



# Climate Program Office Research Transition Activities

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*Building a Weather-Ready Nation by Transitioning Academic  
Research to NOAA Operations Workshop*

*November 1-2, 2017*



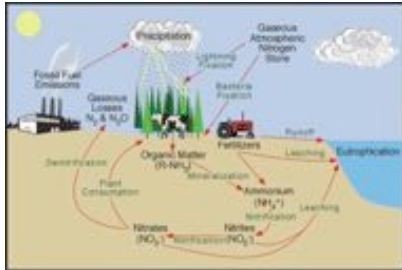
# Context

- **Climate Program Office (CPO)** -- competitive research program in the Office of Oceanic and Atmospheric research focusing on broad research mission from observations to models to societal impacts for climate (week 3 to century)
- CPO supports applied R&D to advance NOAA's research and operational mission
  - Funded projects range from fundamental applications to operational transitions
  - Focus is on enabling **external** community to work with NOAA labs and centers
- This presentation will discuss examples of R2O from various CPO programs and R2O processes used in the Climate Test Bed



# Atmospheric Chemistry, Carbon Cycle, and Climate (AC4) program

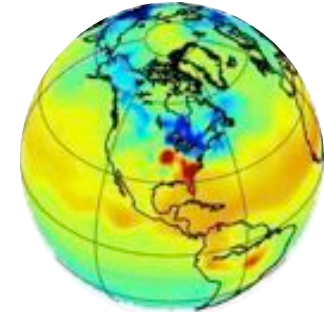
## Nitrogen Cycle



## Atmospheric composition from space



## CarbonTracker



## Urban Emissions



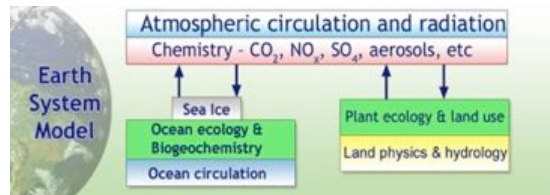
## Field Campaigns



## Emissions and Chemistry of Wildfires



## Process and Earth System Modeling



## Oil & Gas Emissions



## Sustained Observations





# Trace gas products development and validation

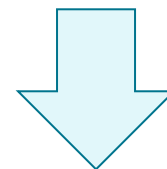
Data source: JPSS/CrIS instrument



## AC4 projects' contributions:

- develop prototype trace gas products → ammonia, ozone
- Identify validation opportunities → field campaign data, AirCore

R



## Available trace gases:

- CO<sub>2</sub>
- CH<sub>4</sub>
- Carbon monoxide
- Ammonia
- Ozone
- SO<sub>2</sub>
- ...

## NESDIS/STAR work:

- Develop operational products
- Validate operational products to meet operational requirements
- Demonstrate utility of the trace gas products (including for weather products)

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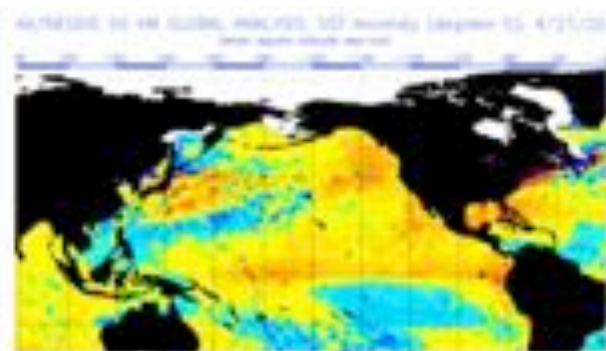
# Climate Variability and Predictability (CVP) Program

CVP Goal:  
To advance the knowledge of the dynamics, and sources of predictability, of the coupled ocean-atmosphere-land-ice system across all climate time scales by using observations, modeling, research, analysis, and field studies to gain a process-level understanding of how the system interacts.



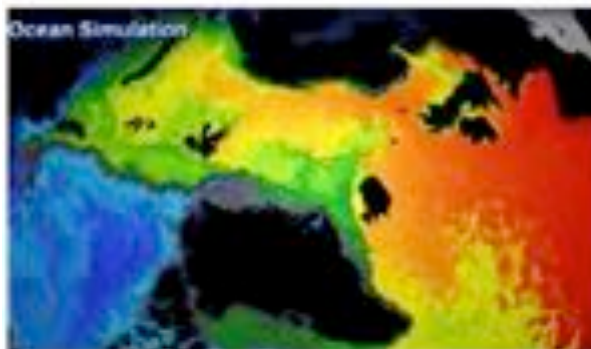
## Tropical Intraseasonal Variability

Understanding the Madden-Julian Oscillation (30-90 day cycles) increases intraseasonal projection skill.



## Pacific Processes, Biases & Climatology

Improving understanding and representation of Pacific climate (ENSO, MJO, etc...) in models.



## Decadal Variability and Predictability

Projecting climate on longer (decadal) timescales is improved by better understanding Ocean circulation.



## Arctic Climatic Mechanisms

Arctic changes are not well understood, and predicting sea ice is important for safety & industry.



# CVP - Mechanisms, Predictability and Predictions of Arctic Sea Ice

New research area for CVP (FY15-17)



Goal: Advance the understanding of Pan- Arctic sea ice interactions in these research areas:

- Climatic mechanisms that affect Arctic temperatures and growth and/or loss of sea ice.
- Mechanisms, predictability and prediction of regional sea ice variation and change.
- Systematic predictability of the fully coupled system, its driving factors, its state dependence as external forcings change, *and whether such predictability can be achieved in operational--like predictions.*

CVP funded 11 projects (3 with NWS/CPC or EMC co-PIs). Projects conduct analysis and experimentation in a varied set of models including GFDL, NCAR, NCEP's model CFSv2.

## **R2O Accomplishment - Improving Seasonal Arctic Sea Ice Predictions at NOAA's CPC**

With funding from CVP, NCEP's CPC has identified the cause of significant errors in their Arctic sea ice predictions and developed an Experimental Sea Ice Forecast System. The System is now a routine contribution to the Alaska Region's Sea Ice Outlook.



# Modeling, Analysis, Predictions, and Projections (MAPP) program Research Areas

Prediction -- Weeks to Decades

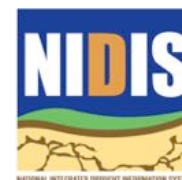
Climate Analysis, Reanalysis, and Data Assimilation

Climate and Earth System Modeling

Drought and Other Applications

Climate Projections

+ Infrastructure



R2O work

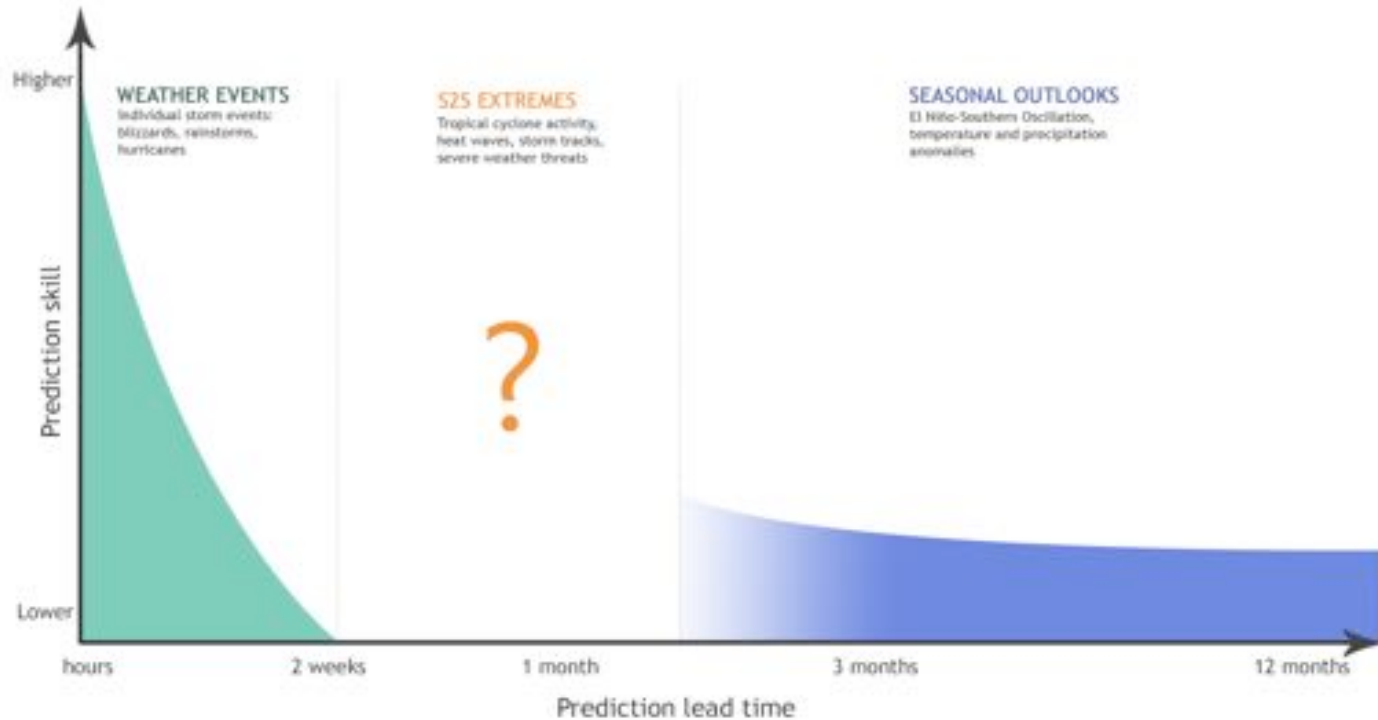
- MAPP supports five core research areas primarily through two- to three-year competitive grants





# Subseasonal to Seasonal (S2S) Prediction

The S2S Prediction Gap



Adapted from: [i1.columbia.edu/news/qa-subseasonal-prediction-project](http://i1.columbia.edu/news/qa-subseasonal-prediction-project)

- No natural boundary between “weather” and “climate”; key climate features such as El Niño make extended-range prediction feasible
- The weather–climate interface represents a new frontier in prediction that will require the expertise of both weather and climate communities

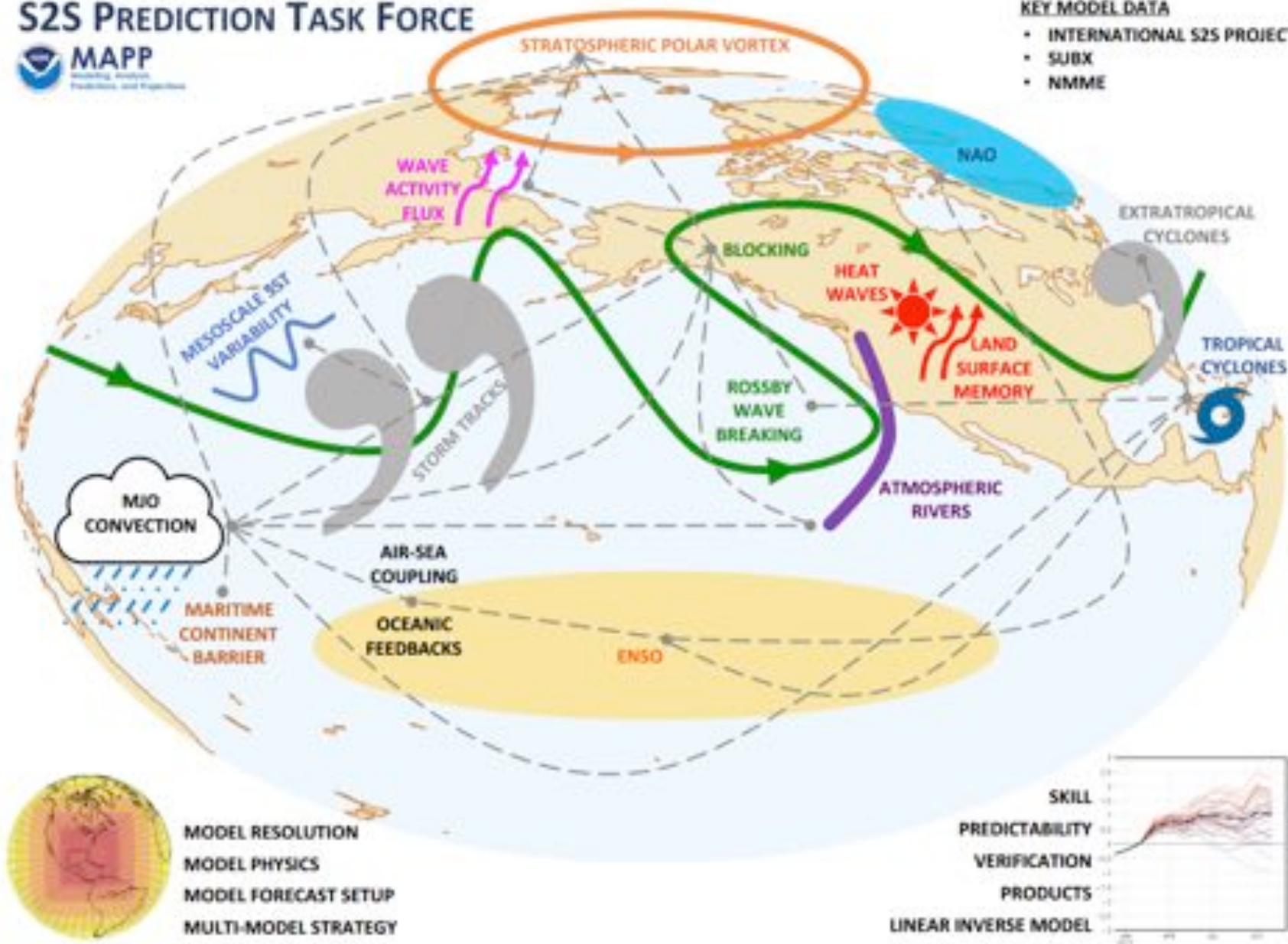


# S2S PREDICTION TASK FORCE



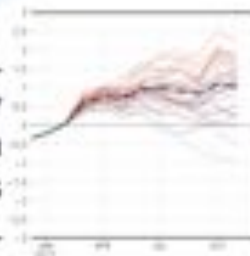
## KEY MODEL DATA

- INTERNATIONAL S2S PROJECT
- SUBX
- NMME



- MODEL RESOLUTION
- MODEL PHYSICS
- MODEL FORECAST SETUP
- MULTI-MODEL STRATEGY

- SKILL
- PREDICTABILITY
- VERIFICATION
- PRODUCTS
- LINEAR INVERSE MODEL



# Testing prediction tools via the Climate Test Bed

- 14 current MAPP-CTB projects that include projects to test experimental subseasonal prediction systems (including SubX; Subseasonal Prediction Experiment)

## Funding partners:

- NOAA NWS – Office of Science & Technology Integration
- NOAA National Environmental Satellite, Data, and Information Service
- DOD Office of Naval Research
- NASA





# Climate Test Bed

- The Climate Test Bed (CTB) is a joint **partnership** between NWS/NCEP and the Climate Program Office's Modeling, Analysis, Predictions, and Projections (MAPP) program.
- The partnership focuses on **transitioning** research-derived modeling and forecasting capabilities and products into operations.
- Through targeted competitive funding, MAPP **entrains the external community** to augment internal capabilities, and link internal organizations.
- A number of **major new capabilities** have resulted from the CTB activity: the North American Multi-Model Ensemble, many new drought capabilities, new forecast products including subseasonal outlooks, advances in operational tropical cyclone forecasting, etc.
  - NMME success based on: clear operational requirements, cooperation agreement, research and operational value, clear research and operational protocol, availability of output, responsiveness to research needs





# Defining Processes and Roles



## Demonstration Phase



## Operational Deployment Phase

### 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
- TRANSITION PLAN

### 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)
- TRANSITION PLAN



END TO END PLANNING





# FY16-FY18 RFP Transition Planning Process

## Letter of Intent (LOI) stage:

- NCEP co-investigator discusses project with NCEP center management
- LOIs indicate product, technique, technology, method to be tested
- LOIs reviewed by MAPP program management

## Proposal stage:

- NCEP co-investigator required
- Transition plan required
  - Must demonstrate pathway to operations
  - How project will progress through research readiness levels
  - Signed by NWS and OAR AA or designees

## Post stage one panel:

- Participation of NCEP management on stage 2 panel





# Ongoing CTB Activities

## Recently-completed or legacy ongoing projects (FY14 or earlier):

- Two projects focused on cloud physics
- Integration of a lake module into the op. land model
- Improvements to the land model
- Improvements to aerosol treatment
- Week 3-4 forecasts
- Extended range severe Wx tools
- NMME post-processing and probabilistic products

*High weather to climate relevance of all projects - several projects co-funded by the NCGPS project*







# Ongoing CTB Activities

## **FY16 project examples:**

- Soil moisture and snow in Land DA
- Ensemble-based sea ice analysis and forecasting
- Wave-Ocean DA
- Flash drought monitoring
- NMME products for water management
- Statistical/dynamical prediction harnessing teleconnections
- Upgrading to Hybrid GODAS
- Fire products
- Excessive heat outlook
- Subseasonal experiment (SubX)

*High weather to climate relevance of all projects - several projects co-funded by the NCGPS project*

## **FY18 call for proposals**

- LOIs were due June 2017, proposals were due September 2018, reviewing now
- Priorities: methodologies and systems, improving NMME, focus on extremes (e.g., heat waves, extreme precipitation)
- In partnership with NWS/OSTI/NCGPS program





# Climate Test Bed Review

The Climate Test Bed was reviewed by a subcommittee of NCEP's UCAR Community Advisory Committee for NCEP (UCACN)

Select takeaways:

- The review was generally very positive and acknowledged the significant deliberate efforts NCEP and CPO have made to improve the CTB over the past few years. The CTB was cited elsewhere in the report as an example for effective TB management and execution.
- HPC issues (access, availability, prioritization) and the lack of an NCEP modeling plan have presented challenges for bringing in the community via the Test Bed.



# A public R2A page: cpo.noaa.gov/MAPP/R2A

DEPARTMENT OF COMMERCE NOAA WEATHER OCEANS FISHERIES CHARTING SATELLITES CLIMATE RESEARCH COASTS CAREERS

**CLIMATE PROGRAM OFFICE**  
Advancing scientific understanding of climate, improving society's ability to plan and respond

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Climate Programs Modeling Analysis Predictions and Projections R2A Search

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

**MAPP**  
Modeling, Analysis, Predictions, and Projections

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...](#)

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Upcoming Events







# CPO and the Weather Act

- Has supported S2S and especially seasonal R&D for over a decade
- Current CPO R&D activities constitute significant contribution to WCRP/WWRP S2S Project
- ~50% of CPO's discretionary research budget estimated to be relevant to the Weather Act
- CPO has proven track record harnessing a rigorous competitive proposal process
- CPO works extensively with operational centers, labs, and external community



# Summary

- CPO supports research across readiness levels
  - Uses rigorous competitive process
  - Many ongoing CPO activities are relevant to the Weather Act
- Climate Test Bed (CTB) provides mechanism for transition-ready research
  - CTB has long history of successful projects
  - Using rigorous transition planning process since 2014





# Extra Slides





# Measure of Progress and Success:

## *Project level metrics*

**Metrics and Protocols for Evaluating NCEP Climate Models and Forecasts** (July 26, 2013; shown in CTB website; Referred by MAPP-CTB call for proposals)

1. Climate Model performance metrics
  - mean and biases
  - modes of variabilities (ENSO, MJO, ENSO); Teleconnections
  - Forecast Skills of SSTs, ENSO, Temp, precipitation
2. Climate forecast evaluation metrics
  - Deterministic/continuous forecasts: AC, RMSE, mean error, biases
  - Categorical: e.g., Heidke score
  - Probabilistic: BSS, RPSS, reliability
3. Climate Forecast and Hindcast Evaluation Protocol
  - Hindcast period: 30 year for seasonal; 15 years for sub-seasonal
  - Forecast lead time

## MAPP Program Task Forces and webinars engaging NCEP scientists together with external community

### S2S Prediction Task Force

Model and predict sources of S2S predictability

Climate Model Diagnostics Task Force  
Diagnosing model biases

MAPP Webinars  
Facilitating Communication

Drought Task Force  
Advancing drought understanding, monitoring and prediction

Climate Model Development Task Force