



Impact Evaluation of New Radiance data, Reduced Thinning and Higher Analysis Resolution in the GEM Global Deterministic Prediction System

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Recent Changes in the GEM Global Prediction Systems

MARCH 2009

Change	Global Det. System	Regional Det. System	GEPS*1
Incorporation of GPS Radio-Occultation (RO) refractivity (COSMIC, GRACE, GRAS)	✓	✓	✗
MODIS Direct Broadcast winds	✓	✓	✓
Metop ASCAT ocean winds	✓	✓	✓
Northern extension of regional Model (IPY legacy)	n/a	✓	n/a

*1 GEPS= Global Ensemble Prediction System



Recent Changes in Operational GEM Prediction Systems

JUNE 2009

Change	Global Det. System	Regional Det. System	GEPS
Model top at 0.1hPa , L80 (was 10hPa and L58)	✓	✓	✗
New forecast error statistics	✓	✓	
New radiation scheme (Li-Barker) & additon of orographic GWG	✓	Already in use	n/a
AMSU-A Ch. 11-14, Increased use of GPS-RO (30 to 40 km)	✓	✓	✗
Increased vertical resolution (L58) & inclusion of GPS-RO in EnKF (model lid still at 10 hPa)	n/a	n/a	✓



Recent Changes in Operational GEM Prediction Systems

DECEMBER 2009

Change	Global Det. System	Regional Det. System	GEPS
AMSUA/MHS NOAA-19 & METOP	✓	✓	✓

- Freeze because of Olympics – Vancouver 2010
- Migration of front-ends from SGI to Linux

Global Operational Deterministic Analysis System

- 4D-Var: Analyses Increment Resolution (240 x180), T108 or ~ 180 km.
- Operational background state, analysis, and GEM* (non-linear) model resolution is 800x600 (~33 km)
- Radiative Transfer Code: RTTOV 8.7

* GEM: Global Environmental Multi-scale

Proposal for upgrade to Global Det. System: New Components Under Testing

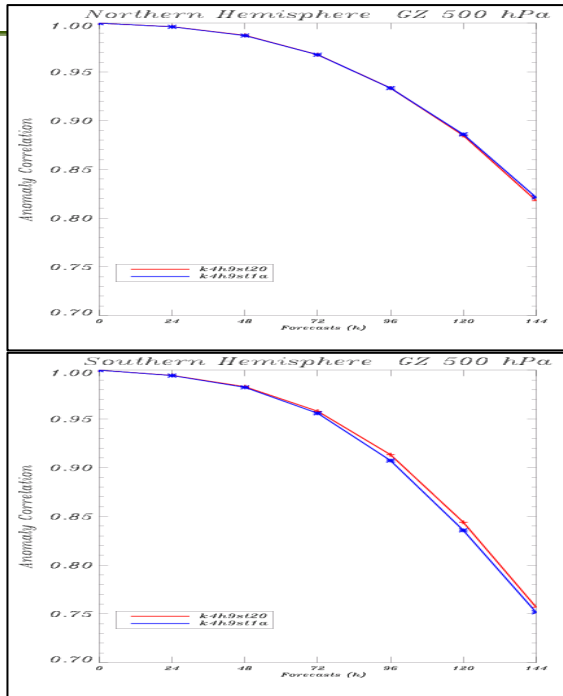
A. Physics/Bias Correction/Surface Analyses	B. Additional Observations	C. Thinning/Resolution
<ul style="list-style-type: none"> • Kain-Fritsch convection scheme to reduce false alarms in tropical cyclones (more stable tropical BL) • Improved dynamical bias correction (offline 7 day window) for radiances (Unified code) • New SST global analysis (Brasnett 2008) 	<ul style="list-style-type: none"> • SSM/IS F16 (SSM/I like channels -7) • IASI (150 channels) • Additional upper peaking AIRS channels (+37 for total of 124) • CSR (Geo-rad) 6.7 micron radiance data with RTTOV – 5 GEO (includes MTSAT-1R) • Moisture data from AMDAR 	<ul style="list-style-type: none"> • Increased resolution of analysis inner loops from T108 to T180 • Reduced thinning for all radiance data (from 250/200 km to 150 km)

C. Increasing The Analysis Resolution versus Operational System

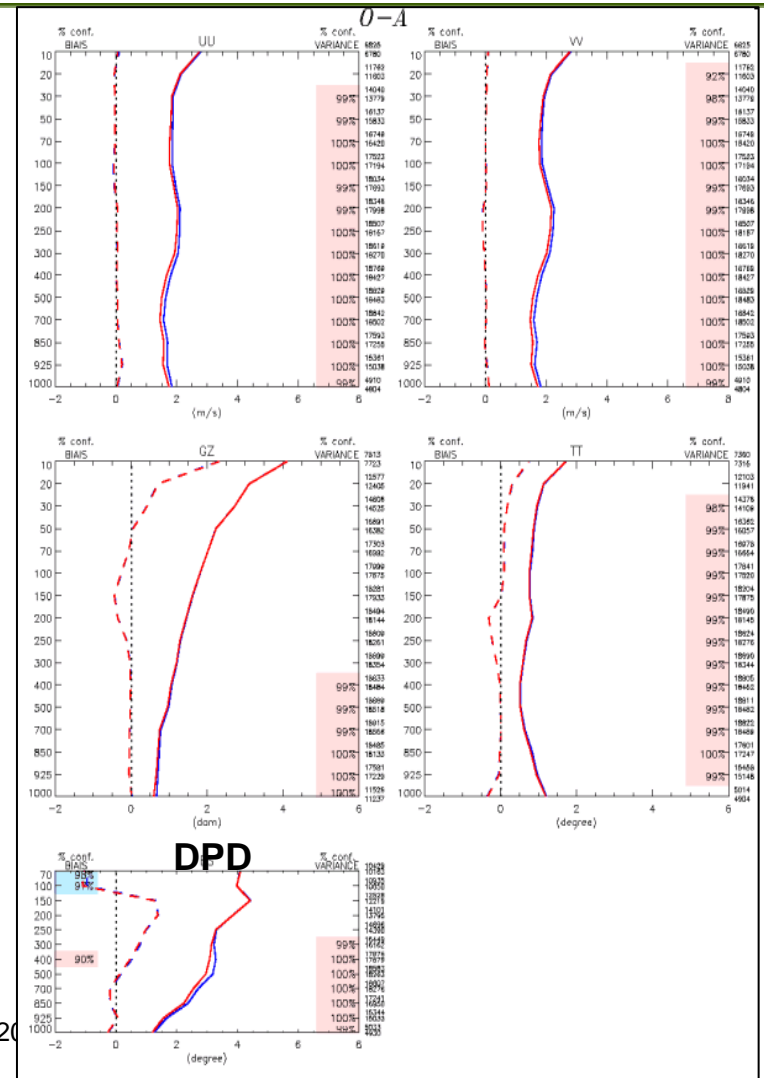
- Change 4D-Var analysis increment resolution:
 - 240x120 T108 (~180 km) => 400x200 T180 (~100 km)
 - Corresponding increase in resolution for the GEM tangent-linear and adjoint models
- 1 month period: 15 Dec 2008 to 15 Jan 2009 (63 cases).



Increasing The Analysis Resolution versus Operational System



World =>



- Increased increment resolution (red curves) gives small (2.6h) forecast gain at day 5 for Southern Hemisphere.
- Overall better fit of analysis to radiosonde data, but the impact is gone in the 6 h forecast (not shown).

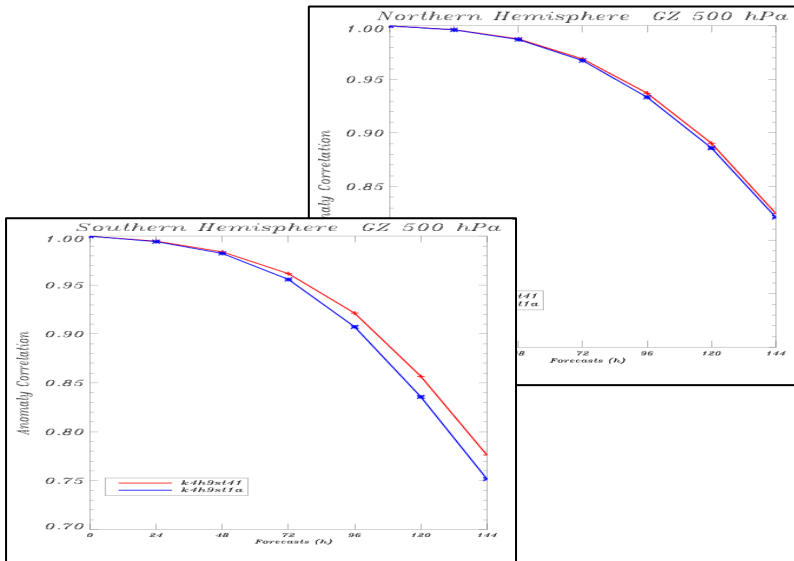


Reducing Satellite Radiance Thinning versus Operational System

Instrument	Thinning Resolution (km)	New Thinning Resolution (km)
AMSU-A AMSU-B/MHS	250	150
AIRS	250	150
SSM/I	200	150
GOES	200	150

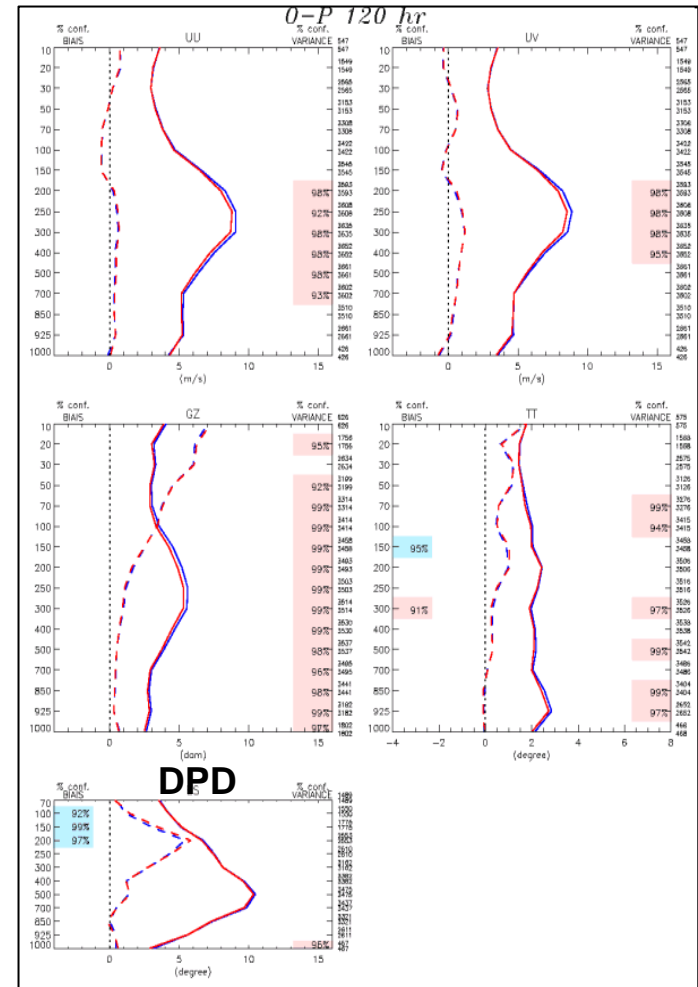
In the experiment, all radiances are thinned to 150 km resulting in a 175% increase in radiance data volume (60% for SSM/I and GOES).

Reducing Satellite Radiance Thinning versus Operational System

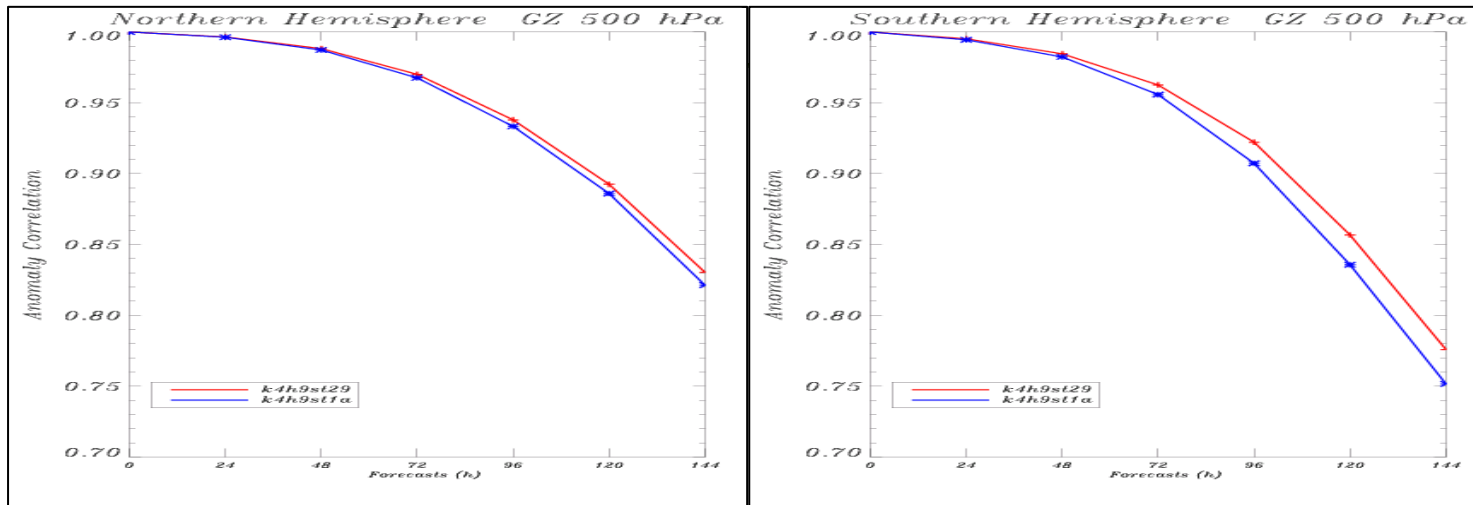


SH=>

- Positive impact of reduced thinning (red curves), especially for SH with forecast gain of 7.5 hours at day 5.
- Generally worse fit of analysis to radiosonde data (not shown), but overall small positive impact on day 3-6 forecasts, mainly in SH.



Combined Effect (red curves)



- Slightly more positive impact on forecasts for NH as seen in AC (small increase in forecast gain after day 3) and verification against radiosondes (not shown).
- Slight degradation in forecast accuracy for SH as seen in AC (drop of ~0.5hr in day 5 forecast gain) and verification against radiosondes (e.g. the improvements noted previously for O-P120h for Southern Hemisphere are absent).
- Verification of forecast 24h precipitation accumulations against precipitation gauge measurements over North America show neutral to slightly positive in terms of bias and threat scores.

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Conclusions

- Tests show that **increasing analysis increment resolution** and **reducing thinning of satellite radiance data** has a positive impact on the analyses and forecasts especially in the SH.
- Most of the improvement stems from increasing satellite data volume through reduced thinning.
- Increasing analysis increment resolution significantly increases the time needed to complete a 4D-Var global analysis and **is currently too expensive for operational implementation.**
- Reduced thinning is part of the proposed analysis and forecast system upgrade (currently being tested).

Conclusions

- Testing (first 36 days of 2.5 month exp. completed).
Encountered degradation in tropics:
 - 1) Higher AIRS & IASI peaking channels were added.
 - 2) Project looking at DFS (M. Buehner & S. Heilliette) of obs. Preliminary results show that there may be some issues with IASI water vapor channels (66).