A Community GSI-based Variational-Ensemble Hybrid Data Assimilation System for HWRF

Hui Shao

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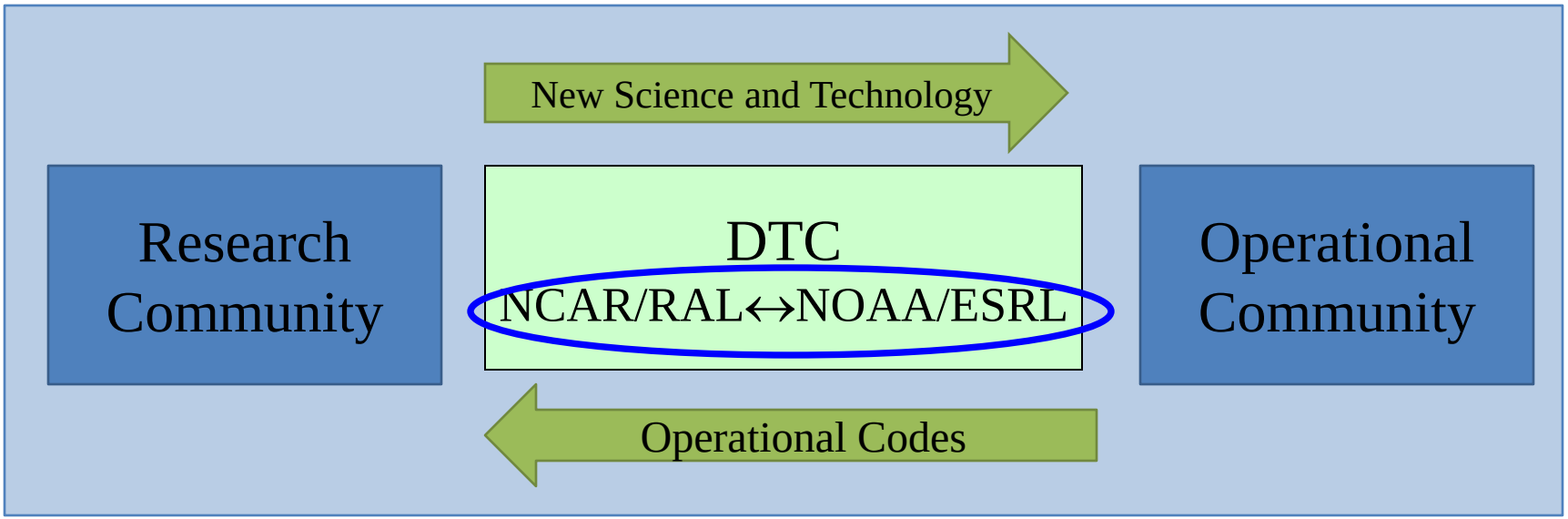
And Developmental Testbed Center Teams

in partnership with
NCEP/EMC and HFIP teams

Developmental Testbed Center (DTC)

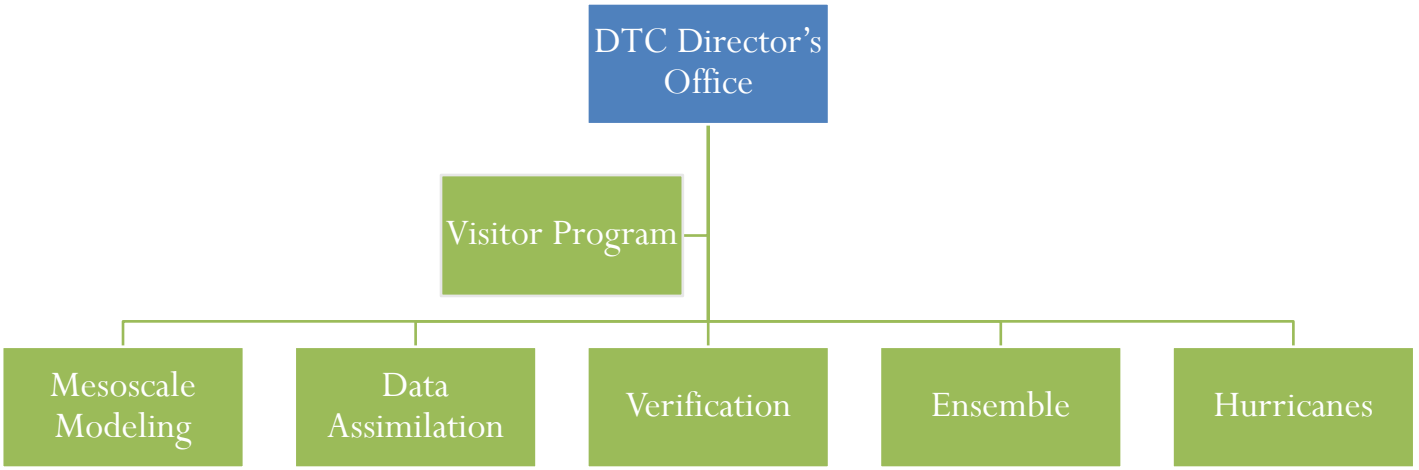
To serve as a bridge between research and operations to facilitate the activities of both halves of the NWP Community

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



DTC Webpage at http://www.dtcenter.org/

Task Management of DTC



Current Community Codes (in collaboration with NCEP/EMC, NCAR/MMM and other partners):

- Weather Research and Forecasting (WRF)
  - Includes NWP model and pre- and post-processors
- Model Evaluation Tools (MET) Verification package
- Gridpoint Statistical Interpolation (GSI) Data Assimilation
- WRF for Hurricanes (coupled atmosphere, ocean and wave system)

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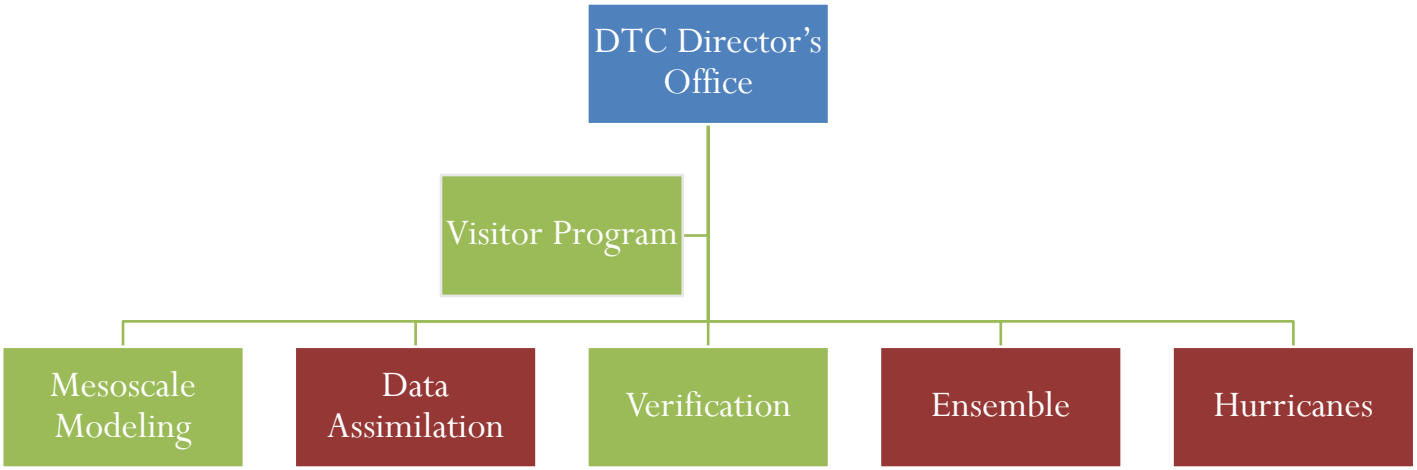

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* GSI hybrid var-ens system for HWRF

Motivations

- HFIP request- Transition from research to operations
- Challenges in current HWRF-GSI system
  - GSI: 3D-Var, Static background error (BE) covariances
  - Chosen to run GSI only for deep and strong storms
  - No inner-core observations assimilated
- Advancing of data assimilation techniques
  - Ensemble-based data assimilation efforts
  - Hybrid Var-Ens
- Promising results from hybrid DA
  - NCEP/EMC GSI-hybrid for global system: tested, to be implemented in Q3FY12
  - Ongoing efforts for experimental regional models being run for HFIP

Long Term Goal?

- One unified GSI-hybrid system for operational applications
  - Improvement to hurricane forecast
- A flexible community GSI-hybrid framework used for both research and operations
  - Transition from research to operations
- One code management: shared repository, distributed development
- Centralized development support (potentially extended to community support)
- Focused research for operations

Short Term Goal?

Proposed Real-time Forecast System

- Multi model regional ensemble (all 3-4km)
  - HWRF (27-9-3) with hybrid DA, parallel run (10 members?)
  - HWRF (27-9-3) with hybrid DA with satellite and aircraft data

Are we ready yet?

Task Plan (June 2011-May 2012)

I. GSI-hybrid Code Management and Support

In collaboration with HFIP and appropriate operational groups (i.e., NCEP/EMC), the DTC will

- Develop a work plan to coordinate GSI-hybrid efforts toward building a unified GSI-hybrid framework and help accelerate the transitions from research to operations in such a system
- Organize a HFIP GSI-hybrid workshop
- Build a GSI-hybrid framework in collaboration with HFIP and NCEP/EMC in order to benefit from the work done by operational and research communities.
- Working with the NCEP/EMC and other developers, start to document the GSI-hybrid framework and system
- Work on building a code management procedure for EMC, DTC, HFIP and other community developers to coordinate hybrid related research and, eventually, transition research to operations.

GSI-Hybrid Framework (Proposed)

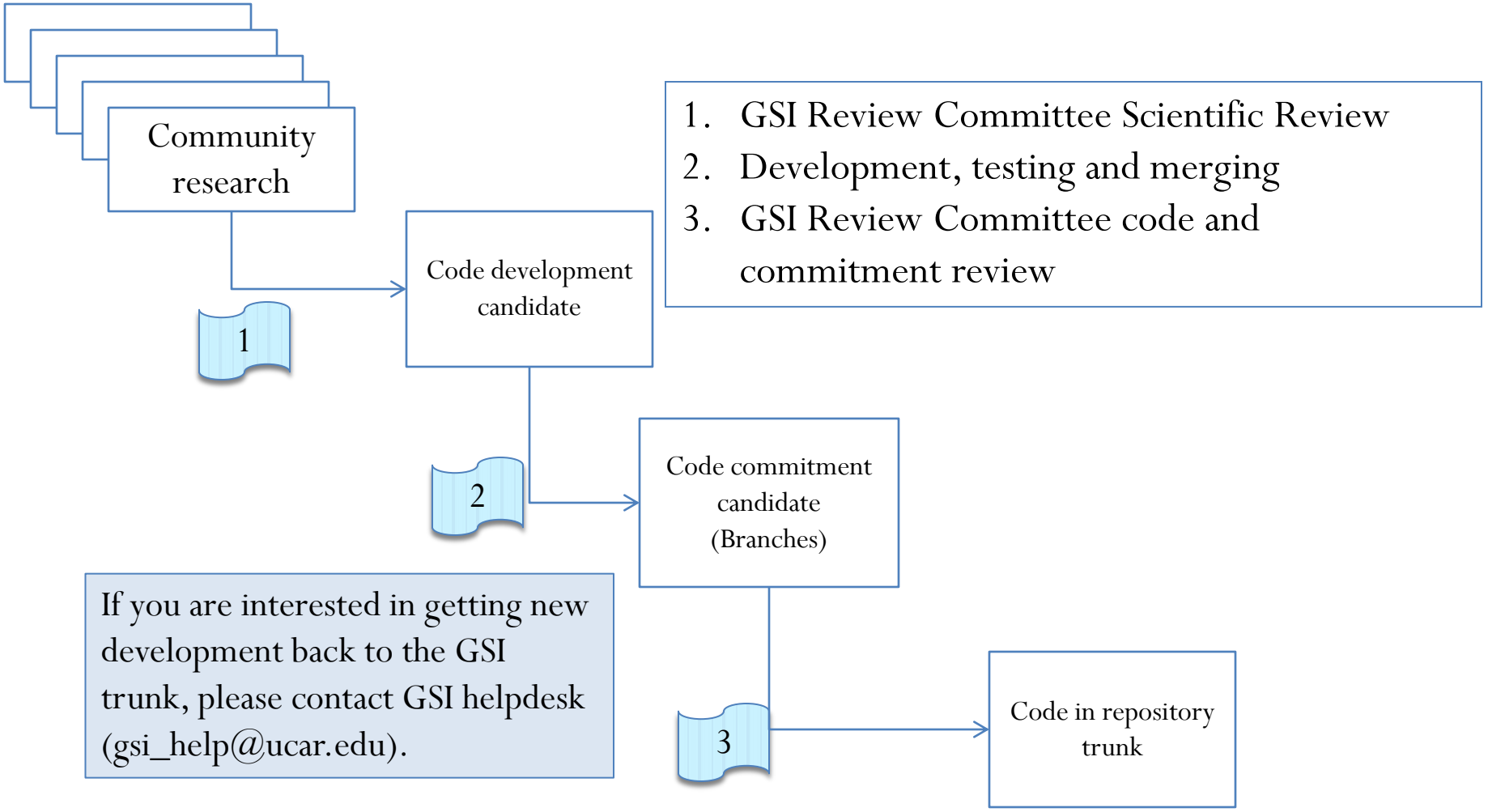
- Based on existing NCEP hybrid framework
- A flexible system, which can potentially use other ensemble packages for research purposes with a default set up for future operational usage
- Common components/repository
- Testing standard, which will emulate operational environment
- Establish a procedure to transition research to repository

Code Management Procedure

"
- Facilitate transfer of code … by improving the way code is shared and managed.
- Reduce the overhead in transferring code between multiple repositories.
- Minimize human error in the code management process.
- Install safeguards to protect integrity of the code. "

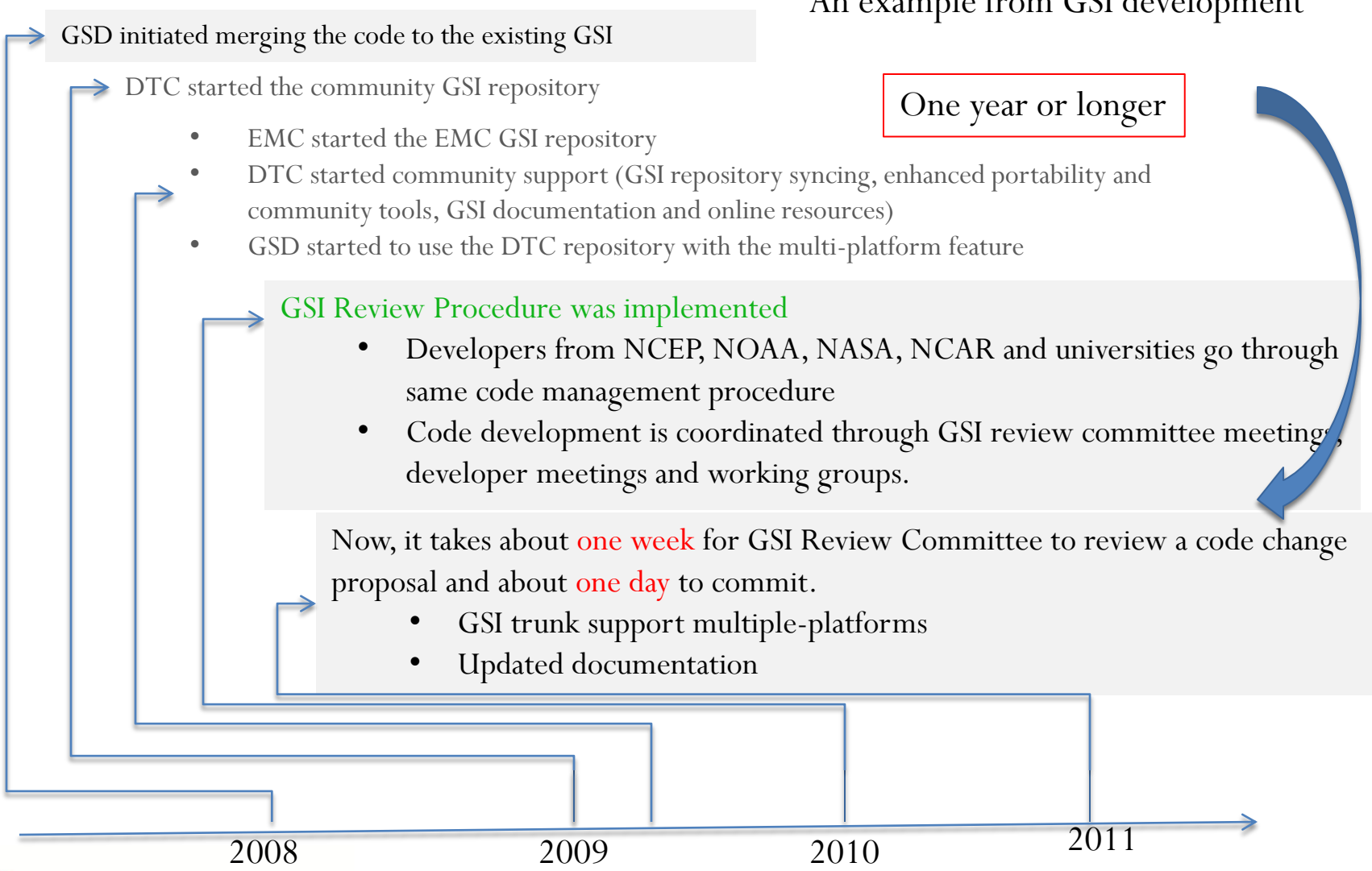
(from HWRF code management plan)

GSI R2O Transition Procedure (2011 Implementation)



Help Accelerate R2O Transitions

An example from GSI development



Task Plan (June 2011-May 2012)
II. Testing and Evaluation

- Conduct benchmark tests using GSI to assimilate observations in hybrid mode using the information provided by a selected ensemble generation scheme

  Core Activity

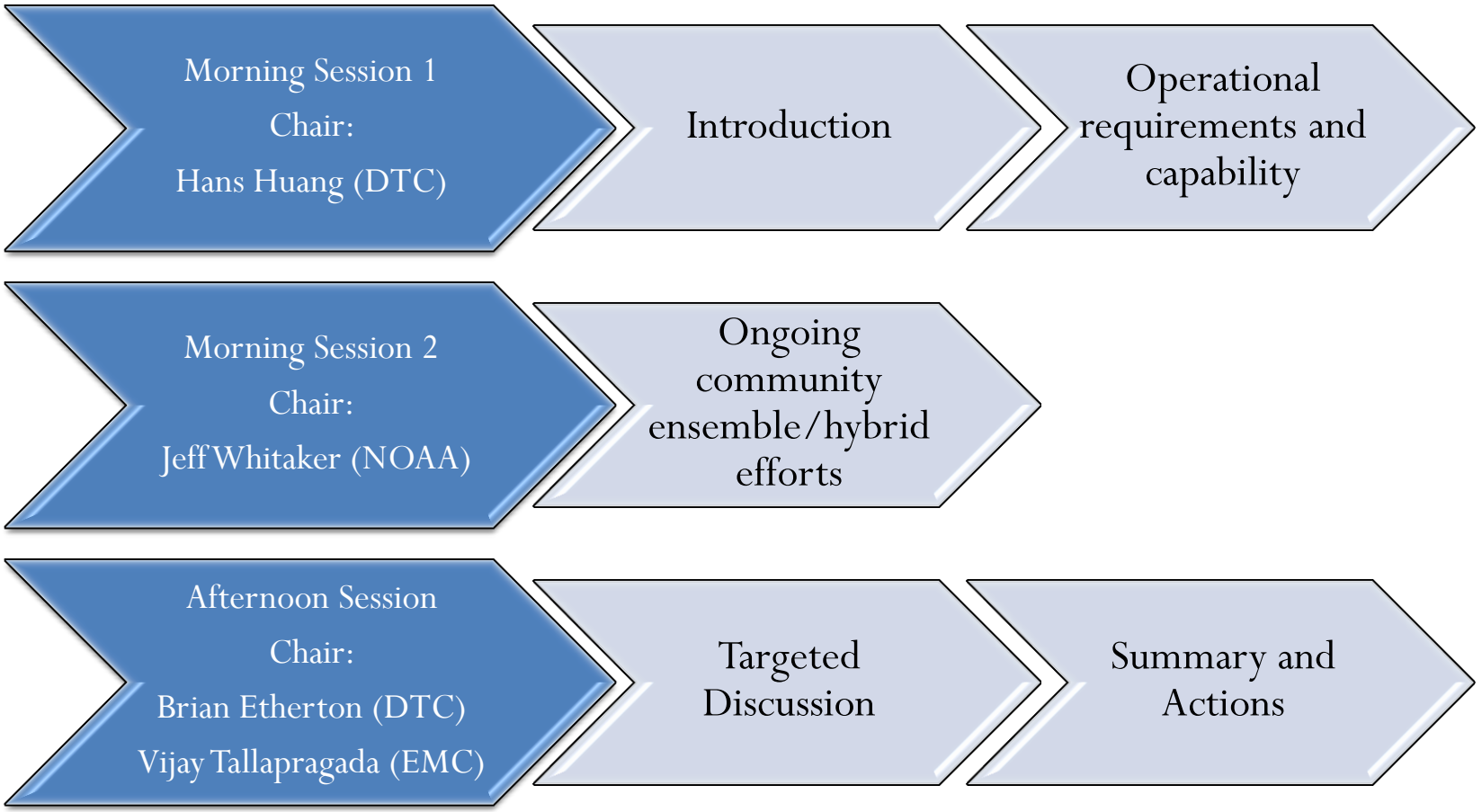
  - The DTC will work with with HFIP and NCEP/EMC on selecting such a scheme, with consideration for future operational implementation

- Investigate different methods for ensemble generation
  - Aligned with the HFIP regional ensemble forecast system (HREF) program

Objectives of the Workshop

- Collect information
- Assess ongoing hybrid related research
- Facilitate discussion on GSI-hybrid framework
- Identify action items
- Work with HFIP management to focus HFIP research community on a single regional hybrid system for hurricane forecast operations

Agenda of the Workshop



Some Discussion Questions (proposed)

- How would our collaboration work?
  - What is the current system? How to work based on it? How many contributors are we expecting? What are the EMC requirements? Community requirements?
- How can we manage the collaboration and monitor the progress?
- Who will make decisions? A committee? What procedure to follow?
- What development work needs to be done in the short term to make the GSI-hybrid system a viable alternative for those folks to run next year.
  - GSI system – EMC baseline, how to let others build on it?
  - Ensemble system – EMC baseline, how to let others build on it?
  - Hybrid system- What are the common parts to be generalized? How to do it? By whom? How to incorporate community contributions (especially those using different packages)
  - How to test the system and incorporate contributions from community
    - Testing metrics
    - Distributed testing or centralized
  - Milestones/deliverables – goals realistic? Computational resources? Timeline? POCs?
- How will the development of the GSI-hybrid system interact with development of the existing system(s), e.g., GSI.

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  - Ensemble system – EMC baseline (**ESRL EnKF, 27km**), how to let others build on it?
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