93rd AMS Annual Meeting/17th IOAS-AOLS/3rd Conference on Transition of Research to Operations, Austin, TX, Jan 6-10, 2013

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

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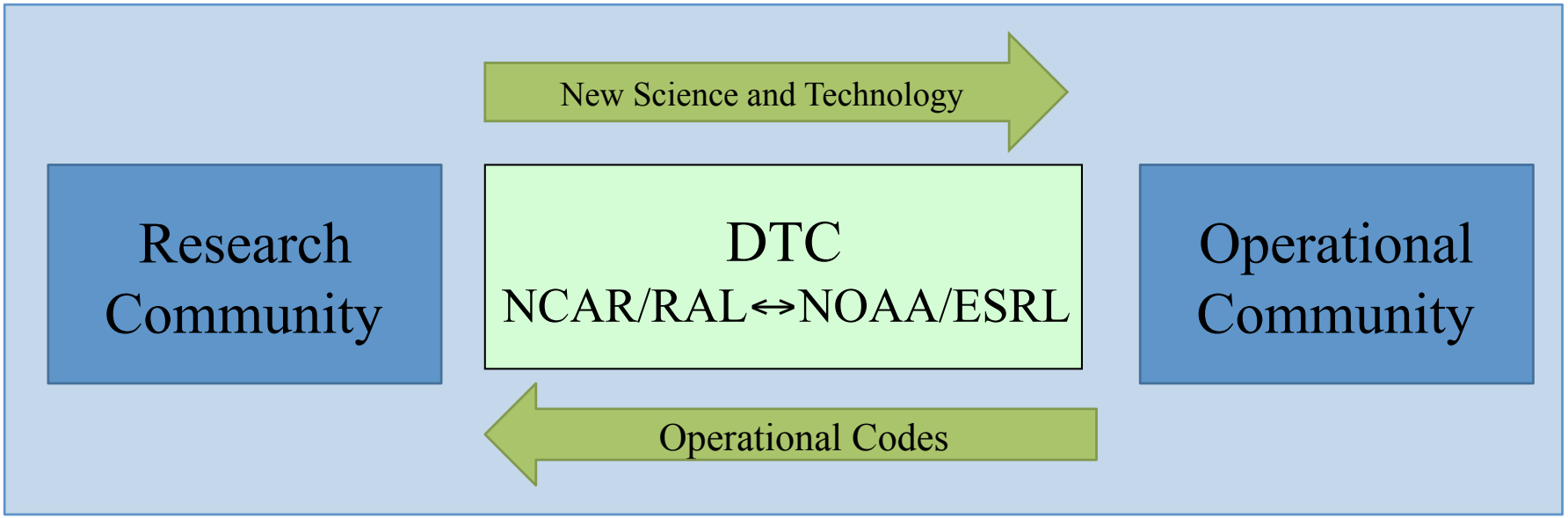
[3]Developmental Testbed Center (DTC)

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

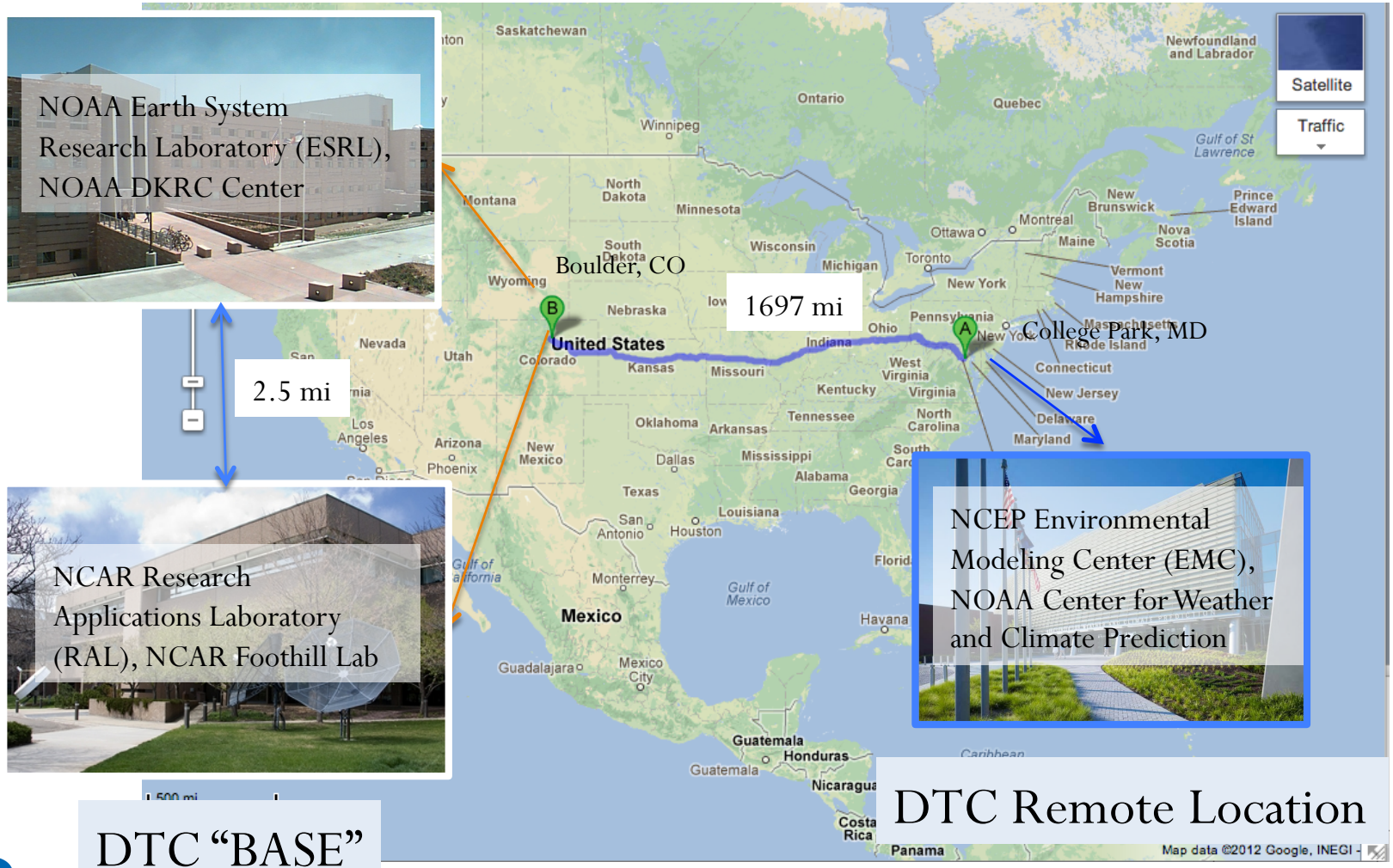
- Research: functionally similar operational environment to test and evaluate new NWP methods over extended retrospective periods
- Operational: benefits from DTC testing & evaluation of strengths and weaknesses of new NWP advances prior to consideration for operational implementation



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?



Developmental Testbed Center

Map data @Google

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

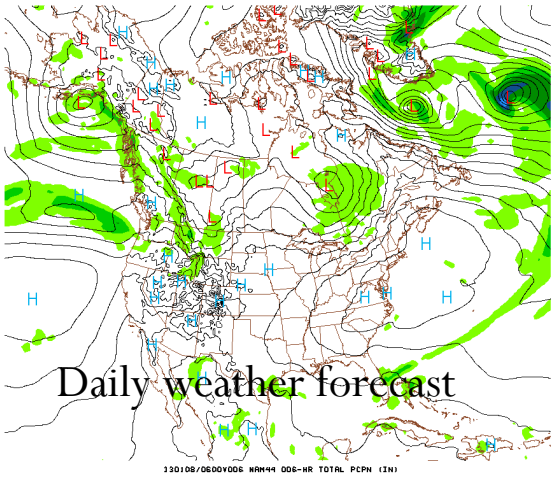
- Global and regional applications
- Weather and climate

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

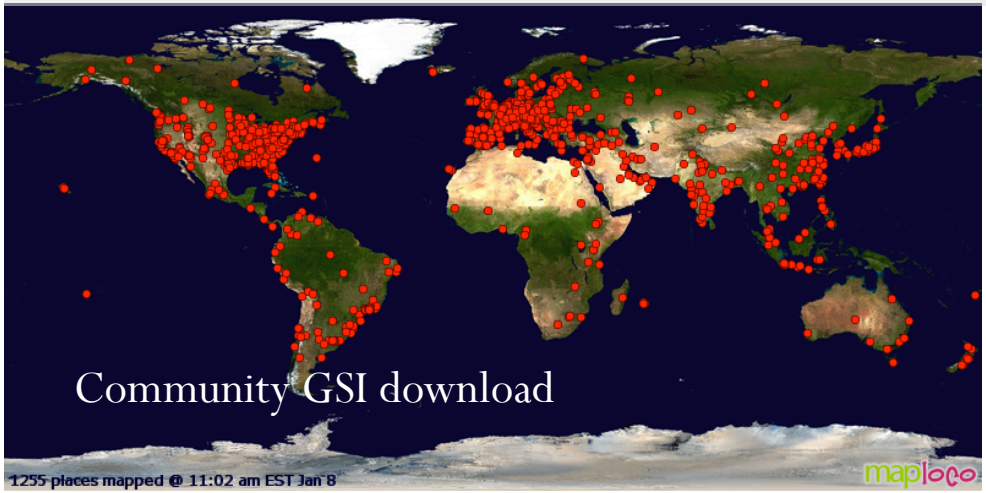
2009:

First GSI release V1.0
First GSI User's Guide
Started the GSI Helpdesk (gsi_help@ucar.edu)

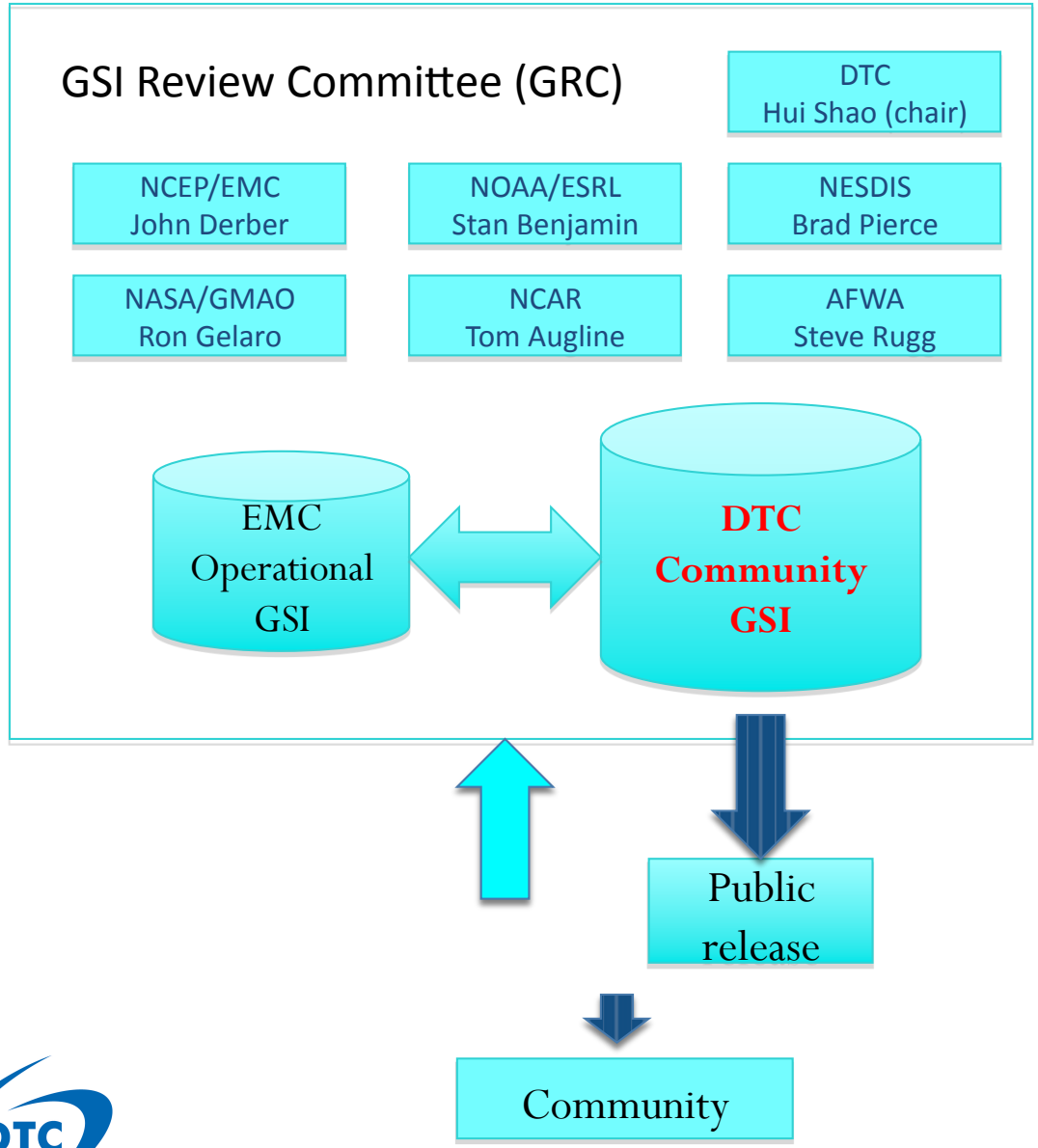
2010:

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

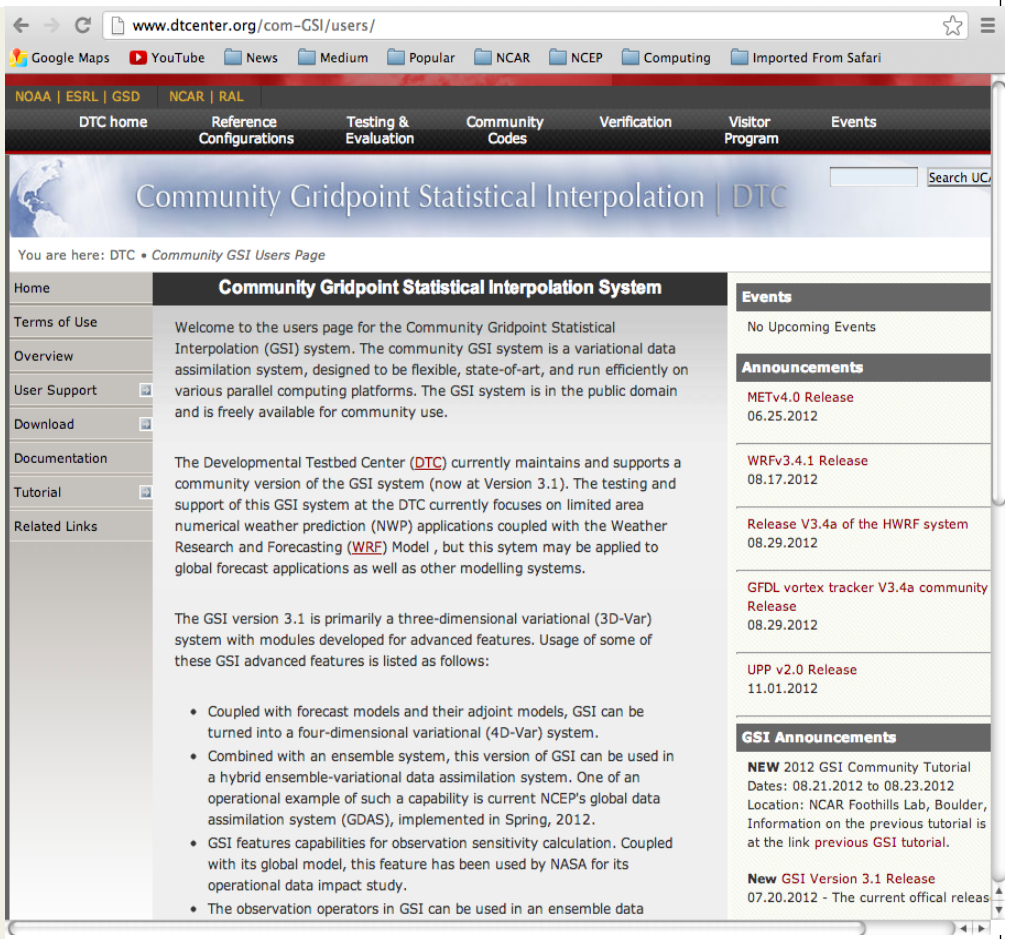
http://www.dtcenter.org/com-GSI/users/

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
- …



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

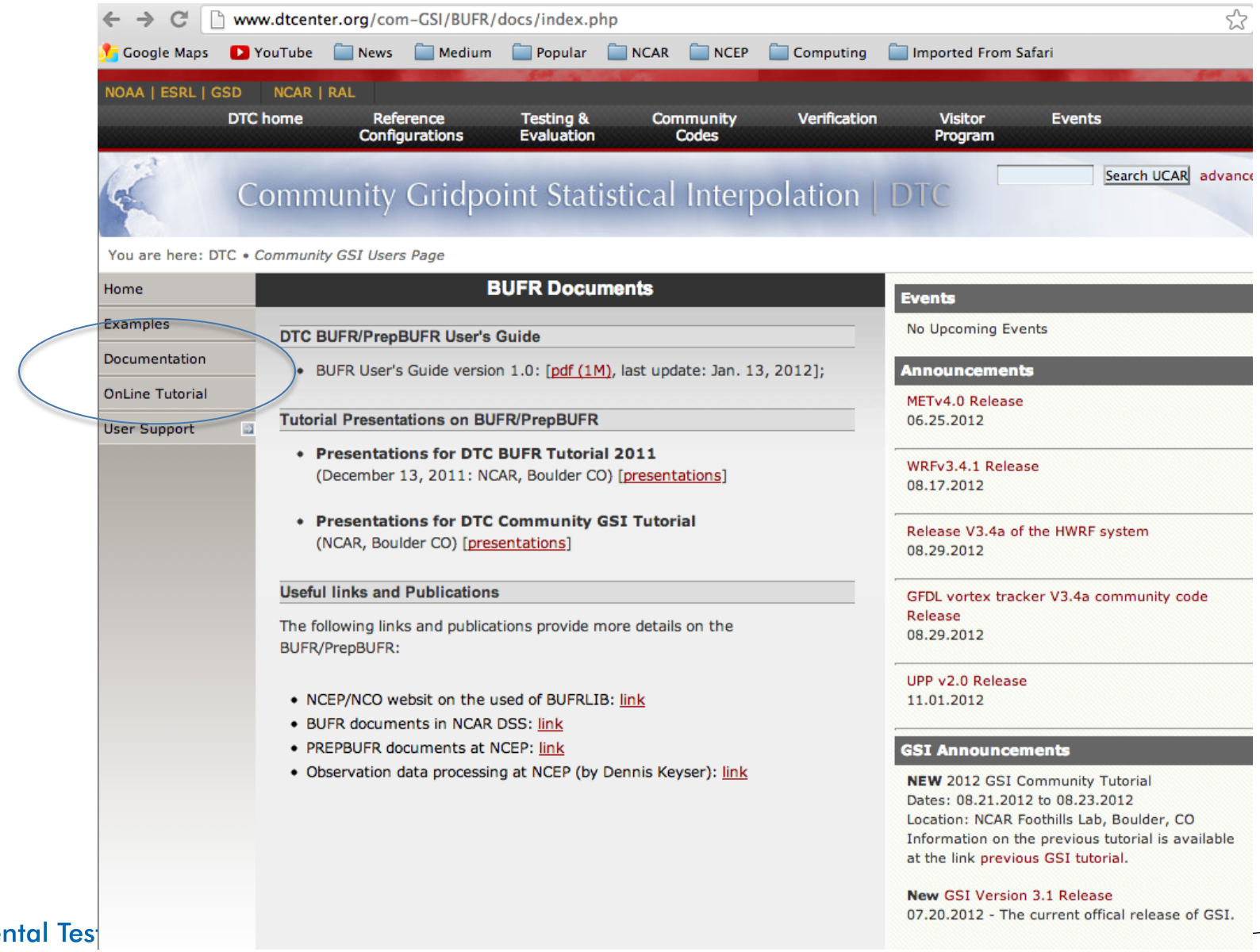
3DVAR

ensembles

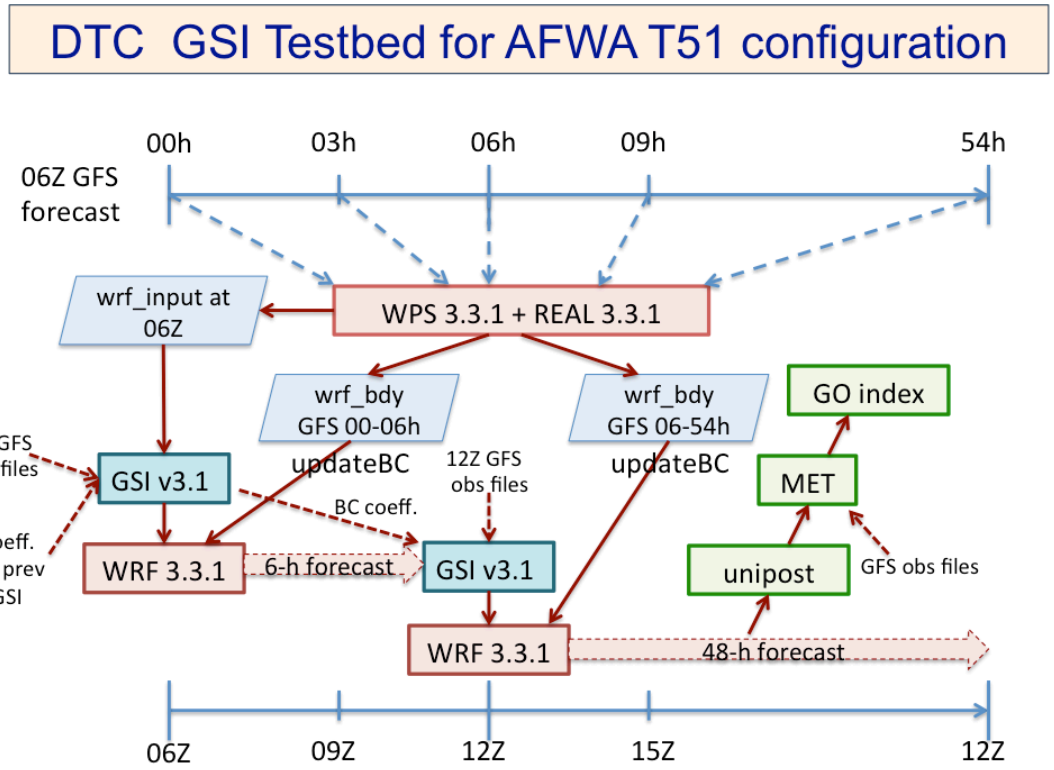
- Capability is available in the current released code (v3.1):
  - Global capability (direct ingest of spectral GFS ensembles) was fully tested (implemented at NCEP, May 2012)
  - Regional capability (ingest of regional ensembles processed by WPS or generated by running WRF ensembles) was not tested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

BUFR/PrepBUFR Data Format Support (Limited)

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

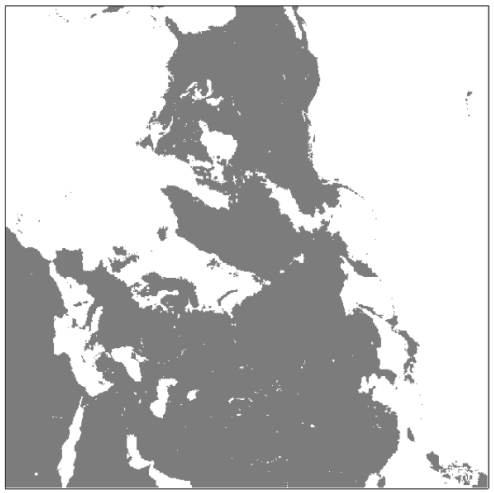


Operational-equivalent Testing and Evaluation



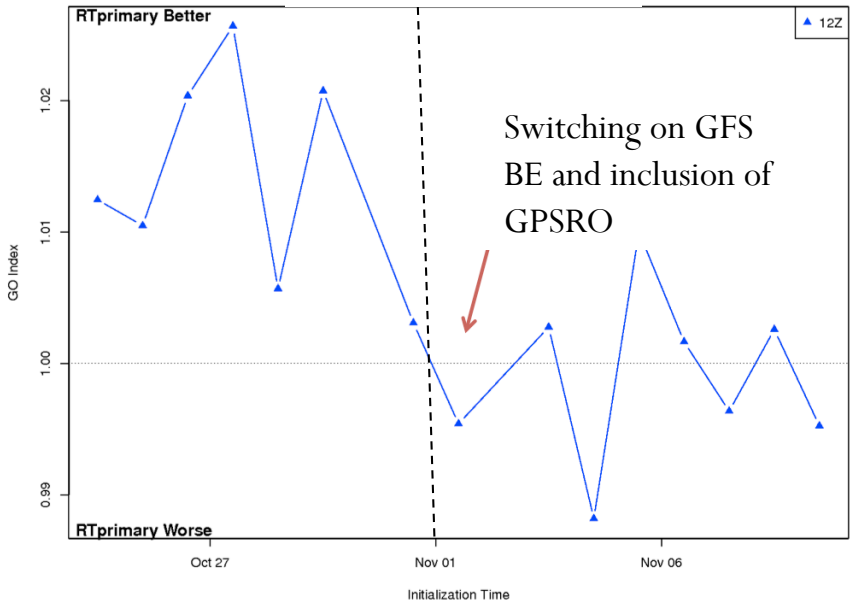
Full end-to-end system runs 1x/day

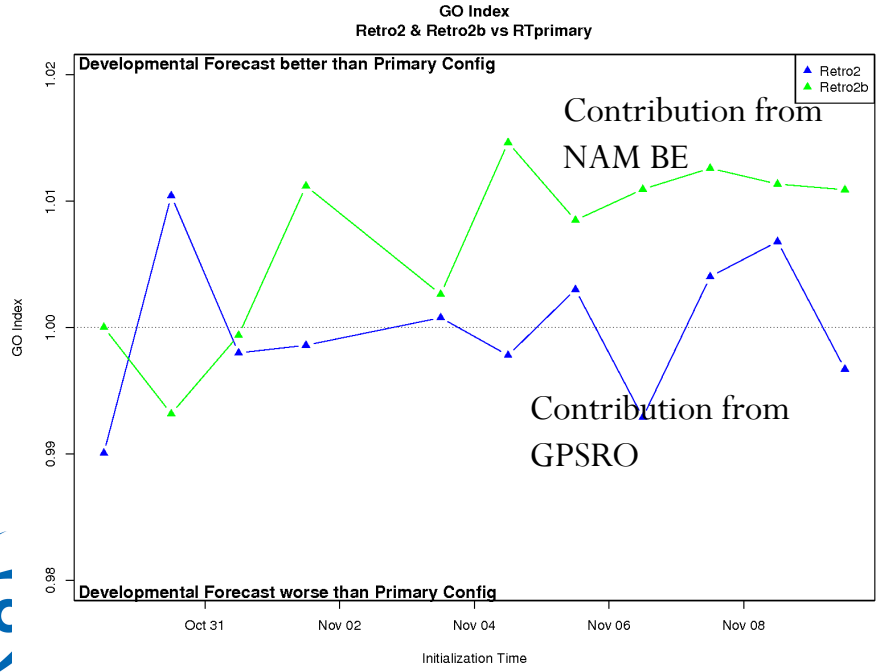
- WPS (v.3.3.1), comGSI (v3.1), WRF-ARW (v.3.3.1), UPP (v.1.0), & MET (v4.0)
- 06 Z cold start cycle
- 12 Z continuous cycle; bkgd 6-hr forecast from 06 Z cold start cycle
- Continuous cycling bias correction coefficients
- 20-km Northern Hemisphere Domain
- 57 vertical levels, 10 hPa model top
- 48-hr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



Kathryn Newman's Poster: IOAS-AOLS 620

AFWA GO Index

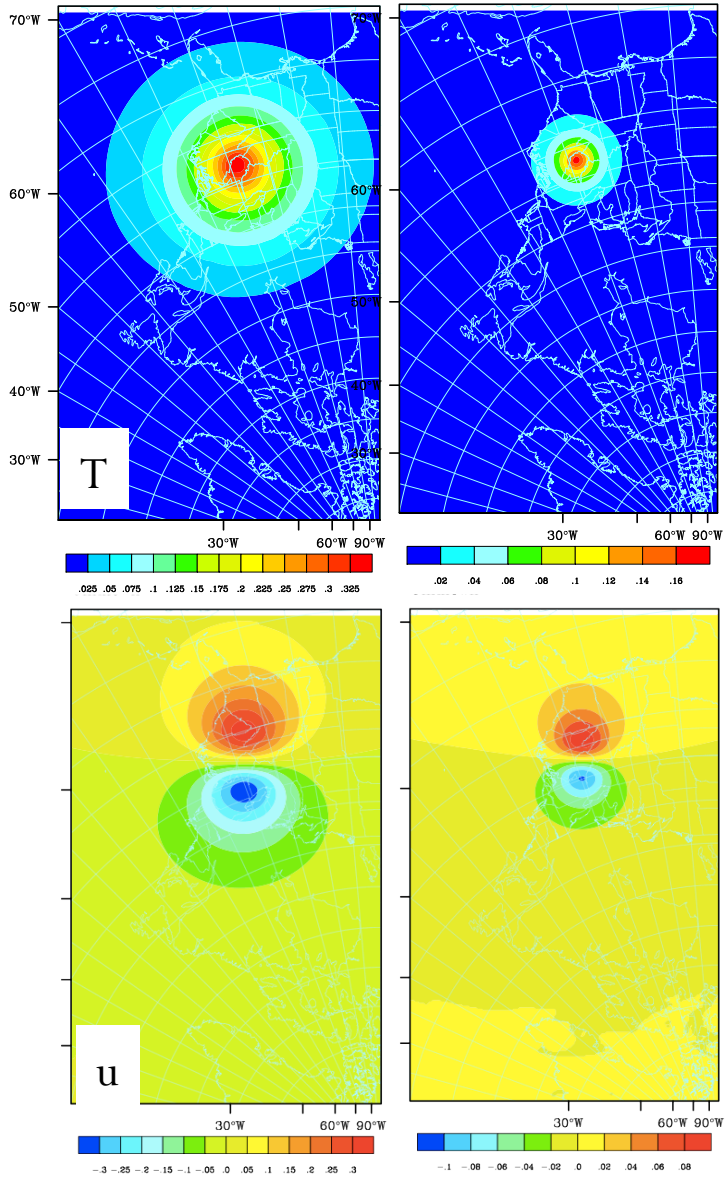




Analysis Increments from Single Obs Test

Global BE

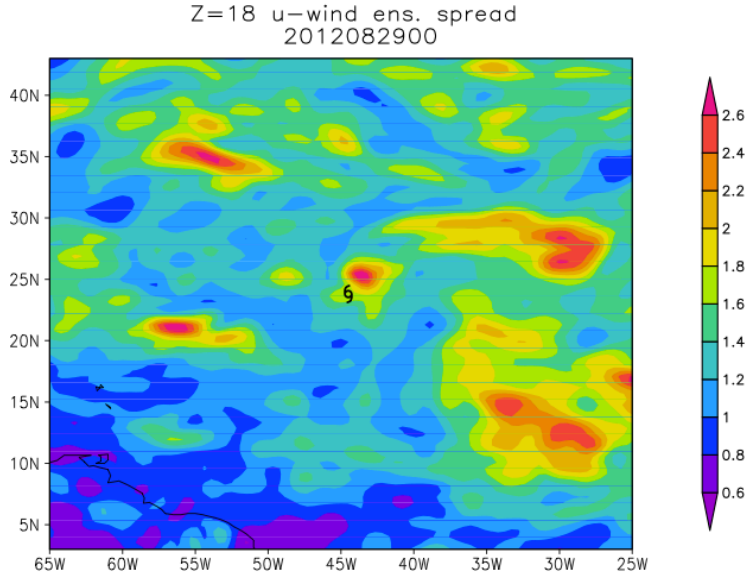
Regional BE

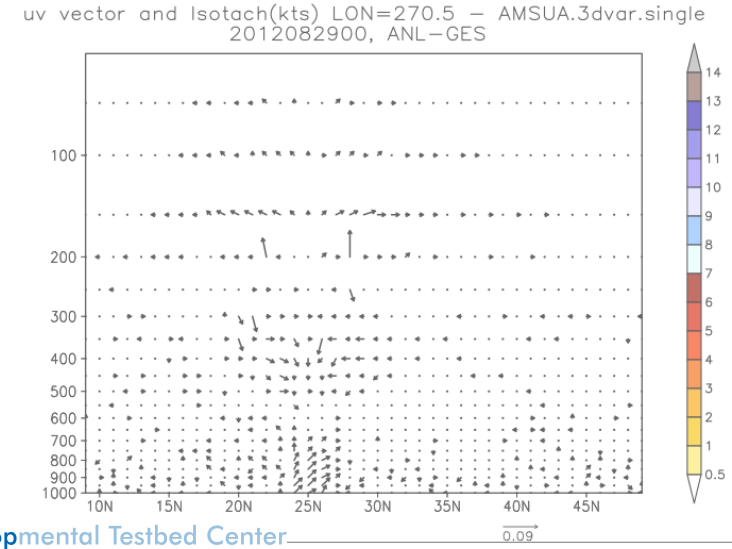


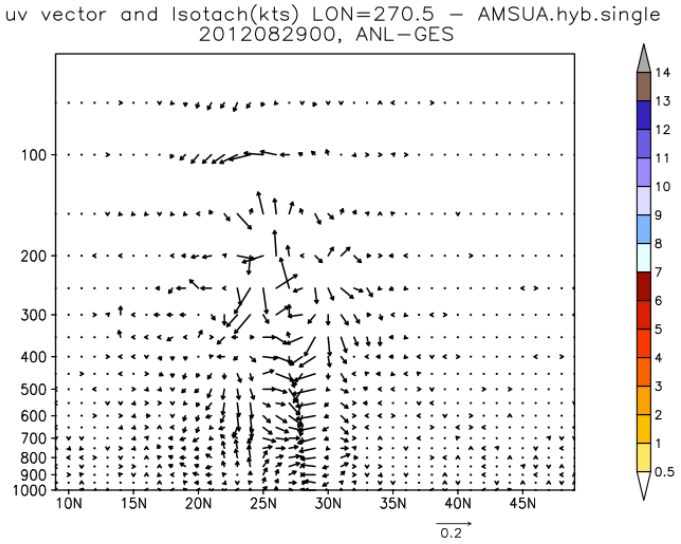
Involvement in Developing the Next-phase Operational DA System

GSI Hybrid test by Chunhua Zhou

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

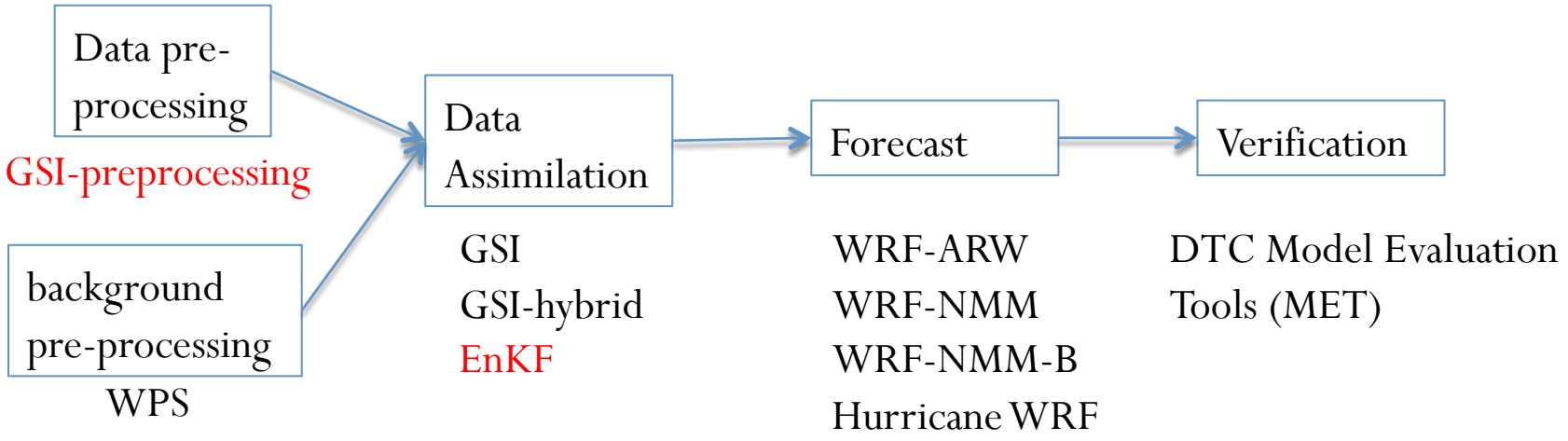






Plans and Future

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