



Developmental Testbed Center

DEVELOPMENTAL TESTBED CENTER ENSEMBLE TESTBED (DET)

Tara Jensen

For DET Team

Team Members:

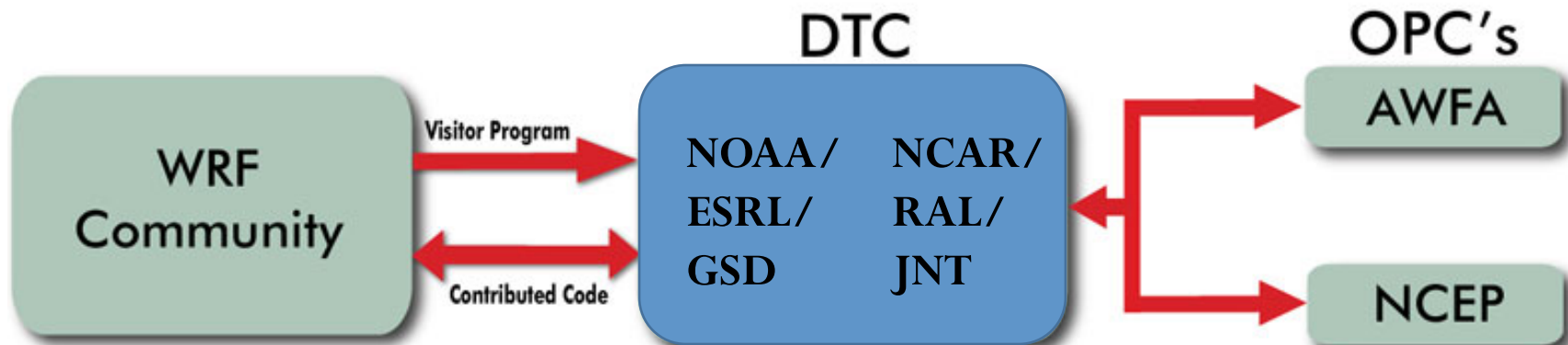
Zoltan Toth, Isidora Jankov, Paula McCaslin, Ed Tollerud, Linda Wharton, Jeff Smith, Barabara Brown, and Brian Etherton

ICAP Workshop - May 11, 2011 Boulder Colorado

What is DTC?

- A National Facility where the NWP community can test and evaluate new models and techniques for use in research and operations
 - Established in 2003 as a multi-agency effort (NOAA and NCAR)
-
- Objective: Bridge between Research and Operations
 - Focus: Mesoscale and Convective Scale NWP
-
- Benefits
 - Research community gets a functionally equivalent operational environment to test and evaluate new NWP methods in retrospective extended period tests using advanced tools
 - Operational community benefits from DTC testing and evaluation of strengths and weaknesses of new NWP advances prior to consideration for operational implementation

Who are our partners?



Distributed Facility
with ~23 FTE from staff
at either NOAA/ESRL
and NCAR/RAL
and 2 staff at NOAA/NCEP

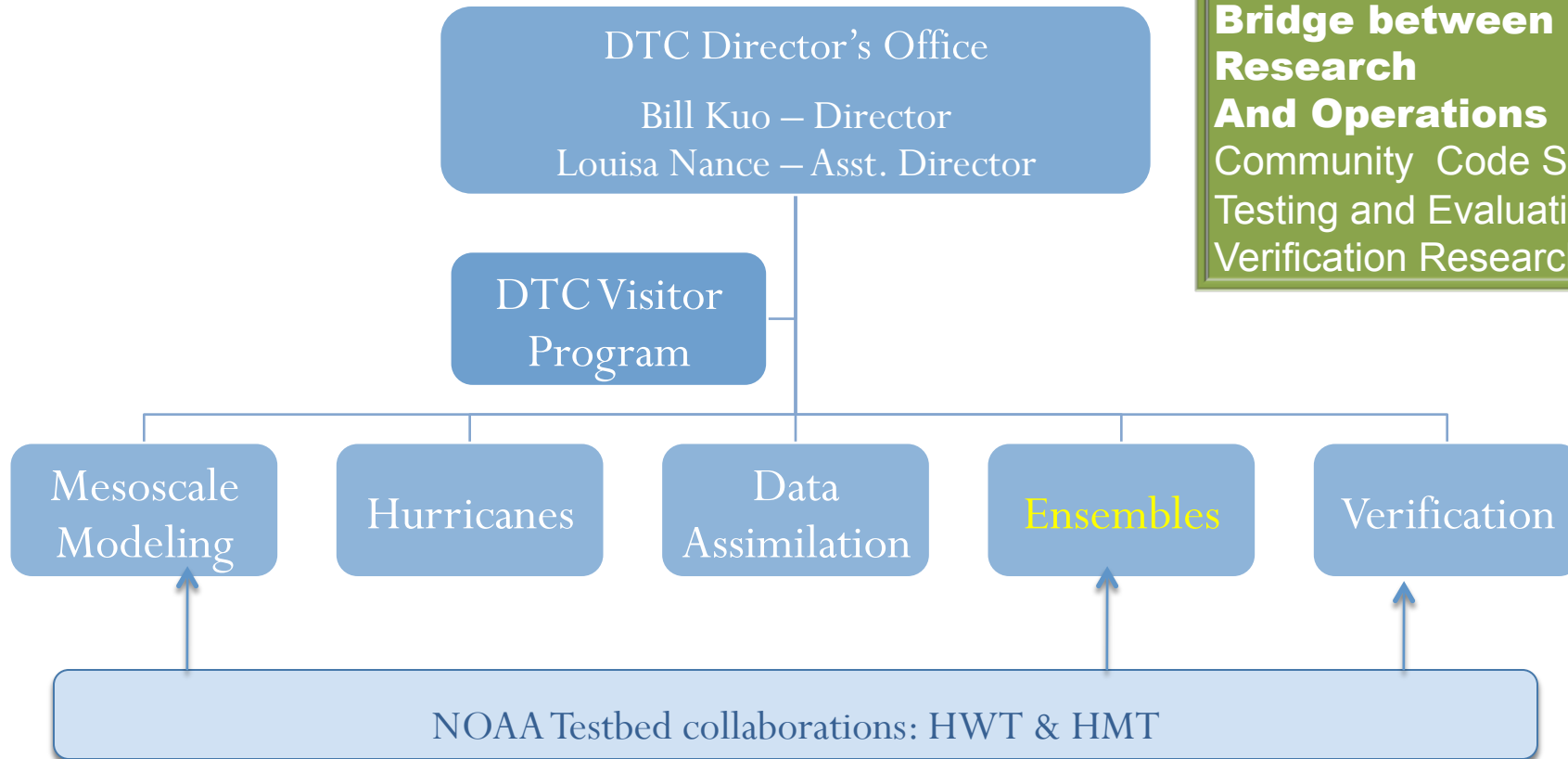
Funded by:
NOAA, USWRP, AFWA,
NCAR, NSF

**Bridge between
Research
And Operations**
Community Code Support
Testing and Evaluation
Verification Research

What do we do?

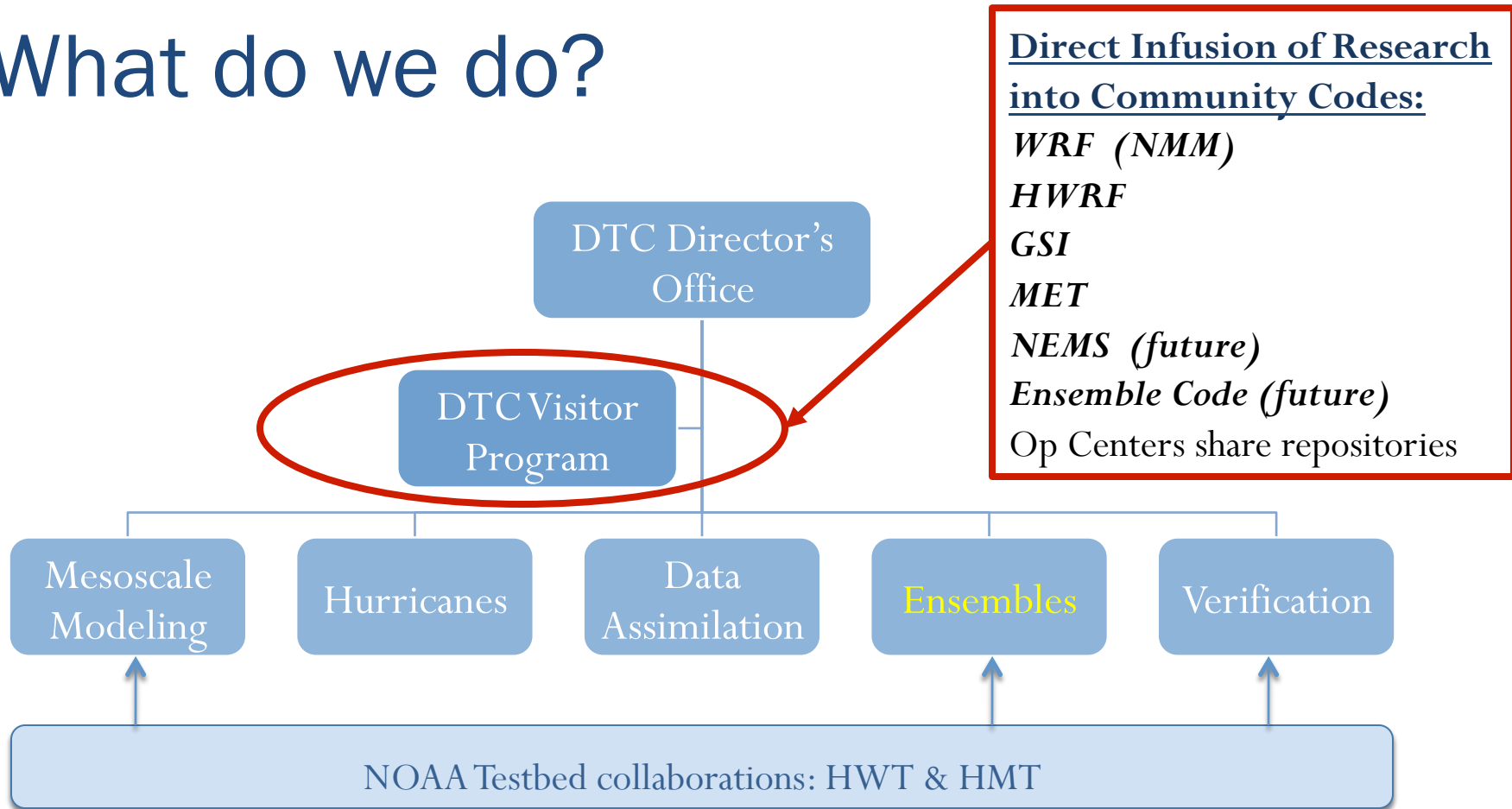
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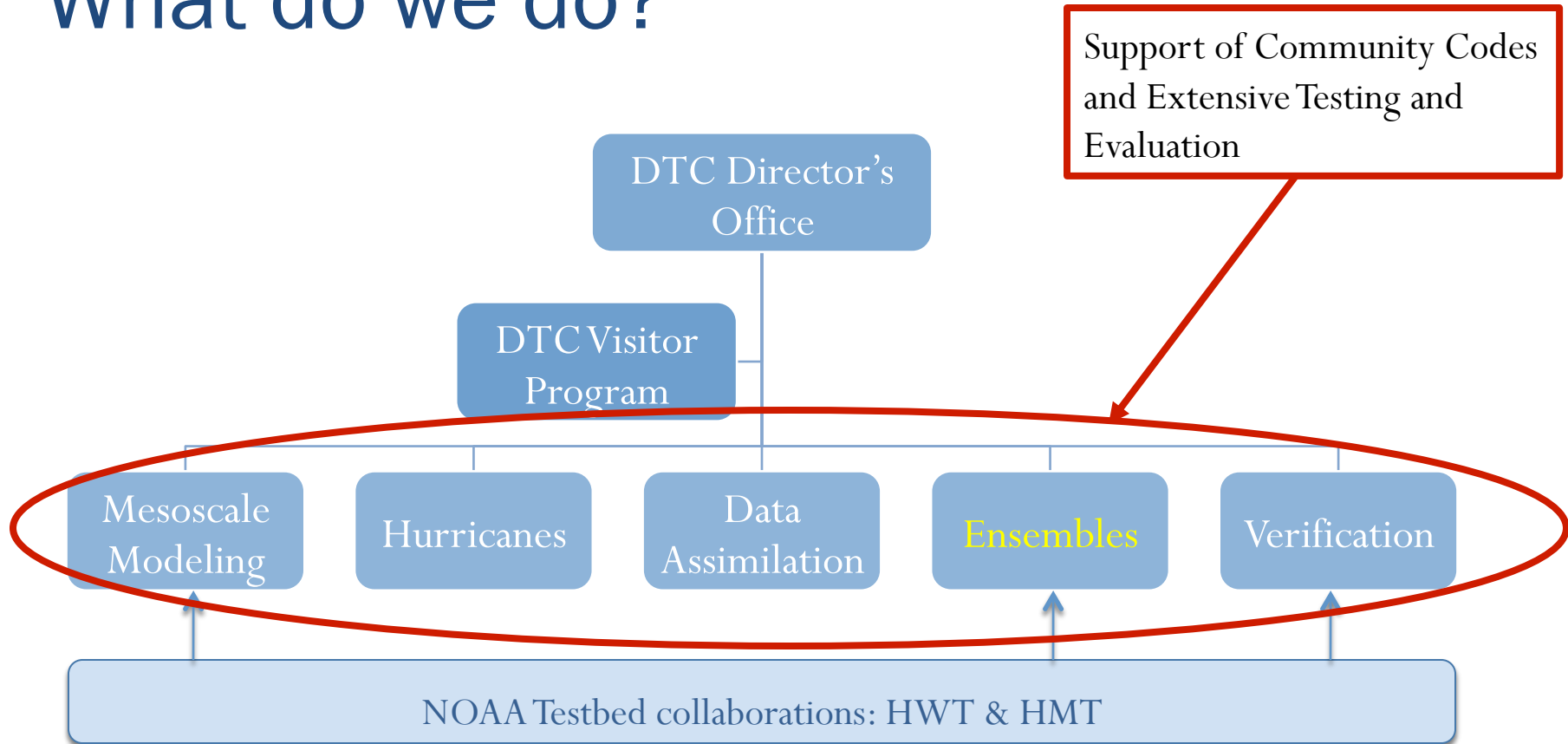
1. DTC activities focused on five key areas: Mesoscale Modeling, Hurricanes, Data Assimilation, Ensembles and Verification.
2. Testbed collaborations are cross-DTC special projects that contribute to identified focus areas.

What do we do?



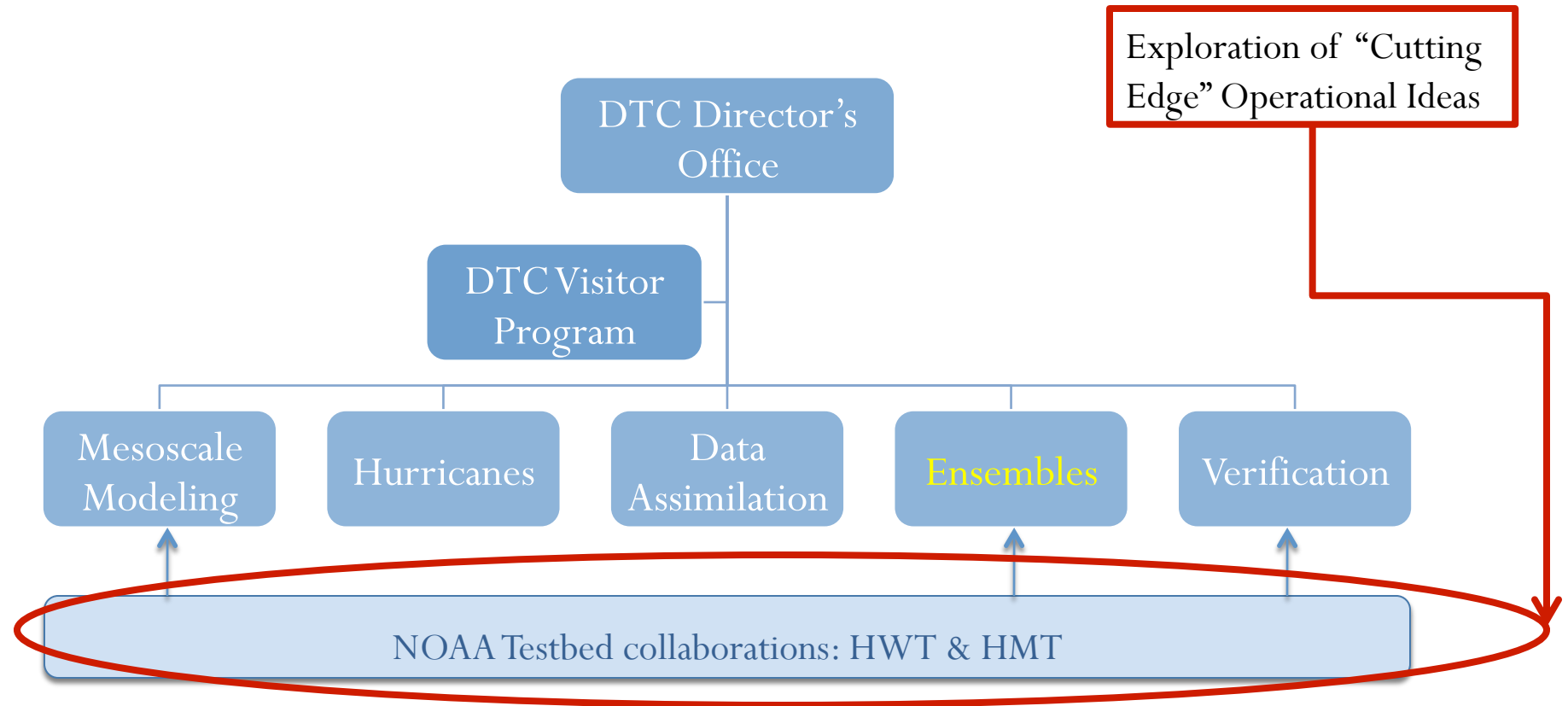
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2. HWT & HMT are cross-DTC special projects that contribute to identified focus areas.

What do we do?



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What do we do?



1. DTC activities focused on five key areas: Mesoscale Modeling, Hurricanes, Data Assimilation, Ensembles and Verification.
2. HWT & HMT are cross-DTC special projects that contribute to identified focus areas.

Formation of DET in 2009

Confluence of necessary ingredients

- **Need**
 - Strong interest from both community & agencies
- **Knowledge base**
 - Roadmap from Sept 2009 Workshop
 - National Workshop on Mesoscale Probabilistic Prediction at NCAR
- **Opportunity**
 - Increase in funding for DTC from NOAA
- **Initiative**
 - DTC Director's Office set planning process in motion (Oct 09)

DTC Ensemble Testbed Leadership

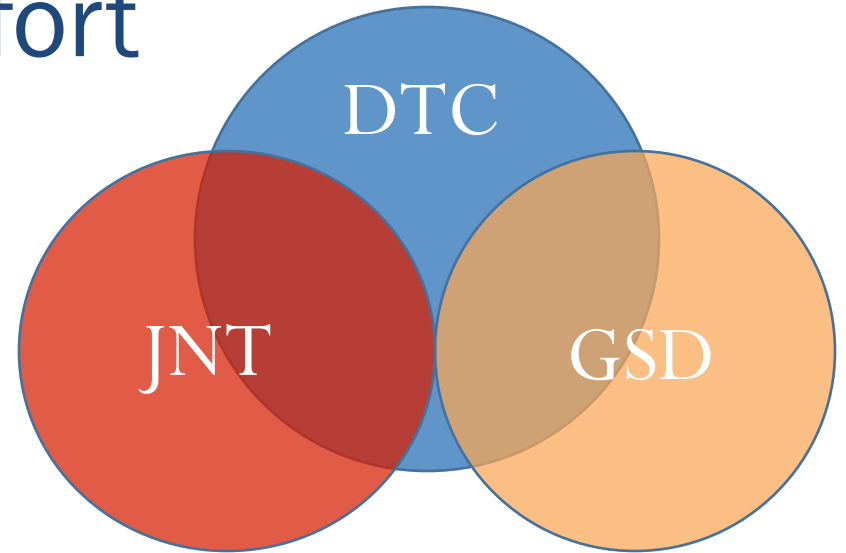


Brian Etherton

Zoltan Toth

DET Staff – A Joint Effort

- Infrastructure Development
- Methods Integration
- Robust Testing and Evaluation
- Community Code Packaging



Funding for ~3 FTE

| | NOAA/GSD | NCAR/JNT |
|--------------------|--|---|
| Scientists | Brian Etherton Isidora Jankov Ed Tollerud Zoltan Toth | Barbara Brown Michelle Harold Tressa Fowler Tara Jensen |
| Software Engineers | Paula McCaslin Linda Wharton Jeff Smith | John Halley Gotway Eugene Mirvis Paul Oldenburg Bonny Strong |
| Students | | Lisa Coco |

INFRASTRUCTURE

- **Objective**

- Assemble software and procedures to carry out main function of testing and evaluation of community methods

- **Structure**

- Six modules identified

- Ensemble configuration
- Initial perturbations
- Model-related uncertainty
- Statistical post-processing
- Products / Services
- Verification

} Ensemble generation – meso-specific

} Use of info – general, applies to all ensembles

- **Requirements**

- *Modularity* to facilitate transition to operations
- *Portability* for ease of execution where computational resources are available
- *Flexibility* to allow testing of new ideas

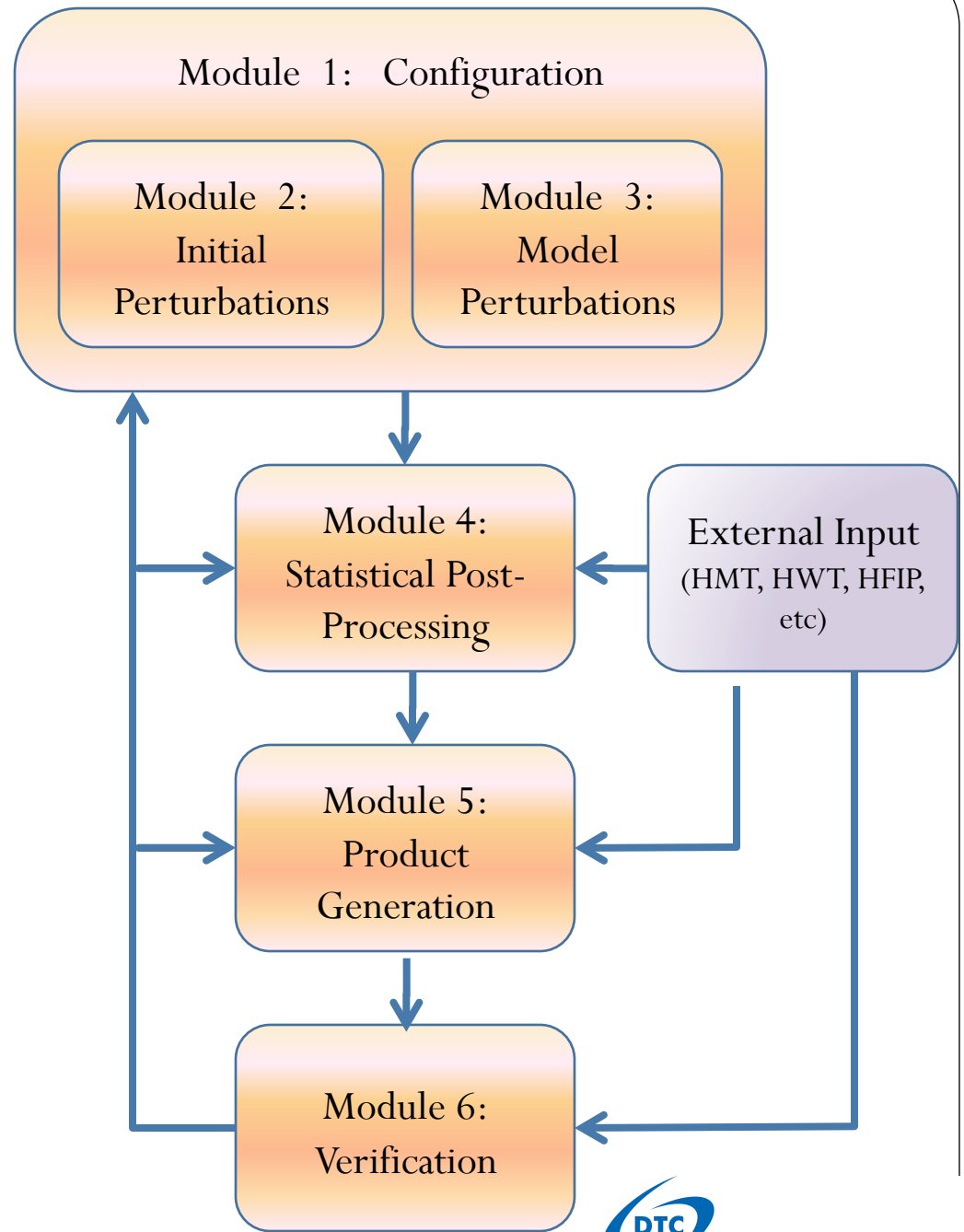
DET Modules – What They Explore

- ***Ensemble configuration:*** Membership; Resolution; Multi-Model/Same Model; Number of Members
- ***Initial perturbations:*** Ability to represent uncertainty in initial conditions based on a variety of techniques.
- ***Model perturbations:*** Model-related uncertainty based on a variety of techniques
- ***Statistical post-processing:*** Fusing information from ensemble using Bias Correction or Calibration of forecast distribution or Statistically downscaling information to user relevant variables.
- ***Products / Services:*** Deriving information from the ensemble, generating probabilistic products, providing decision support services, etc.
- ***Verification:*** Evaluation of ensemble and derived probabilistic forecasts.

DET MODULES

| <u>COMPONENT:</u> | <u>Based on</u> |
|------------------------|------------------------------|
| Configuration UI: | WRF Portal |
| Model Architecture: | WRF and NEMS |
| Initial Conditions: | OPC Needs |
| Model Perturbations: | OPC Needs |
| Statistical Post-Proc: | OPC Needs |
| Product Generation: | OPC Needs |
| Verification: | Model Evaluation Tools (MET) |

OPC = Operational Centers



DTC Ensemble Testbed: Major Accomplishments - Past Year (Mar 2010-2011)

- Plans developed for <http://www.dtcenter.org/det/>
 - Overall architecture of DET infrastructure
 - Each of 6 modules
 - Test and Evaluation
- Established and tested basic capabilities for 2 modules
 - Configuration (Module 1)
 - Initial perturbations (Module 2)
- Collaboration with other DTC tasks / projects
 - NOAA Testbeds – Joint plans for testing DET & testbed ensemble generation
 - HFIP – Fostered connections for future joint efforts
- Outreach
 - Organized DET Workshop and engaged with WRF Ensemble WG
 - Activities coordinated with NCEP/EMC via regular meetings

DTC Ensemble Testbed: Major Accomplishments - Past Year (Mar 2010-2011)

This is a provisional webpage to show DTC Management and others the progress of the Ensemble Testbed on its design status as of Feb 2011 and plan 2011.

Ensemble Testbed Objective

In response to the US NWS operational centers move toward ensemble-based probabilistic forecasting, the DTC established the DTC Ensemble Testbed to provide an environment in which extensive testing and evaluation of ensemble-related techniques developed by the NWP community can be conducted such that the results are immediately relevant to the operational centers (NCEP and AFWA).

When fully developed, Ensemble Testbed activities will involve maintaining and supporting community codes, as well as conducting extensive testing and evaluation of promising new capabilities and techniques that have been incorporated into these community codes.

The Ensemble Testbed Plans and Status

The table below reports the design plans and the status of the Ensemble Testbed and reflects the modular infrastructure of the Ensemble Testbed ensemble system.

| Element | Design Plan | Status | Presentations |
|------------------|-----------------------------------|----------------------------------|--------------------------|
| Overall Design | Overview | n/a | Workshop |
| Module 1 | Overview | Basic Capability | Workshop |
| Module 2 | Overview | Basic Capability | Workshop |
| Module 3 | Overview | n/a | Workshop |
| Module 4 | Overview | n/a | Workshop |
| Module 5 | Overview, Details | n/a | Workshop |
| Module 6 | Overview, Details | n/a | Workshop |
| Testing and Eval | Overview | n/a | Workshop |
| Collaboration | Overview | n/a | Workshop |

As of 2/28/2011

Ensemble Testbed Documents

- > Here is provisional link to the [DTC Ensemble Testbed Plan](#)
- > The DTC Ensemble Testbed Workshop [Presentations](#)
- > National Mesoscale Probabilistic Prediction: Status and the Way Forward, A white paper [report](#) from the National Workshop on Mesoscale Probabilistic Prediction, 23-24 September 2009.

- Status of project, planning documents, and presentations for Ensemble Testbed located at www.dtcenter.org/det

DTC Ensemble Testbed: Planned Activities - Next Year (Mar 2011-2012)

- Establish benchmark for initial perturbation module
 - Testing & evaluation to contribute to next NCEP SREF implementation
- Establish basic capability for model perturbation module
 - Capability of using different versions of NMM under NEMS
- Interface with other testbeds & projects
 - Evaluation of HMT ensemble with focus on hydrometeorological variables
 - Contributions to Product & Verification Modules with HWT ensemble products & evaluation
 - Joint planning for HFIP ensemble development & testing
- Continued engagement with community
 - Co-organize 5th Ensemble User Workshop with NCEP
 - Participate in NUOPC Workshop

Foundation of DET

WRF Portal

WRF – ARW and NMM

NEMS – NMM and ARW

MET

COMPUTE RESOURCES:

NOAA Jet

TeraGrid

Others TBD

WRF Portal [Database=/home/jssmith/.portal-files/portal] [User=portal]

File Tools Window Help

Run Monitor

Search Criteria

Run between: [] [] Workflow: []

And: [] Note: [] Refresh

Status: [] Computer: jet

| Run Config | Run Date | Status | Run Time | Date Started | Elap |
|-----------------------|-----------------------|-----------|----------|----------------------|------|
| jeff-test-run | 2005-07-09 12:00:00.0 | ERROR | 00:04:09 | 2011-02-14 21:50 GMT | 00: |
| arw-fer-1-sref-p-r... | 2010-12-26 18:00:00.0 | SUBMITTED | 00:00:00 | | |
| arw-fer-1-sref-p-r... | 2010-12-26 12:00:00.0 | SUBMITTED | 00:00:00 | | |
| arw-fer-1-sref-p-r... | 2010-12-26 06:00:00.0 | SUBMITTED | 00:00:00 | | |
| arw-fer-1-sref-p-r... | 2010-12-26 00:00:00.0 | SUBMITTED | 00:00:00 | | |

Details for Run Workflow: 'arw-fer-1-sref-p-run' on 2010-12-26 18:00:00.0

| Task | Job ID | Job Started | Run Time | Est. Time | Status |
|--------------|--------|-------------|----------|-----------|--------|
| ungrib | | | | | |
| metgrid | | | | | |
| real | | | | | |
| ungrib2 | | | | | |
| metgrid2 | | | | | |
| real2 | | | | | |
| wrf | | | | | |
| lfmpost0 | | | | | |
| lfmpost1 | | | | | |
| lfmpost2 | | | | | |
| lfmpost3 | | | | | |
| lfmpost4 | | | | | |
| lfmpost5 | | | | | |
| lfmpost6 | | | | | |
| lfmpost7 | | | | | |
| lfmpost8 | | | | | |
| wrfpost_cyc0 | | | | | |
| wrfpost_cyc1 | | | | | |
| wrfpost_cyc2 | | | | | |

This window will refresh in 55 seconds

Refresh View Files Delete Halt Run

Workflow: arw-fer-1-sref-p [Model=WRF] [jet] [User=portal] [Can

Workflow-Options

Task Dependencies (Ext. Workflow Mgr Only) Ensemble Settings

Configuration Files General Settings

Showrun scripts

File: lfmpo

```

#!/bin/sh
#$ -N lfmp_sch
#$ -A hmtb
#$ -l h_rt=04:30:00
#$ -S /bin/sh
#$ -cwd
#$ -pe hmtb 1 1

startFcst=${FCST_HOUR}
numFcsts=${NUM_FCSTS}
fcstIncrMin=${FCST_INCR}
maxWaitSec=${MAX_WAIT}
maxHrsRun=${MAX_HRS}
project=${LPROJECT}
model=${MODEL}

ho "beka is going to run
ho "/usr/bin/perl $LAPS

sr/bin/perl $LAPSRROOT
ror=$?
[ ${error} -ne 0 ]; then
echo "ERROR: lfmpost fa
exit ${error}

it 0
  
```

Run Workflow

Run-Options

Run Name: ar

Note: []

Computer: je

Workflow: ar

Workflow Mgr: Ex

Task

- ungrib
- metgrid
- real
- ungrib2
- metgrid2
- real2
- wrf
- lfmpost
- lfmpost
- lfmpost
- lfmpost
- lfmpost
- lfmpost

Location /whome/j

Dates/Times

To Run:

Import Multiple

Launching WRF Tasks

Run workflow: 'arw-fer-1-sref-p-run' on 2010-12-26 18:00

workflow.xml has been written, but no tasks have been launched

```

copying /whome/jssmith/portal-runs/arw-fer-1-sref-p-run/static/ungrib/ungrib.com...
copying /whome/jssmith/portal-runs/arw-fer-1-sref-p-run/static/metgrid2/metgrid2.ksh...
copying /whome/jssmith/portal-runs/arw-fer-1-sref-p-run/static/real2/real2.ksh...
copying /whome/jssmith/portal-runs/arw-fer-1-sref-p-run/static/wrf/wrf.ksh...
copying /whome/jssmith/portal-runs/arw-fer-1-sref-p-run/static/lfmpost/lfmpost.sh...
copying /whome/jssmith/portal-runs/arw-fer-1-sref-p-run/static/wrfpost_cyc/wrfpost_cyc.sh...
workflow.xml has been written, but no tasks have been launched
  
```

Close

DET Ensemble User Interface

Run Monitor

Search Criteria

Run between ... Workflow ▼

And ... Note

Status ▼ Computer ▼

| Run Config | Run Date | Status | Run Time | Date Started | Elapsed Time | Mo |
|-----------------------|-----------------------|--------|----------|----------------------|--------------|-----------|
| jeff-test-run | 2005-07-09 12:00:00.0 | ERROR | 00:01:08 | 2011-02-18 18:58 GMT | 00:06:11 | jeff-test |
| arw-fer-1-sref-p2-... | 2010-12-26 00:00:00.0 | DONE | 00:58:58 | 2011-02-28 21:35 GMT | 01:23:23 | arw-fer-1 |

Details for Run Workflow: 'arw-fer-1-sref-p2-run' on 2010-12-26 00:00:00.0

| Task | Job ID | Job Started | Run Time | Est. Time | Status | Queue/PID |
|--------------|--------|----------------------|----------|-----------|--------|-----------|
| create_dirs | 251 | 2011-02-28 21:37 GMT | 00:02 | | done | 1125269 |
| ungrib | 252 | 2011-02-28 21:40 GMT | 00:02 | | done | 1125393 |
| metgrid | 253 | 2011-02-28 21:43 GMT | 00:01 | | done | 1125531 |
| real | 255 | 2011-02-28 21:46 GMT | 00:02 | | done | 1125629 |
| ungrib2 | 254 | 2011-02-28 21:46 GMT | 00:01 | | done | 1125630 |
| metgrid2 | 256 | 2011-02-28 21:50 GMT | 00:01 | | done | 1125766 |
| real2 | 257 | 2011-02-28 21:53 GMT | 00:01 | | done | 1125882 |
| wrf | 258 | 2011-02-28 22:10 GMT | 00:39 | | done | 1126047 |
| lfmpost0 | 260 | 2011-02-28 22:19 GMT | 00:01 | | done | 1126571 |
| lfmpost1 | 262 | 2011-02-28 22:24 GMT | 00:01 | | done | 1126712 |
| lfmpost2 | 264 | 2011-02-28 22:30 GMT | 00:01 | | done | 1126906 |
| lfmpost3 | 266 | 2011-02-28 22:30 GMT | 00:01 | | done | 1127054 |
| lfmpost4 | 268 | 2011-02-28 22:40 GMT | 00:01 | | done | 1127300 |
| lfmpost5 | 270 | 2011-02-28 22:46 GMT | 00:01 | | done | 1127454 |
| lfmpost6 | 272 | 2011-02-28 22:49 GMT | 00:01 | | done | 1127601 |
| lfmpost7 | 274 | 2011-02-28 22:53 GMT | 00:01 | | done | 1127763 |
| lfmpost8 | 276 | 2011-02-28 22:57 GMT | 00:01 | | done | 1127925 |
| wrfpost_cyc0 | 259 | 2011-02-28 22:19 GMT | 00:01 | | done | 1126580 |
| wrfpost_cyc1 | 261 | 2011-02-28 22:24 GMT | 00:01 | | done | 1126713 |
| wrfpost_cyc2 | 263 | 2011-02-28 22:30 GMT | 00:01 | | done | 1126907 |
| wrfpost_cyc3 | 265 | 2011-02-28 22:30 GMT | 00:01 | | done | 1127055 |
| wrfpost_cyc4 | 267 | 2011-02-28 22:40 GMT | 00:01 | | done | 1127300 |
| wrfpost_cyc5 | 269 | 2011-02-28 22:46 GMT | 00:01 | | done | 1127455 |
| wrfpost_cyc6 | 271 | 2011-02-28 22:49 GMT | 00:01 | | done | 1127602 |
| wrfpost_cyc7 | 273 | 2011-02-28 22:55 GMT | 00:01 | | done | 1127764 |
| wrfpost_cyc8 | 275 | 2011-02-28 22:57 GMT | 00:01 | | done | 1127926 |

File Viewer: /ifs1/projects/hfiprens/jssmit

Viewer-Options Edit

| |
|--|
| Mon Feb 28 21:35:30 +0000 2011 :: fe5 :: |
| Mon Feb 28 21:36:30 +0000 2011 :: fe5 :: |
| Mon Feb 28 21:37:30 +0000 2011 :: fe5 :: |
| Mon Feb 28 21:38:35 +0000 2011 :: fe5 :: |
| Mon Feb 28 21:39:37 +0000 2011 :: fe5 :: |
| Mon Feb 28 21:39:38 +0000 2011 :: fe5 :: |
| Mon Feb 28 21:39:38 +0000 2011 :: fe5 :: |
| Mon Feb 28 21:40:43 +0000 2011 :: fe5 :: |
| Mon Feb 28 21:41:44 +0000 2011 :: fe5 :: |
| Mon Feb 28 21:42:44 +0000 2011 :: fe5 :: |
| Mon Feb 28 21:43:45 +0000 2011 :: fe5 :: |
| Mon Feb 28 21:43:45 +0000 2011 :: fe5 :: |
| Mon Feb 28 21:43:46 +0000 2011 :: fe5 :: |
| Mon Feb 28 21:44:46 +0000 2011 :: fe5 :: |
| Mon Feb 28 21:45:47 +0000 2011 :: fe5 :: |
| Mon Feb 28 21:45:47 +0000 2011 :: fe5 :: |
| Mon Feb 28 21:45:48 +0000 2011 :: fe5 :: |
| Mon Feb 28 21:45:48 +0000 2011 :: fe5 :: |
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| Mon Feb 28 21:46:48 +0000 2011 :: fe5 :: |
| Mon Feb 28 21:47:50 +0000 2011 :: fe5 :: |
| Mon Feb 28 21:47:50 +0000 2011 :: fe5 :: |
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| Mon Feb 28 21:53:56 +0000 2011 :: fe5 :: |
| Mon Feb 28 21:54:56 +0000 2011 :: fe5 :: |
| Mon Feb 28 21:55:57 +0000 2011 :: fe5 :: |
| Mon Feb 28 21:55:57 +0000 2011 :: fe5 :: |
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| Mon Feb 28 21:58:58 +0000 2011 :: fe5 :: |
| Mon Feb 28 21:59:58 +0000 2011 :: fe5 :: |
| Mon Feb 28 22:00:58 +0000 2011 :: fe5 :: |
| Mon Feb 28 22:01:59 +0000 2011 :: fe5 :: |

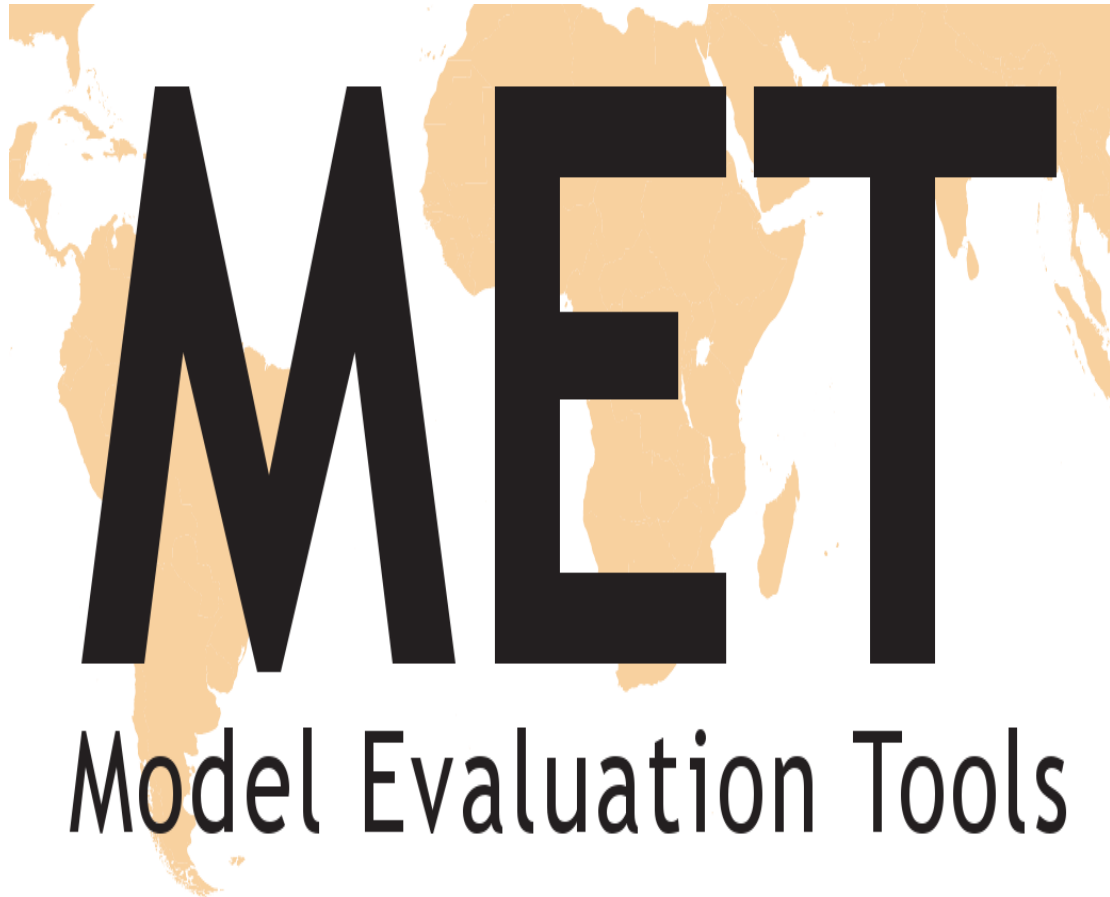
DET Ensemble User Interface

WRF and NEMS

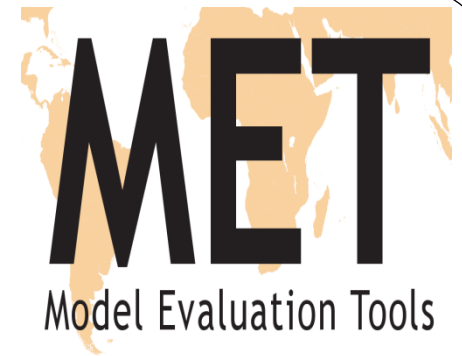
- Weather Research and Forecast (WRF)
 - ARW
 - NMM
 - WRF-Chem is definitely possible
- NOAA Environment Modeling System (NEMS)
 - NMM-B
 - ARW (being ported now)

MET is a set of tools for evaluating NWP forecasts and beyond...

- Preprocessing
- Statistics
- Analysis



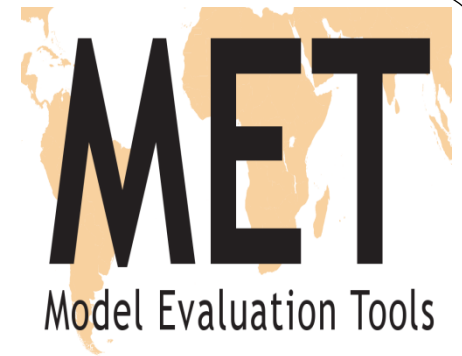
MET Tools



- **Data preprocessing**
 - Accumulate gridded precipitation/other cumulative variables over time
 - Convert Ascii and PREPBUFR to netCDF
 - Read in CloudSat data (other satellite data planned)
- **Individual forecast and observation dataset evaluation**
 - Evaluate forecast with point observations
 - Evaluate forecast with gridded observations
 - Traditional scores
 - Neighborhood methods
 - Evaluate forecast objects with observed objects
 - Determine the scale forecast is skillful through wavelet-based spatial decomposition methods

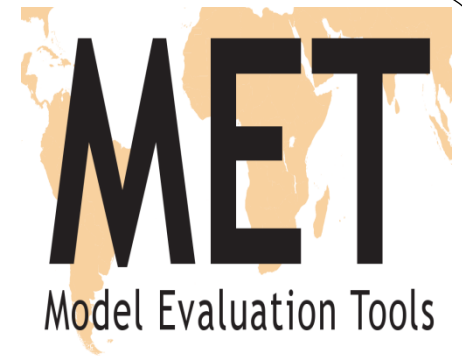
Not limited to Forecast / Obs comparison - Comparing two observation datasets or two models also possible

MET Tools continued



- **Probabilistic/Ensemble verification**
 - Probability Contingency Table Scores
 - Brier Score, Reliability, Resolution, Uncertainty, Area Under ROC
 - Joint/Continuous Statistics of Probabilistic Variables
 - Calibration, Refinement, Likelihood, Base Rate
 - Rank Histogram and Ranked Probability Scores
 - Simple ensemble products
 - Mean, Spread, Min, Max, Probability

MET Tools continued



- **Cumulative analysis**

- **Stat-Analysis**

- Reads Point-Stat, Grid-Stat, and Wavelet-Stat ascii output – aggregates and filters – writes ascii output

- **MODE-Analysis** – same as Stat-Analysis but for MODE output

- **METViewer database and display system**

- loads all ascii output into database
 - user Interface allows analyst to select options for aggregation
 - uses R statistics package for plotting
 - calculates bootstrapped confidence intervals if requested

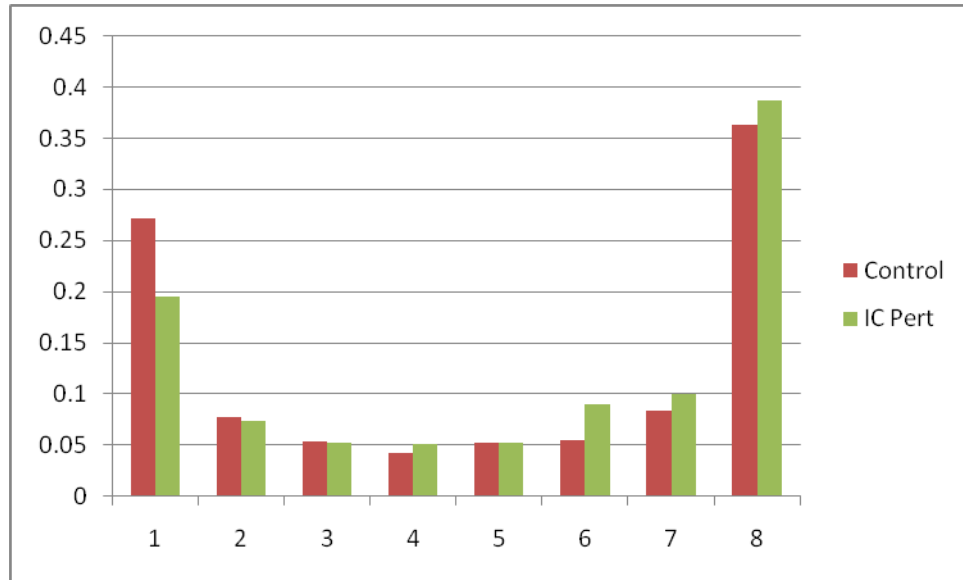
DTC Testing and Evaluation Principles

- **Execution of test is independent of the developer**
 - Developer may have a role in helping to create the test plan
- **A formal test plan is developed**, defining all of the important aspects of the testing and evaluation
- **Focus of test depends on the questions that are of interest**
 - Module being used
 - Variables of interest
- **Many cases evaluated for statistical significance**
 - Not just a few case studies
 - Multiple seasons
- **Meaningful stratifications**
 - Location/region
 - Season
 - Other user-based criteria

Considerations for T&E

- **Number of cases will likely need to be increased**
 - Large enough to assess statistical significance
 - Focused enough for representativeness
- **Verification approaches and metrics are somewhat unique**
- **Computer resources may be a limitation**
- **Real-time vs. post-analysis**
 - DTC intensive tests generally done in post-analysis
 - Real-time demonstrations also have many benefits (e.g., NOAA Testbeds and Projects)
- **How much rigorous end-to-end testing required vs. evaluation of individual components**

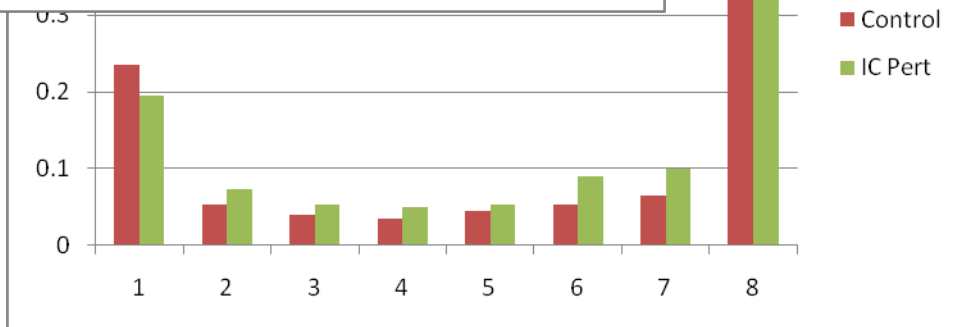
Example – Preliminary IC Perturbation Testing



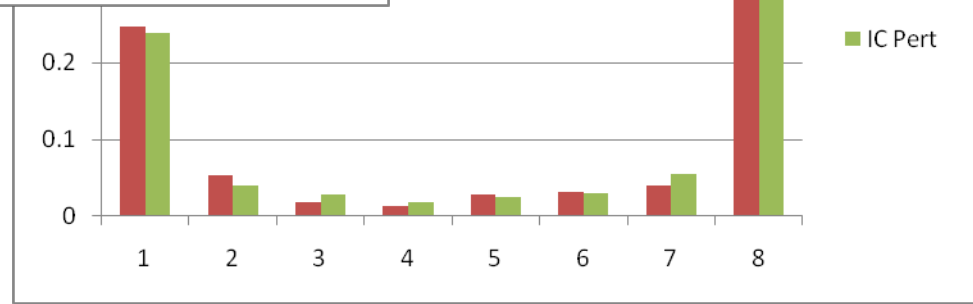
500 hPA TMP Rank Histogram



700 hPA TMP Rank Histogram

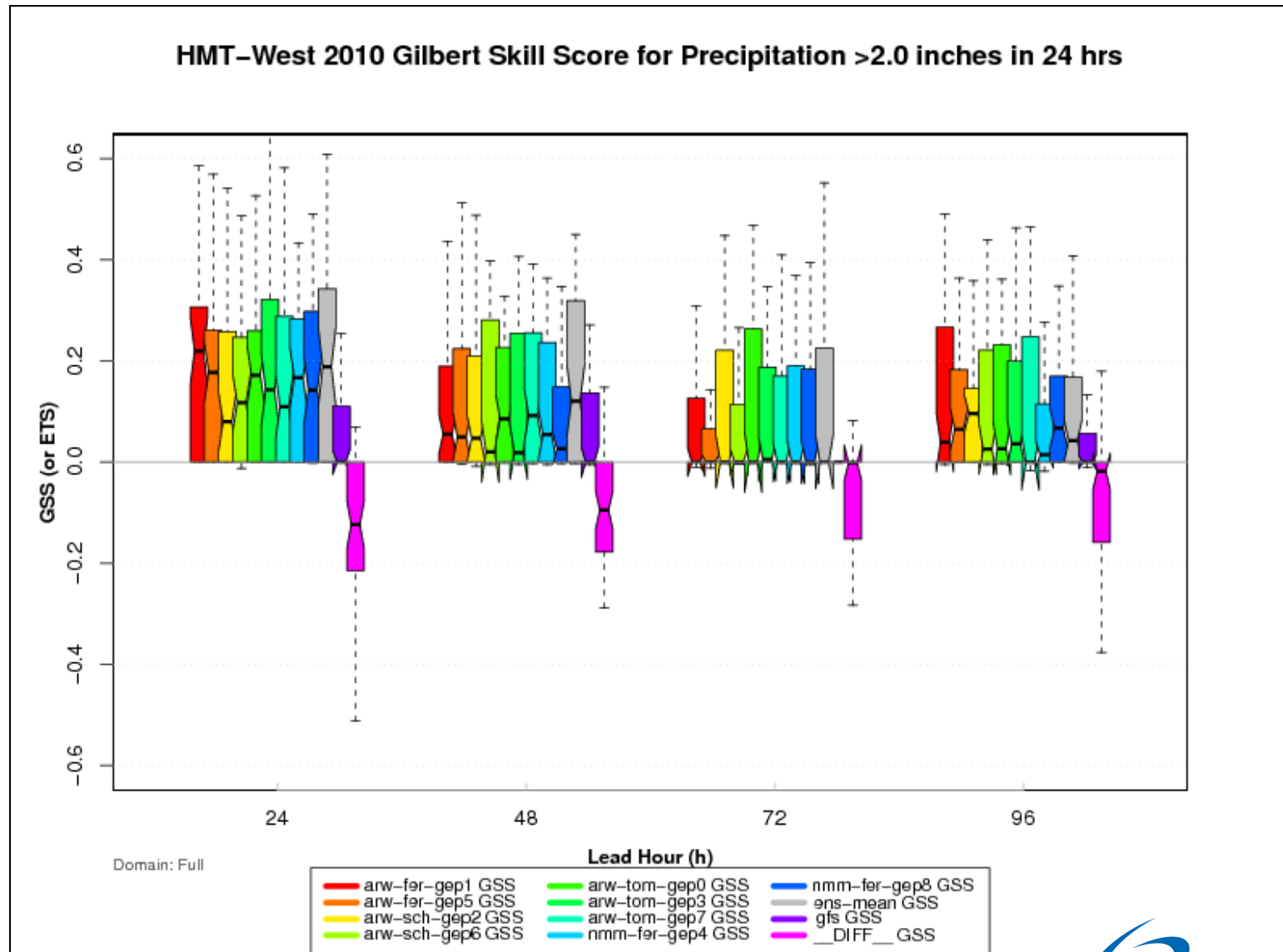


1000 hPA TMP Rank Histogram



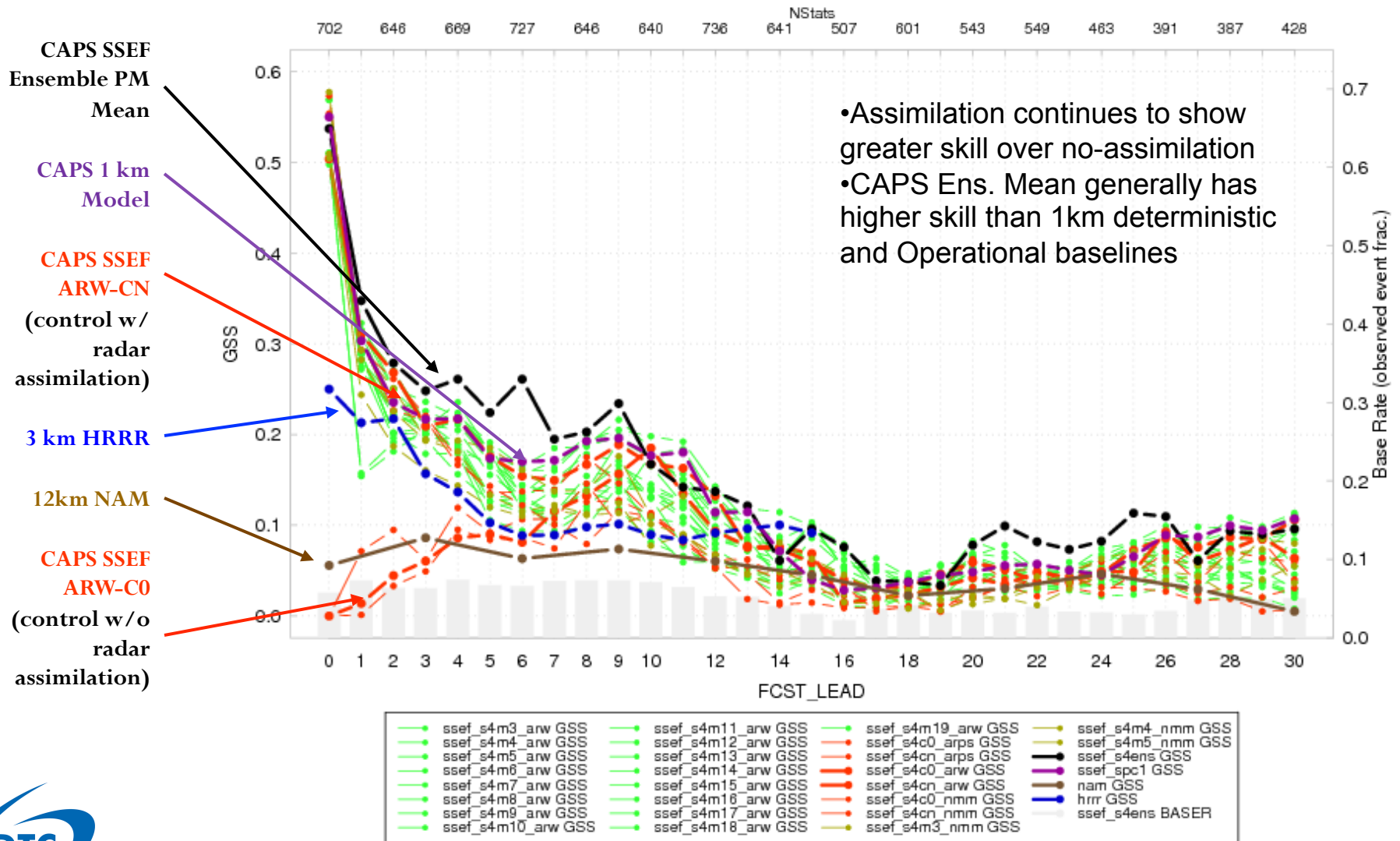
Slight improvement in dispersion near surface
 And more at 700 mb
 But shift in underdispersion to a high bias at
 500 mb

NOAA HydroMet Testbed – Precip Forecasts



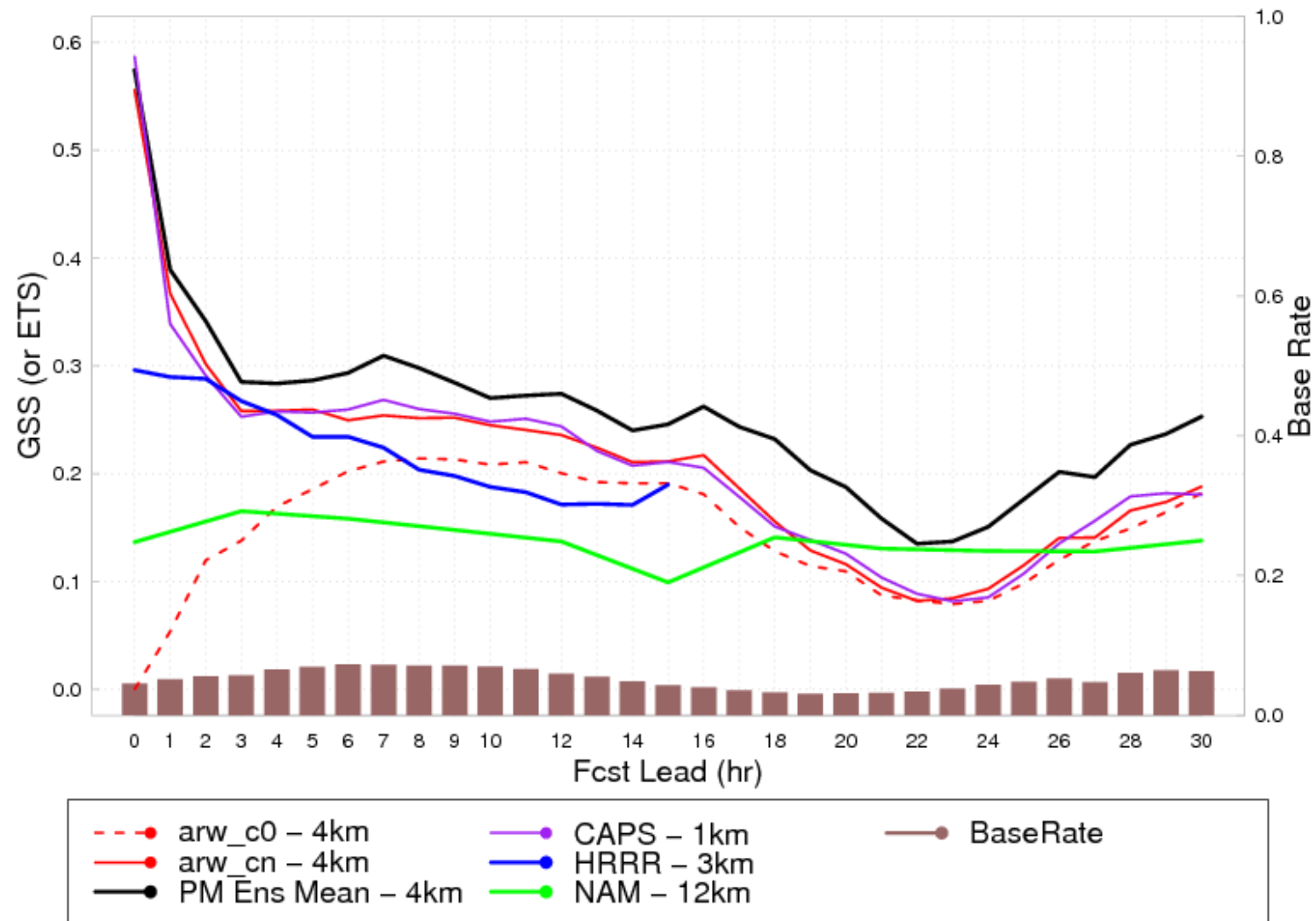
NOAA Haz. Wx. Testbed – Simulated Radar

AGGREGATION for REFC ≥ 20.000 dBZ GSS
OVER FCST_LEAD ENDING 20100618 – Region: VORTEX2



NOAA Haz. Wx. Testbed – Simulated Radar

HWT 2010 SE – GSS – Aggregated Values – REFC > 20dBZ



DET and Aerosol Community

- Areas in which DET could provide help for the aerosol community:
 - Provide baseline information on how the NWP community currently assembles and evaluates ensembles, including recent efforts in multi-model ensembles.
 - Determine computational and infrastructure needs for generating and disseminating the multi-model ensemble of aerosol forecasts.
 - Suggest metrics for evaluating the value and skill of the multi-model ensemble.
 - Plan for advancing research on ensemble aerosol forecasting and ensemble-based data assimilation issues.
 - Provide early findings from other multi-model ensembles.
 - Interact with regards to issues of statistical post processing.
 - Help with code, variables, verification standardization.

What if DET is not for you??

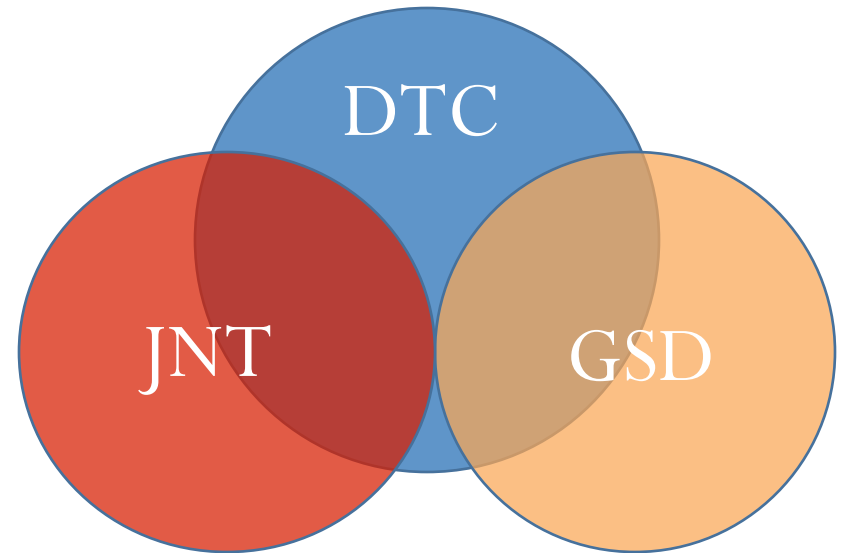
Both Contributing Organizations have a Research Component:

NOAA/ESRL/GSD and NCAR/RAL/JNT

Relationship of JNT to DTC and GSD

DTC is a national organization with a mission of facilitating R2O and O2R activities for numerical weather prediction

DTC Activities are distributed and undertaken in collaboration by JNT and NOAA/GSD staff



- Many Joint Numerical Testbed staff are also DTC staff
- JNT hosts the office of the DTC National Director
- JNT performs other T&E / Verification activities

Mission and Goals of the JNT

Mission:

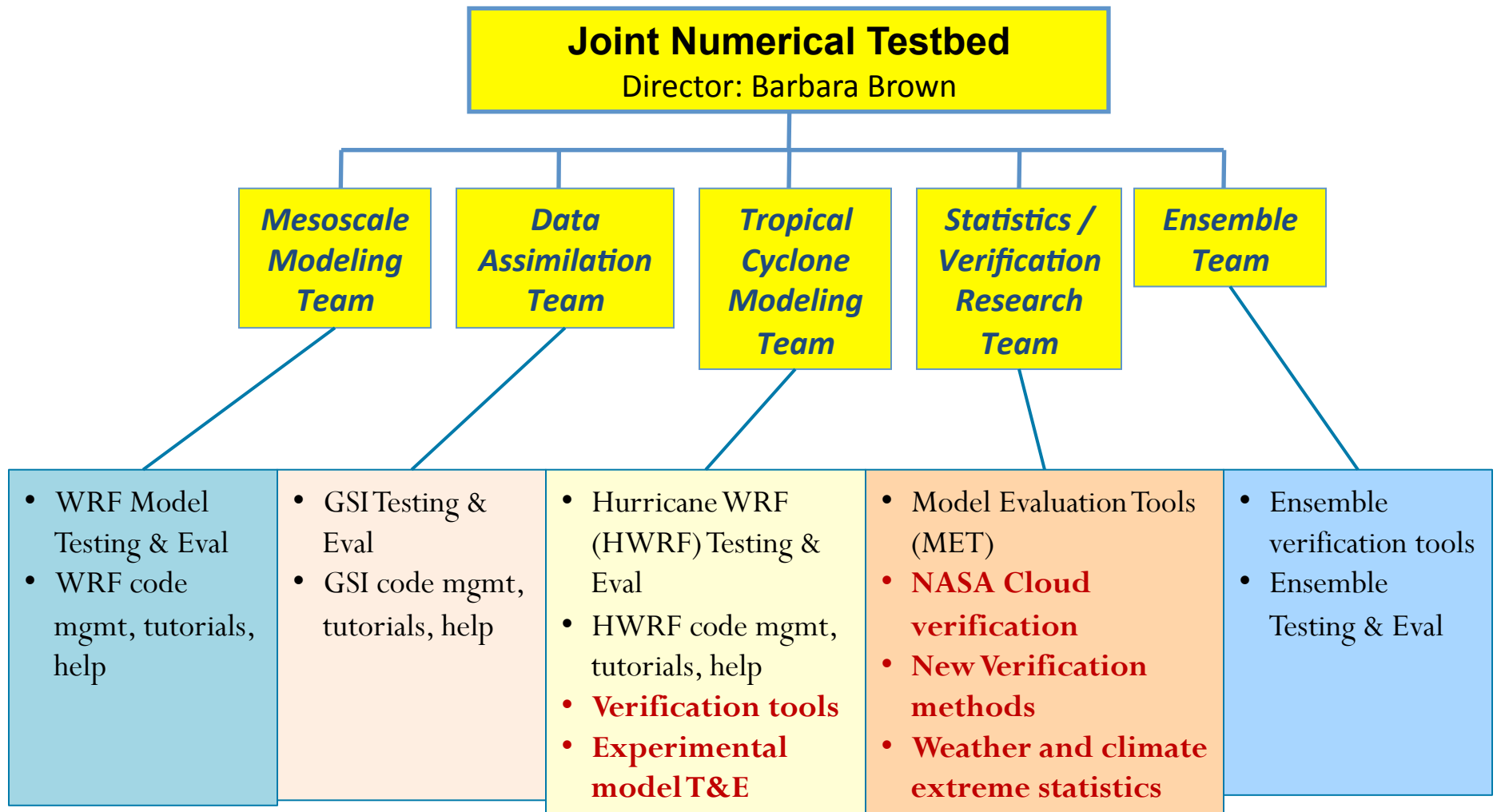
To support the **sharing, testing, and evaluation** of research and operational numerical weather prediction systems, and to

JNT acts as an “independent broker” for the testing and evaluation of forecasting systems.

- Undertake and report on **independent tests and evaluations** of prediction systems
- Research, develop and implement state-of-the-art **tools for forecast evaluation**

JNT Project Areas

DTC related activity
Non-DTC activities



NCAR/RAL/JNT Other Interests

- Interested in exploring use of MET on more Satellite Products
- Ties to AFWA dust forecasting
- Strong ties to WMO Verification Community



5th International Verification Methods Workshop
December 1-7, 2011
Bureau of Meteorology, Melbourne, Australia

Australian Government
Bureau of Meteorology

Home Program Registration Travel/Venue Hotel/Accommodation Contacts

Tutorial Session: December 1-3, Scientific Workshop: December 5-7

The 5th International Verification Methods Workshop will highlight recent advances in the theory and practice of verification of weather and climate forecasts worldwide. The workshop welcomes participants from operational, research, and forecast user communities to discuss how to more effectively measure and convey the accuracy and utility of forecasts and warnings.

The workshop will include both a tutorial session (December 1-3) and a scientific program (December 5-7). The scientific workshop will include keynote addresses as well as contributed talks and posters on new verification techniques and issues related to the practice of forecast verification.

Topics will include:

- Verification of high impact weather forecasts and warnings
- Verification of ensembles and probability forecasts
- Spatial forecast verification
- Seasonal forecast verification
- Climate projection evaluation
- Propagation of uncertainty
- User issues including communicating verification to decision makers
- Verification tools

The tutorial session will include lectures and hands-on laboratory sessions using the [R statistical language](#). Participants are invited to bring their own datasets and verification problems. The tutorial will introduce:

- Basic verification concepts
- Standard verification methods for deterministic and ensemble forecasts from short to seasonal scales
- Spatial forecast verification
- Climate projection evaluation
- Statistical inference
- Brief introduction to operational verification systems

Important Dates

- **15 August 2011:** Tutorial applications due
- **9 September 2011:** Abstracts for scientific workshop due

Program Committee

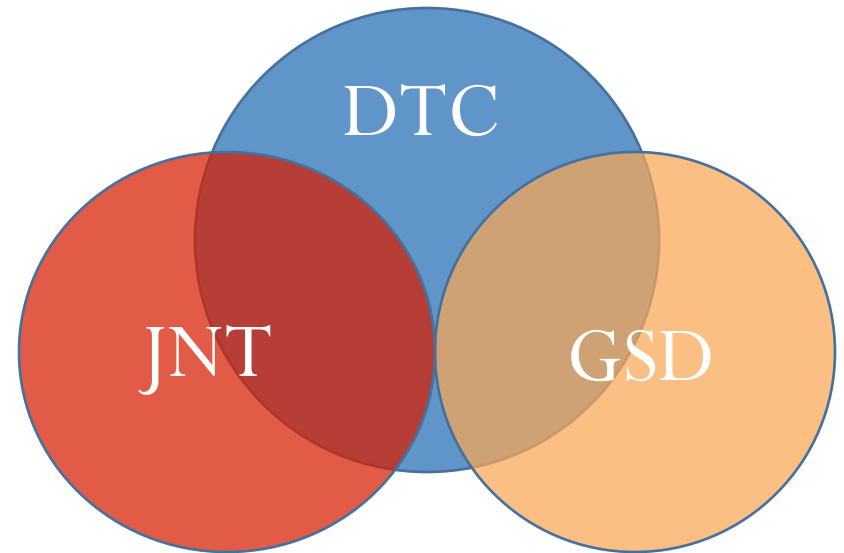
- Beth Ebert (BOM, Australia)
- Barb Brown (NCAR, USA)
- Barbara Casati (Ouranos, Canada)
- Caio Coelho (CPTEC, Brazil)
- Anna Ghelli (ECMWF, UK)
- Martin Göber (DWD, Germany)
- Simon Mason (IRI, USA)

sen63 ICAP-Version2.pptx International Verificat...

Relationship of GSD to DTC and JNT

DTC is a national organization with a mission of facilitating R2O and O2R activities for numerical weather prediction

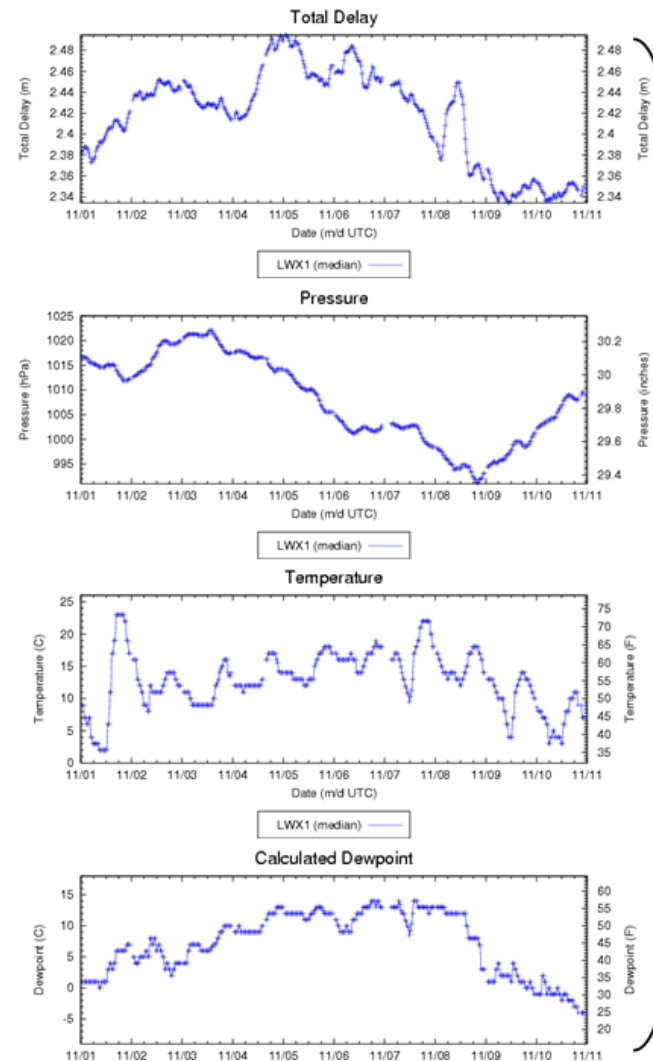
DTC Activities are distributed and undertaken in collaboration by JNT and NOAA/GSD staff



- Many GSD Forecast Applications Branch (FAB) staff are also DTC staff
- GSD also performs Observing Systems, NWP, and Ensemble development research

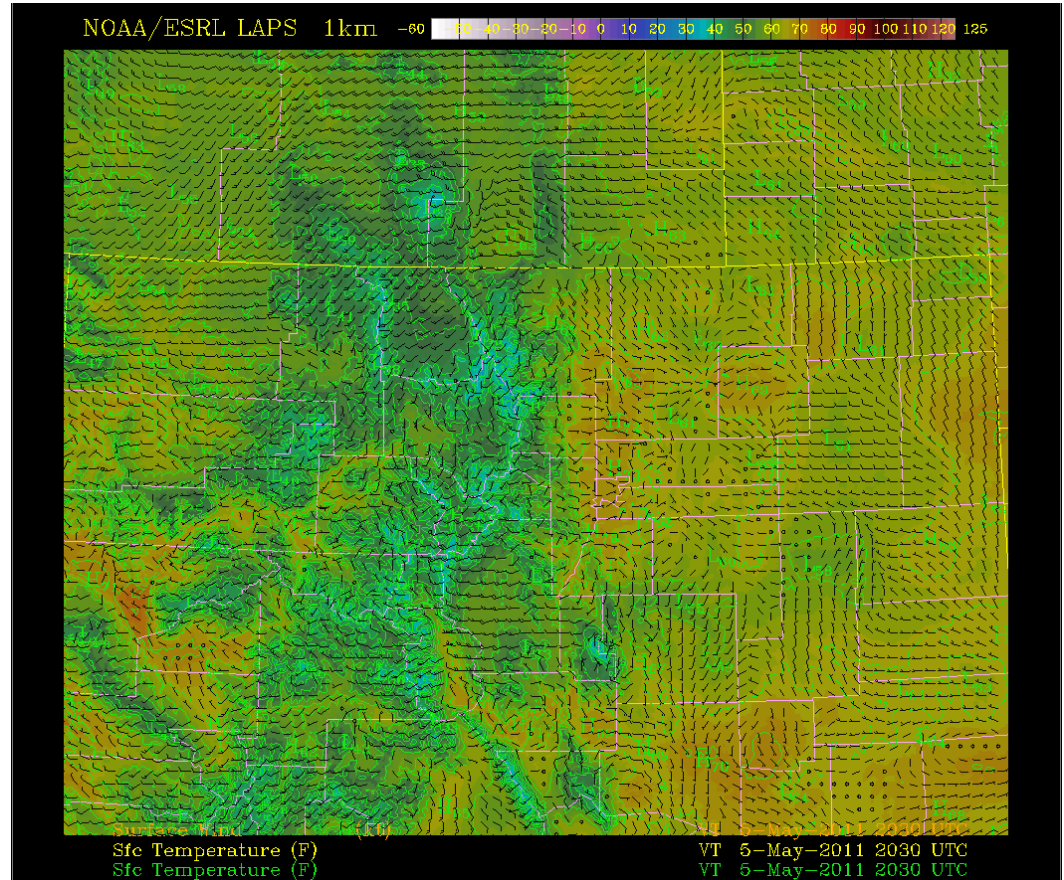
Observing Systems – GPSMet

- Ground-Based GPS-IPW project
- GPSMet was developed by ESRL/GSD in response to:
 - need for low cost, all weather moisture observations for the full thermodynamic (winds, temp, moisture) profiler project
- GPSMet data could be used for improved NWP (precipitable water bounds T, P, Td in the atmospheric column)



Data Assimilation – LAPS and STMAS

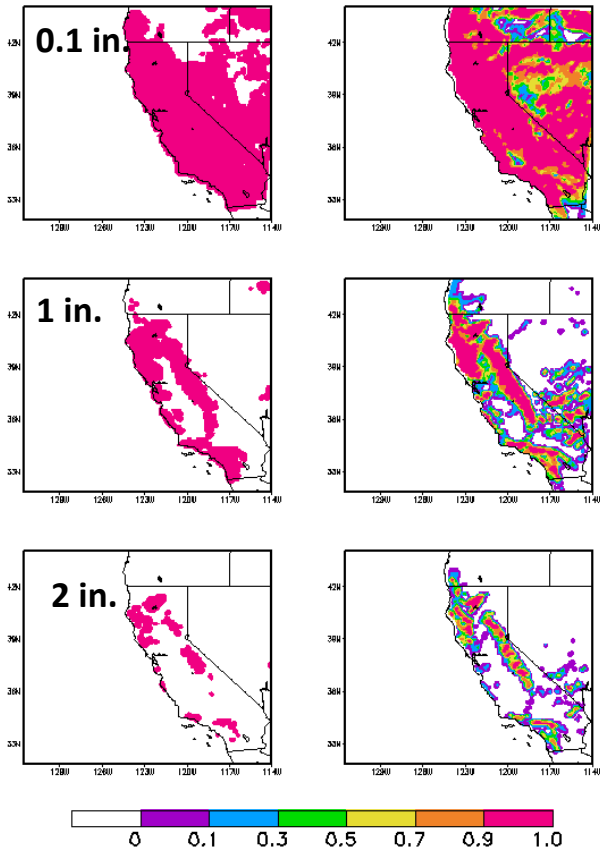
- Generation of high resolution analyses has been a strength of the NOAA/GSD/FAB for years
 - Local Analysis and Prediction System (LAPS)
 - Space Time Multi-scale Analysis System (STMAS)



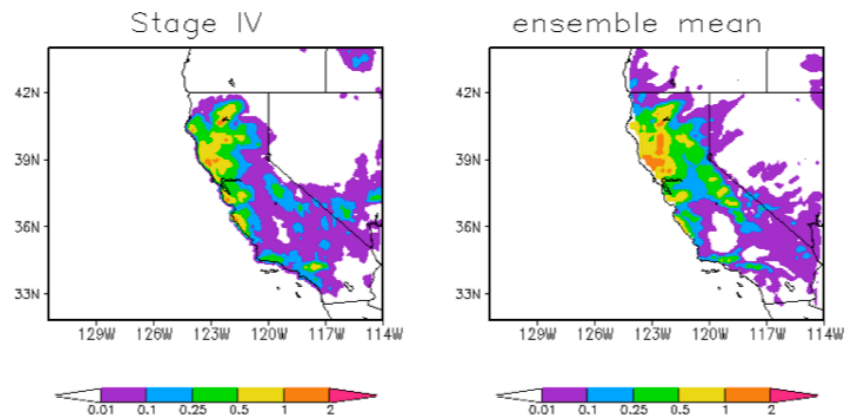
1km LAPS analysis of surface temperature/wind

Ensemble Forecasting

24-hr PQPF



- GSD personnel developed HMT (Hydro-Meteorology Testbed domain) ensemble precipitation forecasting
 - mixed model
 - mixed physics
 - mixed IC/LBCs
- 9 members nested domain LAPS analysis



48-hr forecast starting at 12 UTC, 18 January 2010

Summary

- DTC is geared toward facilitating the R2O and O2R for mesoscale and convective scale models
- DET addresses the Ensemble focus area of DTC
- One avenue to transitioning research on aerosol NWP to operations may be through DTC and DET
- The Statistical Post Processing, Products and Services, and Verification Modules should be useful regardless of scale (i.e. should be able to help address regional climate and potentially global simulations)
- DTC is interested in staying involved in this community!!

Thank You and Further Information

DTC would like to thank you for your interest and the assistance of all of our collaborators...

DTC: <http://www.dtcenter.org>

DET: <http://www.dtcenter.org/det>

MET: <http://www.dtcenter.org/met>

Email: brian.etherton@noaa.gov

jensen@ucar.edu

Support for the Developmental Testbed Center (DTC),



is provided by
NOAA, AFWA
NCAR and NSF

