

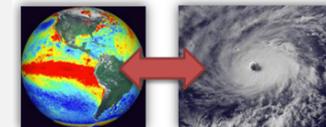
Transition Efforts to Support Wx/Cx Extremes R2O



Dan Barrie, Annarita Mariotti, Heather Archambault
OAR/CPO/MAPP



The Weather–Climate Prediction CHALLENGE



Sources of Predictability

Rossby wave packets

Madden-Julian Oscillation (MJO)

North Atlantic Oscillation

Tropical–extratropical interactions

Blocking

Troposphere–stratosphere interactions

El Niño
Southern Oscillation

Ocean-, ice-, and land-atmosphere interactions

Theoretical limit
of weather
prediction

Predictability

WEATHER

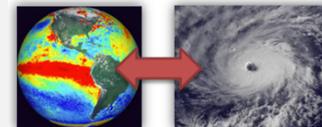
CLIMATE

0 days 15 days 30 days **Lead Time** 2 mo 3 mo

- No natural boundary exists between “weather” and “climate”
- Despite a theoretical 15-day limit of weather prediction, key climate features such as El Niño make extended-range prediction feasible



RESEARCH PROGRAMS AND NWS MISSION REQUIREMENTS

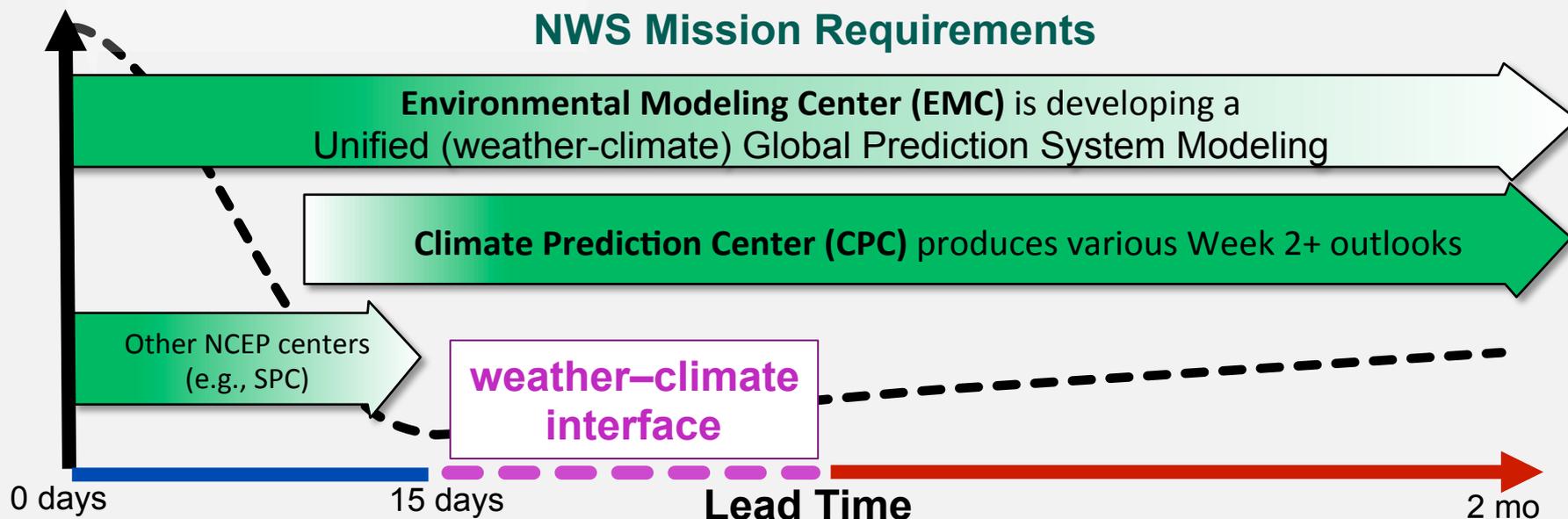


Out 30 Days:

OAR Office of Weather & Air Quality (OWAQ),
NWS Next-Generation Global Prediction System

Week 2 to Seasonal:

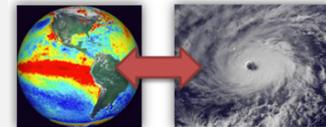
OAR Climate Program Office (CPO),
NOAA Climate Test Bed (CTB)



- Considerable overlap exists between programs addressing the weather-climate continuum within OAR, and between OAR and NWS
- EMC and CPC are two centers with particular mission requirements spanning the weather-climate continuum



CPO contributions to Weather–Climate



- For years, CPO has championed and successfully led multi-institutional, end-to-end, cutting-edge research and R2X activities linking weather and climate, leveraging and playing a leading role in USGCRP

CPO activities support the entire NOAA R&D Funnel:

- **RESEARCH**
- CPO sponsors research to understand sources of predictability like the MJO
- CPO partners with CPC on a variety of Weeks 3–4 research projects
- **DEVELOPMENT**

CPO's modeling and infrastructure investments support EMC's Unified Global Prediction System efforts

CPO and NOAA CTB have jointly organized a workshop in March on subseasonal prediction systems

- **DEMONSTRATION** NOAA CTB supports North American Multi-Model Ensemble (NMME)
- **DEPLOYMENT** CPO co-supports the NMME Phase II system with NCEP



“Strengthen the integration, alignment, and effectiveness of R&D that supports NOAA's operational missions, including accelerating the transition of research advances to applications”

NOAA Annual Guidance Memorandum for FY 2015

Many past calls for NOAA to achieve successful transition – a 30+ year-old problem



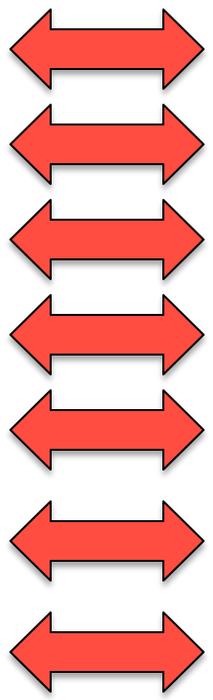
Context for Climate R2X

R, R&D

OAR Labs

External Community

R2X



O And A

NOAA
Operational
Monitoring and
Prediction
(e.g. NWS/NCEP)

Other NOAA-
Supported
Climate Services
(e.g. NIDIS, NCA)

CPO/Modeling, Analysis, Predictions and Projections (MAPP) Program

R, R&D and R2X Mission:

Advance understanding and prediction of variability and changes in Earth's climate system and infuse research advances into NOAA's service activities

Shared responsibility between CPO/MAPP Program and NCEP

Mission: Advancing Operational Climate Prediction and Products

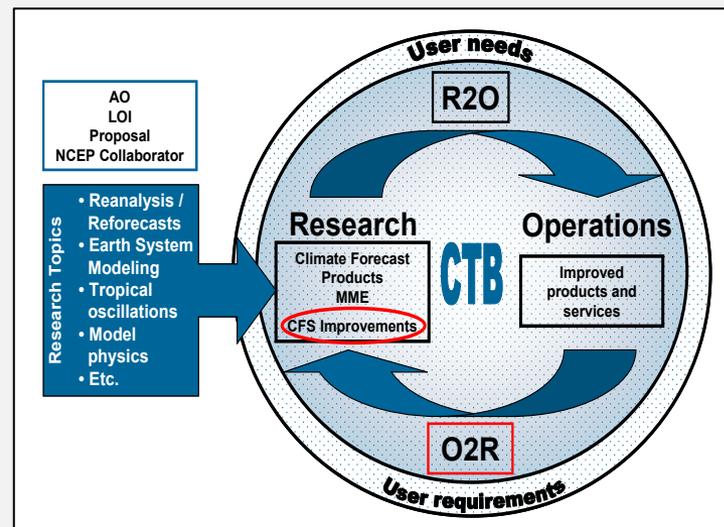
- Accelerate R2O transition to improve NCEP operational climate prediction
- Provide the climate research community with access to operational models, forecast tools and datasets (O2R)

3 Focus Areas:

- Climate Forecast System (CFS) Improvements
- Multi Model Ensembles
- Climate Forecast Products

Highlights:

- North American Multi Model Ensemble (NMME) for operational national monthly/seasonal climate forecasts
- Climate Process Teams to accelerate improvements in Climate Forecast System
- U.S. Seasonal Drought Outlook improvements





The Two-Way R2O/O2R Interface Between CPO & NCEP

A Mission-Driven Process

NCEP

Deploy

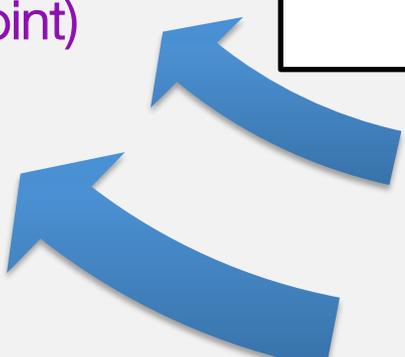
NCEP

Operate and Identify Gaps



Demonstrate

NOAA Climate Test Bed (joint)



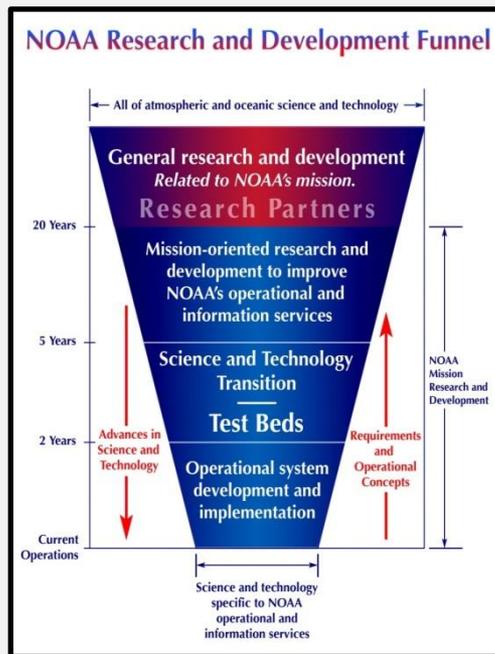
Develop

MAPP



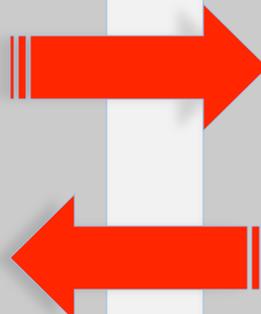
Research

MAPP



KEY ISSUES

- How do we plan and implement end-to-end demonstration and deployment?
- How do we solicit and select the “right” projects?
- Who is responsible for what?
- How do we enable/optimize R2X?
- What are the requirements of R to enable effective X?
- How do we know we are successful?
- Does one size fit all?
- ...



PARADIGM ELEMENTS

PROCESSES &
ROLES

PARTNERSHIPS &
ENGAGEMENT

RESOURCES &
INFRASTRUCTURE

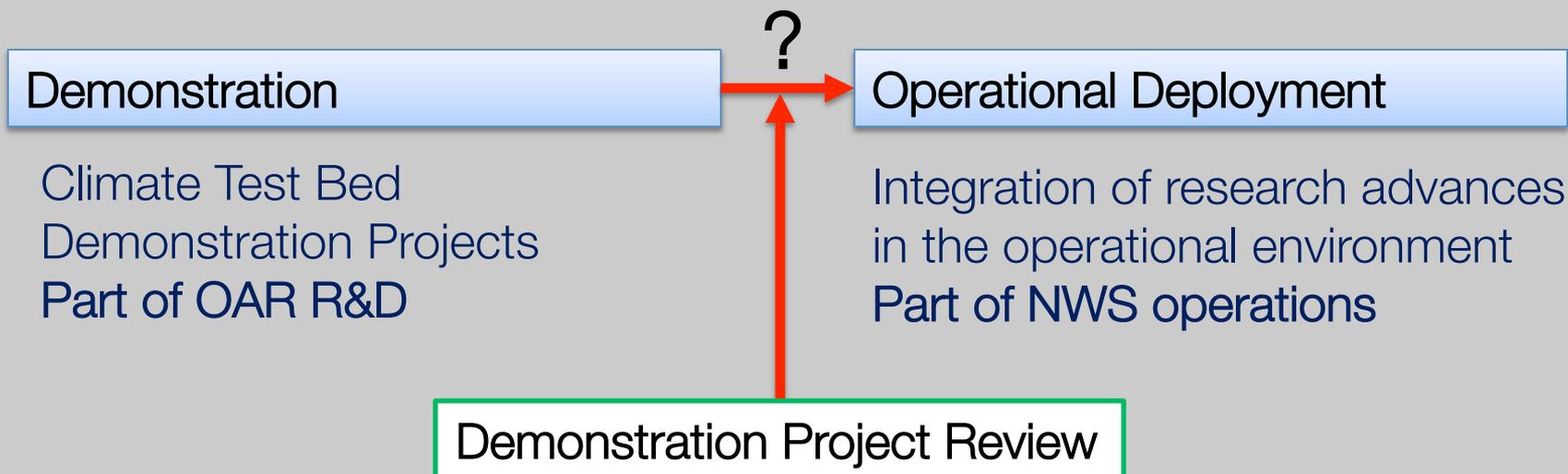
Work in progress; a joint MAPP/NCEP iterative learning process



Defining Processes and Roles – Big Picture

- 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 for transition of research into operations – a shared process



Demonstration



Operational Deployment

Competitively Select Meritorious Climate Test Bed Demonstration Projects

- Research area of relevance to NCEP
- Teams involving an NCEP co-PI
- Clear testing objectives and operational outcomes
- High scientific/technical merit
- Clear metrics
- Feasibility and support from NCEP

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 transition plans developed by PIs at the beginning of research projects, and jointly discussed by CPO and NCEP



The sustained NCEP-CPO partnership has been key to defining and implementing the transition process

NCEP and MAPP managers meet quarterly to:

- Discuss ongoing projects and plan for transition
- Discuss near-term operational objectives and research activities in context of NCEP and CPO Annual Operating Plans
- Plan for new R2O work



- NCEP Visiting Scientist Program
- AGU/AMS Town Halls explaining transition
- MAPP Program Task Forces and webinars engaging NCEP scientists together with external community

Prediction Task Force
Advancing ISI Climate
Prediction

CMIP5 Task Force
Developing Projections for
North America

MAPP Webinars
Facilitating Communication

Climate Reanalysis
Task Force

Climate Model
Development Task Force

Drought Task Force
Advancing Drought Understanding,
Monitoring and Prediction



- NEMS provides software infrastructure for R2O/O2R at NCEP; supported by both NWS and CPO
- Model data availability for research via the National Climate Model Portal

Gaps

- NCEP needs a budget line to support R2O deployment efforts and build an O2R infrastructure to facilitate R2O
- CPO needs a dedicated funding line for R2O grants to support MAPP-CTB projects

CTB/MAPP Example: NMME

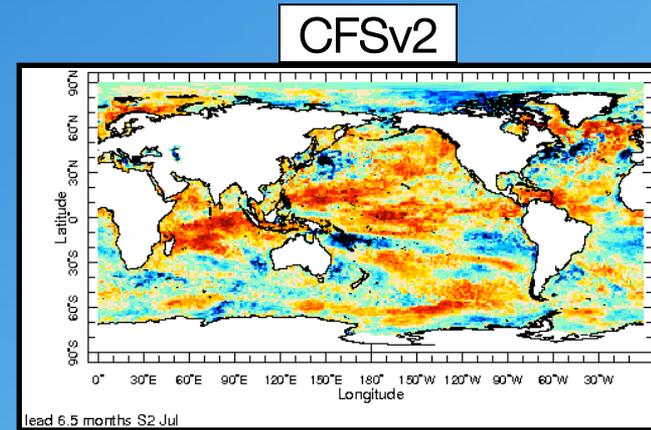
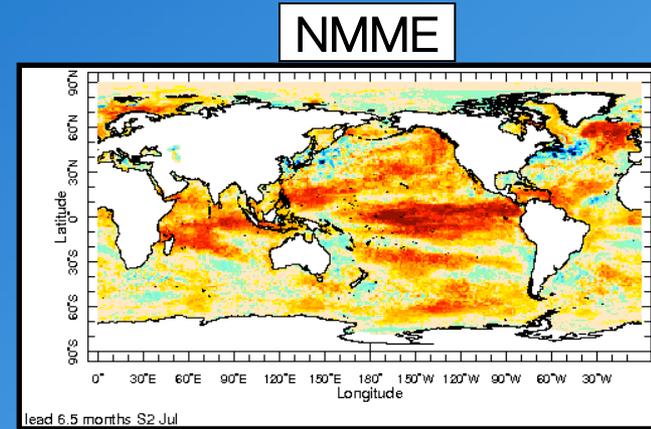
What was tested: A multi-model prediction system based on major climate models in U.S. and Canada for NCEP operational seasonal forecasts

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

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

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

Joint NCEP/CPO planning for transition to operations during FY15 – a dual service/research purpose



Comparison of NMME and CFSv2 skills based on 30-year hindcasts (July 1 start DJF SST forecast Ranked Probability Skill Score)

Two Research-to-Application Examples

Different players, same paradigm principles of process, partnerships and infrastructure



Drought Research Applied to NIDIS

MAPP
Modeling, Analysis,
Predictions, and Projections

ASSESSMENT REPORT

Causes and Predictability of the 2011-14 California Drought

RICHARD SEAGER
Lamont Doherty Earth Observatory of Columbia University

MARTIN HOERLING
NOAA Earth System Research Laboratory

SIEGFRIED SCHUBERT
HAILAN WANG
NASA Goddard Space Flight Center

BRADFIELD LYON,
International Research Institute for Climate and Society

Seager, R., et al. (2014), Causes and Predictability of the 2011-14 California Drought, DTF/NIDIS Assessment report, doi:10.7289/NAOMI_HENDERSON
V58K771F
Lamont Doherty Earth Observatory of Columbia University

Available at http://cpo.noaa.gov/sites/cpo/MAPP/california_drought_report.pdf

Drought Task Force 50+ researchers funded by the NOAA MAPP Program focused on improving understanding, prediction, and monitoring of drought in support of NIDIS

Assessment report on the ongoing California drought (left).

Useful to:

- 1) Help regional stakeholders better understand the causes and extent of the drought (R2A)
- 2) Focus the research community on necessary improvements to prediction systems and areas of understanding requiring research focus (A2R)

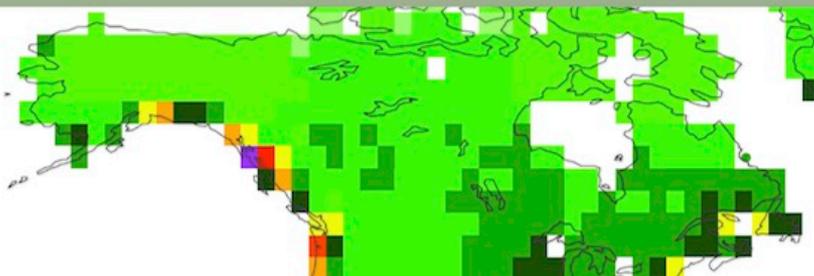
Process: Competitive selection and group in Task Force

Partnerships: Among scientists; MAPP/NIDIS

Infrastructure: MAPP program organization of activities



NOAA TECHNICAL REPORT
**REGIONAL CLIMATE
 PROCESSES AND
 PROJECTIONS FOR
 NORTH AMERICA:**
 CMIP3/CMIP5 DIFFERENCES,
 ATTRIBUTION AND
 OUTSTANDING ISSUES



Sheffield, J., et al. (2014), Regional Climate Processes and Projections for North America: CMIP3/CMIP5 Differences, Attribution and Outstanding Issues, NOAA Technical Report OAR CPO-2, doi:10.7289/V5DB7ZRC

Available at http://cpo.noaa.gov/sites/cpo/MAPP/CMIP5_TR_2014.pdf

CMIP5 Task Force 30+ researchers funded by the NOAA MAPP Program focused on evaluating model performance and producing projections of North American climate based on CMIP5 data

Report on climate processes and projections for North America, focused on comparing CMIP3 and CMIP5 models (left).

Report will be delivered to the National Climate Assessment (NCA).

Process: Competitive selection and group in Task Force

Partnerships: Among scientists; MAPP/NCA

Infrastructure: MAPP program organization of activities



The New R2X Paradigm

PROCESSES & ROLES

PARTNERSHIPS &
ENGAGEMENT

RESOURCES &
INFRASTRUCTURE

*Integrating research and operational cultures
toward more effective transition*



R2A webpage: <http://cpo.noaa.gov/MAPP/R2A>

CLIMATE PROGRAM OFFICE

Advancing scientific understanding of climate, improving society's ability to plan and respond

Research to Applications

Improving operations and informing applied work through research to address societal challenges



Drought and Water Resource Challenges



Extreme Weather and Climate Variability



Sustaining Marine Resources



Sea Level Rise and Coastal Flooding

Listed below are R2A projects that have successfully completed transition to application in the time frame of January 1, 2013 to July 31, 2014.

[Click to expand](#) each project for more details

Project Name: [North American Multi-Model Ensemble](#)

DATE COMPLETED: Monthly
APPLICATION AREA(S): Climate Prediction, Extremes, Drought



Project Name: [Changes in Intraseasonal to Interannual Variability of the Pan American Monsoons Under a Warmer Climate and Their Impacts on Extreme Events as Assessed by the CMIP5 Models and Observations](#)

DATE COMPLETED: September 2014
APPLICATION AREA(S): Extremes, Preparing for 21st century climate



The Modeling, Analysis, Predictions, and Projections (MAPP) Program's mission is to enhance the Nation's capability to understand and predict natural variability and changes in Earth's climate system. The MAPP Program supports development of advanced climate modeling technologies to improve simulation of climate variability, prediction of future climate variations from weeks to decades, and projection of long-term future climate conditions. To achieve its mission, the MAPP Program supports research focused on the coupling, integration, and application of Earth system models and analyses across NOAA, among partner agencies, and with the external research community. [Learn more...](#)

[Download](#) our program brochure (pdf).

- Home
- MAPP Task Forces
- Webinar Series
- Funding Opportunities & Funded Projects
- Publications
- Contact

Upcoming Events



Additional Information

MAPP Program Research Goals

Advance understanding and prediction of variability and changes in Earth's climate system and infuse research advances into NOAA's service activities

Intraseasonal to Interannual Climate Prediction

Long-Term Climate Outlooks

Modeling,
Analysis,
Predictions &
Projections

Climate and Earth System Models

Climate Reanalysis

Drought Understanding, Monitoring and Prediction



CFS Development

- Climate Process Team research on convection parameterizations is embedded in GFS and will contribute to CFSv3
- Contributed land modeling and NLDAS upgrades for CFSv3
- Engaged the external community in CFSv3 planning and development

Multi-Model Prediction

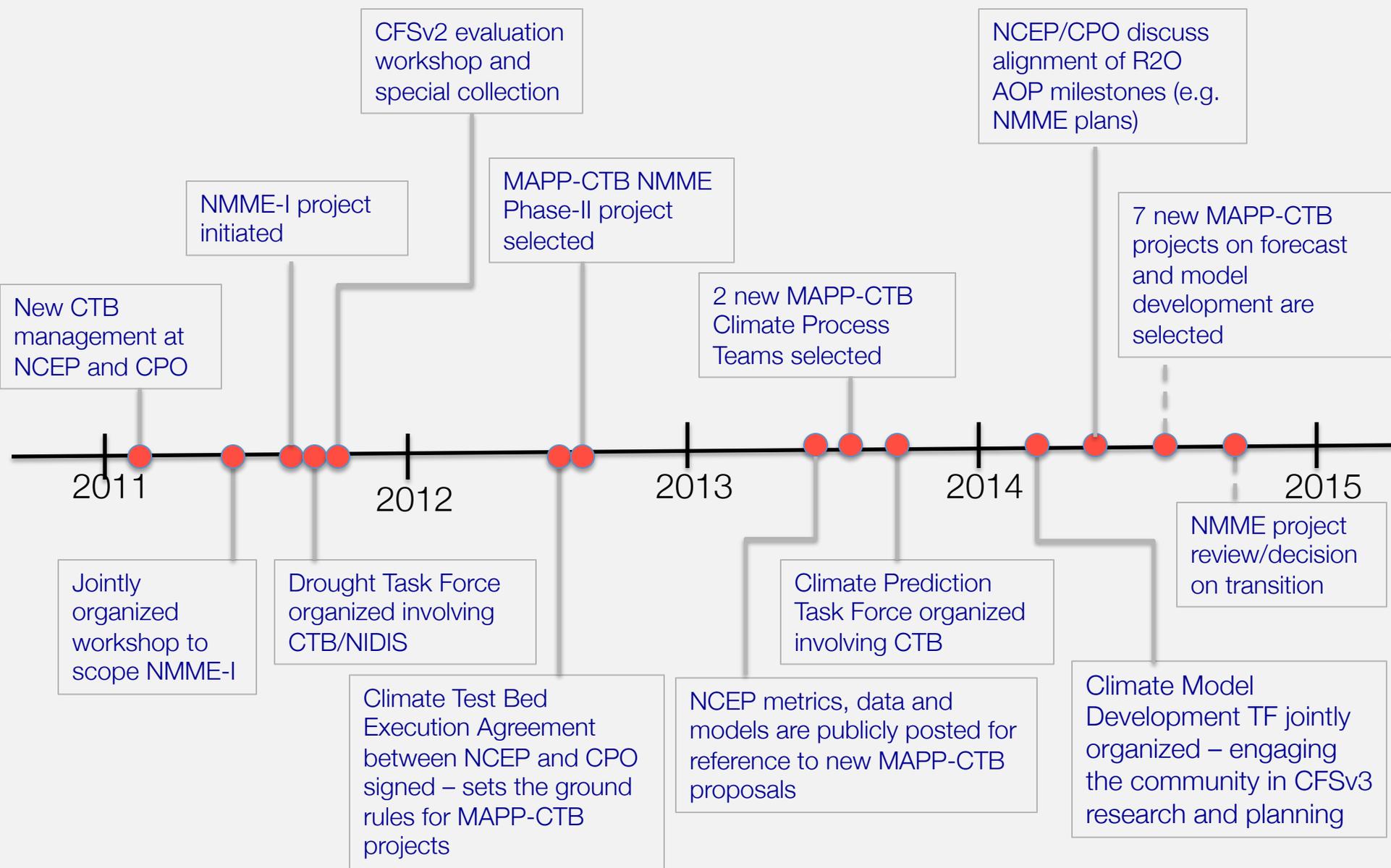
- Tested NMME system for real-time operations
- Tested MJO multi-model prediction, which shows good promise
- Developed a new experimental prediction product for the Pacific Islands

Forecast Products

- NMME-based products have improved NCEP and NIDIS operational drought products
- Engaged external community via the Drought Task Force to assess new drought prediction methodologies



Joint NCEP-MAPP NOAA CTB Milestones





Execution Agreement for the MAPP Program – NCEP CTB Partnership

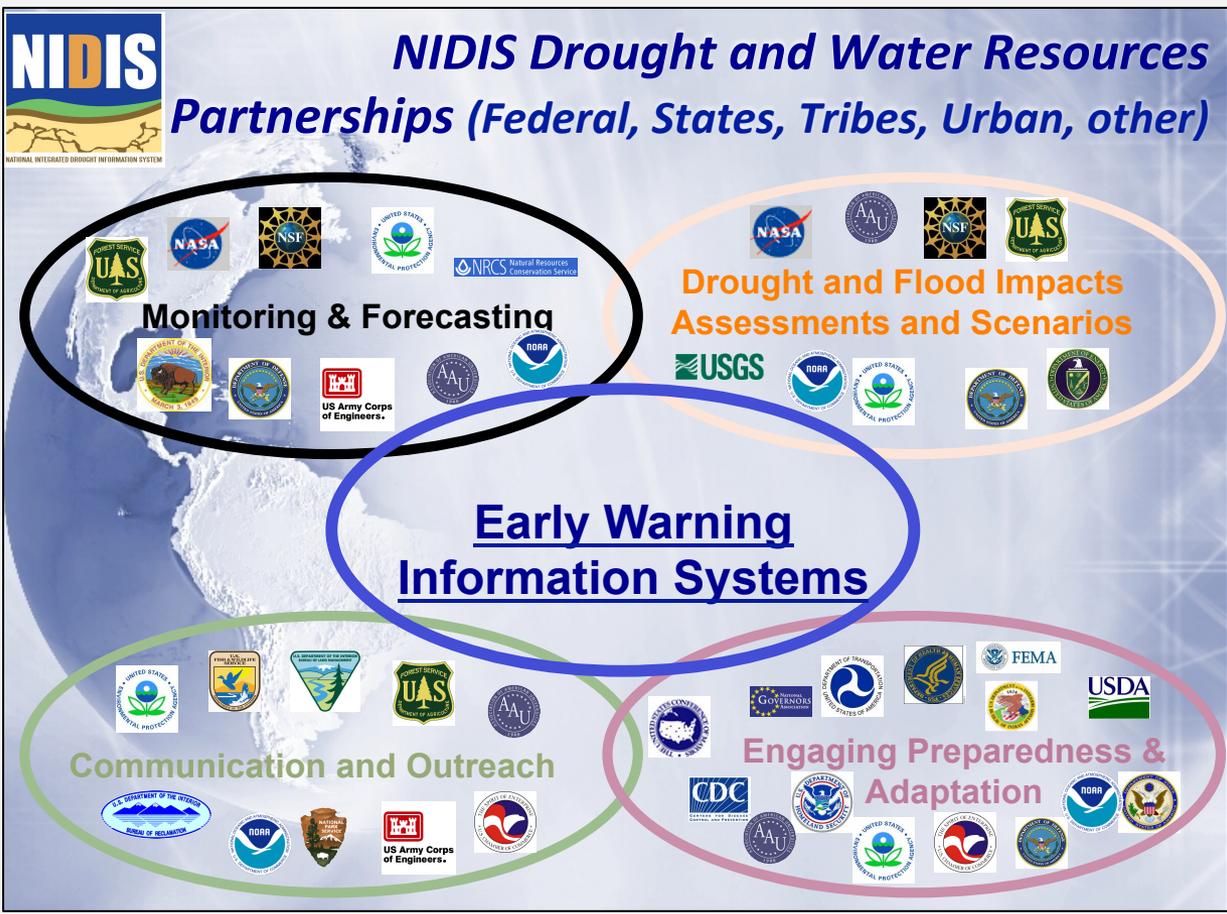
June 27, 2012

The mission of the Modeling, Analysis, Predictions, and Projections (MAPP) Program, as part of NOAA's Climate Program Office (CPO), is to enhance the Nation's ability to understand and predict variability and changes in Earth's climate system. The MAPP Program supports development of advanced climate modeling technologies to improve simulation of climate variability, prediction of future climate variations from weeks to decades, and projection of long-term future climate conditions. To achieve its mission, the MAPP Program supports research focused on the coupling, integration, and application of Earth system models and analyses across NOAA, among partner agencies, and with the external research community. MAPP develops its priorities through interaction with its stakeholders and partners, and with advisory bodies like those associated with the National Research Council and NOAA's Science Advisory Board. For more information regarding the MAPP Program refer to http://www.climate.noaa.gov/index.jsp?pg=/cpo_pa/mapp/

The mission of the Climate Test Bed (CTB), as part of the National Centers for Environmental Prediction (NCEP), is to accelerate the transition of scientific advances from the climate research community to improve NOAA climate forecast products and services. The vision is to significantly increase the accuracy, reliability, and scope of NOAA's suite of operational climate forecast products to meet the needs of a diverse user community. The CTB serves as a conduit between the research and operations communities. For more information regarding CTB refer to <http://www.cpc.ncep.noaa.gov/products/ctb/>.

The partnership between the MAPP Program and NCEP CTB is intended to foster research addressing objectives common to both the MAPP Program and NCEP CTB, accounting as well for the requirements of the Climate Goal priority projects. Emphasis is placed on testing and evaluating advances in climate modeling and prediction for operations. Success of the partnership is achieved through the transition of innovative research advances into improved NCEP operations. In this context, areas of common interest and of high priority are identified by MAPP Program management, mindful of the priorities stated by the CTB in its science plan and related documents. As appropriate and subject to the availability of funds, the MAPP Program will explicitly solicit proposals in the framework of this partnership as part of CPO's annual Federal Funding Opportunity (FFO). The present document describes the additional requirements, beyond those generally applicable in the FFO, that apply to proposals applying for funding or projects funded in the framework of the MAPP Program – NCEP CTB partnership. The aim is to provide guidance to applicants for proposal preparation and information regarding the post-award review/evaluation process.

NIDIS: National Integrated Drought Information System for drought early warning



R2O efforts to improve forecasts such as NMME are being linked to broader efforts to develop an Early Warning system for drought in support of NIDIS

These efforts involve important activities to communicate and engage users of the forecasts information – that meaningfully deliver the warning