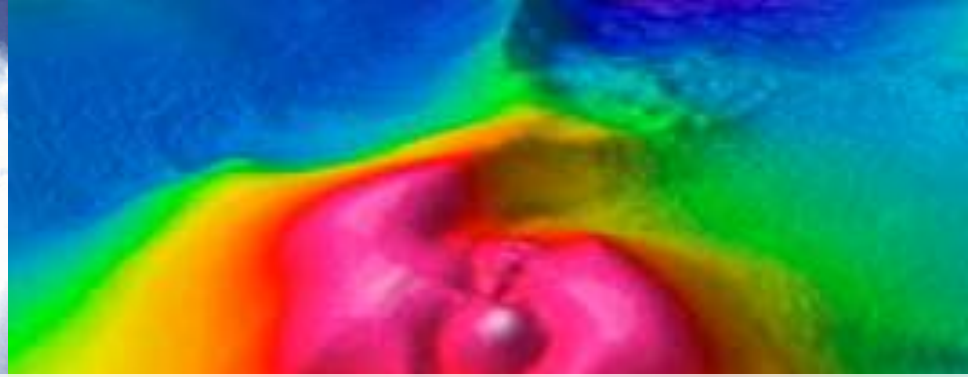
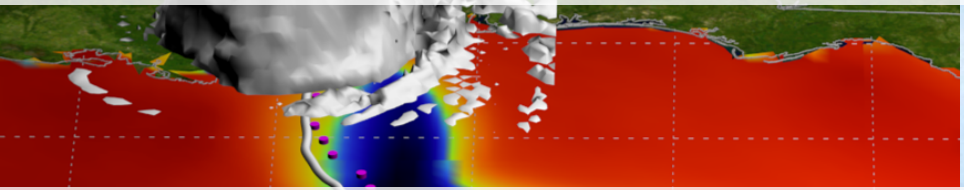



NOAA Climate Program Office

Modeling, Analysis, Predictions, and Projections program



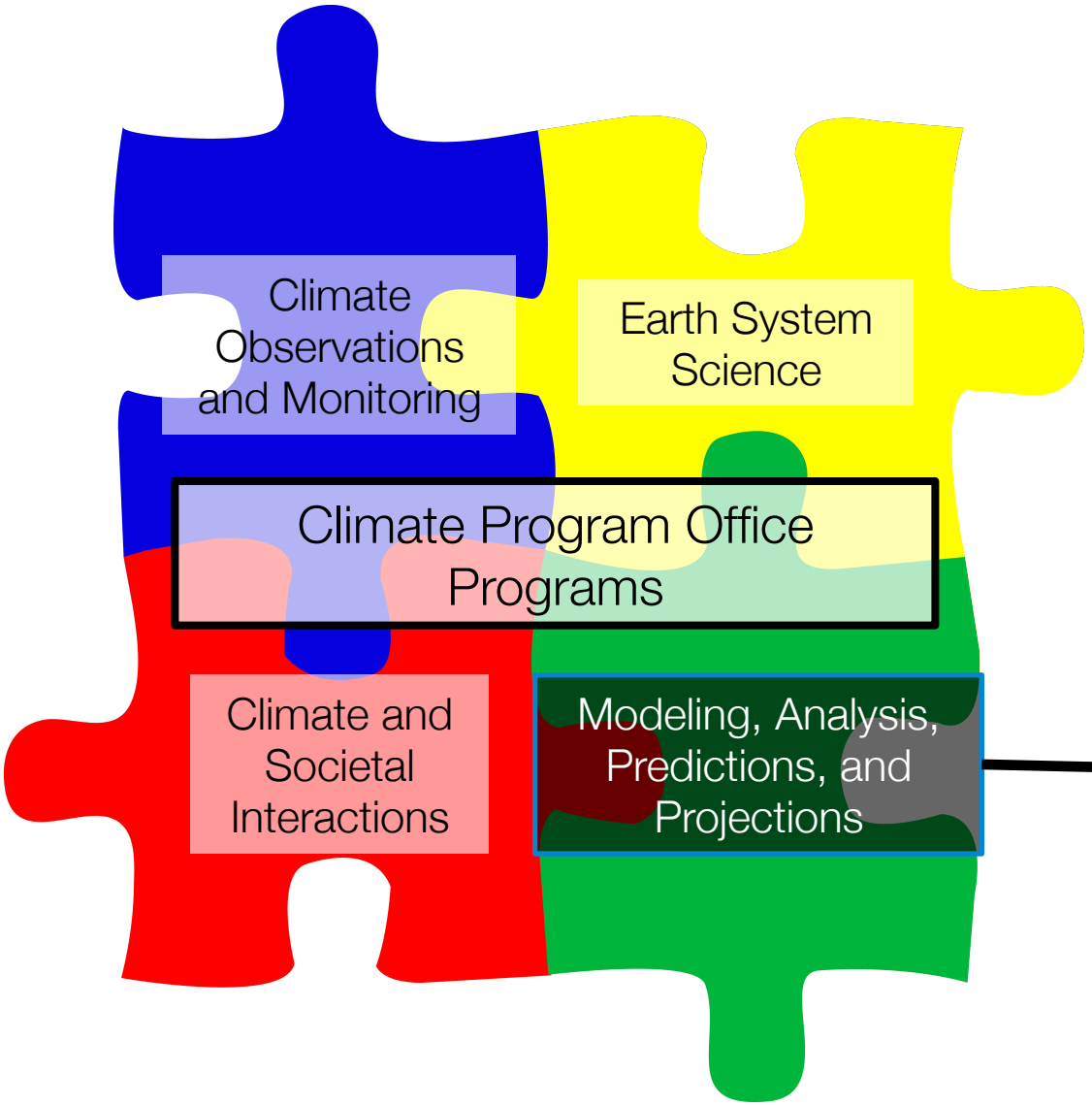
Dan Barrie

WSWC/CDWR Workshop on Sub-Seasonal and Seasonal Precipitation Forecasting

5/28/15

MAPP staff: Annarita Mariotti (program director), Heather Archambault, Will Chong, Ali Stevens

Climate Program Office



NOAA/OAR/CPO/MAPP

A mission-oriented competitive research program at the interface between Earth system science and operational/ service needs.

MAPP
Modeling, Analysis, Predictions, and Projections

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

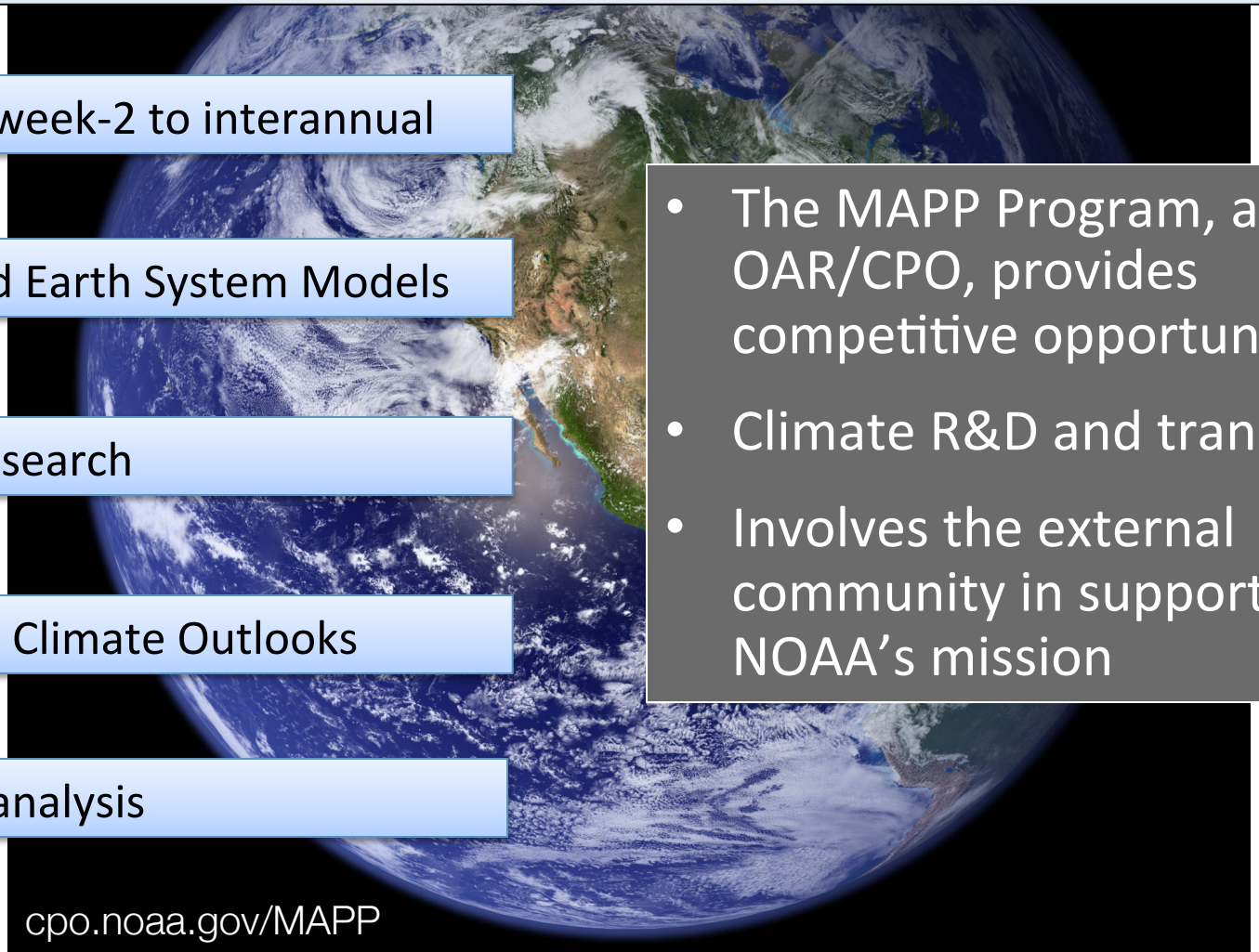
Prediction week-2 to interannual

Climate and Earth System Models

Drought Research

Long-Term Climate Outlooks

Climate Reanalysis



- The MAPP Program, as part of OAR/CPO, provides competitive opportunities
- Climate R&D and transition
- Involves the external community in support of NOAA's mission

cpo.noaa.gov/MAPP

MAPP
Modeling, Analysis, Predictions, and Projections

Drought Task Force

Achieve significant new advances in the ability to understand, monitor, and predict drought over North America, advancing NIDIS goals.

Membership: >30 researchers supported by the NOAA/Climate Program Office (CPO) Modeling, Analysis, Predictions, and Projections (MAPP) program.

Goals:

- Make fundamental scientific advances from basic understanding of drought mechanisms to testing new drought monitoring and prediction tools and methods
- Coordinate and focus MAPP-funded drought research activities
- Facilitate connections with other national and international drought research efforts (e.g., GDIS)
- Contribute to the advancement of NIDIS end-to-end goals

MAPP
Modeling, Analysis, Predictions, and Projections

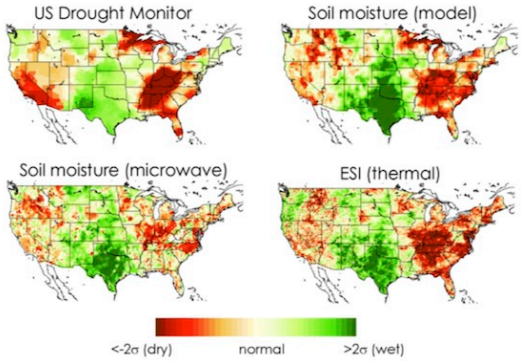
Drought Task Force

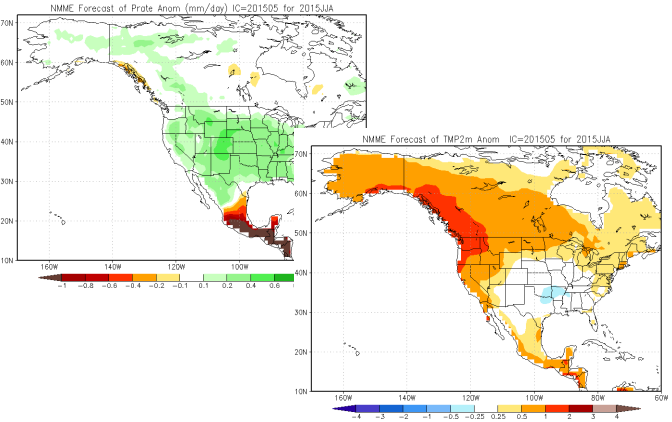
Membership:

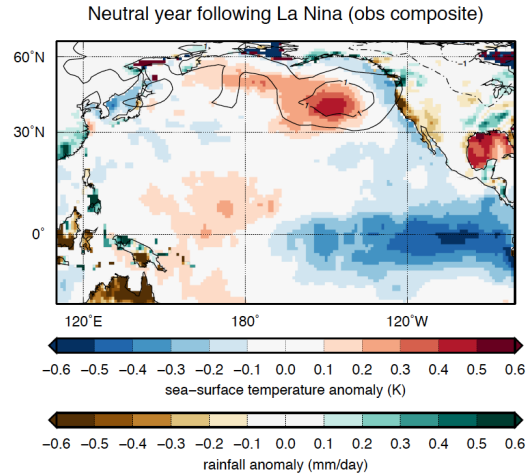
Marty Hoerling (chair)
Eric Wood (co-chair)
Mark Svoboda (co-chair)
Randal Koster (co-chair)
Amir AghaKouchak
Andy Wood
Annarita Mariotti
Arun Kumar
Brad Lyon
Chad McNutt
Chris Hain
Christa Peters-Lidard
Clara Deser
Claudia Nierenberg
Dan Barrie
David Mocko
Dennis Lettenmaier
Dong Eun Lee
Grant Branstator
Hailin Wang
Haiyan Teng
Hamid Mordakhani
Heather Archambault
Isla Simpson
James Verdin
Jason Otkin
Jiarui Dong
Jin Huang
Joe Tribbia
John Nielsen-Gammon
Justin Sheffield
Kingtse Mo
Lifeng Luo
Lisa Darby
Martha Anderson
Martyn Clark
Mike Ek
Mingfang Ting
Nancy Beller-Simms
Naomi Henderson
Nicholas Schiraldi
Ning Zeng
Paul Roundy
Pedro DiNezio
Pedro Restrepo
Rebecca Cumbie
Richard Seager
Robert S. Webb
Roger Pulwarty
Rong Fu
Rongqian Yang
Ryan Boyles
Scott Weaver
Shugong Wang
Siegfried Schubert
Sujay Kumar
Tony Barnston
Vikram Mehta
Will Chong
Xiwu Zhan
Yochanan Kushnir
Yongkang Xue
Youlong Xia
Yuko Okumura

MAPP
Modeling, Analysis, Predictions, and Projections

Drought Task Force







Emphasis on three research areas:

1) **Better Declaration and Characterization of Drought** – Research on tailored indices of moisture deficiencies with particular sectoral relevance and synthesis of multivariate character of moisture imbalances accompanying large-scale drought toward an integrative, objective declaration of the state of drought.

2) **Improved Prediction of Drought Onset and Retreat** – Research on the morphology of historical droughts and their relationship to atmospheric circulation patterns on sub-seasonal time scales to determine the antecedent conditions for sudden onset and retreats in droughts. Understanding of whether the atmospheric conditions associated with drought onset and retreat are well captured in dynamical model systems.

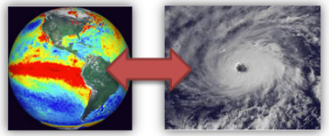
3) **Understanding Factors Driving Long-Lived Drought** – Research on the nature of long-lived drought including what drives its duration, severity, and spatial extent, focused on reasons for the failure of rainy seasons, and the role of ENSO and non-ENSO ocean states.

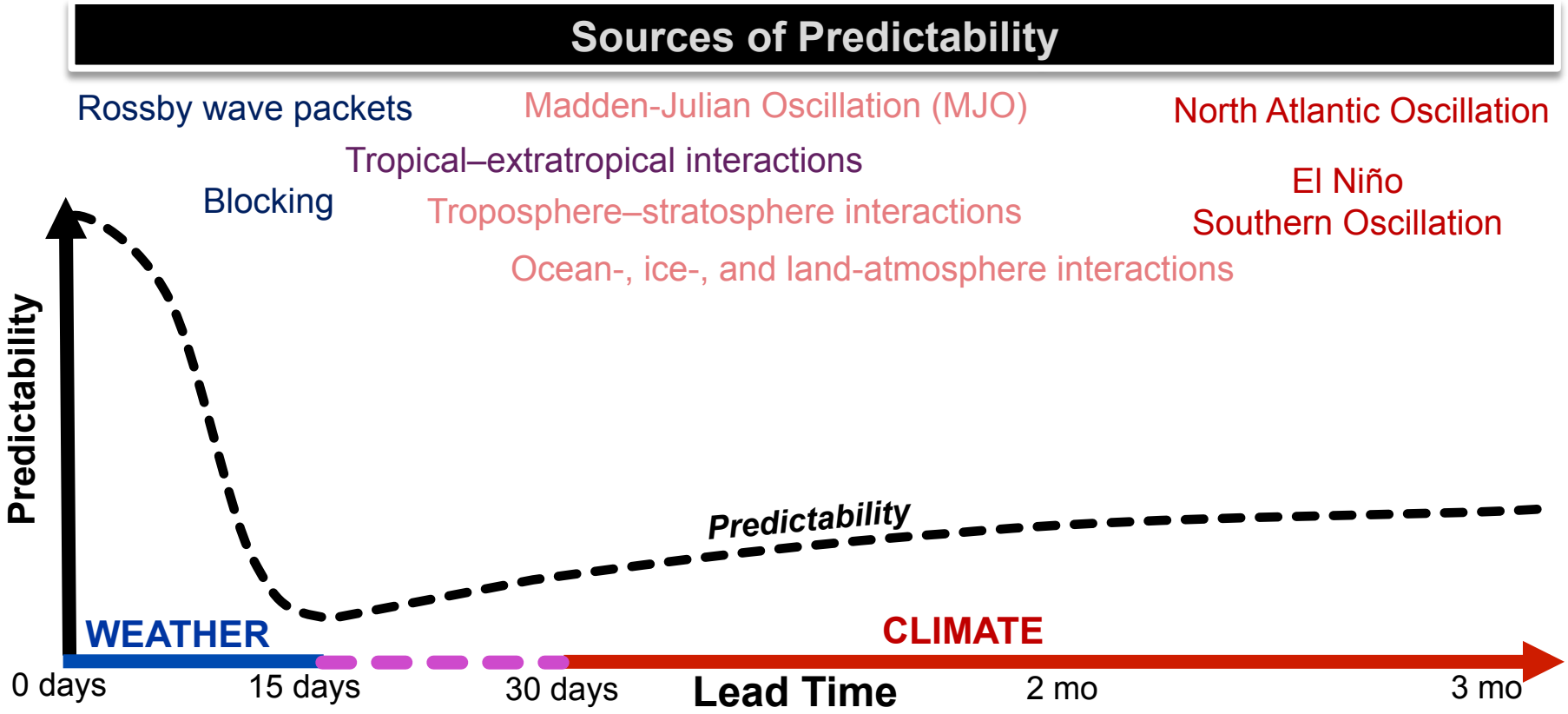
MAPP
Modeling, Analysis, Predictions, and Projections

Prediction Research

- Understanding the capabilities of existing **operational systems**
- **Improving the models** and their representation of relevant processes
- Moving toward **higher resolution**
- Developing techniques to best exploit information from **multiple models**, techniques, and systems
- Estimating and understanding **forecast uncertainty** -- very important for applying prediction products
- Exploiting **atmospheric patterns**, e.g. Rossby wave dynamics
- **Looking for signals** -- MJO, ENSO events (including multi-year), other SST signals (Indian ocean; different "flavors" of El Nino) etc.
- Building up a subseasonal to seasonal prediction/predictability foundation for **Atmospheric Rivers**
- **North American Multi Model Ensemble** and associated research
- Applying **methods from other fields** like applied mathematics/statistics toward the forecasting problem

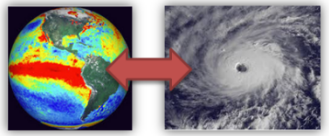
THE WEATHER–CLIMATE PREDICTION CHALLENGE





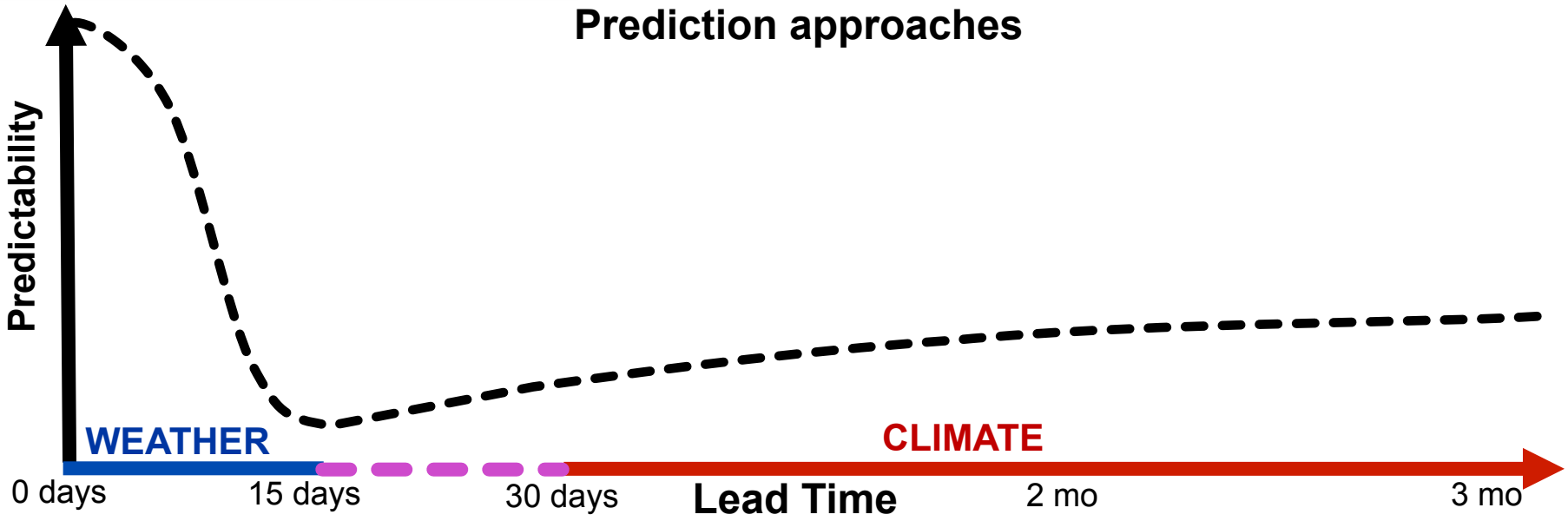
- No natural boundary exists between “weather” and “climate”
- Despite a theoretical 15-day limit of weather prediction, key climate features such as El Niño make extended-range prediction feasible

THE WEATHER–CLIMATE PREDICTION CHALLENGE



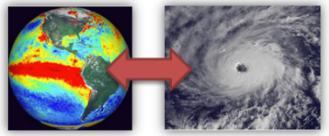
Weather:
Uncoupled models
→ deterministic & probabilistic prediction

Climate:
Statistical & coupled dynamical models
→ probabilistic prediction



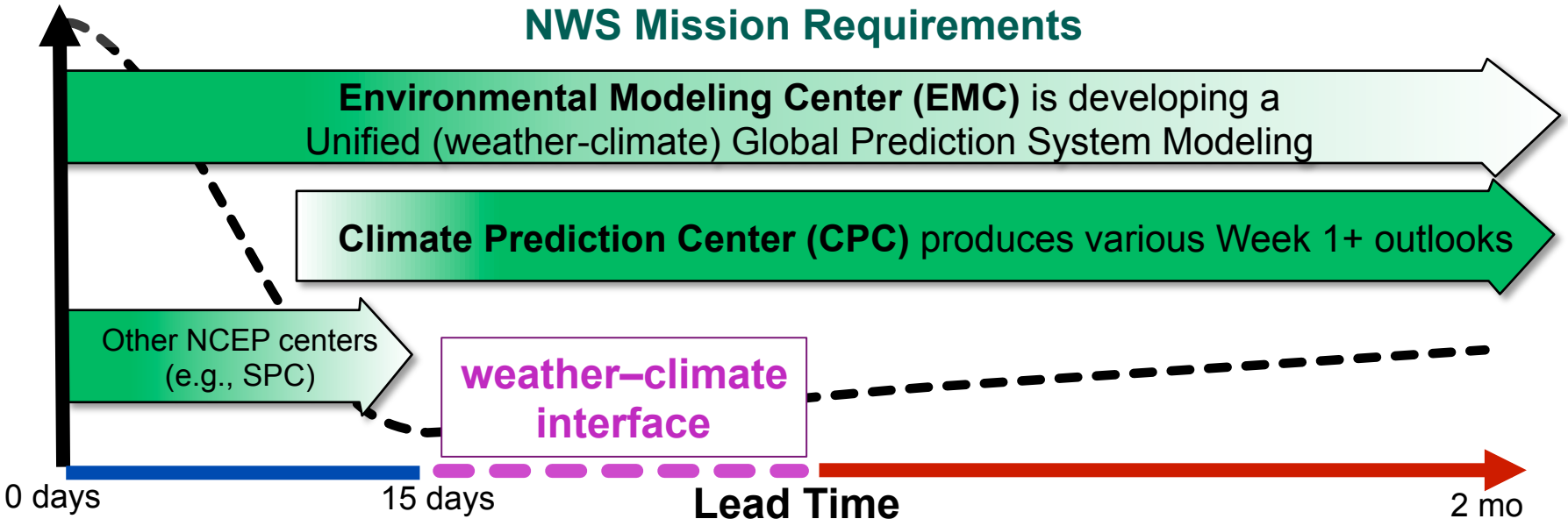
- The weather and climate communities traditionally have had both separate and overlapping approaches to modeling, infrastructure, and prediction
- The weather–climate interface (Weeks 3–4) represents a new frontier in prediction that will require the expertise of both communities

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)



- Some overlap between programs addressing the weather–climate continuum within OAR, and between OAR and NWS; we're working together
- EMC and CPC are two centers with particular mission requirements spanning the weather–climate continuum

Mission Driver

"Strengthen the integration, alignment, and effectiveness of research and development that supports NOAA's operational missions, including accelerating the transition of research advances to applications"

NOAA Annual Guidance Memorandum for Fiscal Year 2015

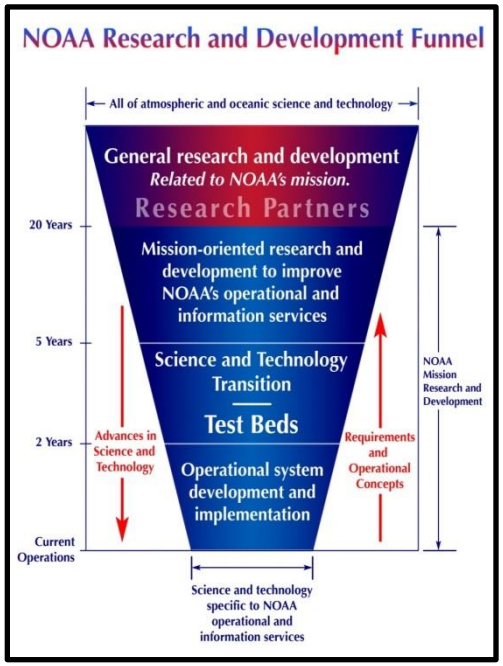
CTB Transition: A Mission-Driven Process

NCEP

Deploy

NCEP

Operate and Identify Gaps



Research

CPO*

Develop

CPO

Demonstrate

NOAA Climate Test Bed (CTB)

*CPO supported work in the external community and NOAA labs

Climate Test Bed Priorities

Goal: To improve intraseasonal to interannual predictions based on ensemble of models augmenting CFS predictions

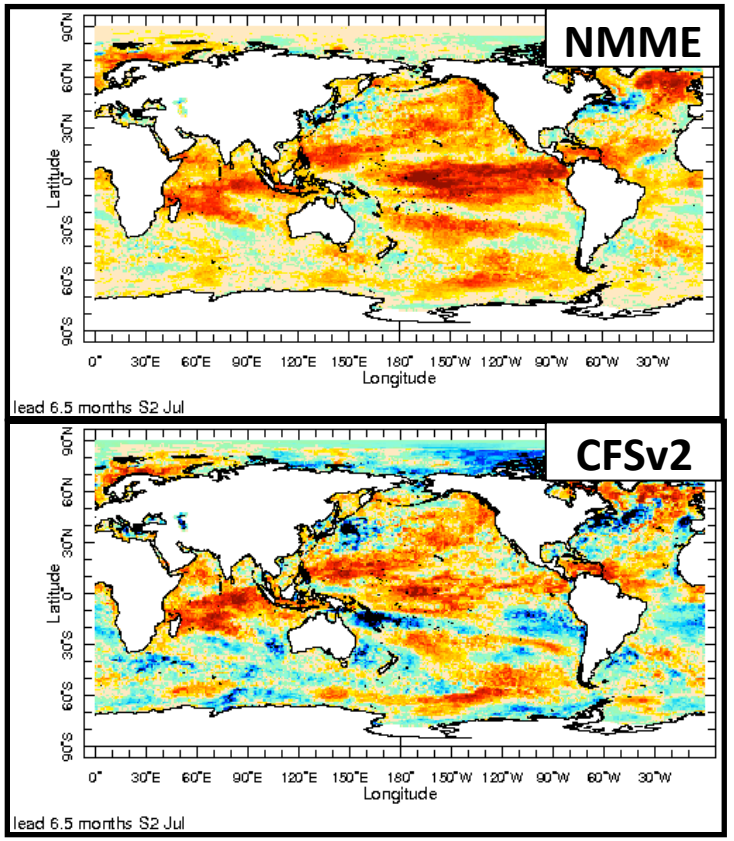
Project in transition during FY15:
Seasonal North American Multi-Model Ensemble

What was tested: A 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 Aug 2011

What was demonstrated: Improved forecast reliability and forecast skill

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



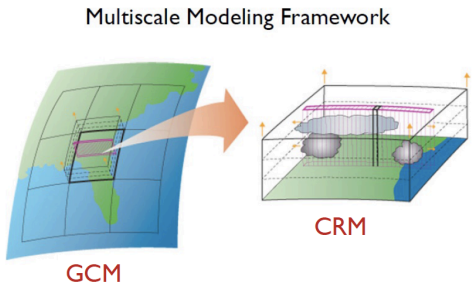
Ranked probability skill scores of 6.5-month sea surface temperature forecasts

Climate Test Bed Priorities

Goal: 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

5 ongoing modeling projects to test new parameterizations and schemes for use in CFS:

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



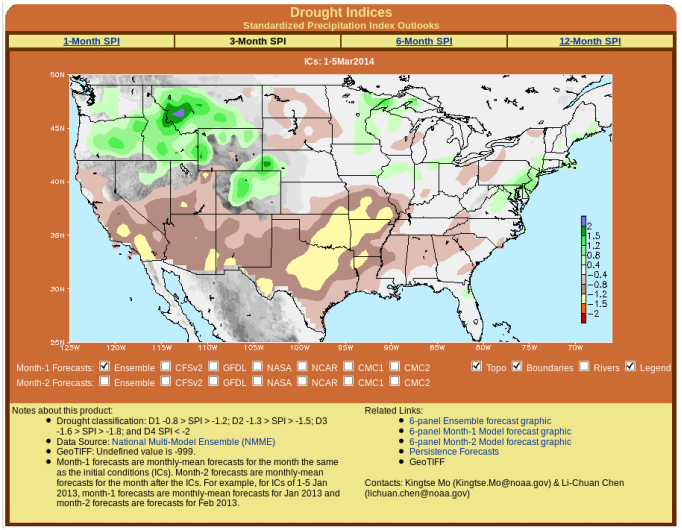
Images courtesy of S. Krueger

Climate Test Bed Priorities

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 Becker



North American Multi-Model-based Seasonal Drought Outlook

Atmospheric Rivers (ARs)

- Drought breaks in the western U.S. are often tied to ARs
- ARs are narrow corridors of enhanced winds and transport of water vapor associated with low pressure systems
- ~ 40-70% of the drought breaks in the west coast since 1950 are due to ARs
- Large & slow moving ARs can cause major flooding