Configuration Testing of GSI within an Operational Environment

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Introduction

- The Developmental Testbed Center (DTC) has developed a functionally similar end-to-end testing environment constructed to follow the Air Force Weather Agency (AFWA) pre-operational testbed.
- Testing and Evaluation efforts are to help test and assist in Grid Point Statistical Interpolation (GSI) configuration, aiming for a 2013 implementation.
- GSI is a 3D-var data assimilation system developed at NCEP/EMC, NOAA/GSD, NASA/GMAO, and NCAR/MMM. The GSI community is maintained and supported through the DTC.

Experimental Design

- Full end-to-end system runs 1x/day:
  - WPS (v3.3.1), cosGSI (v3.1), WRF-ARW (v3.3.1), UPP (v1.0), & MET (v4.0).
  - 06 Z cold start cycle
  - 12 Z continuous cycle
  - 57 vertical levels, 10 hPa model top
  - Continuous cycling bias correction coefficients
  - 20-km Northern Hemisphere Domain
  - 48-hr forecasts initialized at 12 Z
  - Grid-to-point verification against conventional observations.

Methodology

GO Index

General Operations (GO) Index is used for quantitative assessment of forecast performance

- Skill scores (S) computed for specific variables, levels, and lead times
  \[ S = \frac{1}{\sqrt{1-N}} \times \frac{RMSE_{ref} - RMSE_{sys}}{RMSE_{ref}} \]
- For each variable, level and lead time, predefined weights (w) are applied and a weighted sum (Sw) is computed
- Given Sw, the index value is defined as \[ N = \frac{1}{\sqrt{1-S}} \]

Values N < 1 indicate the reference forecast has higher skill, and values N > 1 indicate the developmental forecast has higher skill.

Results

- Real-time tests of the primary configuration indicated degradation in forecast skill during the initial set-up. This drop corresponded to the change from regional NAM BE to global GFS BE as well as the inclusion of GSPRO data.
- Overall skill of the basic primary configuration showed SS improvement over a parallel cold start real-time test.

Conclusions

- The DTC built a GSI testbed based on the AFWA pre-operational testing system.
- Real-time tests showed the primary configuration showed more forecast skill than corresponding cold start runs, but indicated a reduction in skill stemming from the BE.
- Retrospective testing focusing on BE suggested NAM BE produced more forecast skill over the primary configuration (Global BE).
- Developmental real-time testing using current channel selection research resulted in neutral impact.

Future Work

- Generate and tune-domain-specific BE using 3-mo collected real-time forecasts from primary configuration.
- Test forecast skill using domain-specific BE against GFS, NAM, and RR BEs.
- Further studies on impact of radiance data over operational domain and impact of cycling scheme on channel selection.

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Figure 1: GSI index of the primary configuration (black) compared to the corresponding cold start (Right).

Figure 2: Schematic of DTC GSI testbed.

Figure 3a: GO index of the primary configuration (blue) compared to the pair-wise difference (black): AFWA pre-operational configuration with corresponding cold start (RTdev).

Figure 4: GO index of Retrospective tests with Regional BE (green), the primary configuration (blue), and the pair-wise difference (black). Difference is SS CI’s do not encompass 0.

Figure 5: Vertical profiles of 12hr HGT (left) and 24hr TMP (right) showing the Regional BE (lower) for a Temperature increment at 38°N, 81°W (domain is subset), with improved forecast skill over the primary configuration.

Figure 6: Vertical (right) and horizontal (left) length scales for global BE (upper) and regional BE (lower) for a Temperature increment at 38°N, 81°W (domain is subset).

Figure 7: Forks single observation (POT) not using the global BE support and regional BE (green) on a Temperature increment at 38°N, 81°W (domain is subset).

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