

# Sub-Seasonal Predictions at NCEP/CPC

Arun Kumar

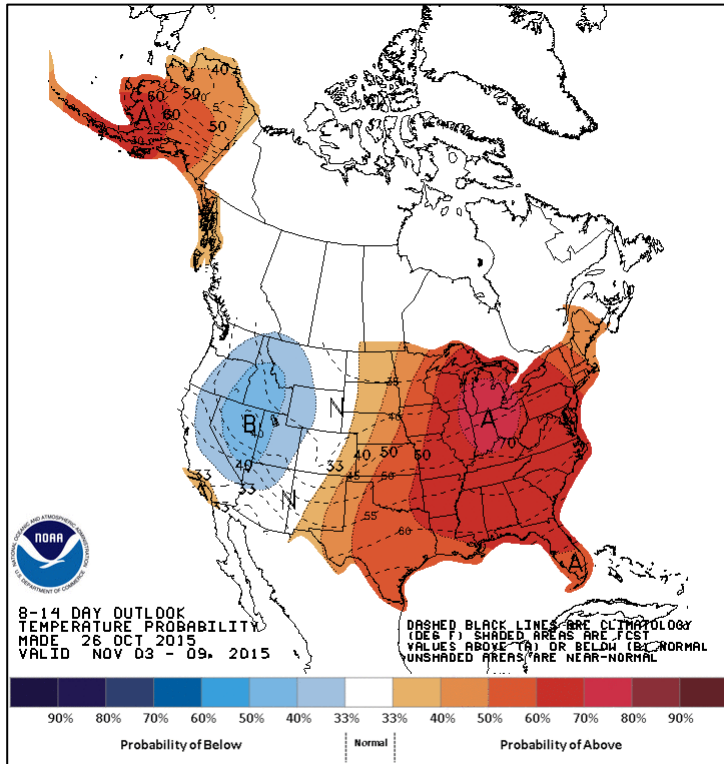
Climate Prediction Center

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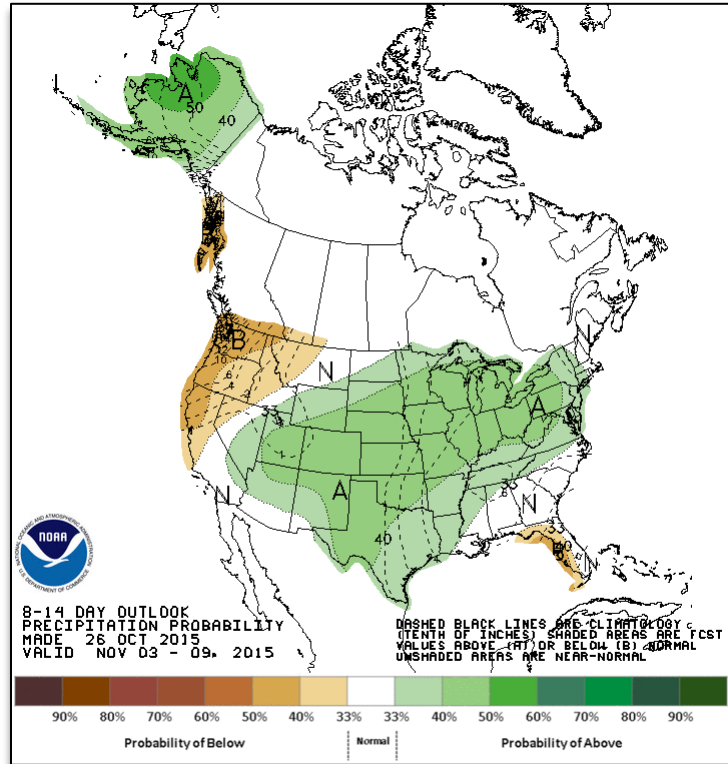
- Climate Prediction Center (CPC) “...delivers real-time products and information that predict and describe climate variations on timescales from weeks to years thereby promoting effective management of climate risk and a climate-resilient society”
- Operational responsibilities
  - Real time climate monitoring
  - Extended-range climate outlooks

- Operational climate outlook products for surface temperature and precipitation
  - Week1 (6-10 day average) : Daily
  - Week 2 (8-14 day average) : Daily
  - Monthly mean : Twice a month
  - Seasonal mean : Once a month

# Week 2 (8-14 day average) Outlooks

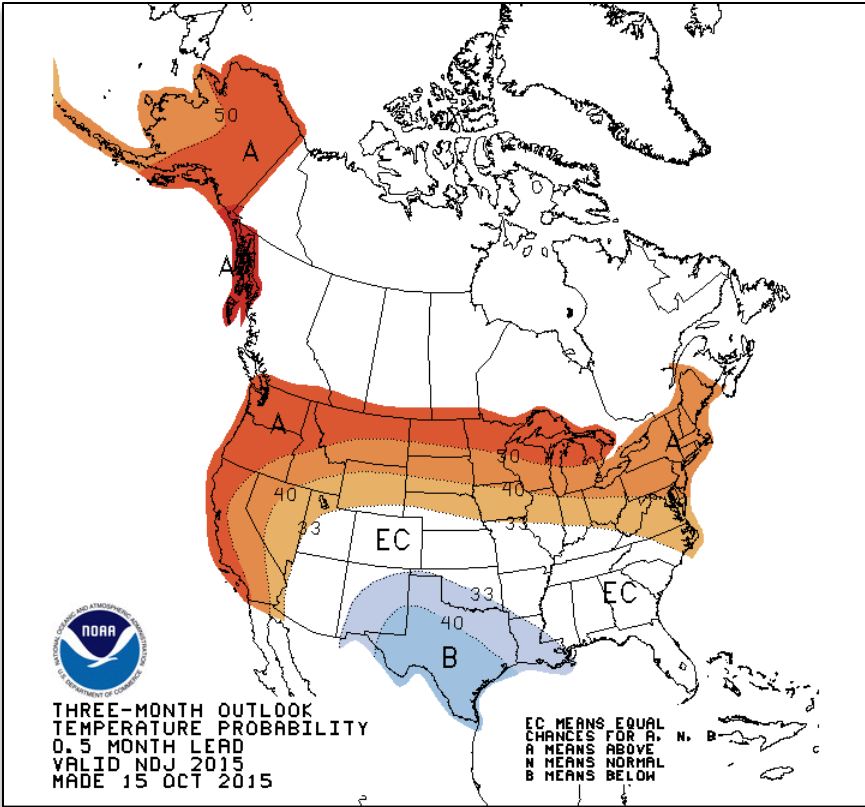


Surface Temperature

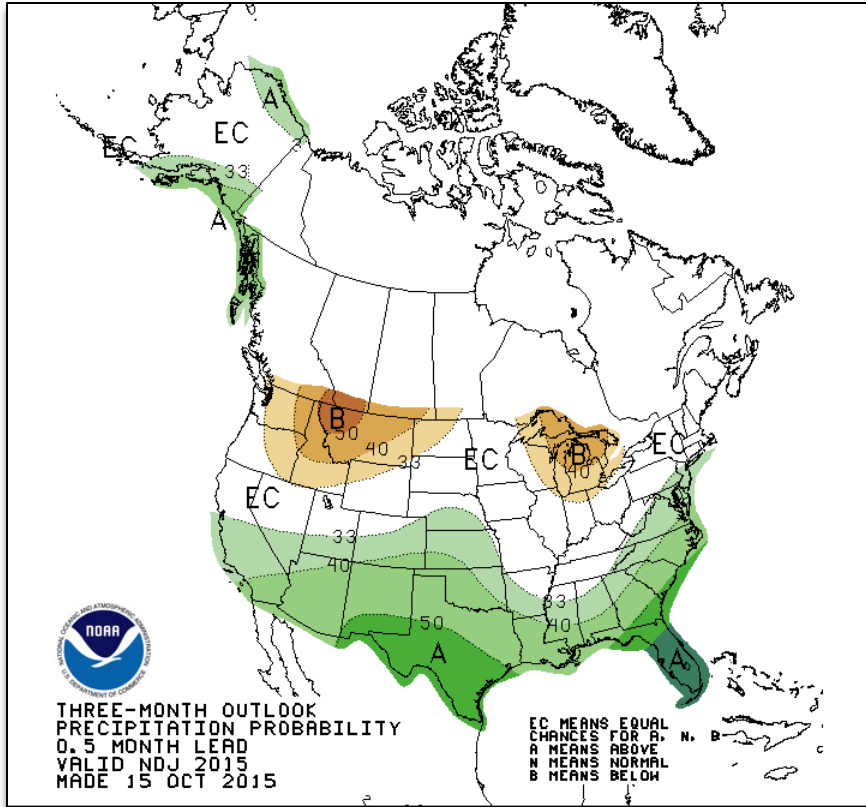


Precipitation

# Seasonal Outlooks

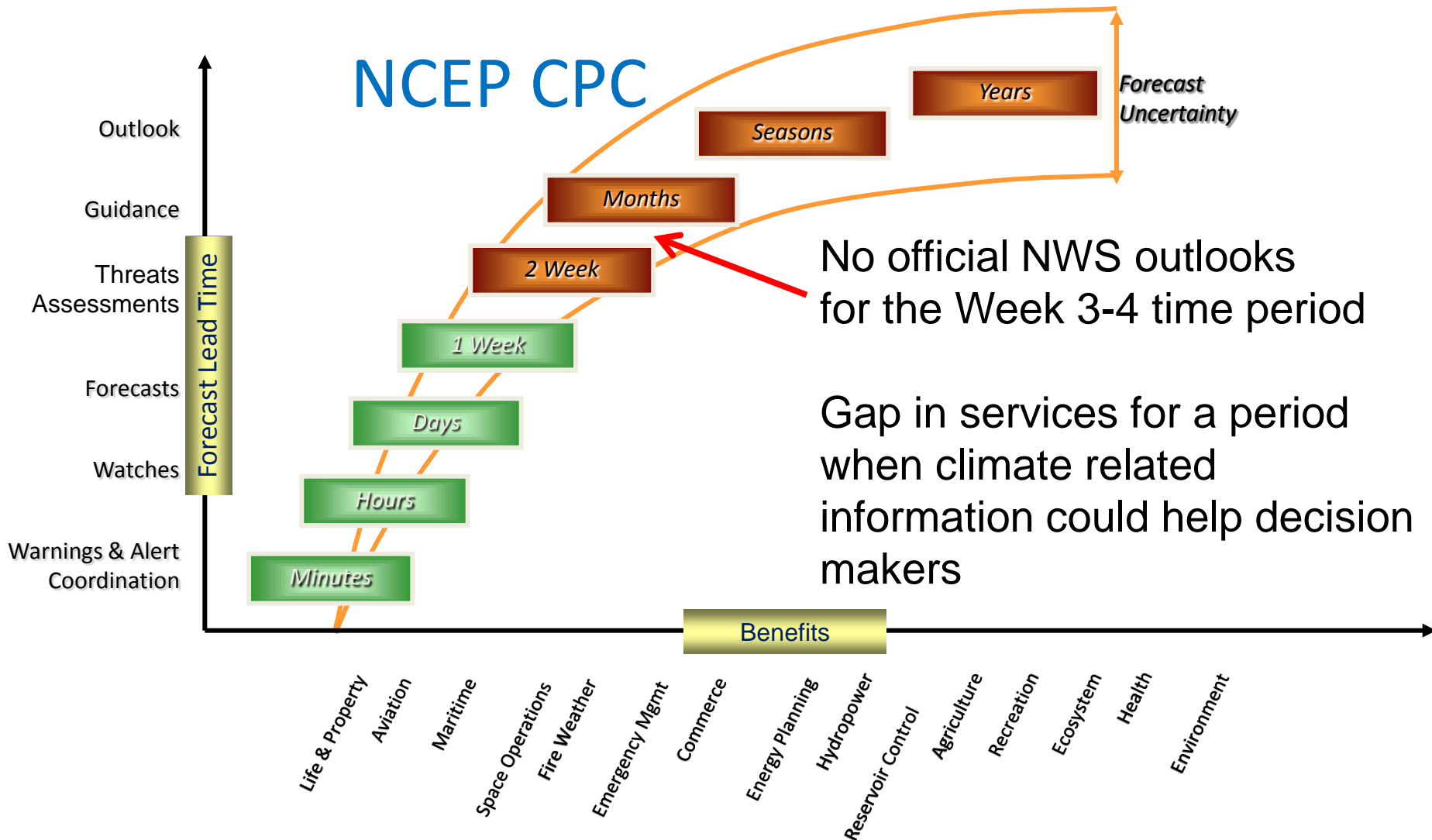


Surface Temperature



Precipitation

# NWS Seamless Suite of Forecast Products



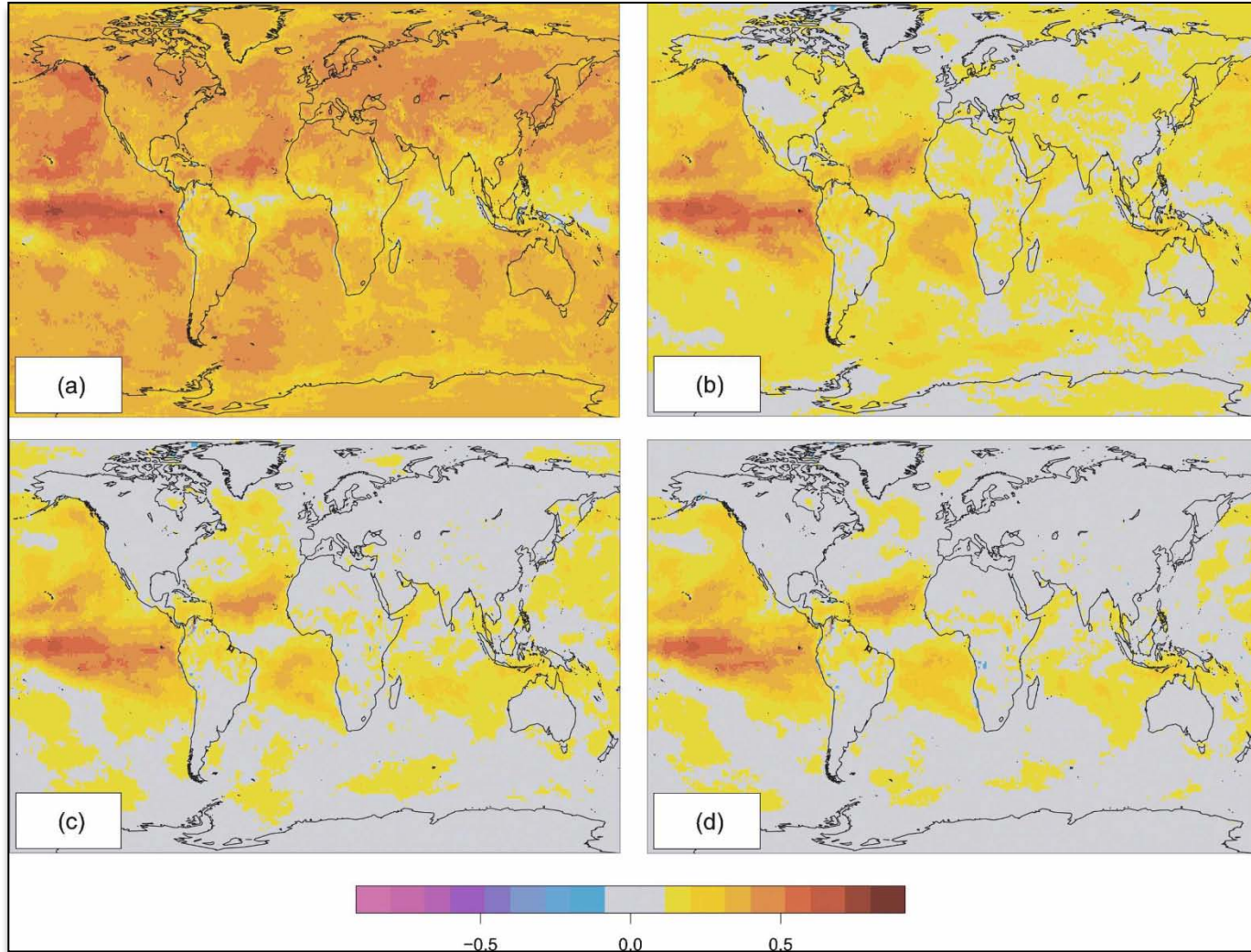
# Additional Background

- Initiation of an activity targeting the Week 3-4 time period was made a major goal in the updated CPC 5-year strategic plan based on discussion at CPC, stakeholder feedback, etc.
- NWS and NOAA leadership as well as the Office of Science Technology Policy (OSTP) at the White House urged making development in this area a high priority

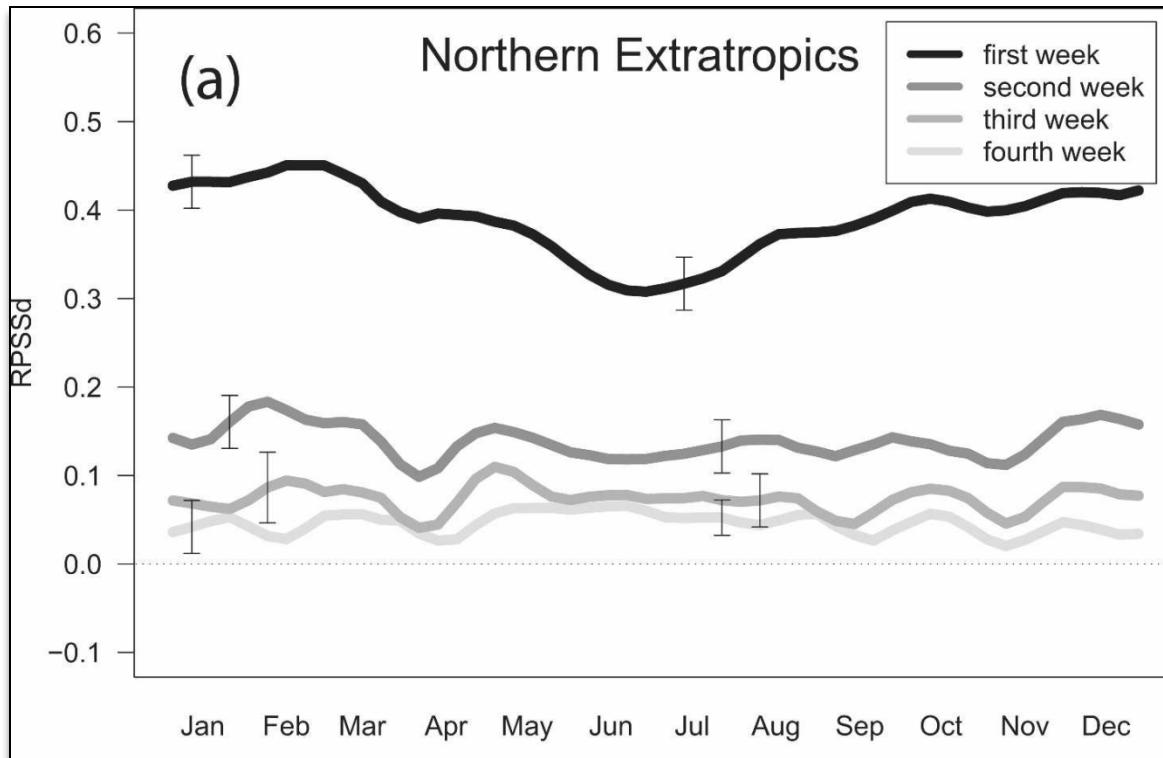
# Challenges in Filling the Forecast Gap

- Declining influence from atmospheric initial conditions (die off curves)
- Time average is short to benefit from the signal associated with the slowly evolving parts of the climate system (e.g., SSTs)
- Consequently, the Week 3-4 time range are likely to suffer from low predictability and prediction skill
- Important to understand this limitation and manage expectations

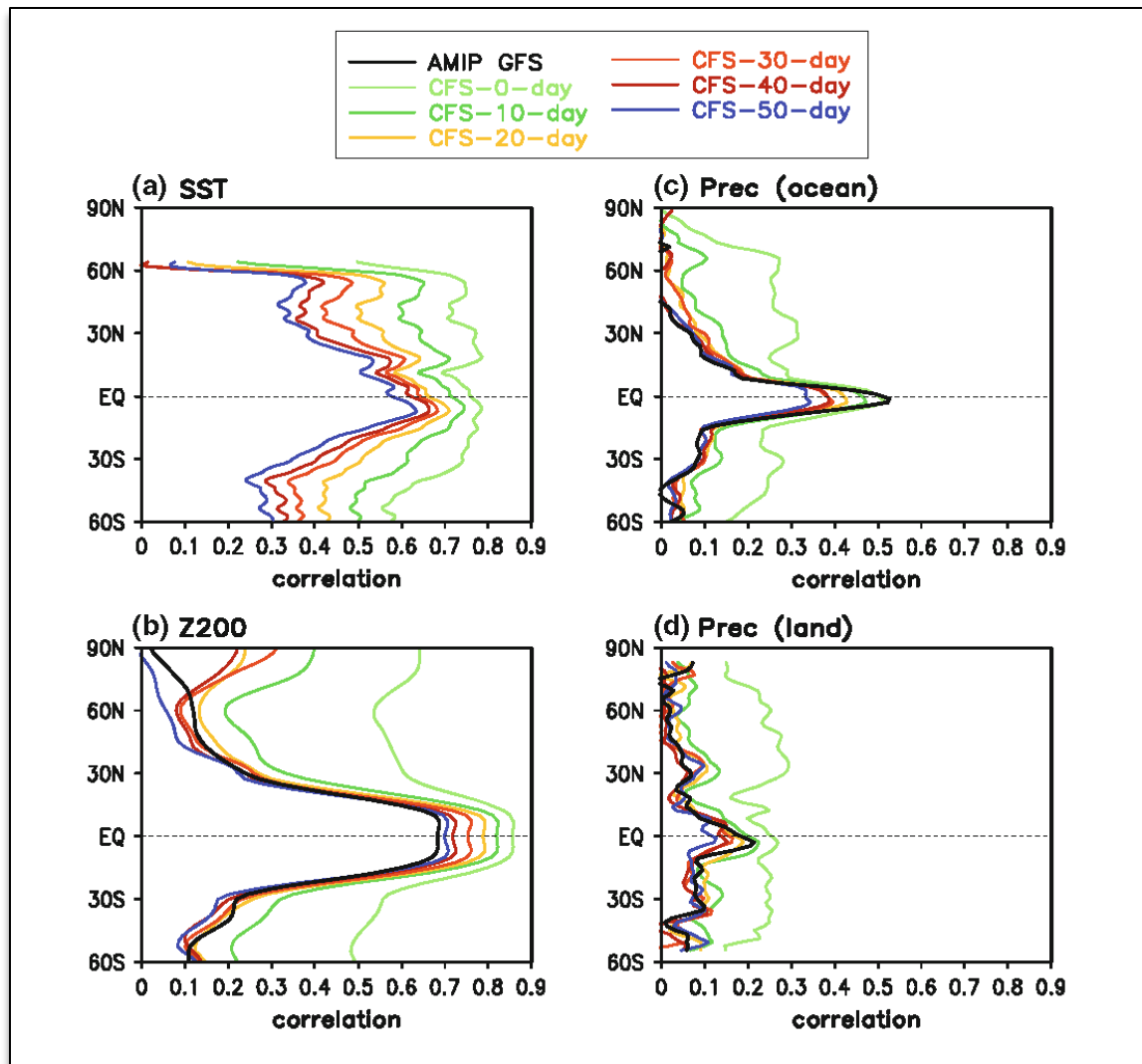




Annually averaged RPSS for week1 – week4 surface temperature forecast (94-06)  
Weigel et. al. (2008), *MWR*



RPSS for week1 – week4 surface temperature forecast (94-06)  
Weigel et. al. (2008), *MWR*



Skill of monthly mean for different lead time  
 Kumar et al. (2011), *Climate Dynamics*

# Sources for Predictability

- Madden-Julian Oscillation (MJO)
- Modes of extratropical patterns of variability (PNA, NAO, Blocking)
- Stratosphere – Troposphere teleconnection
- Soil moisture; Snow
- ENSO; Local/coastal SST anomalies
- Climate Trends

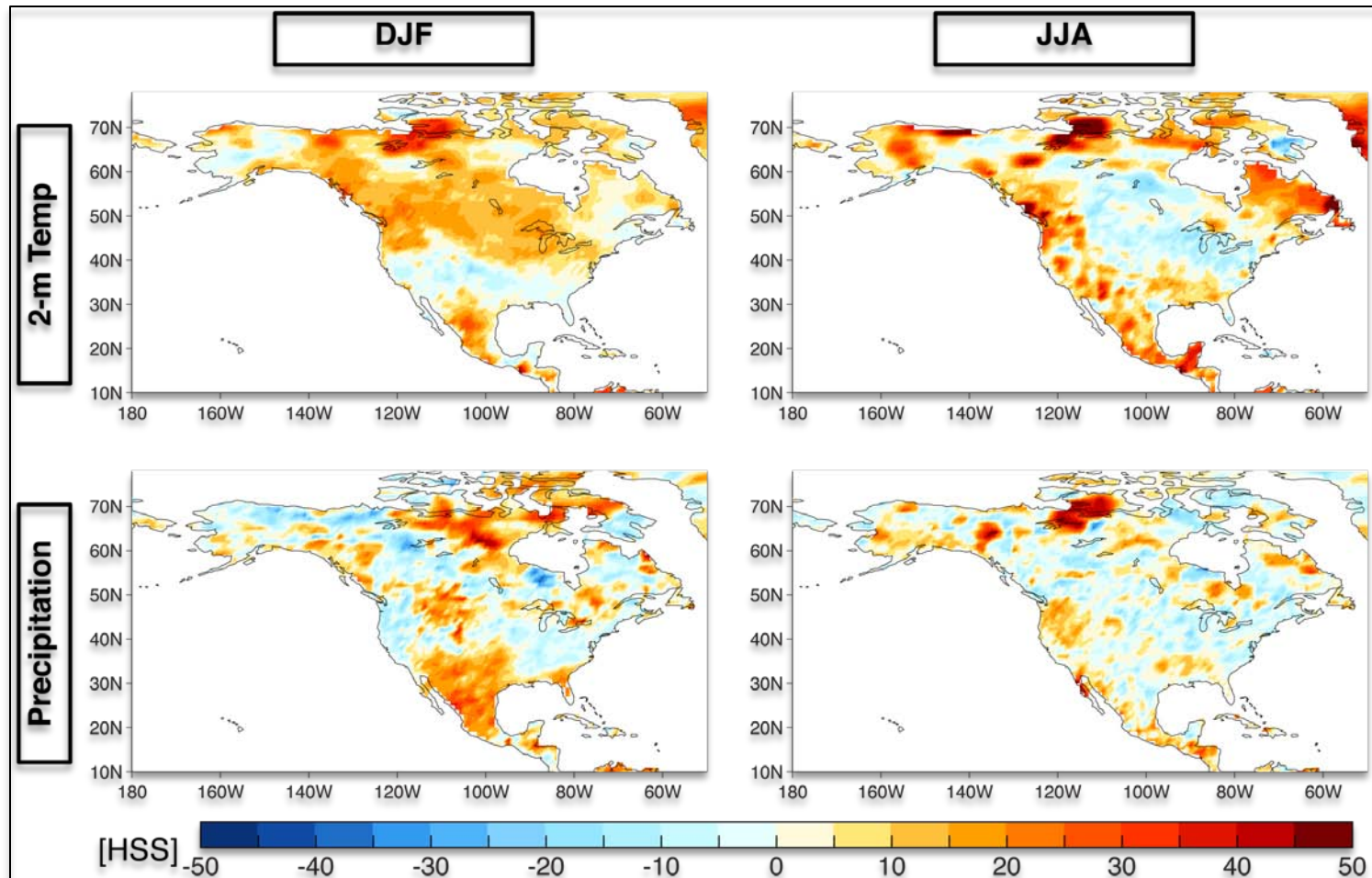
# Development of Weeks 3-4 Outlook at CPC

- Forecast tools
  - Empirical
  - Dynamical
  
- Consolidation of various forecast guidance

# Development of Weeks 3-4 Outlook at CPC

- Empirical tools utilizing historical observations
  - MJO-ENSO phase model: Current strength and phase of ENSO and MJO as well as trends (Johnson et al., 2014, *Weather and Forecasting*)
  - Constructed analogue tool: Matching analogues of 200-mb streamfunction of the past to the current conditions. Past cases are objectively weighted.
  - Coupled Linear Inverse Model (C-LIM)

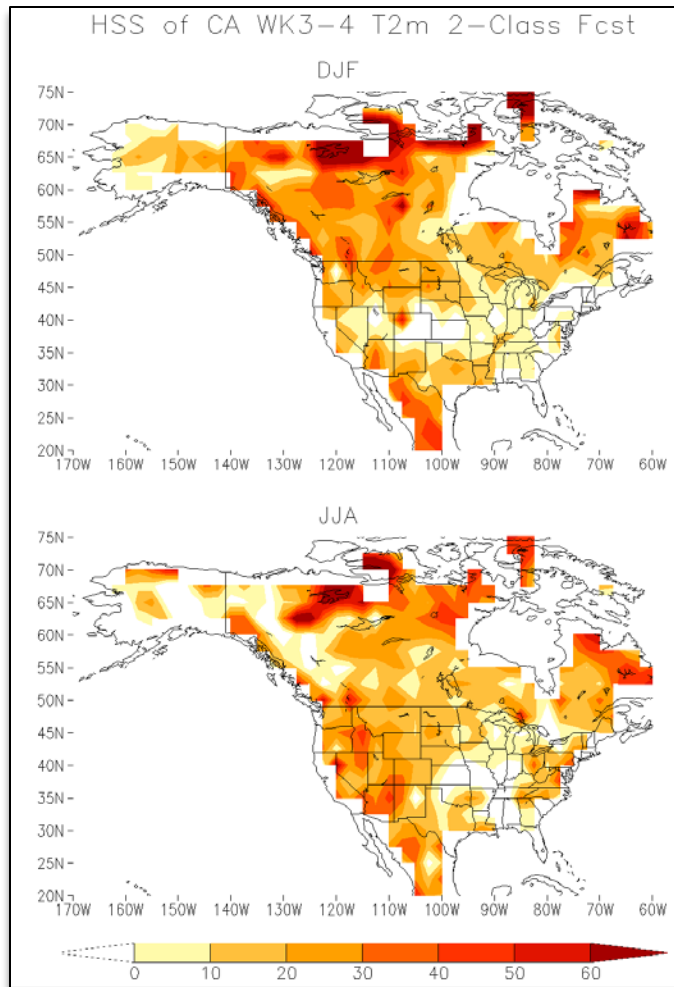
# MJO-ENSO Phase Model Retrospective Skill



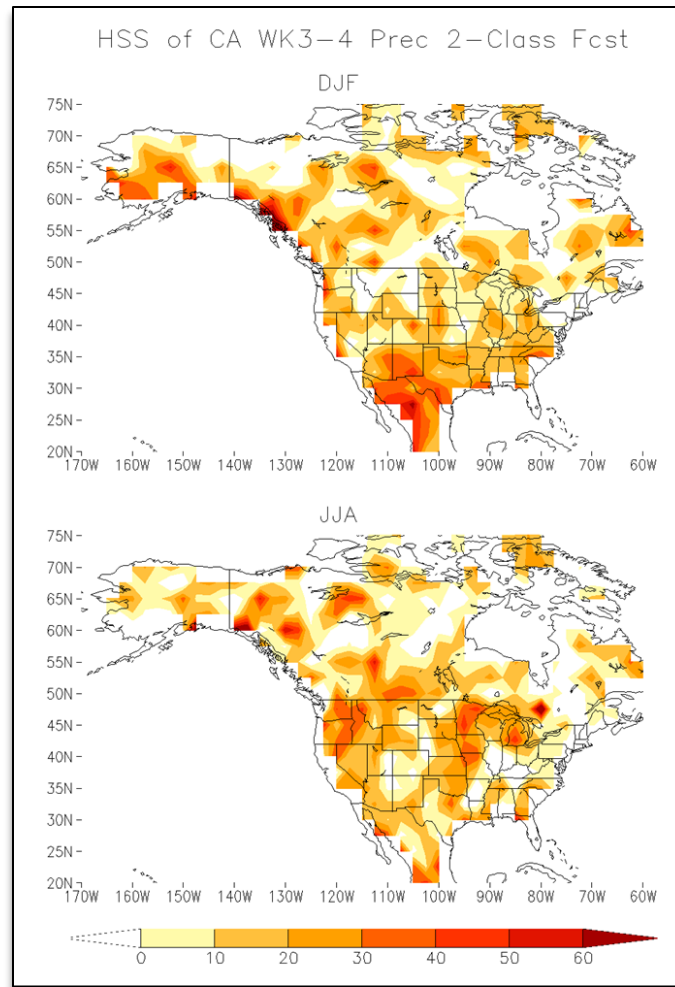
Weeks 3+4 Heidke Skill Score from combined effects of ENSO+MJO+Trend  
Johnson et al., 2014, *Weather and Forecasting*

# Constructed Analog Retrospective Skill

## Temperature



## Precipitation

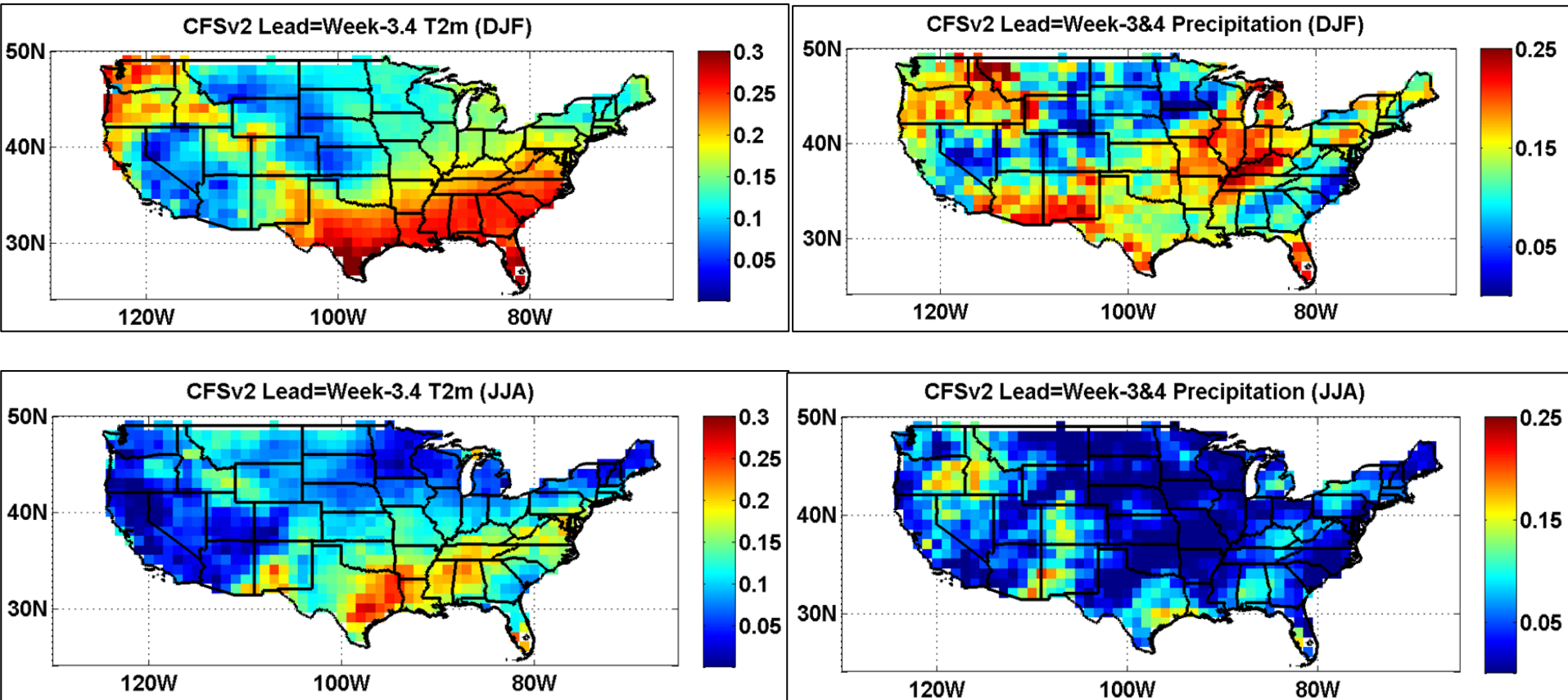




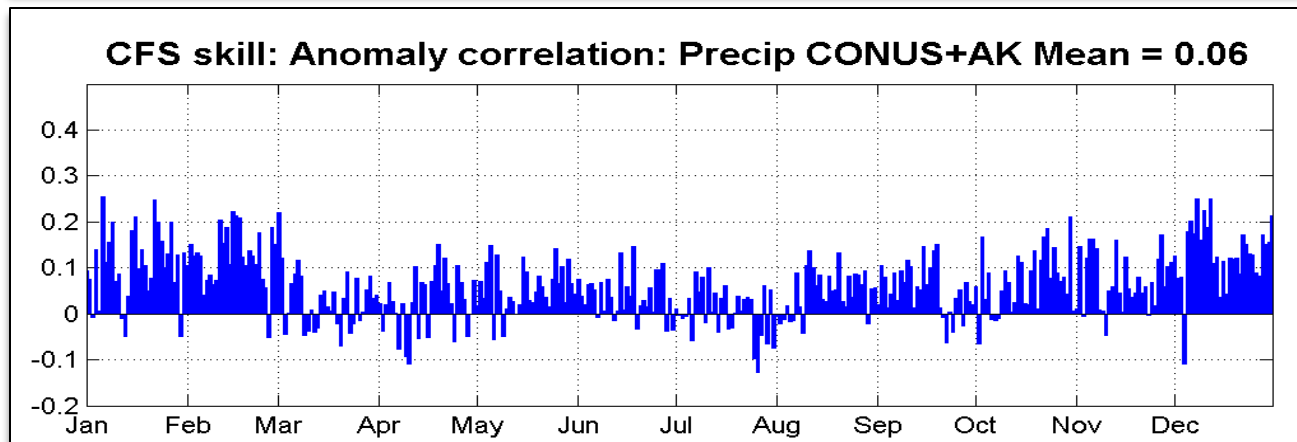
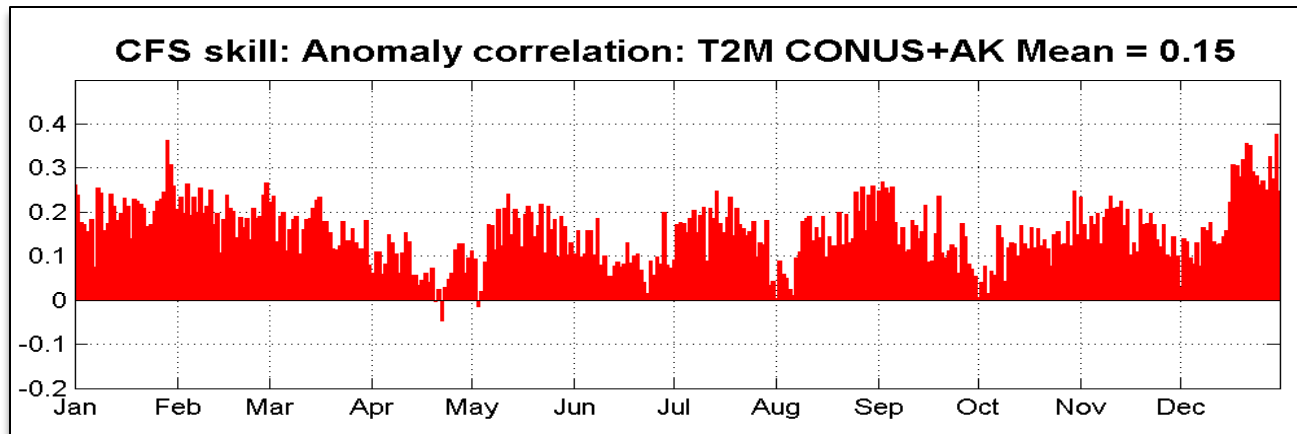
# Development of Weeks 3-4 Outlook at CPC

- Dynamical models
  - Forecasts from CFSv2, ECMWF, JMA
  - Model data is bias corrected and calibrated based on available reforecasts
  - Plans in FY16 to include Environment Canada and NCEP GEFS

# CFS Retrospective Forecast Skill

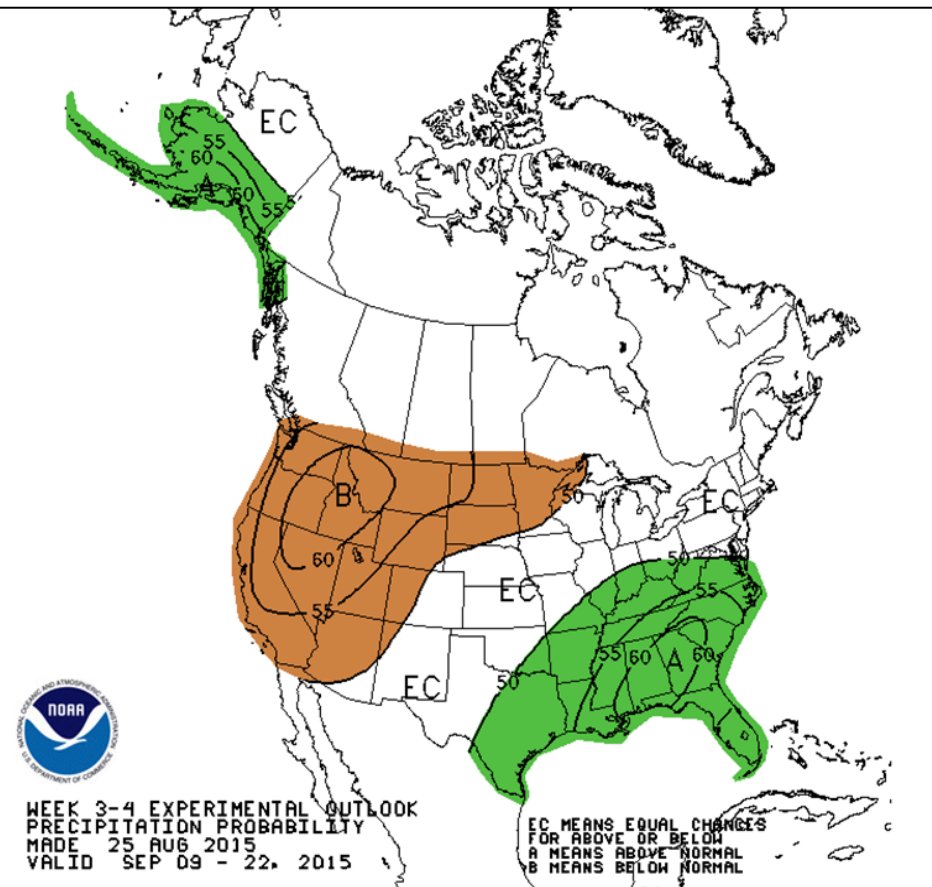
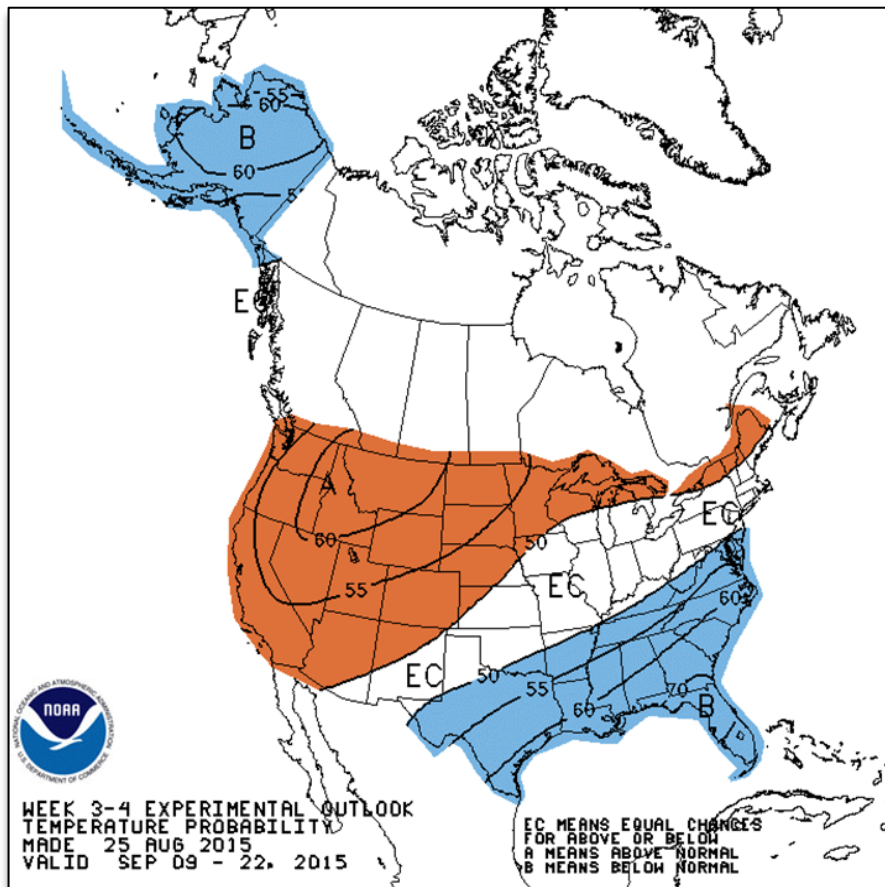


# CFS Retrospective Forecast Skill



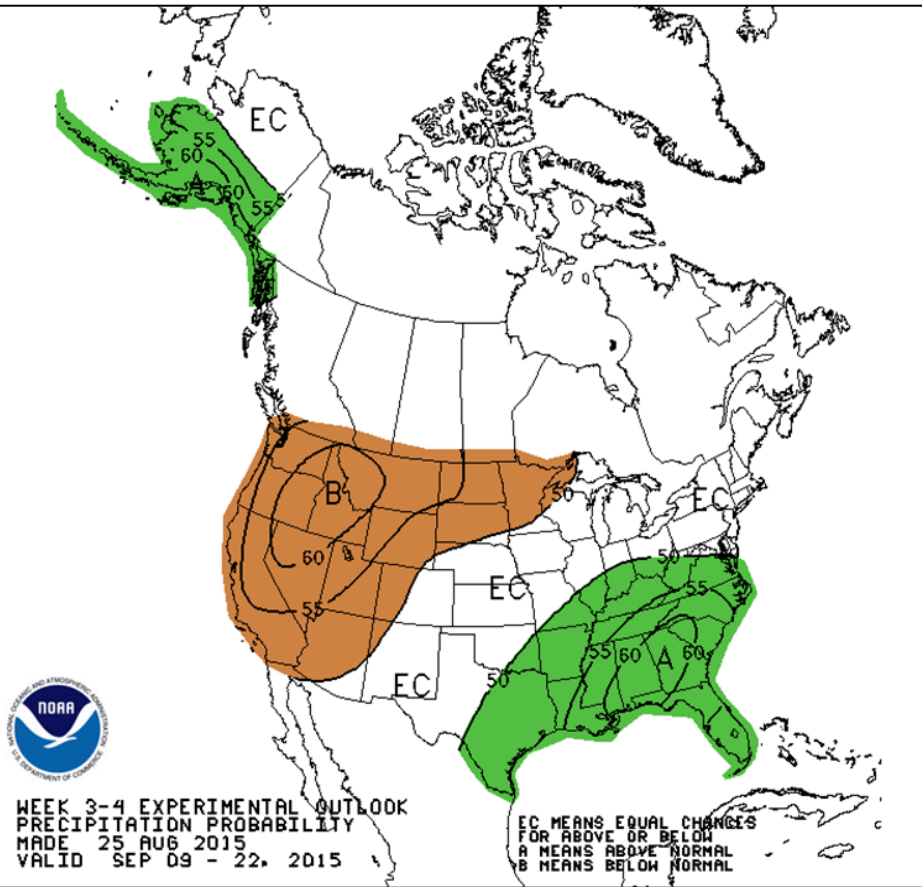
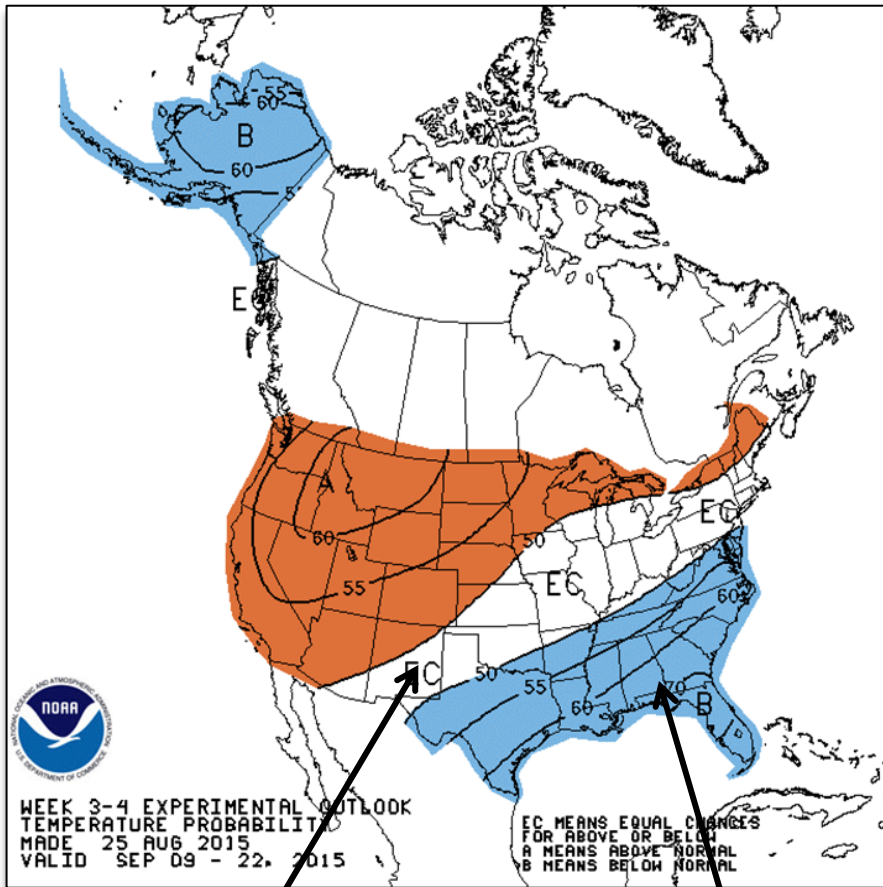
# Experimental Week 3 & 4 Product

- The experimental product is 2-class (above or below-average) temperature and precipitation outlook maps for the favored category of **two-week** mean temperature and **two-week** total accumulated precipitation
- The target is a combined two week outlook for Weeks 3-4 in the future
- Outlook maps depict probabilities for the favored category
- Released every Friday



Orange: Above average temperatures favored  
Blue: Below average temperatures favored  
Equal Chances (EC): Equal odds for above/below

Green: Above average precipitation favored  
Brown: Below average precipitation favored  
Equal Chances (EC): Equal odds for above/below



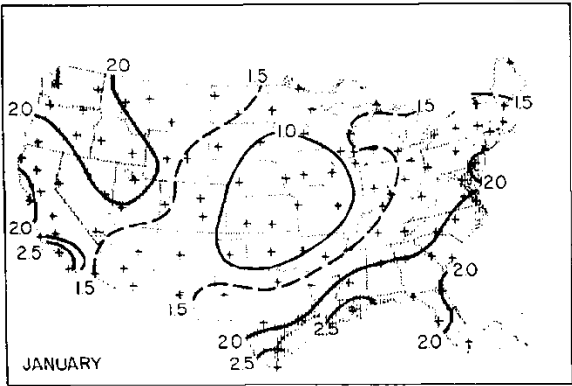
A: 50%  
B: 50%

A: 30%  
B: 70%

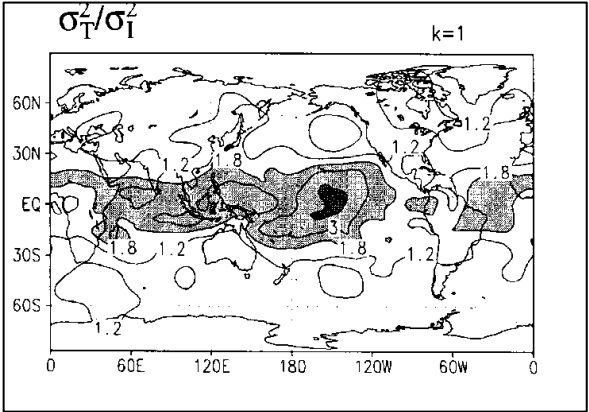
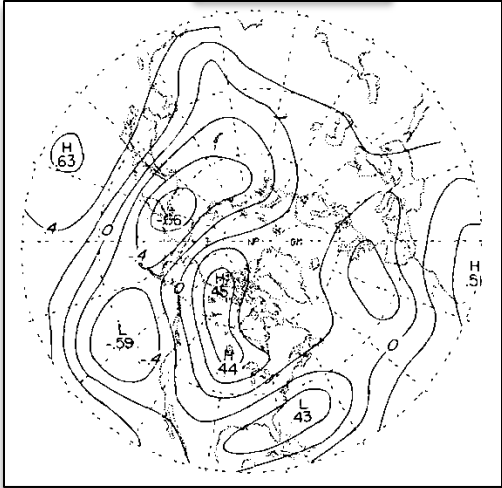
# Comments

- Need to have a better coordination for operational forecasts from different centers (e.g., scheduling; hindcast period etc.)
- Projects like S2S and NMME will help provide better estimates for average predictability, and manage user expectations
- Expectation is that skill is going to be low (in extratropics, noise for shorter time averages is high compared to the predictable signal from various sources)

1976



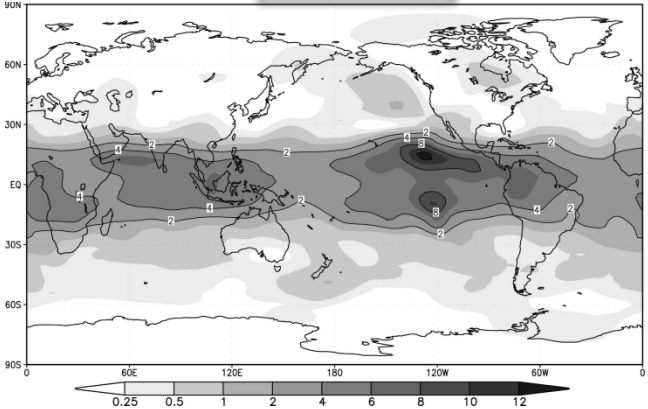
1981



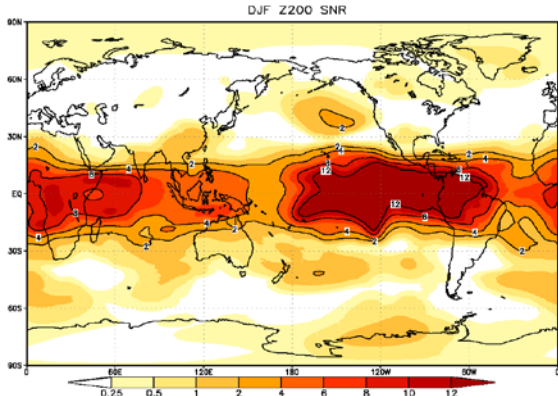
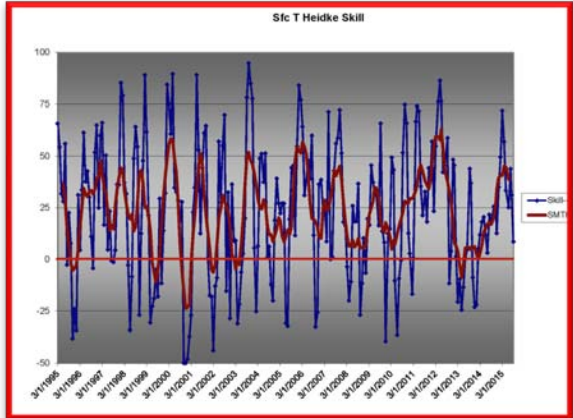
1995



2007



2015





# Thanks!