

The Developmental Testbed Center: Update on Data Assimilation System Testing and Community Support

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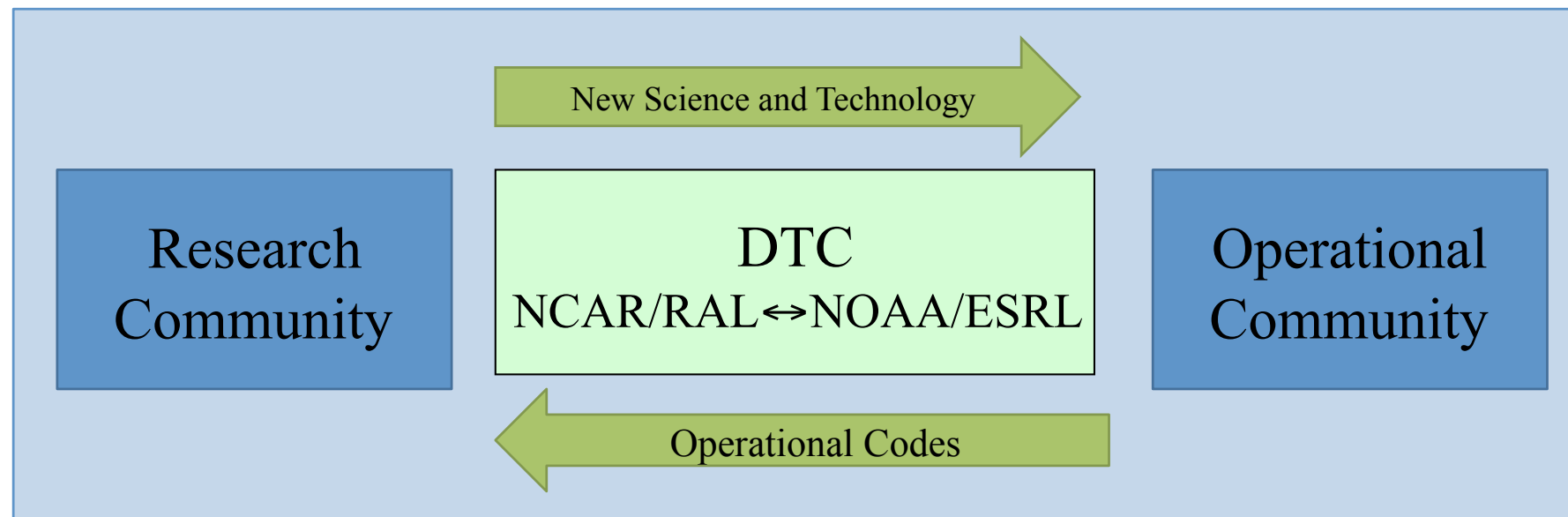
Special Acknowledgement: NCEP/EMC, AFWA, NOAA/OAR and HFIP



Developmental Testbed Center (DTC)

To serve as a bridge between research and operations to facilitate the activities of both halves of the NWP Community

- Research: functionally similar operational environment to test and evaluate new NWP methods over extended retrospective periods
- Operational: benefits from DTC testing & evaluation of strengths and weaknesses of new NWP advances prior to consideration for operational implementation



DTC Director, Bill Kuo: DTC Model Testing and Evaluation Activities in Support of R2O in NWP, Ballroom A, 11:00am, Thursday
DTC Webpage at <http://www.dtcenter.org/>



Where is the DTC?



DTC Data Assimilation Mission

- Provide code management for operational code and coordinate distributed developers
- Bring operational code to community and provide technical support
- Conduct objective tests and evaluation for sponsors, operational centers, and community users
- Assist community research to operation transitions



Gridpoint Statistical Interpolation (GSI)

Unified variational (var) data assimilation (DA) system with hybrid ensemble-var capability

- Global and regional applications
- Weather and climate

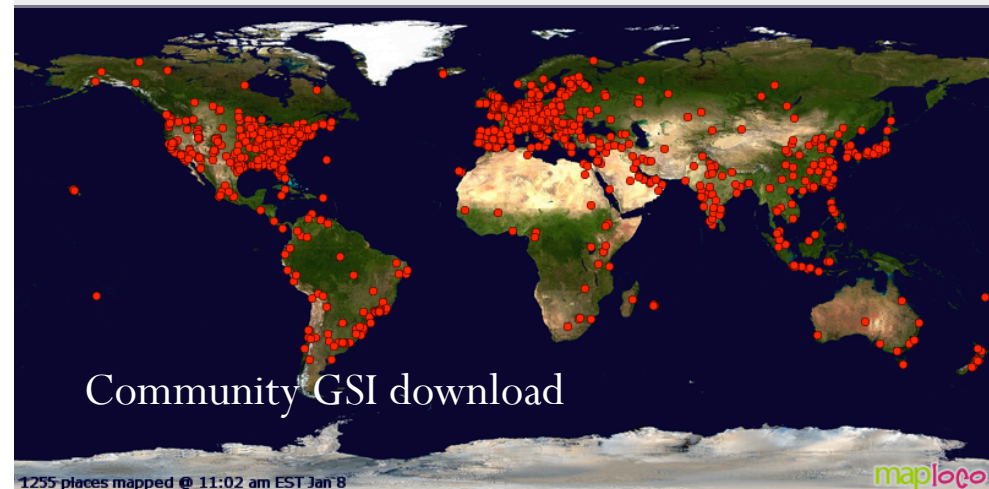
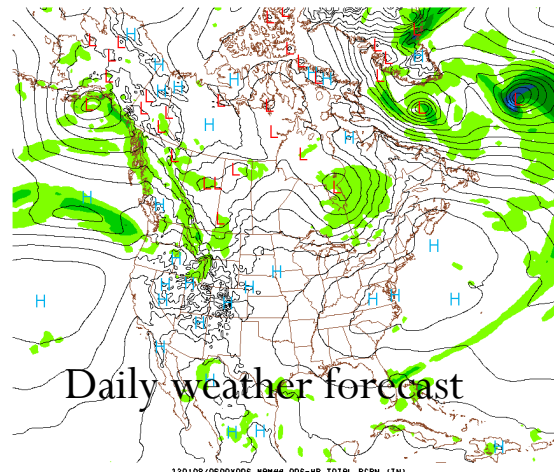
Operational system being used by

- NOAA (GFS, NAMS, RTMA, HWRF, RR...)
- NASA (GMAO global)
- and to be used by AFWA

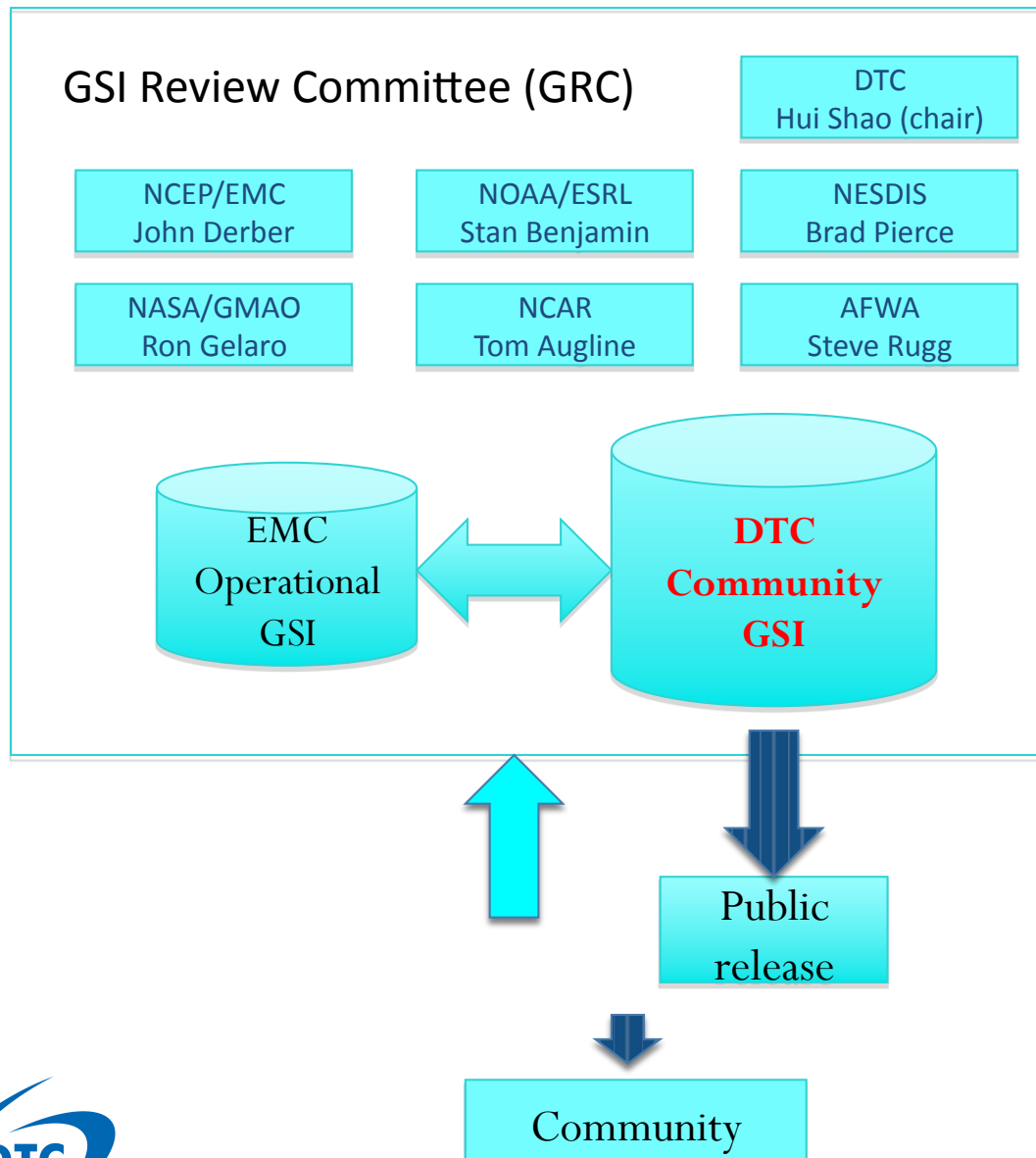
Distributed development:

- NCEP/EMC, NASA/GMAO, NOAA/ESRL, NCAR/MMM, ...

- ✓ A community model, supported by DTC and overseen by the GSI Review Committee
 - Well documented
 - User friendly interface and modularized code
 - Multi-platform compatibility
 - Training and support for developers and users
 - Coordinated distributed community contributions
- ✓ Community GSI Milestone
 - 2009:
 - First GSI release V1.0
 - First GSI User's Guide
 - Started the GSI Helpdesk (gsi_help@ucar.edu)
 - 2010:
 - First Community GSI Tutorial
 - Formed GSI Review Committee
 - Near real-time syncing of the trunks of DTC GSI community and NCEP operational GSI repositories
 - 2011: First Community GSI Workshop



GSI Code Management



- GRC mission:
 - GSI development planning and coordination
 - GSI code review
- DTC represents general community researchers in the GRC. Community requests come in via the GSI Helpdesk (gsi_help@ucar.edu)

- ✓ DTC GSI code repository/release contains the **same GSI source code** plus
 - Source code for the required NCEP GSI libraries
 - Multi-platform configure/ compilation utility
 - Additional DTC diagnostic/ plotting tools



GSI V3.1 released in July 2012

Upcoming annual release/tutorial in ~Summer 2013

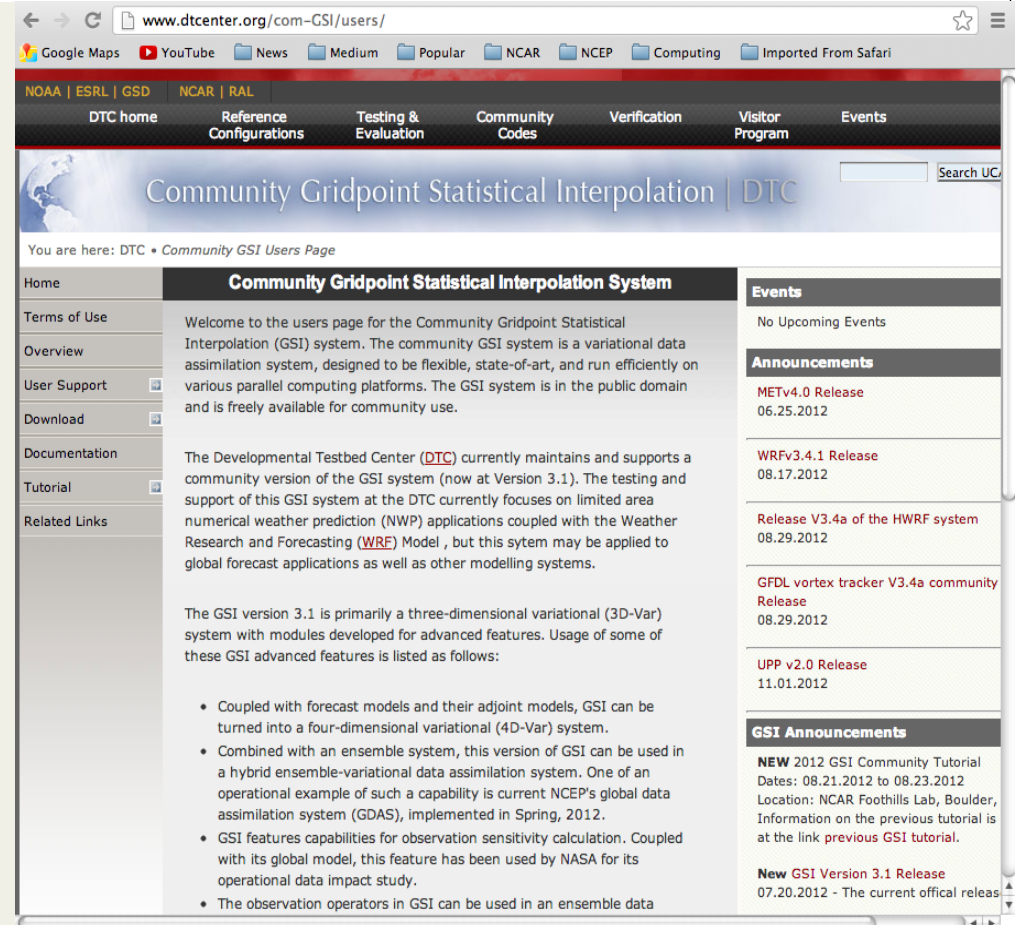
<http://www.dtcenter.org/com-GSI/users/>

GSI V3.1 Release Note:

- Updated GSI-hybrid capability. Add dual resolution capability for regional hybrid applications
- Added 4d capability for ensembles to allow several flavors of 4dvar using ensembles

Peek at GSI V3.2:

- New radiance bias correction scheme by direct use of global satellite bias correction coefficients and ozone profiles from GFS in regional models
- Enhanced capability of GSI-hybrid in regional applications
- Updated radiance data assimilation (new data type, ongoing cloudy radiance assimilation, updated satellite fixed files, ...)
- Updated conventional/retrieval data assimilation (e.g., radar, satellite wind, ...)
- Enhanced GSI 2D-var capability (RTMA)
- Enhanced Rapid Refresh GSI capability
- ...



The screenshot shows a web browser displaying the 'Community Gridpoint Statistical Interpolation | DTC' page. The page has a navigation menu with links for 'DTC home', 'Reference Configurations', 'Testing & Evaluation', 'Community Codes', 'Verification', 'Visitor Program', and 'Events'. The main content area is titled 'Community Gridpoint Statistical Interpolation System' and includes a welcome message, a description of the system, and a list of advanced features. The right sidebar contains an 'Events' section with 'No Upcoming Events', an 'Announcements' section with several release dates (e.g., METv4.0 Release on 06.25.2012), and a 'GSI Announcements' section with a 'NEW 2012 GSI Community Tutorial' and a 'New GSI Version 3.1 Release'.

GSI Based Hybrid Ens-Var DA System

▣ GSI-3DVAR (static BE)

$$J(x) = \frac{1}{2}(x - x_b)^T B^{-1}(x - x_b) + \frac{1}{2}[y - H(x)]^T R^{-1}[y - H(x)]$$

▣ GSI-Hybrid

$$J(x, \alpha) = \beta_1 J_b + \beta_2 J_e + J_o$$

$$= \beta_1 \frac{1}{2}(x - x_b)^T B^{-1}(x - x_b) + \beta_2 \frac{1}{2} \alpha^T A^{-1} \alpha + \frac{1}{2}[y - H(x + x_e)]^T R^{-1}[y - H(x + x_e)]$$

extended control variables

3DVAR

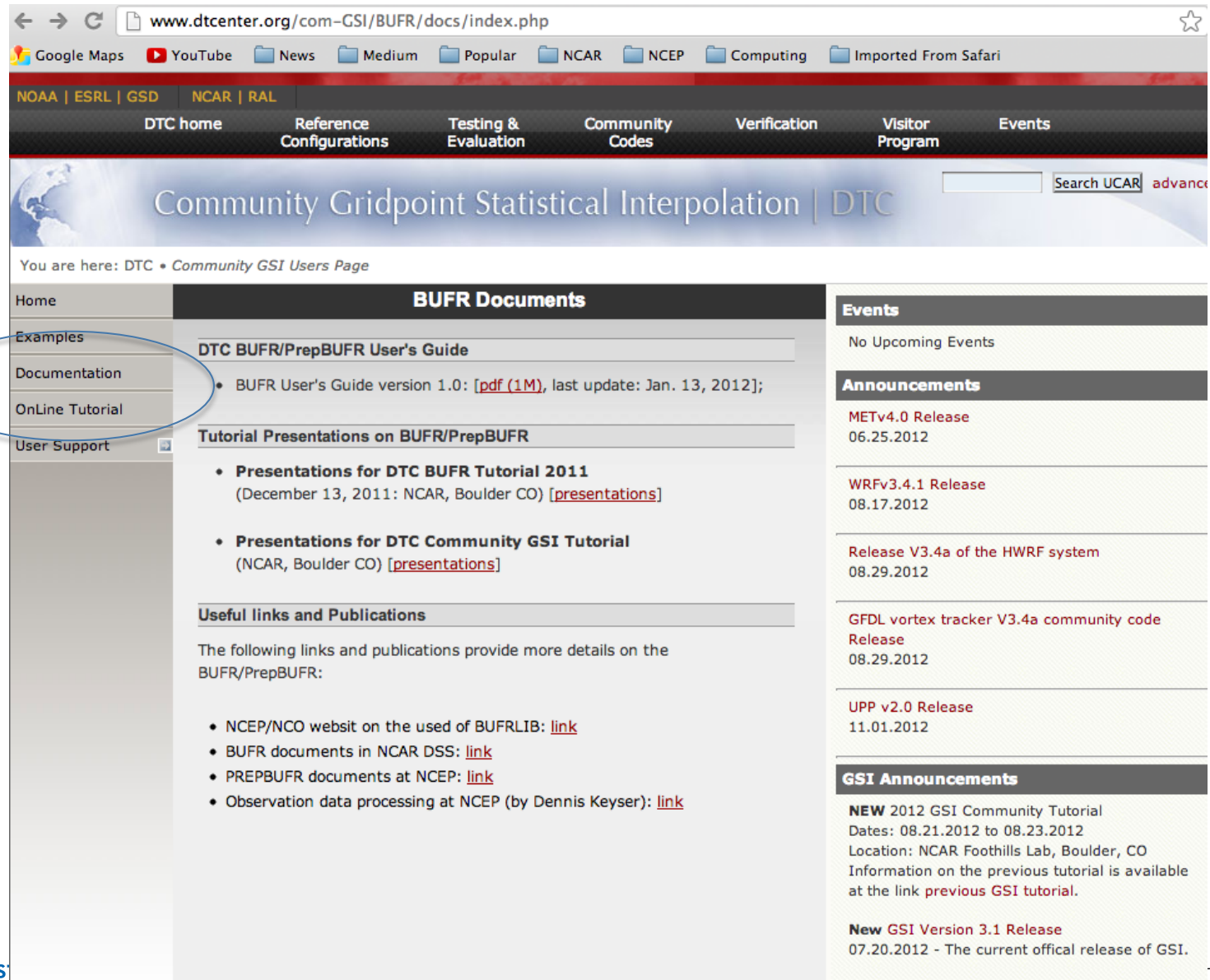
ensembles

- Capability is available in the current released code (v3.1):
 - Global capability (direct ingest of spectral GFS ensembles) was fully tested (implemented at NCEP, May 2012)
 - Regional capability (ingest of regional ensembles processed by WPS or generated by running WRF ensembles) was not tested (Please use the upcoming version)



BUFR/PrepBUFR Data Format Support (Limited)

- <http://www.dtcenter.org/com-GSI/BUFR/tutorial/index.php>



The screenshot shows the DTC website interface. The browser address bar displays www.dtcenter.org/com-GSI/BUFR/docs/index.php. The navigation menu includes links for NOAA | ESRL | GSD, NCAR | RAL, DTC home, Reference Configurations, Testing & Evaluation, Community Codes, Verification, Visitor Program, and Events. The main heading is "Community Gridpoint Statistical Interpolation | DTC". Below the heading, a search bar is visible with the text "Search UCAR" and "advance".

The breadcrumb trail indicates the current location: "You are here: DTC • Community GSI Users Page".

The main content area is titled "BUFR Documents" and contains the following sections:

- DTC BUFR/PrepBUFR User's Guide**
 - BUFR User's Guide version 1.0: [\[pdf \(1M\)\]](#), last update: Jan. 13, 2012];
- Tutorial Presentations on BUFR/PrepBUFR**
 - **Presentations for DTC BUFR Tutorial 2011** (December 13, 2011: NCAR, Boulder CO) [\[presentations\]](#)
 - **Presentations for DTC Community GSI Tutorial** (NCAR, Boulder CO) [\[presentations\]](#)
- Useful links and Publications**

The following links and publications provide more details on the BUFR/PrepBUFR:

 - NCEP/NCO website on the use of BUFR/LIB: [link](#)
 - BUFR documents in NCAR DSS: [link](#)
 - PREPBUFR documents at NCEP: [link](#)
 - Observation data processing at NCEP (by Dennis Keyser): [link](#)

The right sidebar contains the following sections:

- Events**

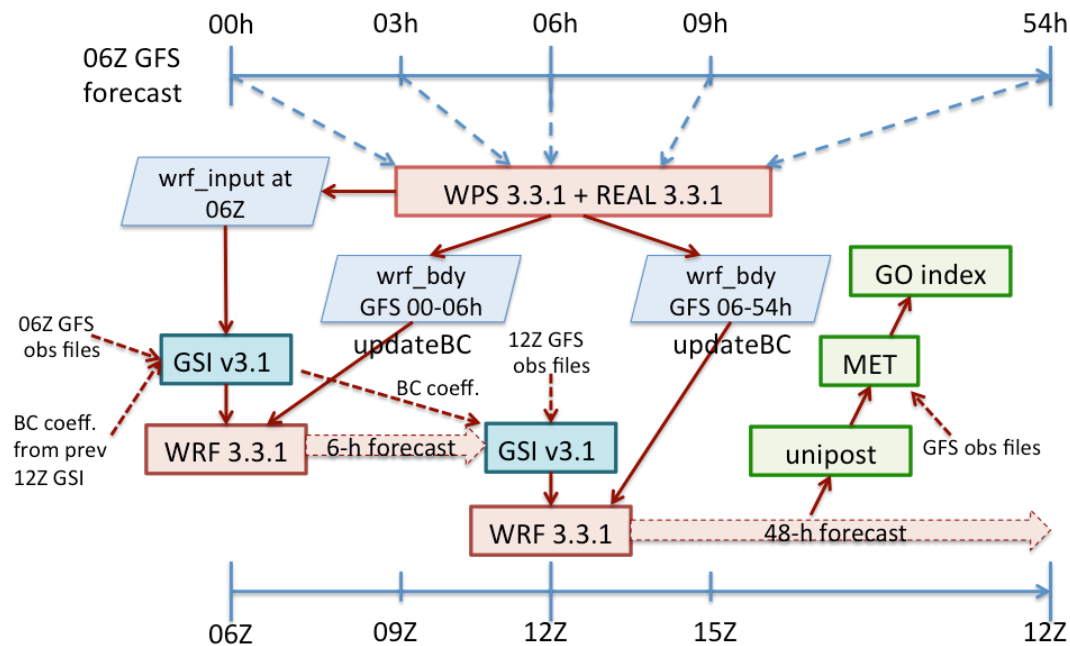
No Upcoming Events
- Announcements**
 - METv4.0 Release**
06.25.2012
 - WRFv3.4.1 Release**
08.17.2012
 - Release V3.4a of the HRRF system**
08.29.2012
 - GFDL vortex tracker V3.4a community code Release**
08.29.2012
 - UPP v2.0 Release**
11.01.2012
- GSI Announcements**
 - NEW 2012 GSI Community Tutorial**
Dates: 08.21.2012 to 08.23.2012
Location: NCAR Foothills Lab, Boulder, CO
Information on the previous tutorial is available at the link [previous GSI tutorial](#).
 - New GSI Version 3.1 Release**
07.20.2012 - The current official release of GSI.

Operational-equivalent Testing and Evaluation

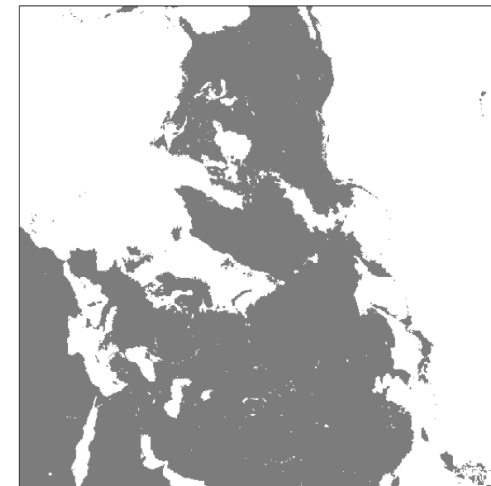
Full end-to-end system runs 1x/day

- WPS (v.3.3.1), comGSI (v3.1), WRF-ARW (v.3.3.1), UPP (v.1.0), & MET (v4.0)
- 06 Z cold start cycle
- 12 Z continuous cycle; bkgd 6-hr forecast from 06 Z cold start cycle
- Continuous cycling bias correction coefficients
- 20-km Northern Hemisphere Domain
- 57 vertical levels, 10 hPa model top
- 48-hr forecasts initialized at 12 Z
- Grid-to-point verification against conventional observations

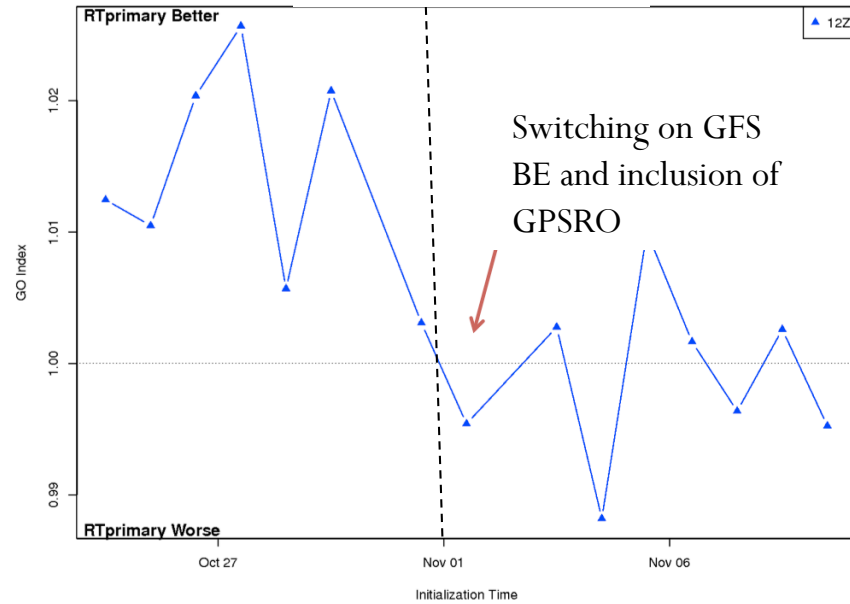
DTC GSI Testbed for AFWA T51 configuration



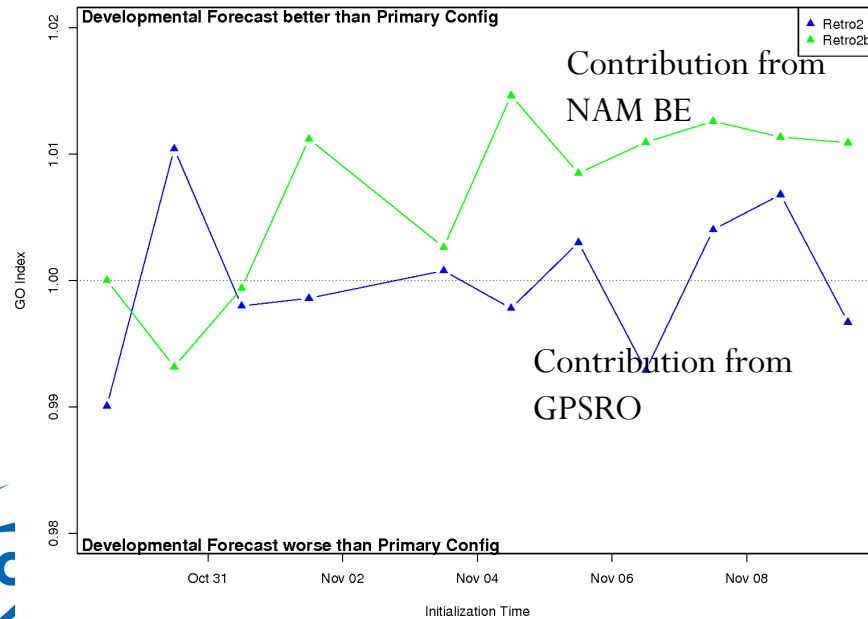
Kathryn Newman's Poster: IOAS-AOLS 620



AFWA GO Index



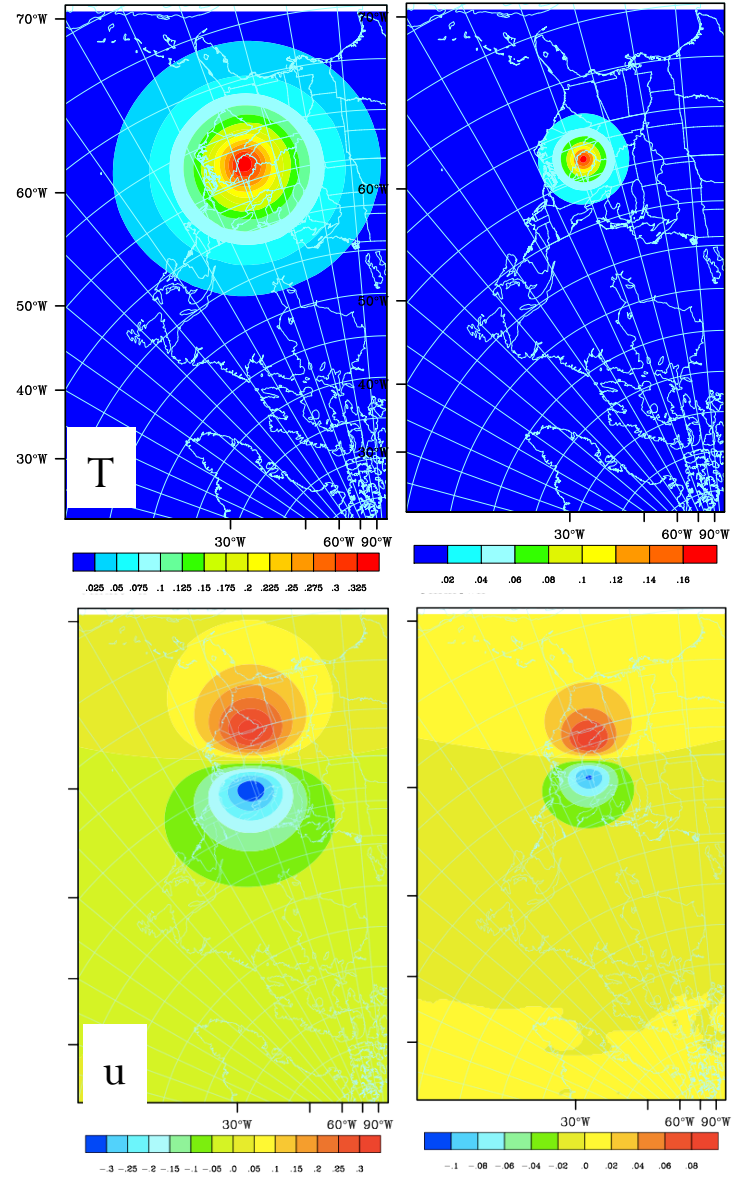
GO Index Retro2 & Retro2b vs RTprimary



Analysis Increments from Single Obs Test

Global BE

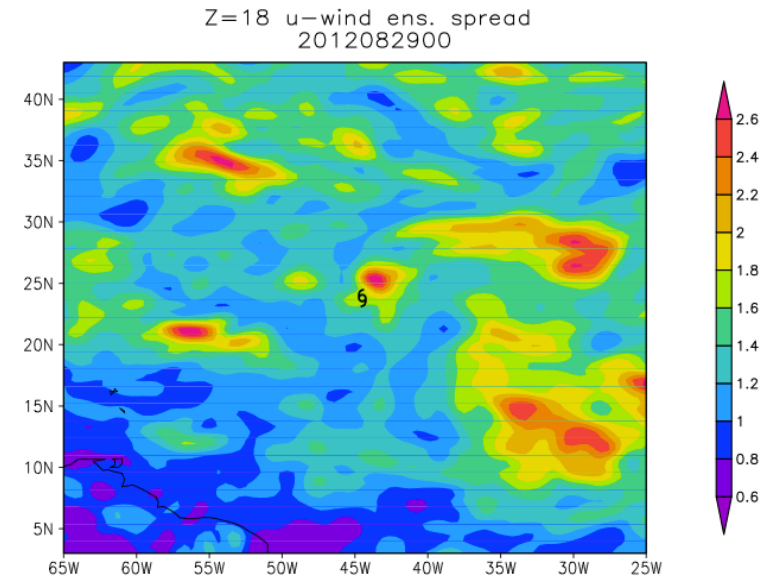
Regional BE



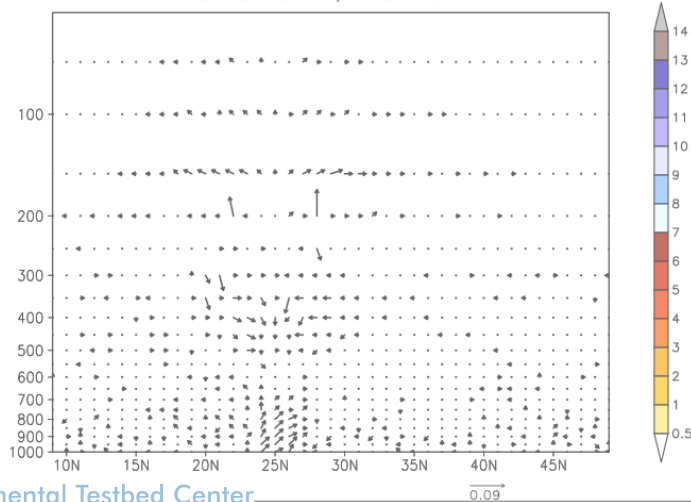
Involvement in Developing the Next-phase Operational DA System

GSI Hybrid test by Chunhua Zhou

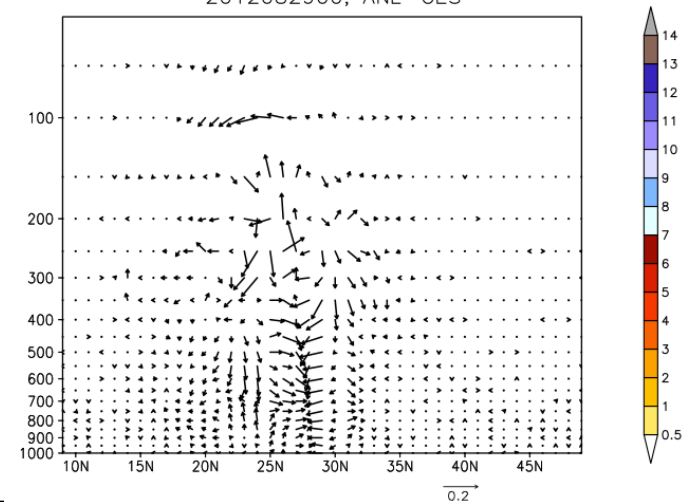
- Horizontal localization scale 600km
- Vertical localization scale $-0.5 (\ln P)$
- 80 global ensembles
- The single observation is around storm center: AMSU-A radiance profile
- Background: 2012082900



uv vector and Isotach(kts) LON=270.5 - AMSUA.3dvar.single
2012082900, ANL-GES

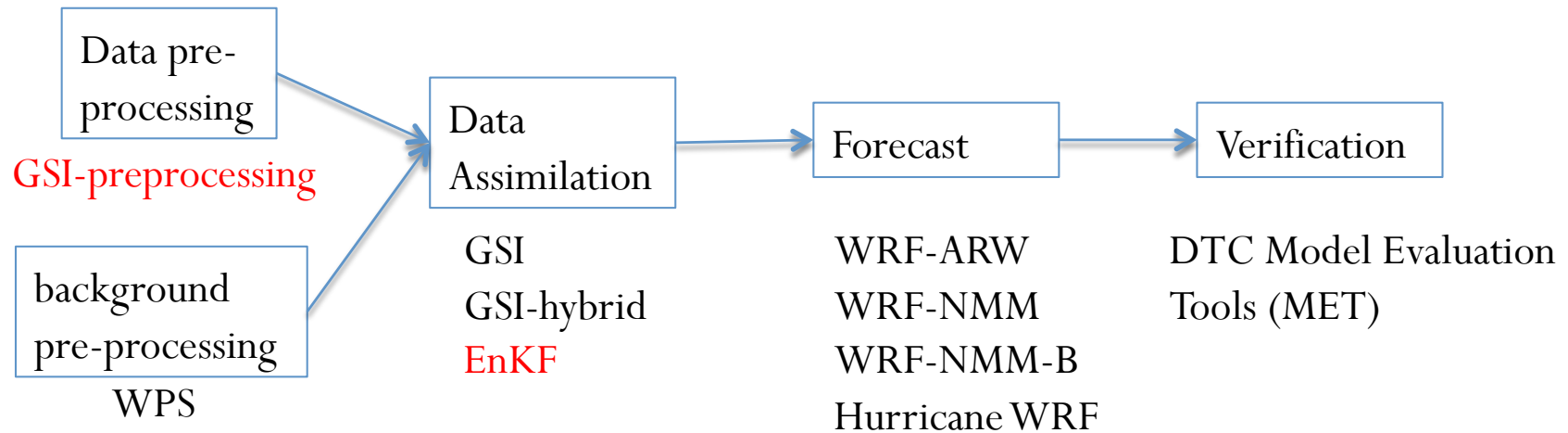


uv vector and Isotach(kts) LON=270.5 - AMSUA.hyb.single
2012082900, ANL-GES



Plans and Future

A Complete Community Forecast-DA System



✓ Community DA Pre-processing System

- Operational capability of conventional data quality control (QC)
- Data conversion/BUFR format support
- User friendly interface (background plug in, optional setup, ...)
- Documentation



Plans and Future

- ✓ Community Ensemble Kalman Filter (EnKF) system (ongoing effort): To be used alone or for the GSI-hybrid
 - Community system following the protocol set up by the GSI community model
 - Multi-platform capability
 - Modularized code
 - User friendly interface
 - Documentation
 - Code management
 - Shared version controlled repository with regular regression tests
 - Coordinated distributed development
 - Community test benchmark

