2014 Community GSI Tutorial

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Developmental Testbed Center (DTC)

July 14-16, 2014, Boulder, CO

Acknowledgement: NOAA/OAR and NCAR. NCAR is supported by NSF.
Developmental Testbed Center (DTC) and Community NWP Systems

DTC (http://www.dtcenter.org/):
- A bridge between the research and operational communities
- Supports NWP systems
  - WRF, HWRF, GSI, MET, UPP, …
Gridpoint Statistical Interpolation (GSI) Data Assimilation (DA) System

• DA techniques:
  • Three-Dimensional Variational (3D-Var)
  • Hybrid ensemble-variational
  • 4D-Var (coupled adjoint model not provided)
  • 4D EnsVar (no adjoint) (ongoing)
• Obs. operator for the NOAA Ensemble DA system

<table>
<thead>
<tr>
<th>GSI config.</th>
<th>DA applications</th>
<th>Coupled model</th>
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<tbody>
<tr>
<td><strong>Global</strong></td>
<td></td>
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<tr>
<td>GSI-hybrid</td>
<td>GDAS (NOAA)</td>
<td>GFS &amp; EnKF</td>
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<tr>
<td>GSI-4D-Var</td>
<td>GEOS-DAS (NASA)</td>
<td>GEOS &amp; GEOS adjoint</td>
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<tr>
<td>GSI-analysis</td>
<td>NOAA reanalysis</td>
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<tr>
<td><strong>Regional</strong></td>
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<tr>
<td>GSI-hybrid (using GFS ens)</td>
<td>HWRF, RAP (NOAA)</td>
<td>WRF-NMM, ARW,</td>
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<td>GSI-3D-Var</td>
<td>AFWA mesoscale</td>
<td>ARW</td>
</tr>
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<td>NAM (NOAA)</td>
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<td>NMM-B</td>
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<td>GSI-2D analysis</td>
<td>NOAA RTMA</td>
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GSI was developed as an operational system
Advantage of Using an Operational Model

- Sustained development and support
  - NCEP/EMC (2005-)
  - NASA/GMAO (2006-)
  - NOAA/ESRL (2012-)
  - AFWA (2012-)
  - NCAR/MMM (supporting AFWA ops.)
  - NESDIS (satellite group)
  - DTC (supporting community & sponsors)
  - other community developers

- Direct transitions from research to operations
- Robust system performance, cross-checked by multiple daily operations
- High priority for assimilating new data types/instruments
- Running efficiency
Community GSI Effort

- GSI provided to the research community with central user support through DTC since 2009
- Operational and community GSI development are incorporated under the unified code management framework
Community GSI Support

- **GSI webpage**
  

- **Working on the code:**
  - Work directly with developers
  - or
  - Use released code or apply the community GSI repository access through DTC
  - Transitioning code advancements to GSI repo. assisted by DTC or other GSI partners

- **DTC Visitor Program**
  - Annual program, applied through DTC
  - Hosted by DTC staff in associated areas
  - Visit to other operational centers (e.g., EMC) can be arranged

- **Other visitor opportunities**

- **Contact DTC for tailored instruction sessions or tutorials**

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GSI help desk:
 gsi_help@ucar.edu
(registered users only)
Community GSI Outreach

V3.3:

- June 30, 2014
- Users’ Guide divided into two separate documents:
  Fundamental and advanced

HWRF GSI release (scheduled in Aug, 2014):
From same repository with tailored config.

<table>
<thead>
<tr>
<th>Year</th>
<th>Public release</th>
<th>Tutorial/instruction session</th>
<th>Workshop</th>
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</table>
| 2009 | v1.0           | • GSI Instructional Session, the 10th WRF Workshop, Boulder, Colorado  
         • Introduction to GSI, WRF Data Assimilation (WRFDA) System Tutorial, Boulder, Colorado |          |
| 2010 | v2.0           | GSI Tutorial, Boulder, Colorado |          |
|      | v2.5           |                              |          |
| 2011 | v3.0           | • GSI Tutorial, Boulder, Colorado  
         • BUFR/PrepBUFR\(^1\) Tutorial, Boulder, Colorado (with remote access) | • The 1\(^{st}\) Community GSI Workshop, Boulder, Colorado  
         • The GSI-hybrid Workshop, Miami, Florida (with remote access) |
| 2012 | v3.1           | GSI Tutorial, Boulder, CO |          |
| 2013 | v3.2           | • GSI Tutorial\(^2\), College Park, Maryland  
         • GSI Instructional Session\(^3\), Beijing, China | The 2\(^{nd}\) Community GSI Workshop\(^2\), College Park, Maryland (with remote access) |
| 2014 | v3.3           | GSI Tutorial, Boulder, CO |          |
About this tutorial...
Fundamentals of data assimilation - Milija Zupanski (CSU)

- General introduction to DA methodology and techniques. More information can be obtained from DA related courses and literature.
### Tutorial Agenda

**Overview of GSI**
- John Derber (NCEP)

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- **GSI Fundamentals (DTC)**
  - Setup & Compilation- Don Stark
  - Run & Namelist- Ming Hu
  - Diagnostics- Kathryn Newman
  - Review and Applications- Chunhua Zhou
Tutorial Agenda

Data Processing: Obs proc & BUFR/PreBUFR
- Ming Hu (DTC)

- Preparing input observations for GSI
- Introduction to background error covariance and estimation
- GEN_BE: a stand-alone utility for generating domain & model specific BE, developed and supported by NCAR/MMM

Background Error & GEN_BE v2.0
- Tom Auligné, Gael Descombes (NCAR)
GSI specifics (EMC)
- Radiance DA-John Derber
- Radar DA-Jacob Carley

✓ We are rotating some of the specific topics (e.g., assimilation of different data types)
GSI hybrid
-Jeff Whitaker (NOAA/ESRL)

\[ \checkmark \text{GSI technique: operational config. for GFS (2012), HWRF (2013), RAP (2014)} \]

GSI Infrastructure & Advanced Features
-Ricardo Todling (NASA/GMAO)

\[ \checkmark \text{For advanced users and developers} \]
Tutorial Agenda

Practical Hands-on Sessions:
-DTC

- Please bring your Yellowstone token or obtain your token from instructor.
- 30 computers provided. May need double up.
- You may bring your own laptop, if adequate software installed (e.g., X-window, Putty, Terminal, Xquartz, etc).

Please return your token at the end of your last practical session!

Monday, July 14, 2014 GSI Tutorial: Day 1

8:30 AM Registration
9:00 AM Welcome/Introduction
9:30 AM Fundamentals of data assimilation
10:30 AM Coffee Break (Group photo)
11:00 AM Overview of GSI
12:00 PM Lunch
1:00 PM GSI Fundamentals (1): Setup & Compilation
1:30 PM GSI Fundamentals (2): Run & Namelist
2:15 PM GSI Fundamentals (3): Diagnostics
3:00 PM Coffee Break
3:30 PM Intro to Practical Session
3:45 PM Practical Session (Teaching Lab FL-2 Rm 1024)
5:30 PM Adjourn
5:35 PM Shuttle Leaves

Tuesday, July 15, 2014 GSI Tutorial: Day 2

9:00 AM GSI Fundamentals (4): Review and Applications
9:30 AM Data Processing: Obs proc & bufr/prebufr
10:30 AM Coffee Break
11:00 AM Background error & Gen BE
12:15 PM Lunch
1:15 PM Practical Session (Teaching Lab FL-2 Rm 1024)
3:00 PM Coffee Break
3:30 PM Radiance data assimilation
4:30 PM Radar data assimilation
5:30 PM Adjourn
5:35 PM Shuttle Leaves

Wednesday, July 16, 2014 GSI Tutorial: Day 3

9:00 AM GSI Hybrid
10:00 AM Coffee Break
10:30 AM GSI Infrastructures & Advanced Features
11:30 AM Lunch
12:30 PM Practical Session (Teaching Lab FL-2 Rm 1024)
Misc.

- Group photo: Monday morning break (~10:30am), in front of main entrance
- Complimentary refreshment and lunch: Cafeteria atrium

Thanks to all the speakers!
Special Thank You to Don Stark for overall coordinating and Marybeth Zarlingo for logistic support!
Please introduce yourself:
- Name
- Affiliation
- Plans of using GSI