NGGPS Annual Meeting

Verification and Validation Team Plans

June 14-15 2015

Ivanka Stajner
NGGPS Verification and Validation Team Objectives

• Verification and validation team objectives:
  – A comprehensive and flexible verification package for evaluation of progress in the development and operational readiness of NGGPS and of future NGGPS operational performance
  – Enable stakeholder validation of NGGPS performance
Team Members

• Proposed Team Members
  – Lead: Ivanka Stajner (NWS/STI)
  – Glenn White (NWS/EMC)
  – Geoffrey Manikin (NWS/EMC)
  – Fanglin Yang (NWS/NCEP)
  – Bonnie Strong (OAR/ESRL/GSD)
  – Stephen Weygandt (OAR/ESRL/GSD)
  – Others TBD
State of the Current Verification System

• The current GFS verification system evaluates several metrics

• NCEP’s Global NWP Model Verification package includes:
  – Computation of model forecast statistics for global NWP model simulations
  – Comparison of statistics among different model simulations
  – The data is saved in VSDB format

• Examples of statistics include:
  – Anomaly Correlation (AC)
  – Root Mean Square Error (RMSE) for Geo-Potential Height (HGT), Temperature (T) and Vector Wind (Wind)
Current Status

**Main Verification Web Page**  [http://www.emc.ncep.noaa.gov/gmb/STATS_vsdb/](http://www.emc.ncep.noaa.gov/gmb/STATS_vsdb/), including 1) verification statistics of AC, RMSE, Bias etc for major international NWP models and GFS implementation parallels in the past 31 days, 2) real-time weather forecast maps of GFS, ECMWF and GFS implementation parallels, 3) links to other verifications.

Including 1) verifications of surface 2-m T, RH, Td, 10-m winds, SLP and total clouds against ground observations over the CONUS and its sub-regions and, 2) verifications of atmospheric T, Q, RH and Winds against rawinsonde and aircraft observations over the globe and its sub-regions.

Including precipitation forecast maps verified against CCPA over the CONUS and CPC gauge observations over the globe, and precipitation Equitable Threat Scores for major international models.
Current Status cont.

Objected-Oriented (MODE) Verification
http://www.emc.ncep.noaa.gov/gc_wmb/tdorian/
Including MODE verifications of precipitation over CONUS and jet streams over the globe.

Historical Performance http://www.emc.ncep.noaa.gov/gmb/STATS_vsdb/longterm/
Including annual review of GFS forecast skills and historical performances of major international NWP models.

Ensemble Forecast Verification
http://www.emc.ncep.noaa.gov/gmb/STATS_vsdb/ensm/, and
http://www.emc.ncep.noaa.gov/GEFS/verif.php
including GEFS, NAEFS and other international global ensemble forecasts.

Data Assimilation Monitoring http://www.emc.ncep.noaa.gov/gmb/gdas/

GFS Experimental Parallels Verification:
http://www.emc.ncep.noaa.gov/gmb/wd20rt/vsdb/ and
http://www.emc.ncep.noaa.gov/gmb/wx24fy/vsdb/

Merging HIWPP Verification Systems

Deterministic Ensemble g2o, g2g

EMC System

VSDB files running sums

EMC Image & stat generator (static)

Verification Plots

MySQL Database (interactive)

MySQL DB - EM C running sums

MySQL DB - AMB running sums

AMB System

AMB Image & stat generator (interactive)

Verification Plots

Ensemble verification in database with web-interface

Global precip verification (CRPSS for ensemble pcp)

Tropical cyclone verification (in database, select options)

Scorecard verif in database

Advanced Features

Some aspects will occur in NGGPS

HPC research systems

Initial

Deterministic g2o, g2g database

Mid-range

User

MySQL Database (interactive)
HIWPP Verification Development

1. **Initial System** – EMC verification package *(VSDB output)*
   -- run within HIWPP (basic stats, reference)

2. **Mid-range System** -- MySQL database system
   -- Incorporates EMC and AMB verification
   **global:** upper-air, AC *(work toward surface / precip)*
   conversion package from VSDB → database in place
   -- Basic verification system with interactive database

3. **Advanced System** -- Fully merged system with additional capabilities *(ensemble verification, global surface, global gridded and station-based precipitation)*
# HIWPP Verification metrics / attributes

<table>
<thead>
<tr>
<th>Variable</th>
<th>Levels</th>
<th>Area</th>
<th>Scores</th>
<th>Forecast Range (Hours)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Height</td>
<td>500 hPa</td>
<td>NH, SH</td>
<td>ACC, RMSE, Spread, CRPS</td>
<td>0 to 384</td>
</tr>
<tr>
<td>Height</td>
<td>1000 hPa</td>
<td>NH, SH</td>
<td>CRPS</td>
<td>0 to 384</td>
</tr>
<tr>
<td>Temperature</td>
<td>850 hPa</td>
<td>NH, SH</td>
<td>CRPS</td>
<td>0 to 384</td>
</tr>
<tr>
<td>Pressure</td>
<td>Surface</td>
<td>NH, Tropics</td>
<td>Track Error</td>
<td>0 to 120</td>
</tr>
<tr>
<td>Winds</td>
<td>850, 200 hPa</td>
<td>NH, Tropics</td>
<td>CRPS, RMSE</td>
<td>0 to 384</td>
</tr>
<tr>
<td>Precipitation</td>
<td>GLOBAL</td>
<td></td>
<td>ETS, CRPS, Bias</td>
<td>0 to 384</td>
</tr>
<tr>
<td>Temperature</td>
<td>2 meter</td>
<td>NH</td>
<td>RMSE, bias, CRPS</td>
<td>0 to 384</td>
</tr>
<tr>
<td>Winds</td>
<td>10 meter</td>
<td>NH</td>
<td>RMSE, bias, CRPS</td>
<td>0 to 384</td>
</tr>
</tbody>
</table>

Tropical cyclone track and intensity verification
NGGPS verification priorities

- Identify gaps, additional metrics (e.g. standard, sensible weather, ensemble verification)
- Prioritize metrics to be added to the existing verification package
- Leverage/coordinate with HIWPP verification effort
- Consider a more flexible database approach
Examples of GFS verification gaps

- GDAS *analysis-minus-first guess* increments
- Forecast consistency from cycle to cycle
- Monitoring of extreme cold temperatures near the surface
- Hurricane track and intensity verification to day 7 (currently to day 5) and significance
- Sensible weather over the globe (currently for CONUS and Alaska)
- Quantitative Precipitation Forecast over the globe
- Cloud verification against satellite products
Development of verification priorities

• Requesting a prioritized list of verification gaps from all NGGPS area teams
  – Consider gaps in verification of forecast skill, process representation, coupling of system components, increased model resolution
Validation priorities

• Does NGGPS meet user needs?
• Are phenomena or thresholds of most interest to stakeholders predicted well?
• Coordinate with UMAC evaluation of NCEP production suite and collection of stakeholder input.
Summary

• A comprehensive and flexible verification package for evaluation of progress in the development and operational readiness of NGGPS and of future NGGPS operational performance

• Enable stakeholder validation of NGGPS performance

• Requesting prioritized verification gaps from NGGPS area teams

• Leveraging/coordination with HIWPP verification effort

• Coordinate validation with UMAC evaluation of NCEP production suite and collection of stakeholder input
Questions?

NGGPS Website:
http://www.nws.noaa.gov/ost/nggps
Future of Verification and Validation System

• Examples of some skill metrics/capabilities to consider/add:
  – What other verification fields are desired?
  – What other types of error measures?
  – Preset vs. on-the-fly skill score assessments (or both)?
  – Database and web interface aspects?
  – Precipitation and reflectivity verification (also novel fields like solar irradiance, etc.)?
  – Ensemble, tropical cycle and scorecard verification?