped.

- Primary evaluations show a little bit stronger fields, better POD for NARRE-TL than VSREF. More evaluations will be focused.
THANKS!