

# Task 3.3: Code Management, testing and support for the data assimilation system

3.3.1: GSI code management and community

3.3.2: Annual baseline experiments

FY2011 leftover: DART EnKF tests (completed and reported in mid-term)

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and Hans Huang

\*Shared costs with other partners



# GSI Code Management

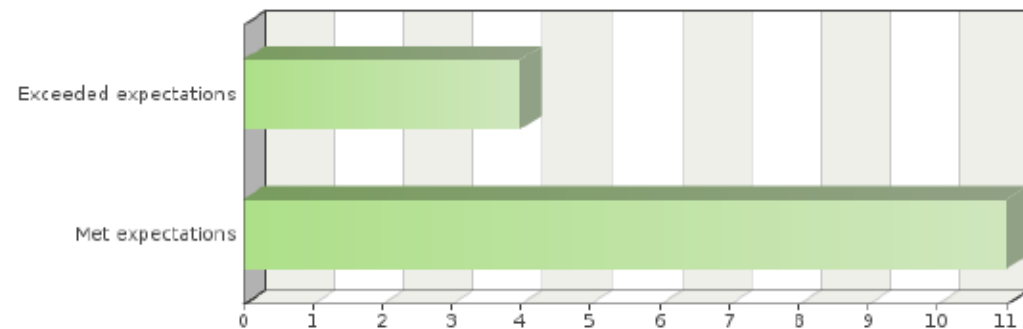
- Continue to maintain the DTC community repository
- Chair the GSI Review Committee and facilitate GRC activities:
  - GRC development coordination meeting: All committee members are required to present their ongoing effort and future plans:
    - April 16, 2012, telecon (3hr event)
    - August 28, 2012, on-site (1-day event)
    - January 15, 2013, telecon (3hr event)
  - Maintain GRC wiki at  
<https://wiki.ucar.edu/display/dtcgsi/GSI+Review+Committee>
- Review code changes
  - Test code changes on multiple platforms
  - Conduct DTC regression tests
- Assist developers to transition their code changes to the GSI trunk
- Organize small group discussion, e.g., aerosol working group, for work coordination
- DTC staff (Ming Hu, Chunhua Zhou) visited the EMC GSI group, College Park, MD

# GSI Community Support

- Annual code release:
  - The code review procedure reduces the pre-release testing period to less than one month for the beta release and less than two months for the official release
    - Beta release: June, 2012
    - Formal release: July 2012
- GSI Users' Guide v3.1: available at <http://www.dtcenter.org/com-GSI/users/>
  - Updated contents
  - New materials on satellite radiance data assimilation, modification of the GSI build environment, GSI hybrid capability and bias correction for satellite radiance observation
- GSI helpdesk:
  - 686 users registered through the DTC GSI webpage: 58% from universities, 24% from government users, 7% from private companies, and 12% from non-profit companies.

# Annual Community GSI Tutorial

- August 21-23, 2012, NCAR Foothills Lab, Boulder CO:
  - 44 participants
  - First time to provide remote access
  - 13 Lectures (speakers from NCEP, NASA, NCAR, ESRL and DTC)
  - ~5hr basic practice session
  - half-day optional advanced practice session
- Lectures include
  - GSI fundamentals
  - Advanced talks
  - ✓ First time lectures:
    - GSI Hybrid Data Assimilation
    - Cloudy Radiance Data Assimilation

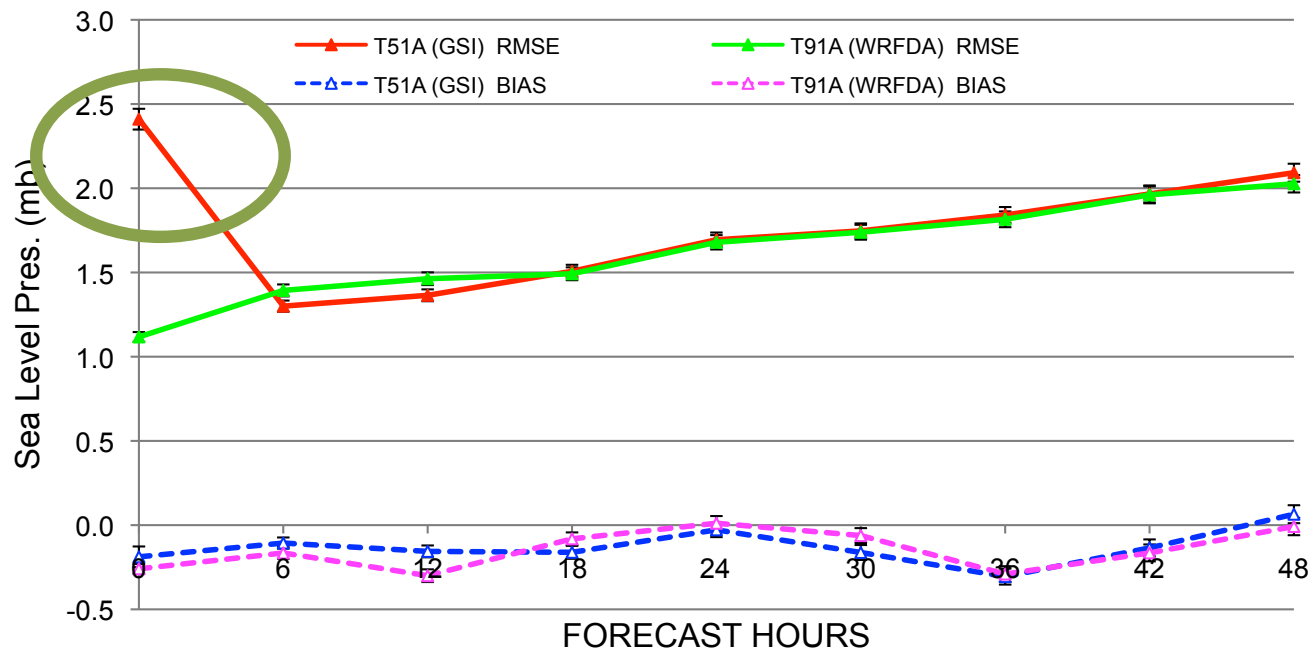


Participants' rating on overall tutorial expectations

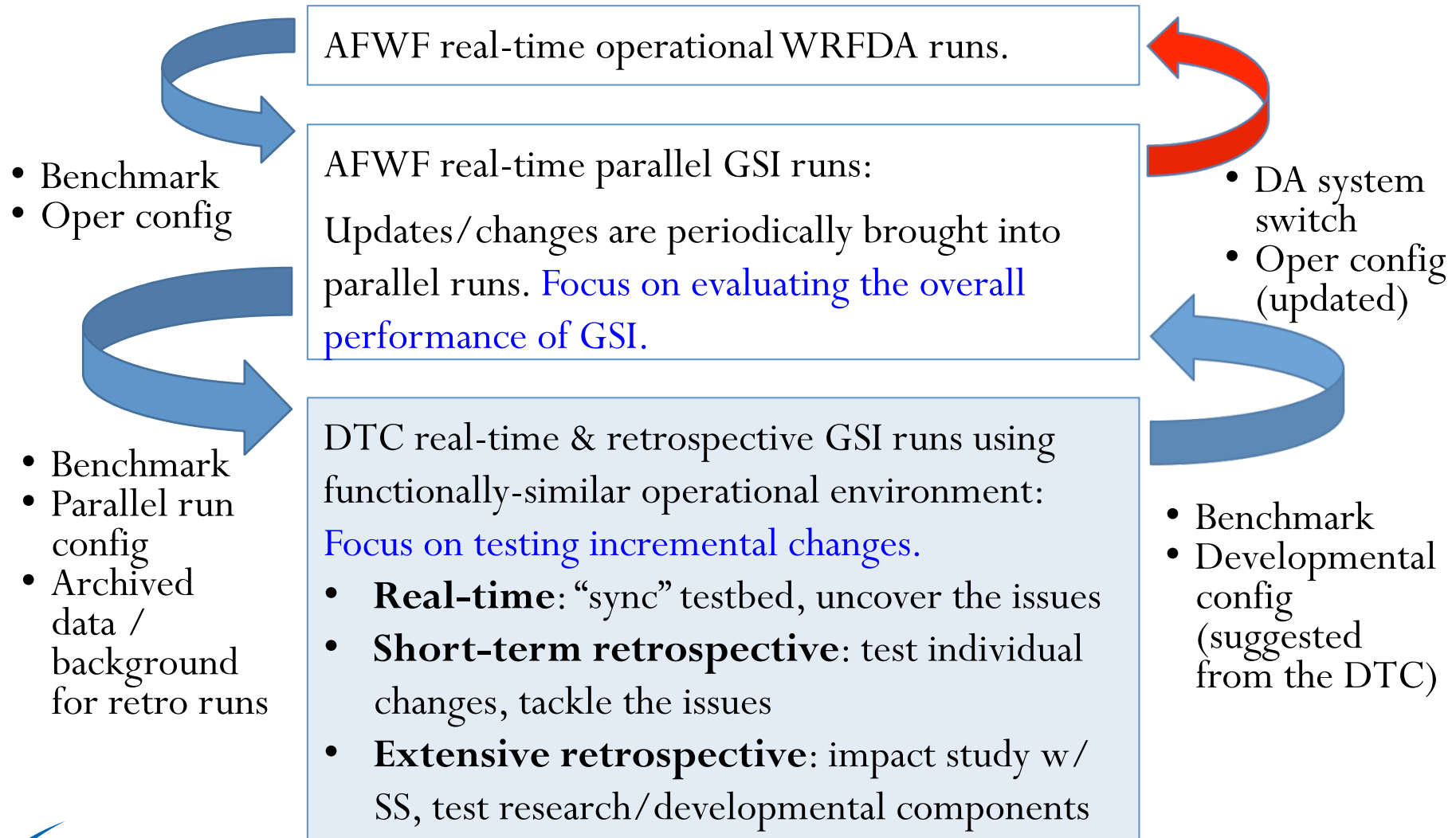
# GSI Baseline Tests for AFWA

Motivation: Assist AFWA with determining appropriate initial configuration of GSI for operational implementation (proper set-up and definition of background error covariance).

**Black-box Run of GSI in SLP forecasts**  
Between 5/14/2012 And 7/25/2012

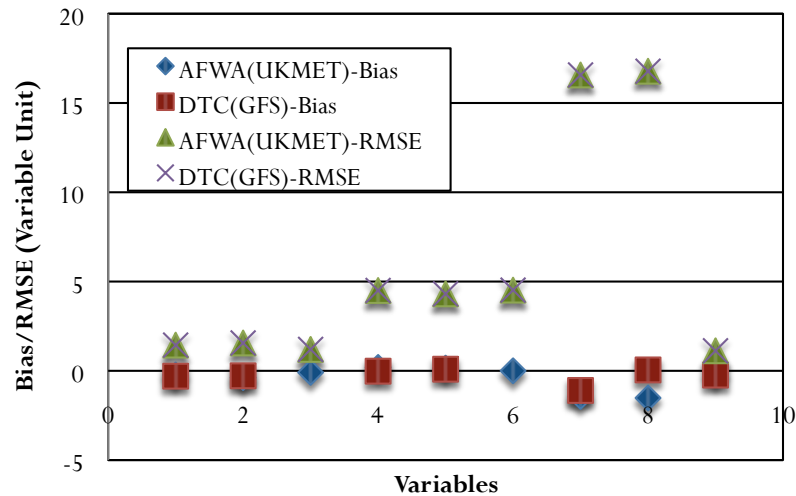


# Mechanism for AFWA-DTC Communications

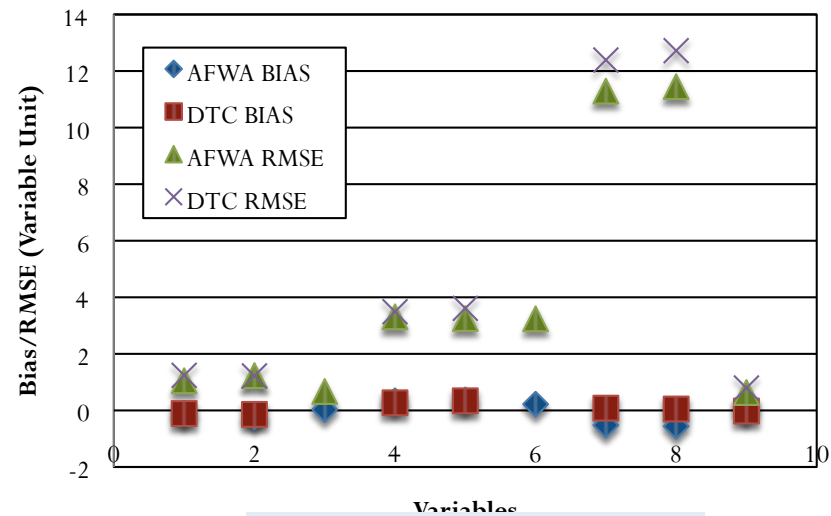


# Functionally Similarity Check

Only differences are **input fields (background and observations)** and individual changes to be tested.



**Background Comparison**

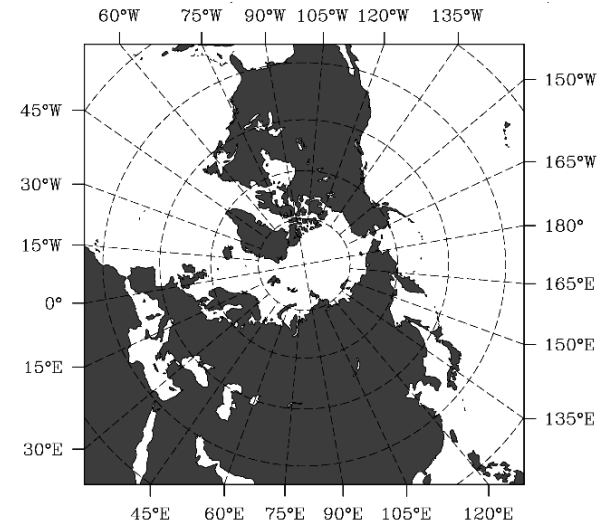
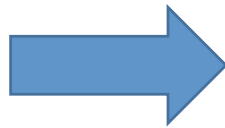


**Analysis Comparison**

Variable No.	1	2	3	4	5	6	7	8	9
Variable Name	T	T-120	T-131	UV	UV-220	UV-231	q	q-120	Ps-180,181,187

# Experiments and Results

- Real-time system test
- BE retrospective test
  - Operational BE
  - Domain-specific BE
- Data impact test
  - GPSRO
  - Channel selection
- Regional BE generation methods
  - NMC method
  - Ensemble perturbation method



AFWA Northern Hemisphere (T51) Domain

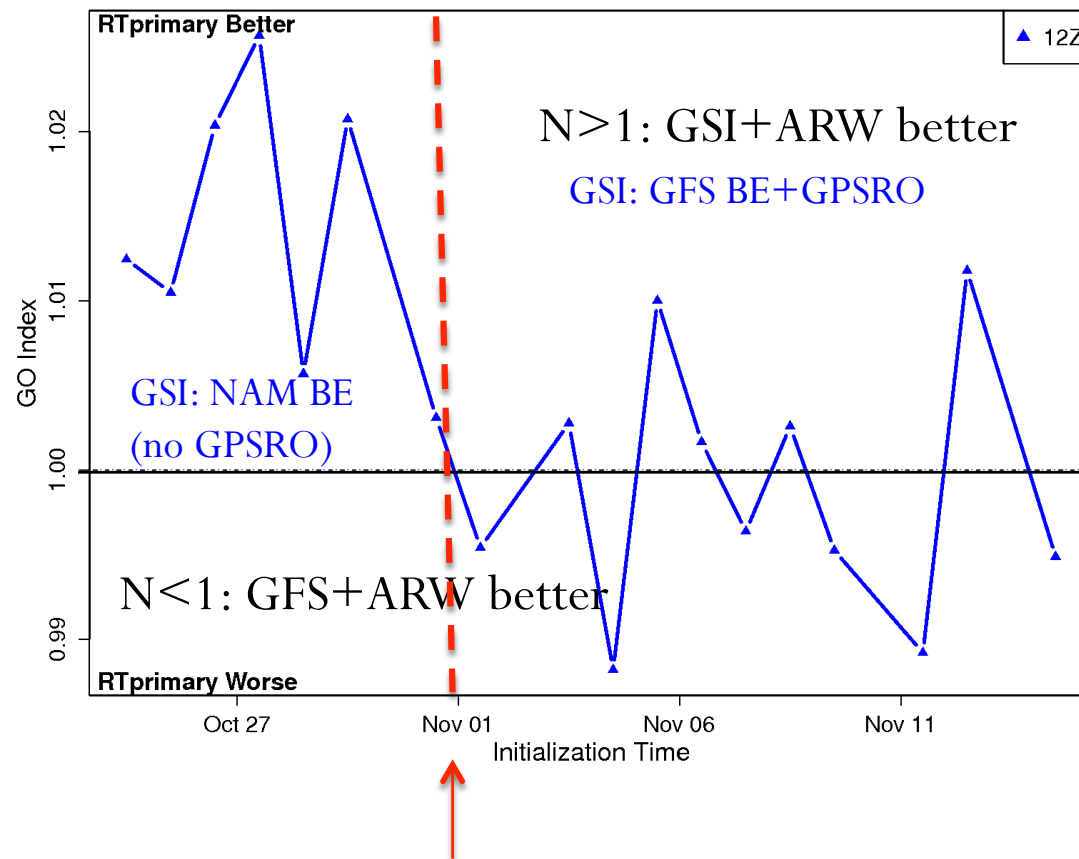
- 20km horizontal resolution
- 57 vertical levels
- 10hPa model top



# Real-Time Runs

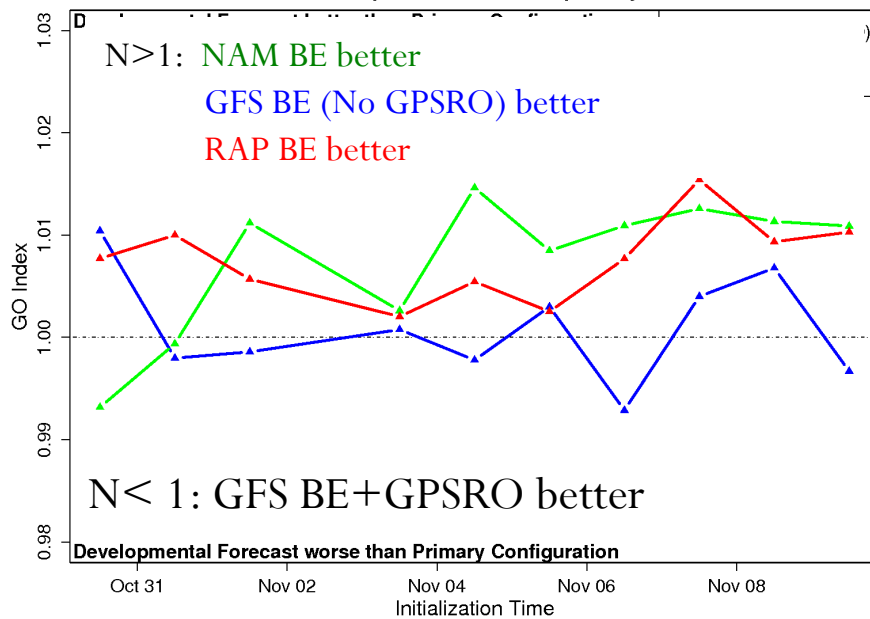
AFWA GO index: 
$$N = \sqrt{\frac{1}{1-S_w}}$$

where  $S_w$  is the sum of the skill scores, weighted by lead time, for wind speed, dew point temperature, temperature, height at various levels and surface, and mean sea level pressure.



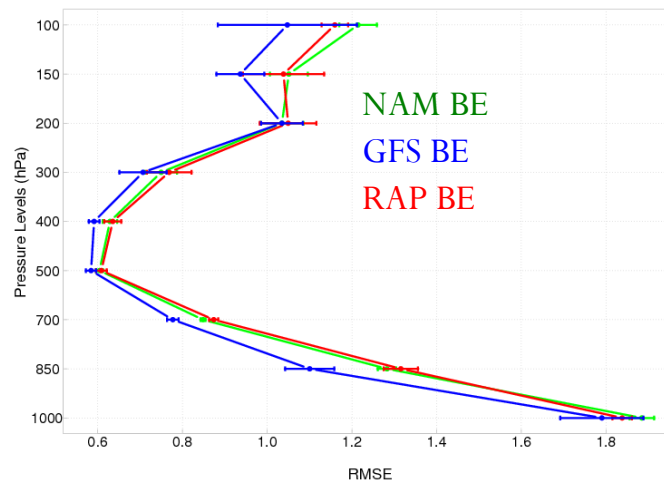
GSI+ARW runs switched to AFWA parallel run configuration

# Retrospective Runs: What caused the drop?



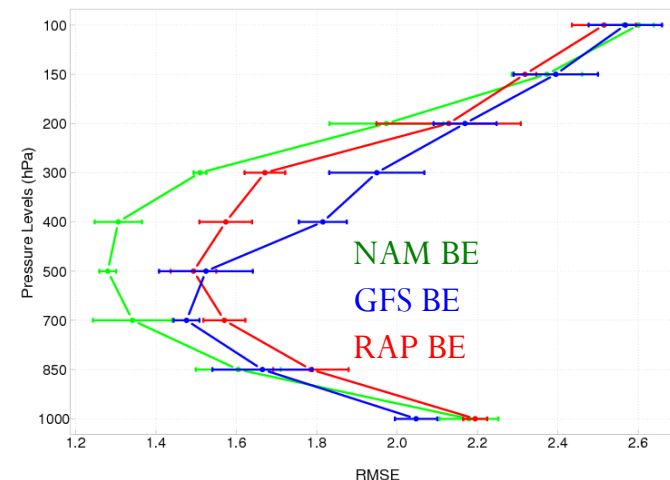
- ✓ **NAM BE**: Northern Hemisphere BE computed based on NAM forecasts.
- ✓ **GFS BE**: Global BE computed based on GFS forecasts.
- ✓ **RAP BE**: Global BE tuned for the RAP. combination of global/regional (*balance = GFS, Lengthscales/variance = NAM*)

Regional BE Tests vs. Primary Configuration: Temperature Analysis



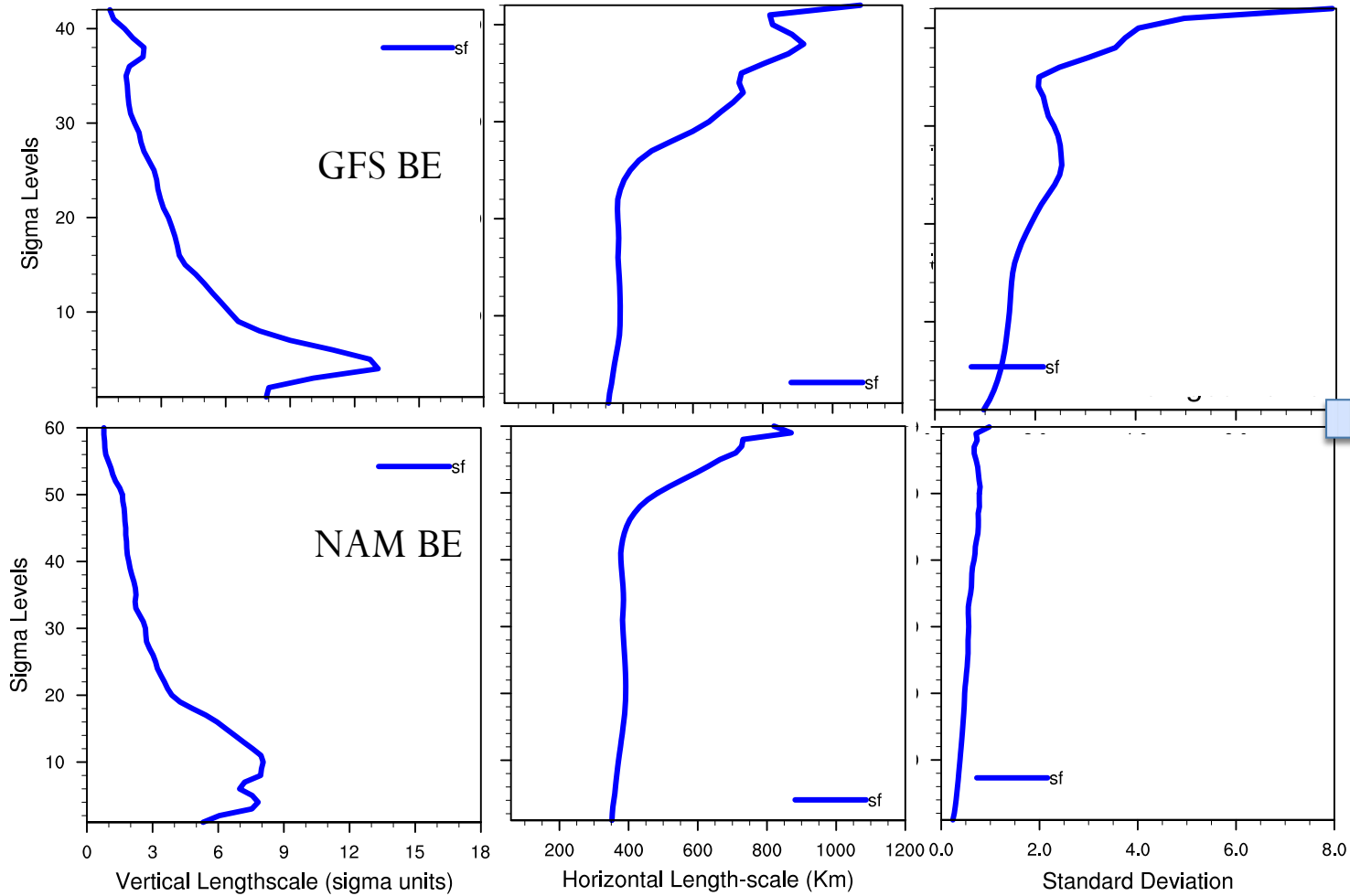
Temperature Analysis RMSE

Regional BE Tests vs. Primary Configuration: Wind Analysis



Wind Analysis RMSE

# Retrospective Runs: Background Errors (BE)



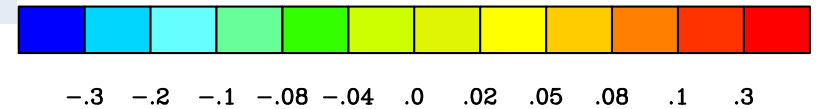
Vertical Lengthscale

Horizontal Lengthscale

Standard Deviation

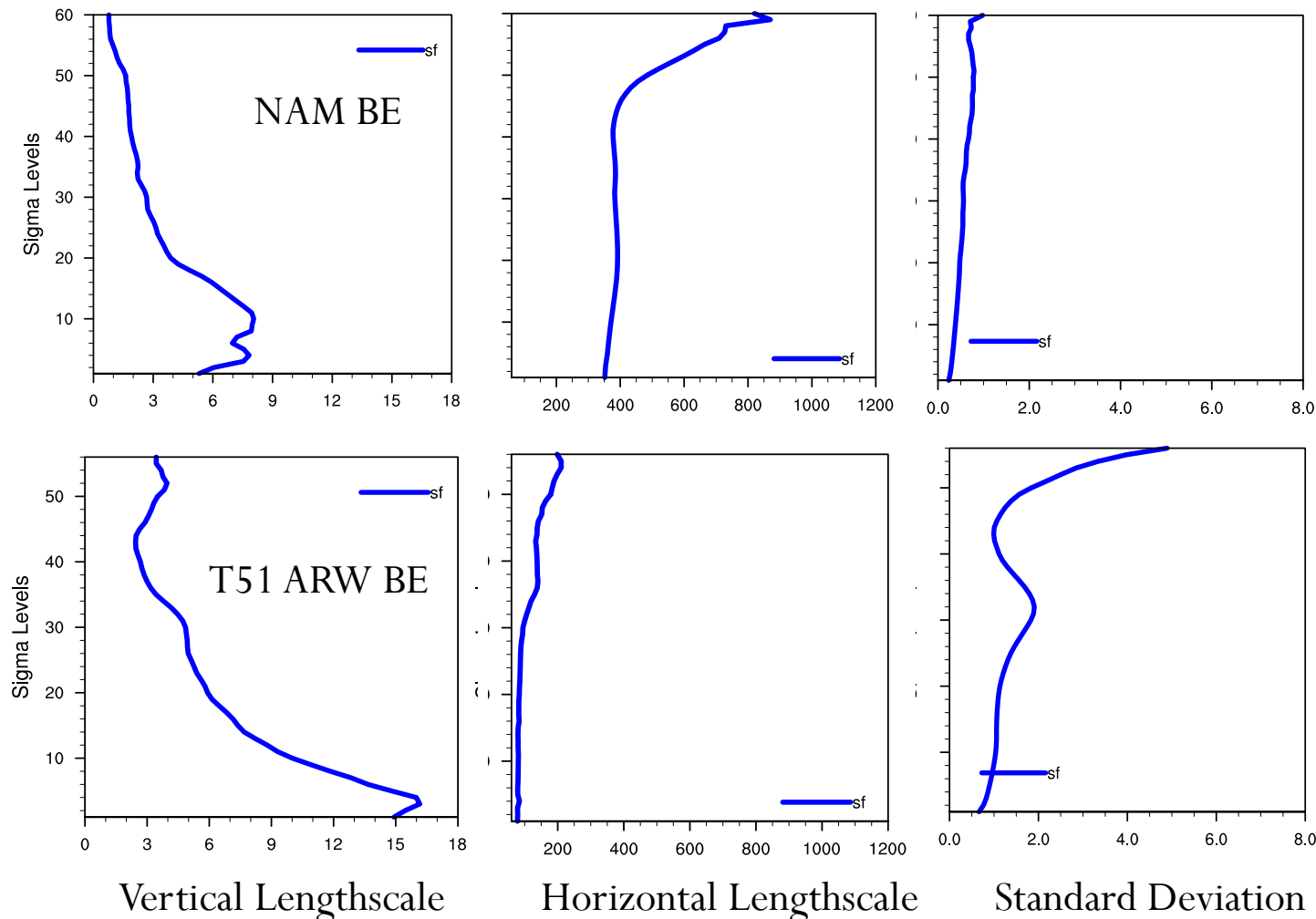
BE factors for Stream Function

Analysis Inc. from single T obs test



# Domain-Specific BE

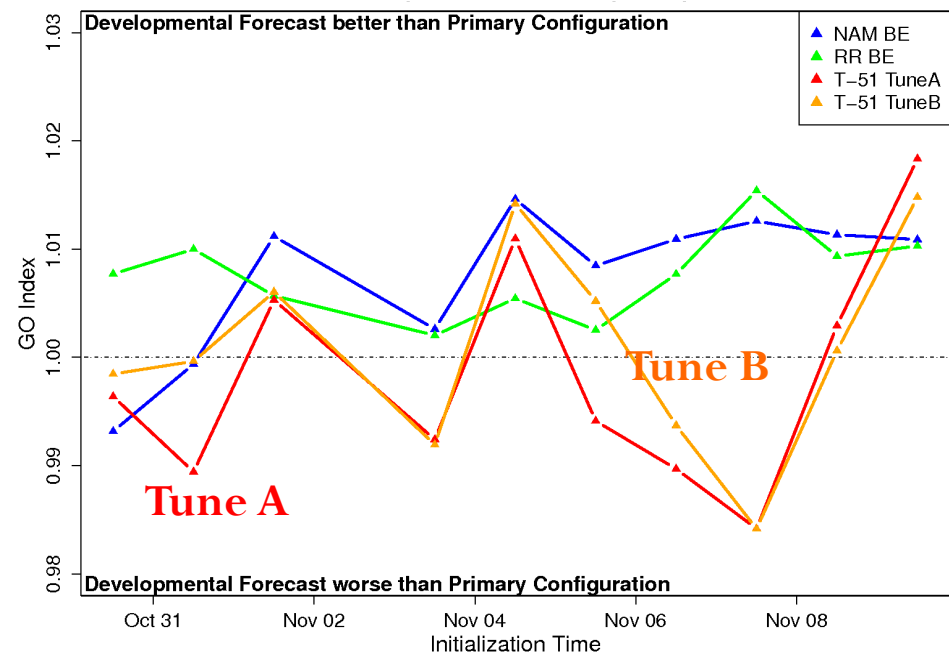
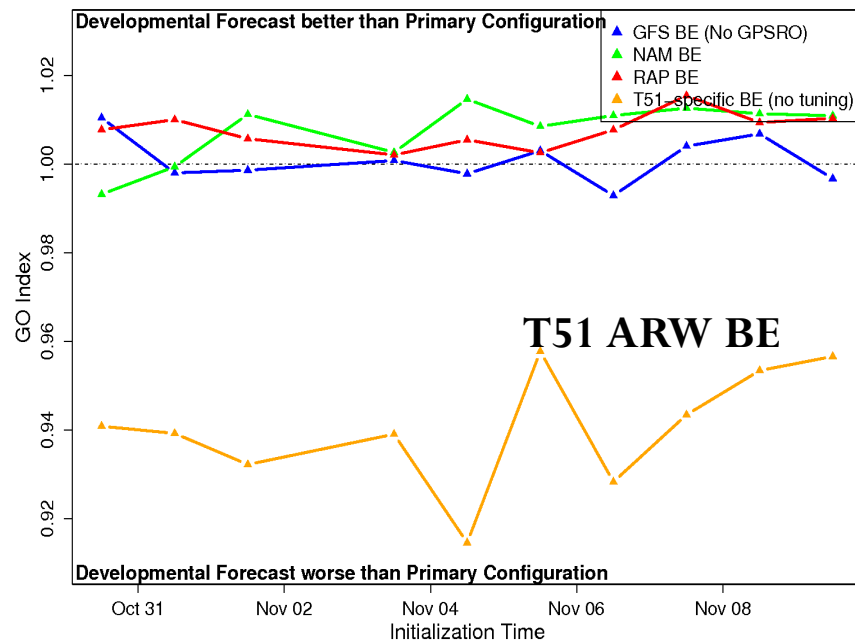
- GEN\_BE-GSI code developed by Rizvi Syed (NCAR) based on the NCEP BE code.
- NMC method: 3month period of ARW forecasts: Oct-Dec, 2012
- ✓ Horizontal length scales of T51 ARW BE are significantly smaller that those of the NAM BE.



# Domain-Specific BE: Impacts

Three additional retrospective experiments:

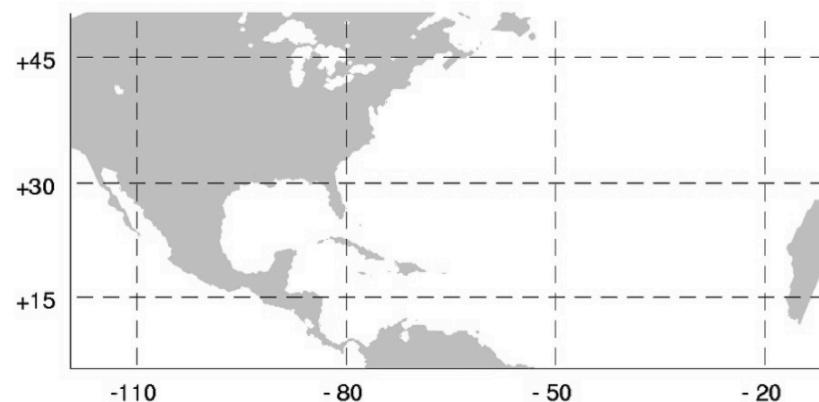
- ✓ T51 ARW BE: Northern Hemisphere BE computed based on ARW forecasts.
- ✓ Tune A: Tuned T51 ARW BE (*balance*=T51 ARW, *Lengthscales/variance* = NAM)
- ✓ Tune B: NAM BE interpolated onto the T51 grid



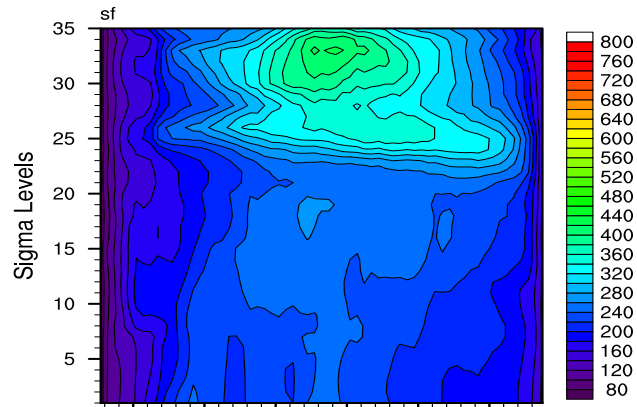
$N < 1$ : GFS BE (with GPSRO) better  
 $N > 1$ : other BE experiments better

# NMC Method Versus “Ensemble Perturbation” Method

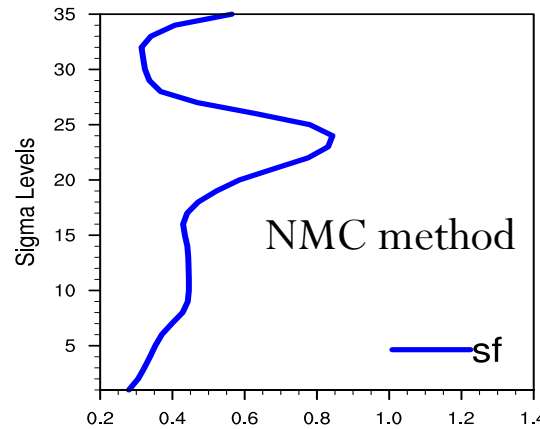
- ✓ Perturbations used for the **static** BE generation can come from:
  - Forecast differences, e.g., 48hr forecasts-24hr forecasts -> “NMC” method
  - Ensemble perturbations -> “Ensemble Perturbation” method
- Experiments:
  - AFWA Caribbean domain (T8)
  - Ensembles generated using the NCAR DART system (FY2011 leftover task)
  - Model configuration: 36-km horizontal resolution, 45 vertical levels, and a 20 hPa model top.
  - Testing period:  
2008081100-2008091312



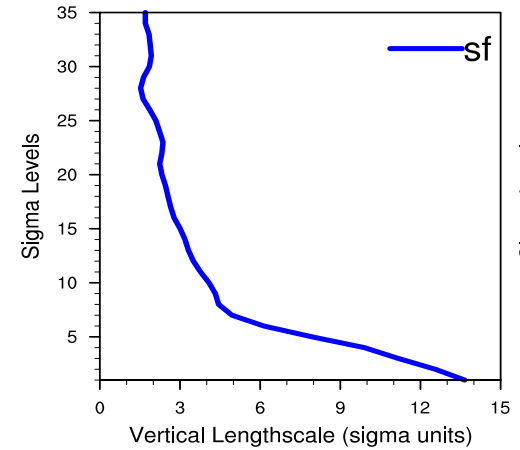
# NMC Method Versus “Ensemble Perturbation” Method: BE factors



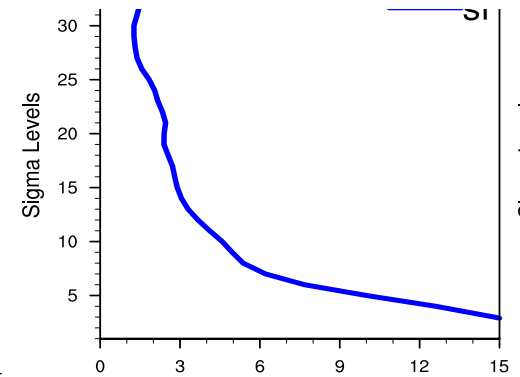
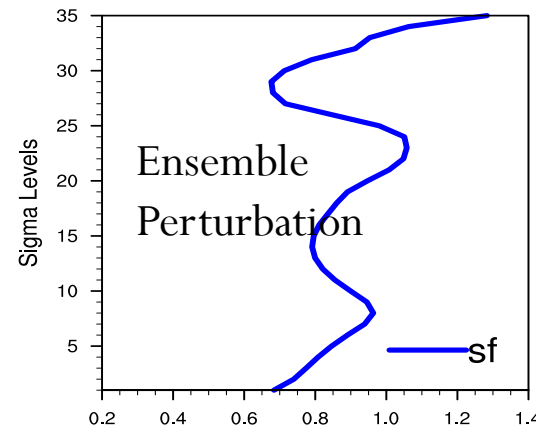
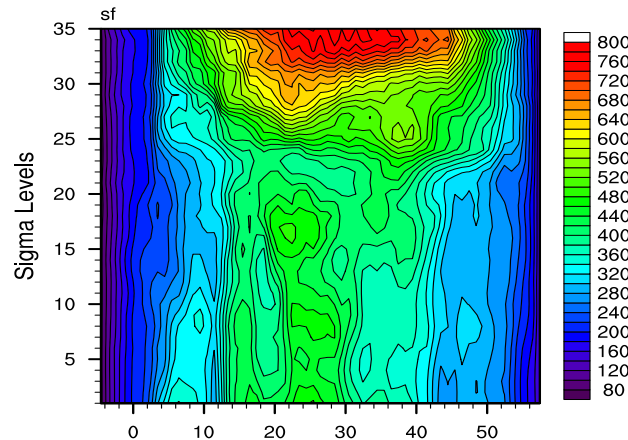
Horizontal Lengthscale



Standard Deviation

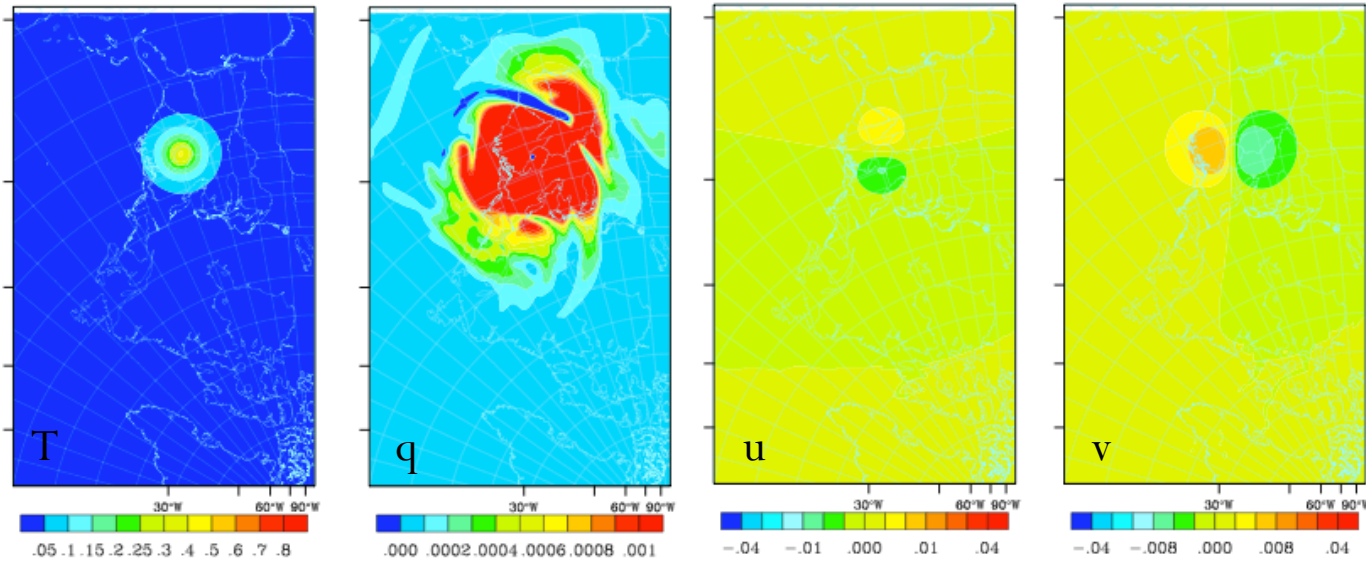


Vertical Lengthscale

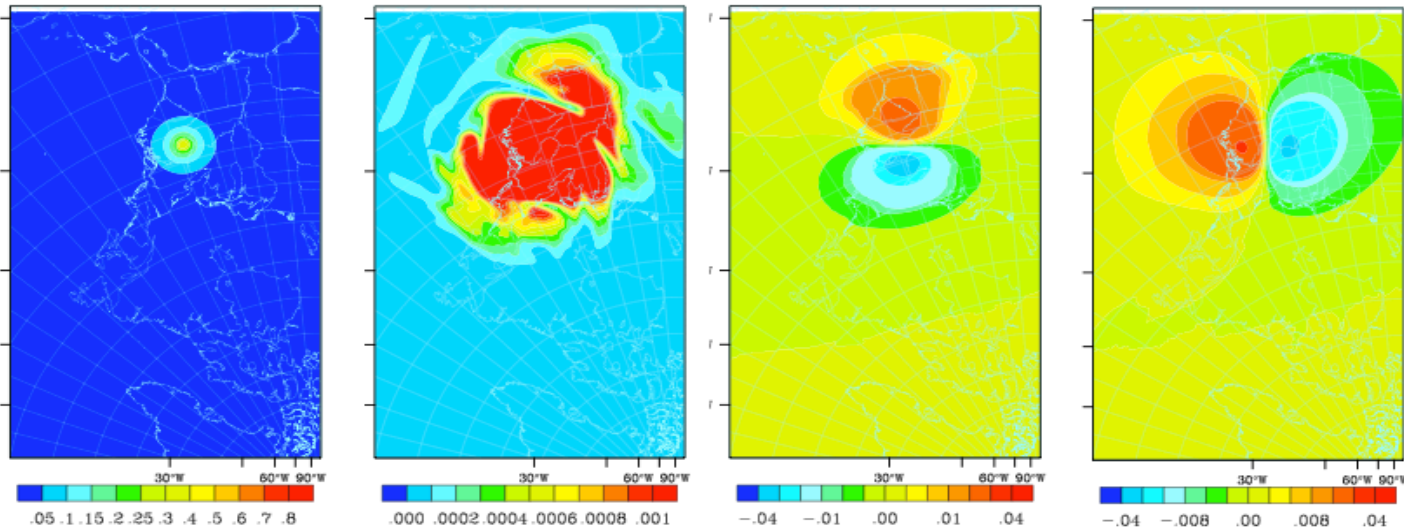


# NMC Method Versus “Ensemble Perturbation” Method: PSOT tests

NMC method



Ensemble





# Summary and Conclusions

- DTC built and configured a functionally similar testing environment.
- For Northern Hemisphere, the NAM BE or tuned global BE w/ regional scaling is recommended at current stage. For Southern Hemisphere, BE should be examined separately since the model errors are expected to be larger than those in Northern Hemisphere.
- Domain specific BE still needs further tuning and investigation.
- The BE statistics computed using the ensemble perturbations resulted in much larger increments in wind fields compared with the NMC ones.
- Impacts of GPSRO data assimilation and alternative channel selection are neutral.

# Data Assimilation AOP 2013 Activities

ID	Activity Description
DA1	GSI code management & repository maintenance, public release & user support*
DA2	GSI Tutorial*, Aug 6-8, 2013, College Park, MD
DA3	GSI Workshop*, Aug 9, 2013, College Park, MD
DA5	GSI baseline for AFWA
DA7	Community-base GSI observations pre-processing capability (currently beyond DTC 100% senario)