Climate Prediction Center
Research Interests/Needs

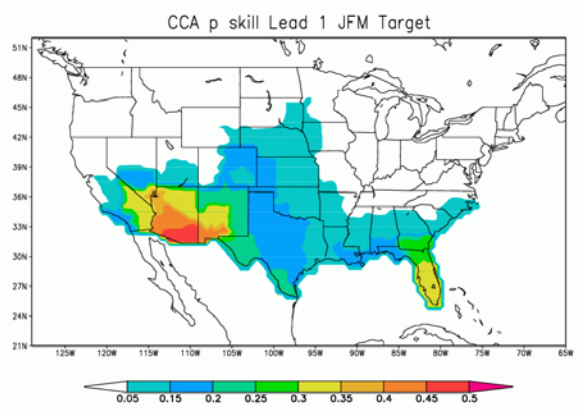
Outline

- Operational Prediction Branch research needs
- Operational Monitoring Branch research needs
- New experimental products at CPC
- Background on CPC
- Thanks to CICS/ESSIC/UMD for Inviting us to participate!

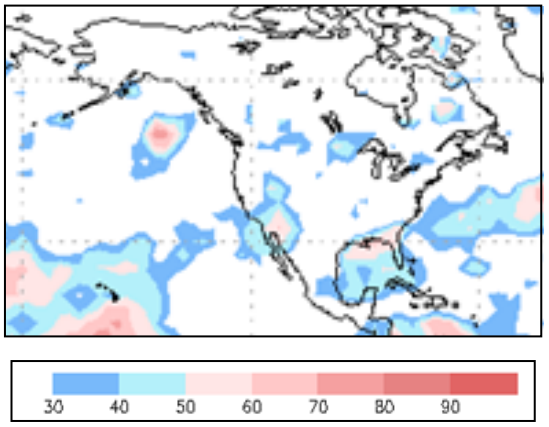
Operational Prediction Branch Research Interests and Needs

(1) Subseasonal and seasonal precipitation prediction

- Evaluation of the latest generation of model's prediction skill
- Downscaling: Statistical methodologies to relate broad scale model circulation or SST fields to determine regional precipitation forecasts
- Develop next generation of statistical or empirical methods for seasonal precipitation prediction



Canonical Correlation Analysis
Jan-Feb-Mar, Lead 1, AC

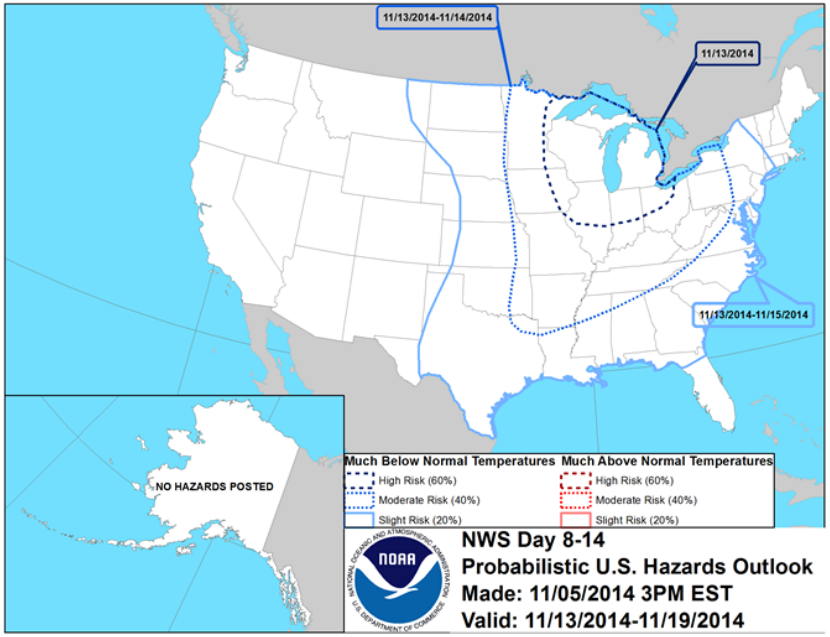


Constructed Analogue
Jan-Feb-Mar, Lead 1, AC x 100

Operational Prediction Branch Research Interests and Needs

(2) Extremes

- Assess and determine scientific basis for predictions of extremes at varying time scales (predictability, operational feasibility, etc.)
- Subseasonal (Week 2-4) and seasonal (i.e., activity compared to average within the season, etc.)
- Excessive heat/cold, heavy precipitation, high winds, severe weather, drought



Example Week-2 probabilistic U.S. Hazards graphic displaying much below normal temperature

November 2014

Operational Prediction Branch Research Interests and Needs

(3) Social Science

- Evaluate current methods of display of CPC climate information, assess and develop improved ways of displaying and conveying CPC products

(4) Subseasonal and seasonal prediction of Arctic Oscillation

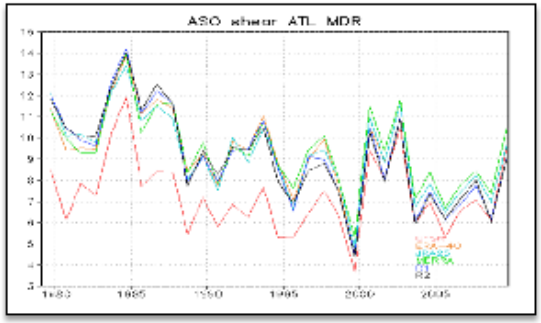
- Evaluation of the latest generation of model's prediction skill
- Downscaling: Statistical methodologies to relate forecasts of AO indices to regional temperature and precipitation forecasts

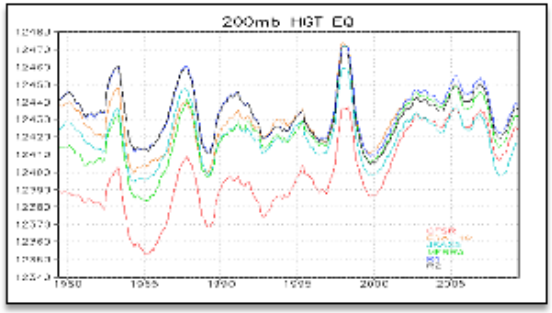
Operational Monitoring Branch Research Needs/Interests

- Low-frequency variability in ENSO and its prediction skill (e.g., recent changes in the characteristics of ENSO variability)
- Understanding atmospheric response to various flavors of ENSO
- Sources of atmospheric and oceanic predictability, and predictability limits on sub-seasonal and seasonal time scale (including weeks 3 & 4)
- A NOAA climate reanalysis capability
- Improving seasonal precipitation outlooks
- Quantifying economic values of climate outlooks

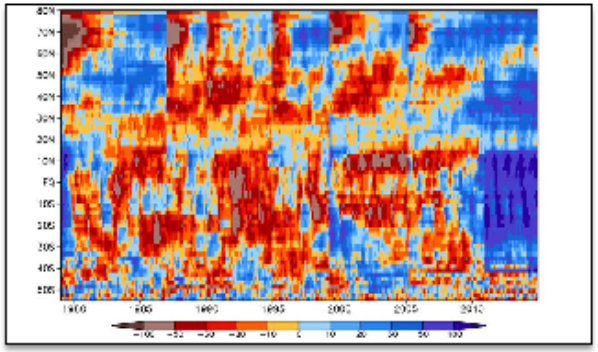
Need for new Climate Monitoring Re-Analysis to Replace R1
CFSR is not Suitable for This

Climate Forecast System Reanalysis (CFSR)

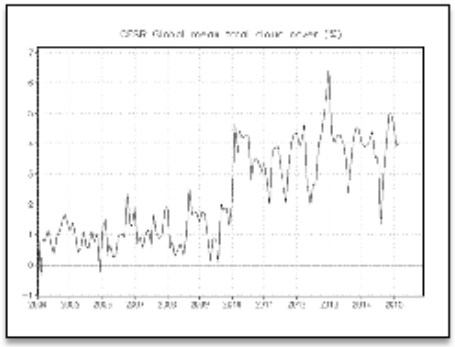




Analysis during earlier period is an outlier



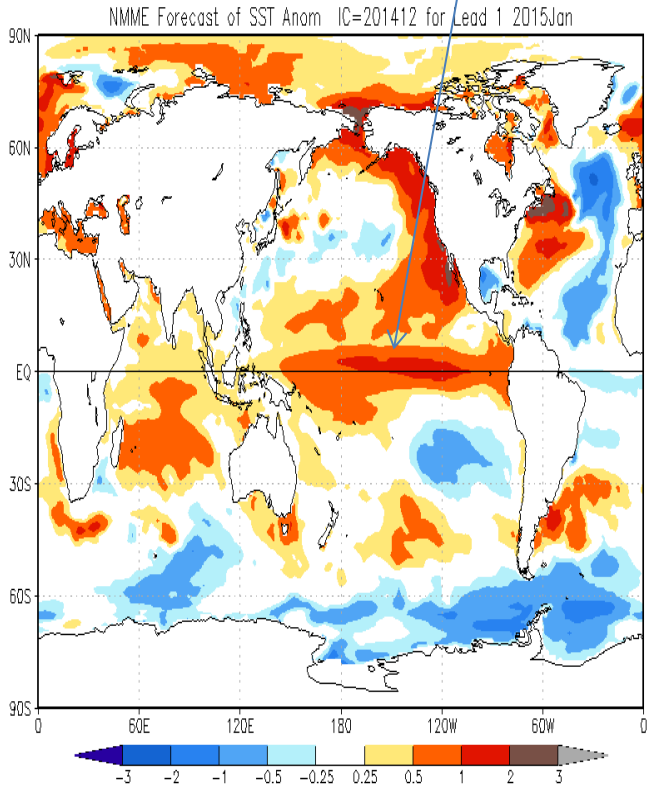
Multiple Streams – Zonal Avg. SM

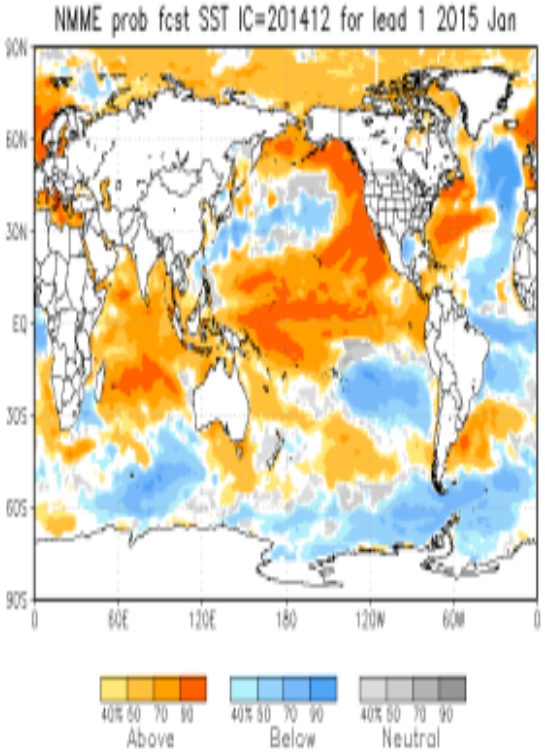


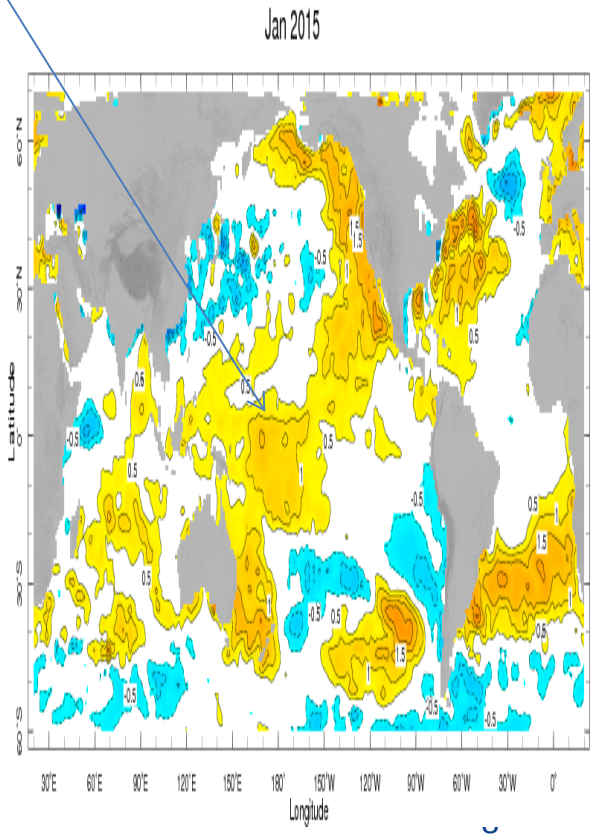
Change in Resolution – NH SM

Lead 1 NMME SST Forecast for January 2015

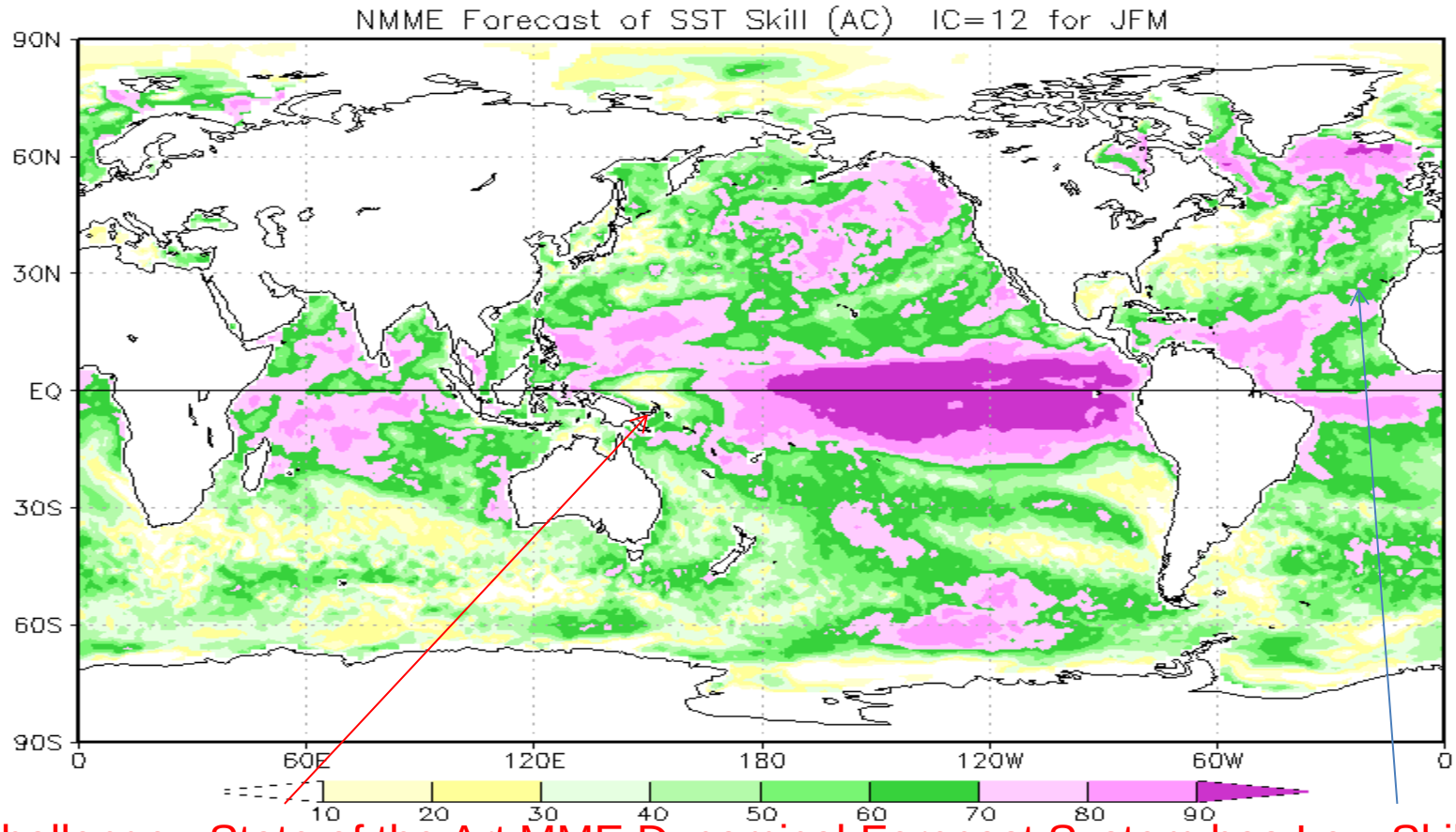
Challenge: State of the art dynamical MME systems still have trouble forecasting ENSO even at short lead time.





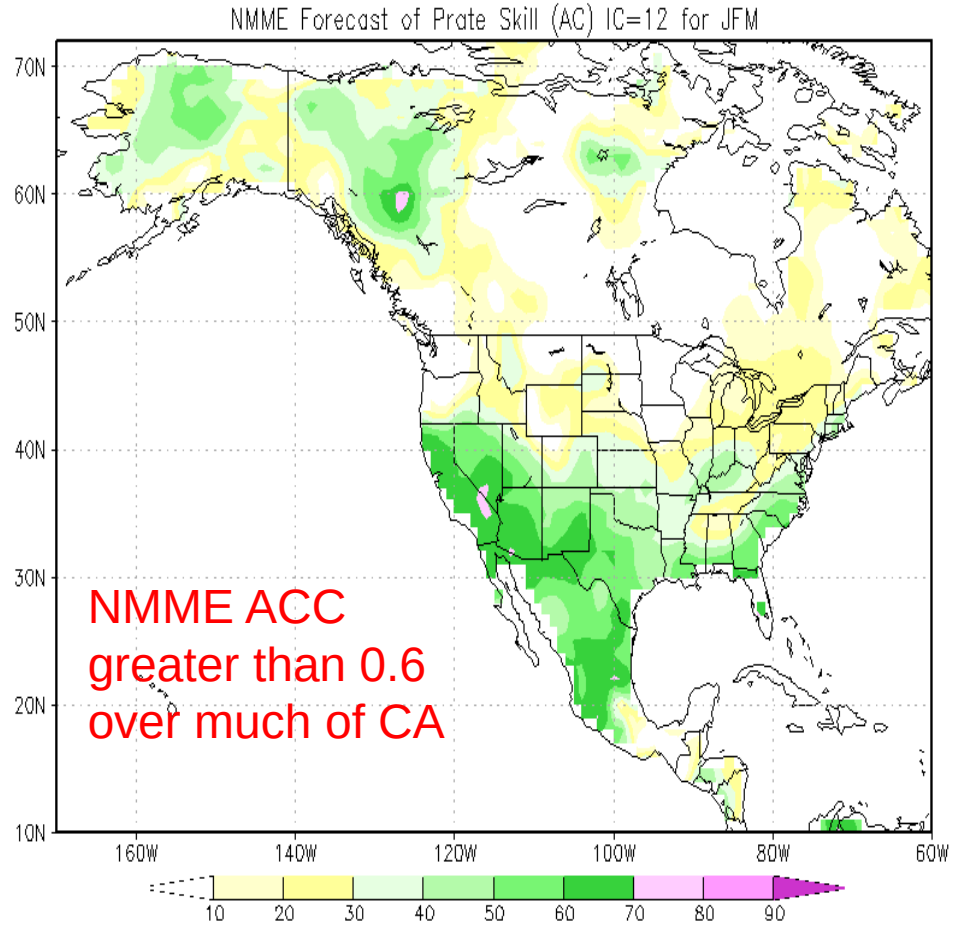


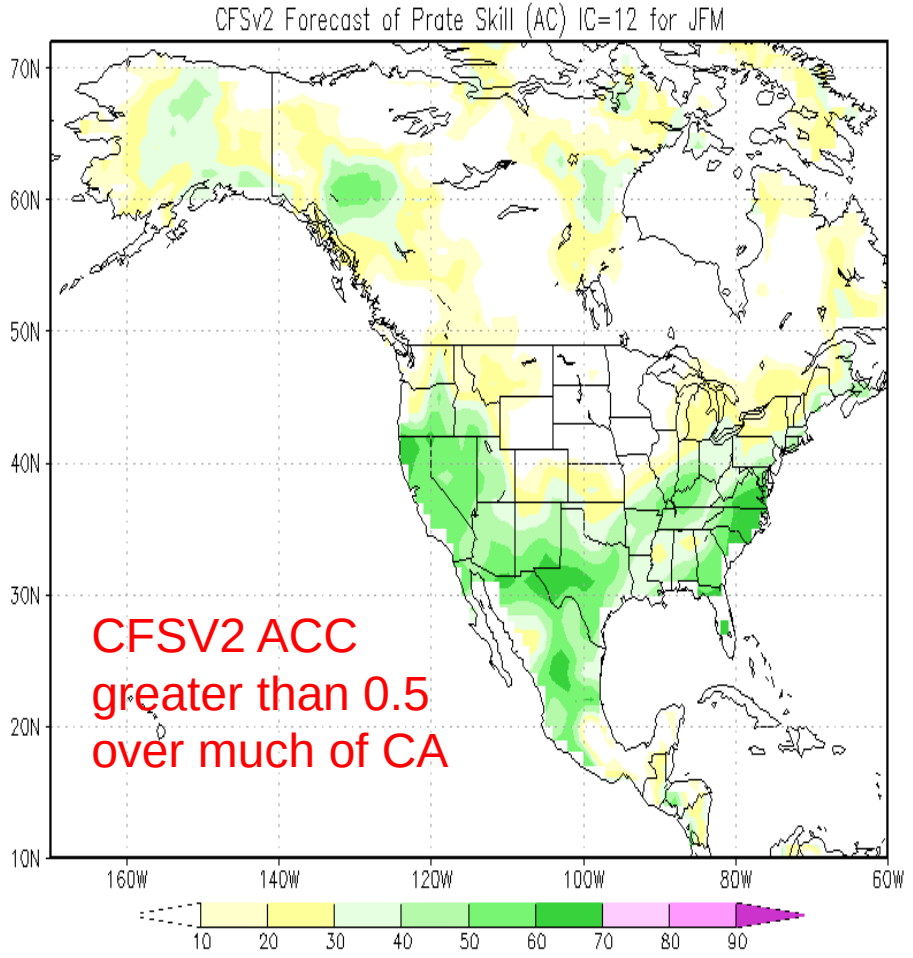
ACC (1982-2010) of Lead 1 NMME SST Forecast for JFM from NMME



Challenge : State of the Art MME Dynamical Forecast System has Low Skill in Predicting Near-Equatorial Western* Pacific SST. If SST in this region drove the large-scale pattern past two years there is an issue. Also plenty of room for improvement in forecast skill everywhere outside tropical central and eastern Pacific.

ACC (1982-2010) of Lead 1 Precipitation Forecast for JFM from NMME and CFS





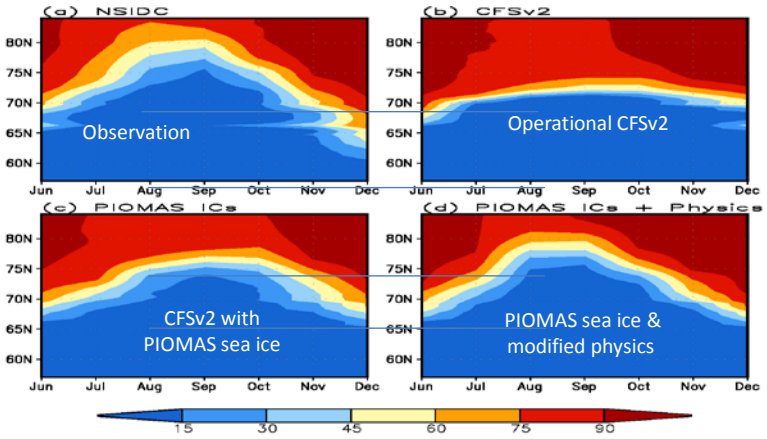
Challenge: State of the Art Dynamical Prediction System Can Explain at most on Order of 30% of Precipitation Variability in JFM at 1 Month Lead

New Experimental Products Being Developed at CPC

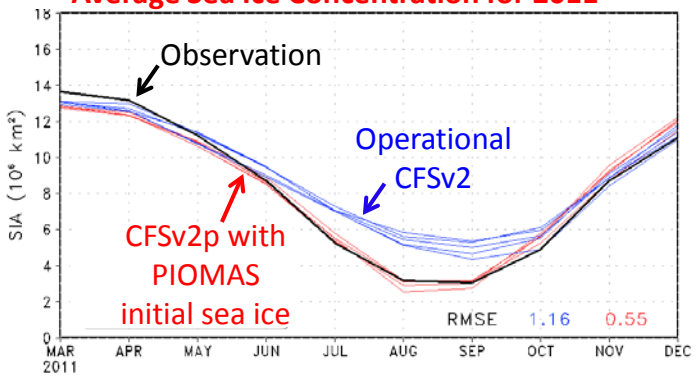
- Experimental Arctic Sea Ice Melt and Freeze Outlooks
- Experimental Combined Week 3 and 4 Temperature and Precipitation Outlooks

Grand Challenge Development of Experimental Arctic Sea Ice Melt/Freeze Forecasts

Average Sea Ice Concentration from 2009-2013



Average Sea Ice Concentration for 2011



Improved Sea-Ice Forecasts Using CFSV2 due to:

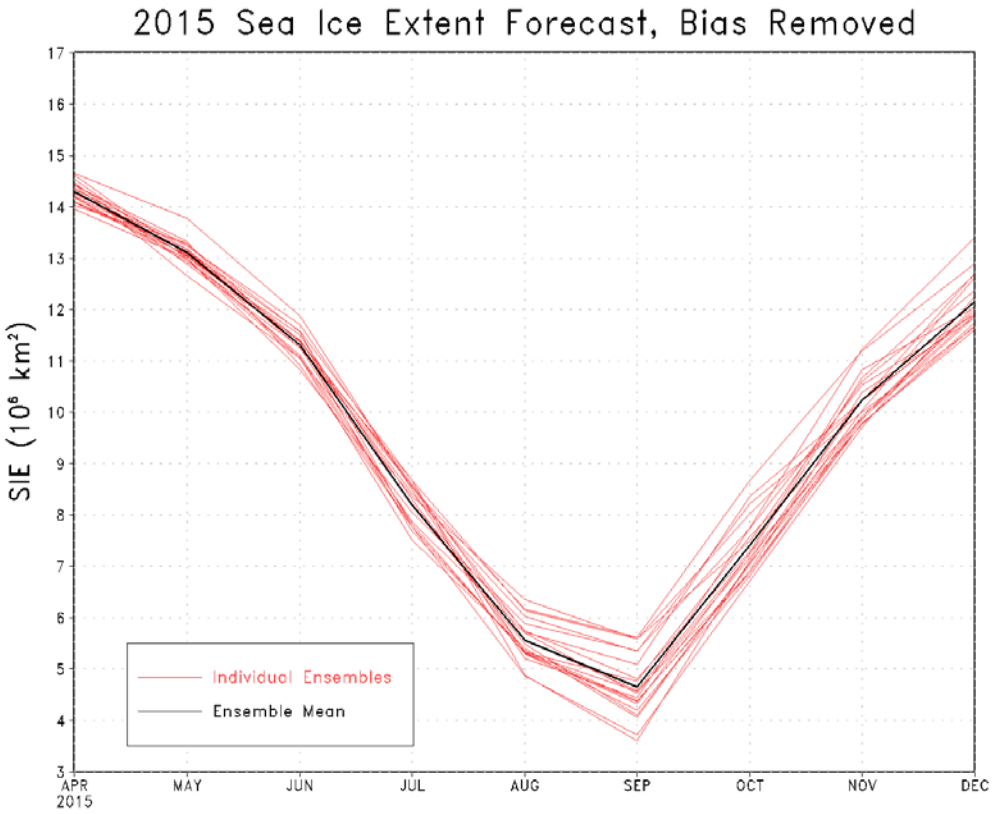
1. **Improved Ice Initial Condition**
2. **Modified Atmospheric Physics**
3. **Removal of bottom heat-flux constraint**

Sea ice extent (SIE) forecast

- Use experimental model output with PIOMAS initial sea ice thickness conditions (20 initializations March 8-12, 2015).
- Correct biases using 2009-2013 mean error with respect to NASA observations

September SIE Values (*10^6 km^2)

Source	SIE Value
NSIDC 2009-2013 Climatology	4.80
CFSv2 2015	4.65



Toward Week 3-4 Experimental Outlooks

- A major goal in the CPC 5-year strategic plan is to develop official Week 3-4 operational outlooks. An initiative to work in this direction was started in late FY14.

- Many challenges to overcome over the next few years to meet this objective

  ➔ Assessing and documenting the scientific basis for this type of outlook?
  ➔ If so, would they be reliable?
  ➔ What would be the frequency and format of this type of product?

- CPC wide team has determined an initial inventory of information to be targeted in a Phase 1 project during FY15 with outlined requirements, deliverables, project plan and timeline.

- The initial experimental product is to be a combined Week 3-4 probabilistic temperature and precipitation outlook released once per week, similar in style to current CPC monthly outlook.

Grand Challenge
Development of Experimental Week 3-4 Outlooks

Experimental Week 3-4 Temperature / Precipitation Outlooks

- The initial experimental product is to be a combined Week 3-4 probabilistic temperature and precipitation outloo
- Released once per week. Format still being decided.

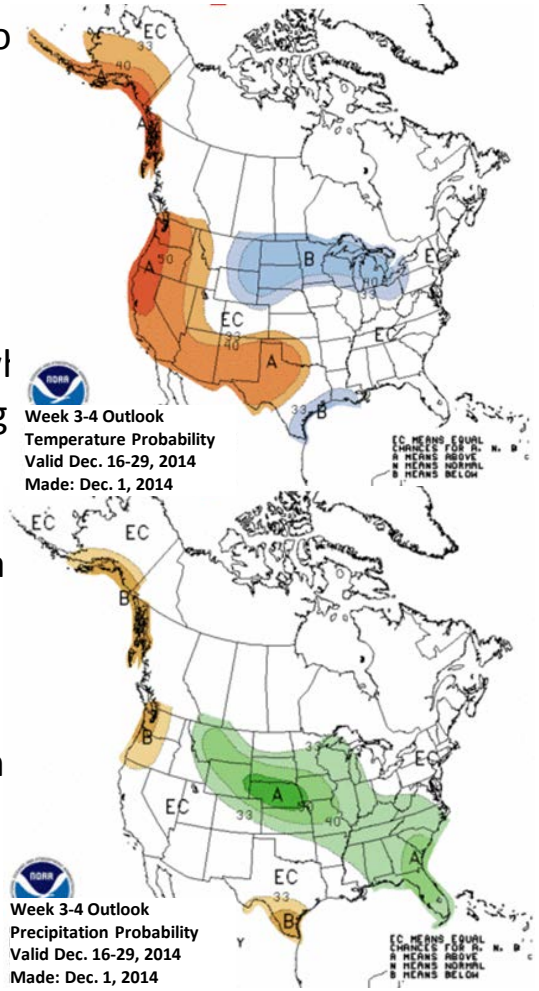
FY15 plan focus in three main areas:

(1) Enhancement or development of select empirical techniques (constructed analogue, regression, etc.) wh methodologies target MJO/ENSO, trends and blocking as predictors.

(2) Analysis of dynamical model guidance from severa operational centers including NCEP, ECMWF, JMA and Environment Canada

(3) Operational implementation at CPC of Coupled Lin Inverse Modeling (C-LIM) techniques from ESRL (complement to models for tropical rainfall forcing)

Possible Format of Product

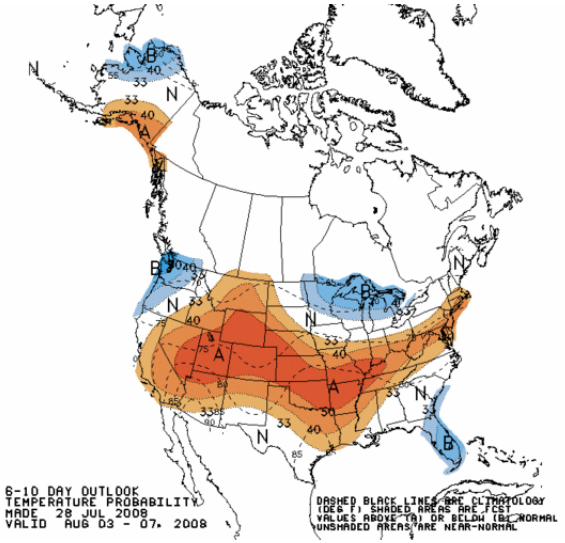


CPC Mission

Deliver real-time products and information that predict and describe climate variations on timescales from weeks to year(s) thereby promoting effective management of climate risk and a climate-resilient society.

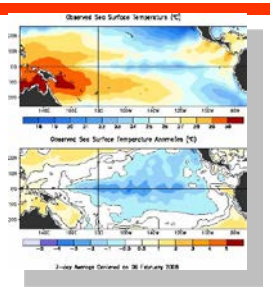
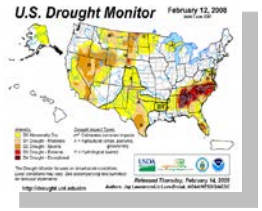
- **Focus: weeks, months, seasons, years (i.e. short term climate)**
- **Integral to NWS Seamless Suite of Products**
- **Valuable resource for NOAA's efforts to deliver climate services**

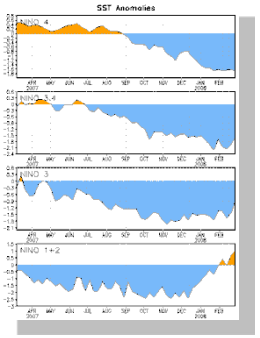
Temperature Outlook

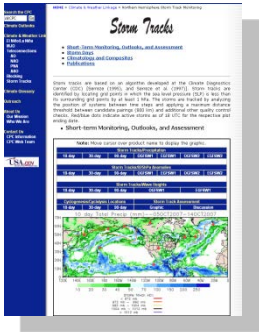


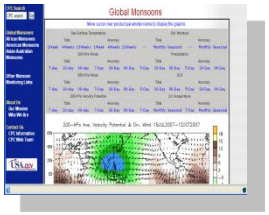
Climate Monitoring Products

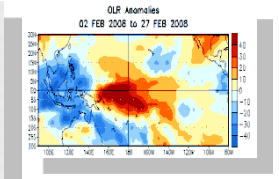
- **Daily and monthly data, time series, and maps for various climate parameters and compilation of data on historical and current atmospheric and oceanic conditions**
  - **Primary modes of climate variability (ENSO, MJO, NAO, PNA, AO,...)**
  - **Atmospheric Circulation (global troposphere and stratosphere)**
  - **Storm Tracks and Blocking**
  - **Monsoons**
  - **Oceanic Conditions (global and coastal)**
  - **Precipitation and Surface Temperature (global and US)**
  - **Drought (US, North America; NIDIS)**
  - **Climate Reanalysis**



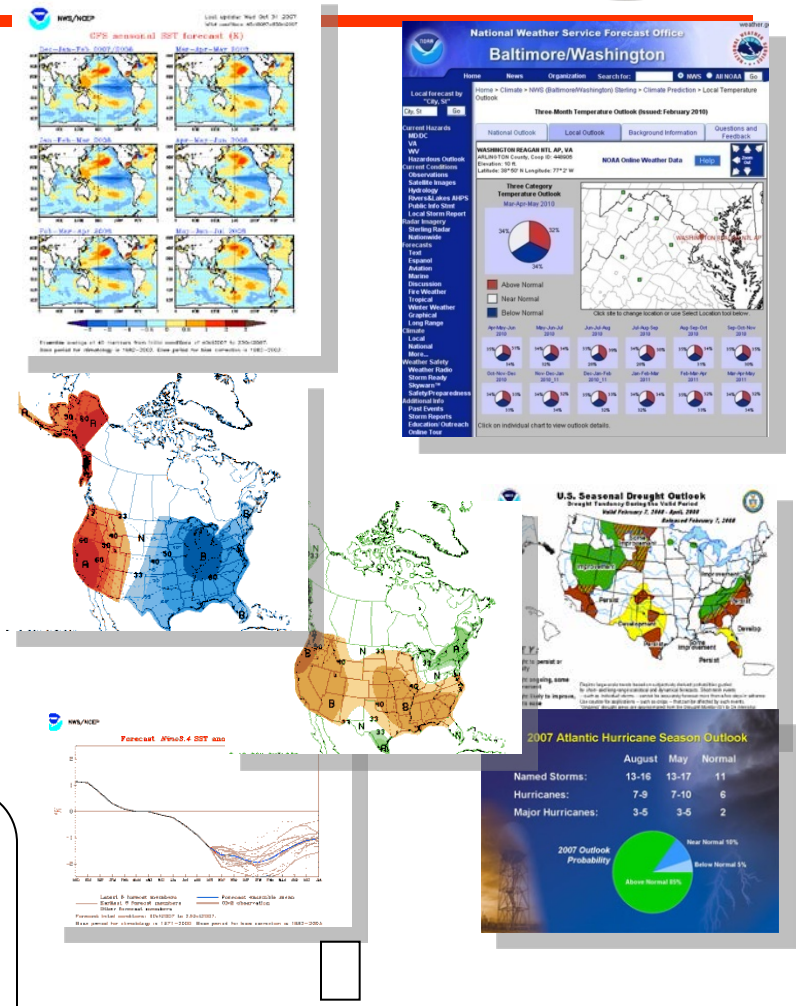






Climate Prediction Products

- **Focus on week-2 to seasonal-to-interannual**
  - 6-10 Day & 8-14 Day Precipitation & Temperature Outlooks
  - Day 3-14 Hazards Outlooks (US, Global Tropics)
  - Monthly & Seasonal Precipitation & Temperature Outlooks
  - Monthly and Seasonal Drought Outlook
  - Seasonal Hurricane Outlooks (Atlantic and Eastern Pacific)
  - Monthly ENSO Prediction

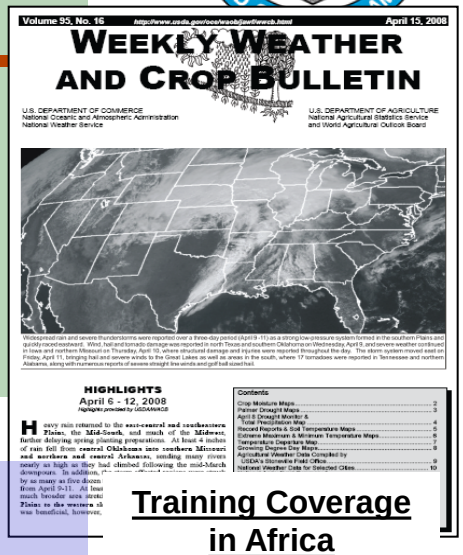


Human Forecasters Use Various Tools To Develop Prediction Products

- Dynamical Models
- Statistical Models
- Historical Analogs
- Historical Composites

Selected Other Climate Services at CPC

- **Joint Agriculture Weather Facility**
  - *USDA – DOC partnership*
  - *Weekly Weather and Crop Bulletin*
  - *Briefings & Weather Summaries on global weather and crop conditions*


Volume 93, No. 16 April 15, 2008

WEEKLY WEATHER AND CROP BULLETIN

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Weather Service

U.S. DEPARTMENT OF AGRICULTURE
National Agricultural Statistics Service
and World Agricultural Outlook Board

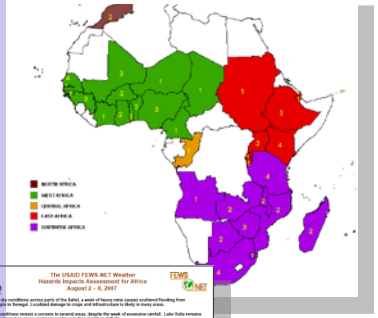
HIGHLIGHTS
April 6 - 12, 2008

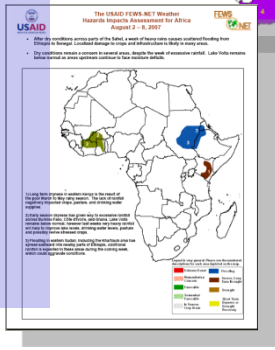
Contents

- **CPC International Desks**
  - *African Desk*
  - *Monsoon Forecaster Training Desk*
  - *Activities*
    - Training and Education
    - Partnerships
    - Products

      Famine Early Warning System
      Hazards Assessments (Africa, global tropics)
      Tropical Cyclone Monitoring

Training Coverage in Africa




The USAID FEWS.NET Weather Hazards Impacts Assessment for Africa
August 2 - 8, 2007