NOAA Climate Test Bed (CTB)

a mechanism to support NCEP-CICS collaborations

Jin Huang, CTB Director

Mission: To accelerate the transition of scientific advances from the climate research community to improved NOAA climate forecast products and services.

http://www.cpc.ncep.noaa.gov/products/ctb/
What’s CTB? How does CTB operate? What’s new?

Outline:

• CTB mission, scope, priorities, structure
• Ongoing projects
• Proposal writing and review processes
• Post-project review
NCEP Test Beds
Service – Science Linkage with the Outside Community:
Accelerating the R2O Transition Process

- **EMC**  WRF Developmental Test Center (DTC)
  Joint Center for Satellite Data Assimilation
- **CPC**  Climate Test Bed
- **NHC**  Joint Hurricane Test Bed
- **HPC**  Hydrometeorological Test Bed
- **SPC**  Hazardous Weather Test Bed with NSSL
- **SWPC**  Space Weather Prediction Test Bed with AFWA
- **AWC**  Aviation Weather Test Bed
- **OPC**  IOOS Supported Test Bed (in discussion with NOS/IOOS)

Organization structure, scope and funding sources are different for different Test beds
CTB Mission: Advancing NOAA operational climate monitoring, modeling, and prediction capabilities

- Accelerate research-to-operation (R2O) transition to improve NCEP operational climate prediction
- Provide operation-to-research (O2R) support to the climate research community with access to operational models, forecast tools and datasets

CTB priorities:
1) CFS improvements
2) Multi-model ensembles
3) Climate forecast products
4) Climate Reanalysis (new)

Currently MAPP-CTB calls for proposals every 2 years.
A Mission-Driven Process

Operate and Identify Gaps

Deploy

Demonstrate

NOAA Climate Test Bed (CTB)

Develop

Research

NCEP

CPO
MAPP-CTB Currently Funded Projects

Modeling:
1. A CPT to improve cloud and boundary layer process in GFS/CFS (Bretherton)
2. A CPT for improving turbulence and cloud processes in the NCEP global models (Krueger)
3. Improving the NCEP Climate Forecast System (CFS) through Enhancing the Representation of Soil-Hydrology-Vegetation Interactions (Chen)
4. Advances in Lake-Effect Process Prediction within NOAA’s Climate Forecast System for North America (Jin)
5. Improving Cloud Microphysics and Their Interactions with Aerosols in the NCEP Global Models (Lu)

Prediction:
1. North American Multi-Model ensemble (NMME) Phase II (Kirtman)
2. Improved probabilistic forecast products for the NMME seasonal forecast system (Barnston)
3. Subseasonal NMME Forecasts: Skill, Predictability, and Multi-model combinations (DelSole).
4. Assessment of CFS predictions of U.S. severe weather activity (Tippett)
5. Bridging the gap in NOAA’s extended and long range prediction systems through the development of new forecast products for weeks 3 and 4. (Johnson)
CTB Priority (1): Multi-Model Ensembles

NMME (North American Multi-Model Ensemble)
An unprecedented MME system to improve intra-seasonal to interannual (ISI) operational predictions based on the leading US and Canada climate models.

NMME was funded as a CTB project in FY11 and FY12-13 and extended to FY14 by NOAA/CPO/MAPP and other US agencies.

What was tested: A multi-model prediction system based on major climate models in U.S. and Canada for NCEP operational seasonal forecasts

How it was tested: Tests based on 30-year hindcasts and real-time forecasts since August 2011

What was demonstrated: Improved forecast reliability, forecast skill (anomaly correlation, rank probability score)

Impact: (1) Improved numerical guidance for NCEP/CPC operational seasonal forecasts; (2) the most comprehensive seasonal prediction dataset available to the public for research and applications

Current NMME Forecast Providers

<table>
<thead>
<tr>
<th>Organizations</th>
<th>Models</th>
</tr>
</thead>
<tbody>
<tr>
<td>NOAA/NCEP</td>
<td>CFSv2</td>
</tr>
<tr>
<td>NOAA/GFD</td>
<td>CM2.1</td>
</tr>
<tr>
<td></td>
<td>FLOR</td>
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<tr>
<td>NASA/GMAO</td>
<td>GEOS5</td>
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<tr>
<td>Environment Canada</td>
<td>CMC1-CanCM3</td>
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<td></td>
<td>CMC2-CanCM4</td>
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<tr>
<td>NCAR</td>
<td>CCSM3.0</td>
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<tr>
<td></td>
<td>CCSM4.0</td>
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<tr>
<td>NCAR</td>
<td>CESM1.0</td>
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</table>

Next Steps:
• Sustain the NMME seasonal forecast system
• Explore the potential for NMME sub-seasonal forecast for weeks 3-4
CTB Priority (2): CFS Evaluation and Improvements

To accelerate evaluation of and improvements to the operational Climate Forecast System (CFS) and to enhance its use as a skillful tool in providing NCEP’s climate predictions and applications

(1) Support R2O testing/demonstration grants projects

• Test and evaluate new parameterizations, schemes, model components in NCEP operational models

• 5 ongoing modeling projects
  - **Cloud-CPT 1** PI: Krueger, EMC Co-PI: Moorthi
  - **Cloud-CPT 2** PI: Bretherton, EMC Co-PIs: Jongil Han and Rui-Yu Sun
  - **Lake Module** PI: Jin J, EMC Co-PIs: Ek and Wu
  - **Land Module** PI: Chen, EMC Co-PIs: Ek, Yang and Meng
  - **Aerosol Module** PI: Lu, EMC Co-PI: Hou YT Co-I Moorthi

(2) Engage the external community

• Led the publication of the Special CFSv2 Collection in Climate Dynamics (23 articles)

• Leading **MAPP Climate Model Development Task Force** with a focus on NCEP/CFSv3 planning/development in 2014-2016
CTB Priority (3): Improving Prediction Tools and Products

Goal: To provide reliable climate forecast products that are responsive to the needs of users and incorporate state-of-the-art science and research

4 ongoing Projects on Prediction Tools and Product Development

1. **Week-3 and Week-4 Forecast Tools**  
   PI: Xie/Johnson, CPC Co-Pis: L'Heureux and Baxter

2. **Extended Range Severe Weather Forecast Tools**  
   PI: Tippett, CPC Co-PI: Gottschalck, SPC Co-PI: Carbin

3. **NMME Prediction Post-processing Protocol**  
   PI: Del Sole, CPC Co-PI: Kumar

4. **Probabilistic NMME Products**  
   PI: Barnston, CPC Co-PIs: van Den Dool and Becke

NMME-based Seasonal Drought Outlook
Two Phases in CTB R2O Process

- A MAPP-CTB Execution Agreement (2012) defining basic process and roles
- Guiding Document: NOAA Administrative Order 216-105 Policy on Transition of Research and Development to Application
Two Phases in CTB R2O Process – Requirements

Demonstration Phase

Competitively Select Meritorious Climate Test Bed Demonstration Projects

- Relevance to NCEP
- Involve an NCEP co-PI
- Clear testing objectives and operational outcomes
- High merit/right Technical Readiness Level (TRL)
- Clear metrics
- Feasibility and support from NCEP

Operational Deployment Phase

Operationally Deploy Successful New Methods and Models

- Plan for deployment, both systems and resources
- Adapt experimental new methods and models to comply with the operational suite (e.g., code requirements)

END-TO-END PLANNING

Demo Project TRL 5-7

Demo Project TRL 6-8

Technical Readiness Levels (TRLs)

5 6 7 8 9
Specific Requirements for CTB Proposals

• CTB proposals need to include
  – NCEP Co-PIs or collaborators.
  – A transition plan for both demonstration phase and operational deployment phase

• NCEP will review the CTB proposals in particularly the transition plans before they are submitted to CPO for peer reviews

• NWS management needs to sign the transition plans.
Template for MAPP-CTB Transition Plans

**Demonstration Phase:**
- Metrics for measuring the success of the demonstration phase
- Tasks, timelines
- Targeted TRL

**Deployment Phase:**
- What is potentially being deployed operationally? and where?
- Year of potential deployment
- Tasks and timeline for deployment
- Cost to NCEP for deployment (if any)
- HPC requirements for NCEP during deployment and operations
<table>
<thead>
<tr>
<th>Mission Function</th>
<th>TRL #</th>
<th>Technical Readiness Level Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Research</td>
<td>1</td>
<td>Basic principles observed and reported</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>Technology concept and/or application formulated</td>
</tr>
<tr>
<td>Development</td>
<td>3</td>
<td>Analytical and experimental critical function and/or characteristic proof-of-concept</td>
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<tr>
<td></td>
<td>4</td>
<td>Component/subsystem validation in laboratory environment</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>System/subsystem/component validation in relevant environment</td>
</tr>
<tr>
<td>Demonstration</td>
<td>6</td>
<td>System/subsystem model or prototyping demonstration in a relevant end-to-end environment</td>
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<tr>
<td></td>
<td>7</td>
<td>System prototyping demonstration in an operational environment</td>
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<tr>
<td></td>
<td>8</td>
<td>Actual system completed and &quot;mission qualified&quot; through test and demonstration in an operational environment</td>
</tr>
<tr>
<td>Deployment</td>
<td>9</td>
<td>Actual system &quot;mission proven&quot; through successful mission operations</td>
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*NAO 216-105