Framing Performance Outcomes for Seasonal Predictions

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Motivation

How can the CWG help the Climate Service work with external partners to frame performance outcomes?

Example: CPC Seasonal Outlook for Winter 2010-2011

Outline

- **Elements of Seasonal Prediction**

- **Scientific Basis for Seasonal Prediction**

- **Probabilistic Nature of Seasonal Outlooks**

- **Rationale for CPC Winter Outlook 2010-11**

- **Winter Wildcards**

- **Preliminary Verification of Winter Outlook 2010-11**

- **How can the CWG help frame performance outcomes?**

Elements of Seasonal Prediction

- **Existence and understanding of predictable low-frequency variability – ENSO, trend, …**
- **Forecast skill data over a long period (skill mask)**
- **Coupled dynamical model forecasts**
- **Statistical model forecasts**
- **Objective consolidation of forecast tools**

Scientific Basis for Seasonal Prediction

The scientific basis for Seasonal Prediction is the existence of predictable variability on long time scales.

- # ENSO
- # Trends
- ## Warm season soil moisture anomalies
- ### Coastal SST
- Cold season snow cover
- PDO?
- Arctic sea ice?
- ……..

Probabilistic Nature
Of Seasonal Outlooks

CPC Categories and Probabilities:

- Seasonal outlooks are prepared for average temperature and total accumulated precipitation

- Three categories are used (terciles). These are BELOW-,NEAR- and ABOVE-normal (median), for temperature (precipitation).

- Regions where the likelihoods of the three categories are the same (33.33…% each) are designated as "EC", for equal chances.

- In non-EC regions the labels on the contours give the total probability of the dominant category.

Rationale for CPC
Winter Outlook 2010-2011

- **Moderate/Strong La Niña conditions observed across the tropical Pacific.**

- **La Niña expected to persist or strengthen through the fall 2010 and persist through the winter 2010-11.**

- **NAO (AO) has been and continues to be erratic. Large swings possible in any year.**

- **Trends favor above-normal temperatures, especially over the northern part of the nation, although trends have weakened recently.**

- **La Niña impacts expected to dominate.**
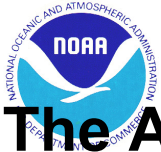
Winter Wildcards:
The Arctic Oscillation / North Atlantic Oscillation and Changes in Winter Weather Patterns
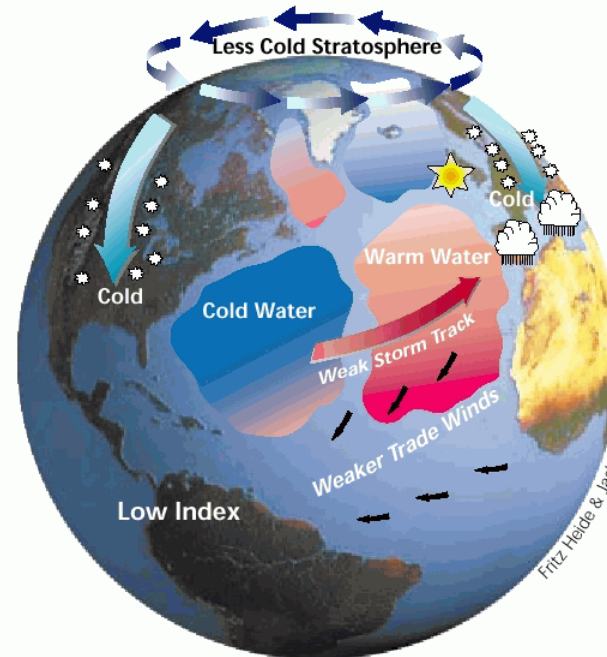

Positive Phase
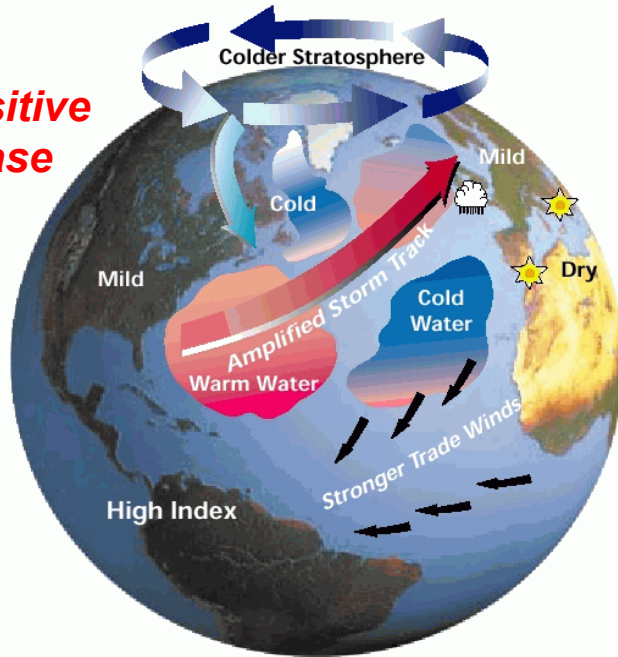
- **Strong polar vortex**
- **Cold pole**
- **Warm mid-latitudes**
- **More extreme warm days**
- **Fewer snowstorms**

Negative Phase

- **Weak polar vortex**
- **Warm pole**
- **Cold mid-latitudes**
- **More extreme cold days**
- **More snowstorms**

Significant AO Impacts over US - Winter

Positive Phase of the AO

More Storm Force Winds and High Waves

Frequent Warm-ups

Infrequent "Northeasters"

Warmer-than-Normal

Increased Rains and Cloudiness

More Heavy Rain Events

Negative Phase of the AO

More Ice Storms, Snows Inland

More Storm Force Winds, High Waves and Beach Erosion

More "Northeasters", Heavy Snows and Ice Storms

Colder-than-Normal

Decreased Rains and Cloudiness

Frequent Cold Air Outbreaks

Above-Normal-Snowfall

More Cold Surges

The AO Influences the number and intensity of significant weather events affecting the U.S.
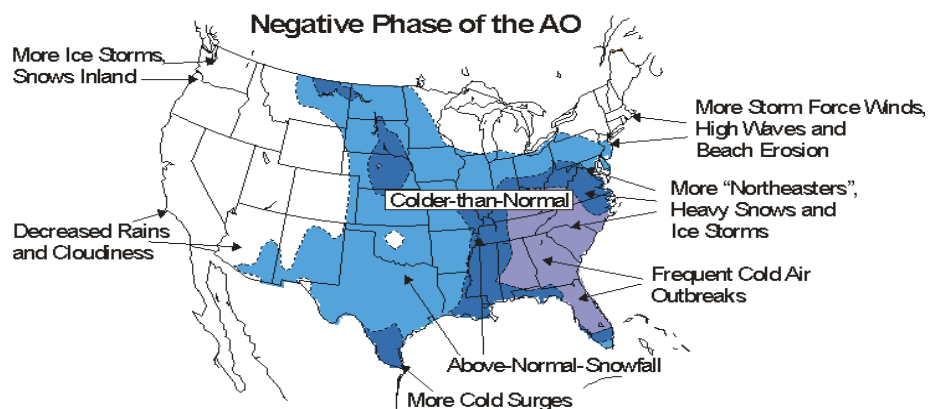
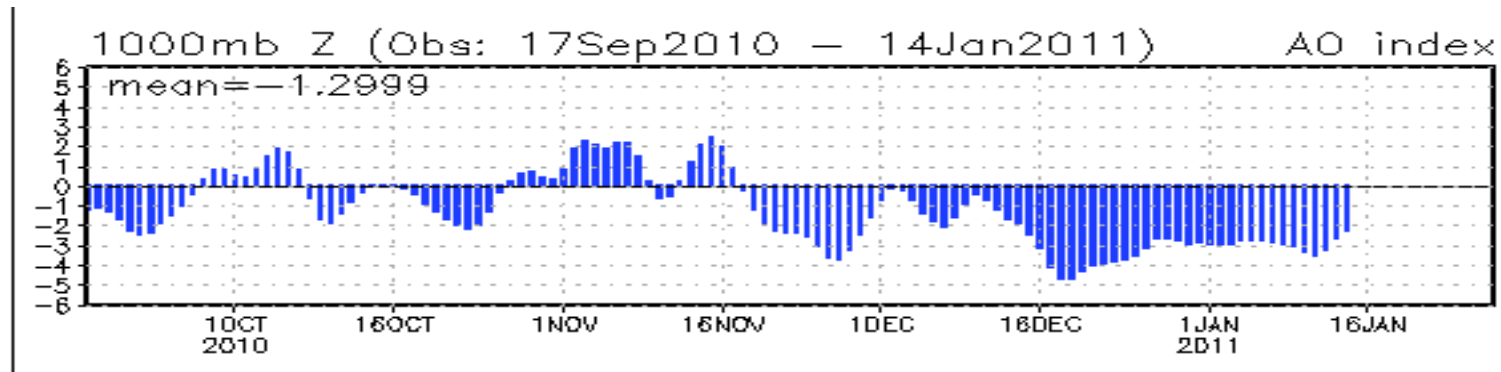**Currently there is no reliable capability to forecast the seasonal phase .**

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Persistence of AO
(through mid-January 2011)

The AO has been negative since mid-November and significantly negative since mid-December.

1000mb Z (Obs: 17Sep2010 — 14Jan2011)   AO index
mean=—1.2999

What is causing the persistence of the AO?
Could this have been predicted?

Possible Explanations:
- Multi-decadal variability of AO/NAO?
- Forced by reduced arctic sea-ice?
- Fall Siberian snow cover?
- Persistence of AO from summer to winter?

Multi-Decadal Variability of the Winter AO

- **1950s and 60s dominated by negative AO**
- **Late 1980s through early 2000s positive AO**
- **Return to negative values???**

Standardized Seasonal Mean (JFM) AO index (1950-2010)
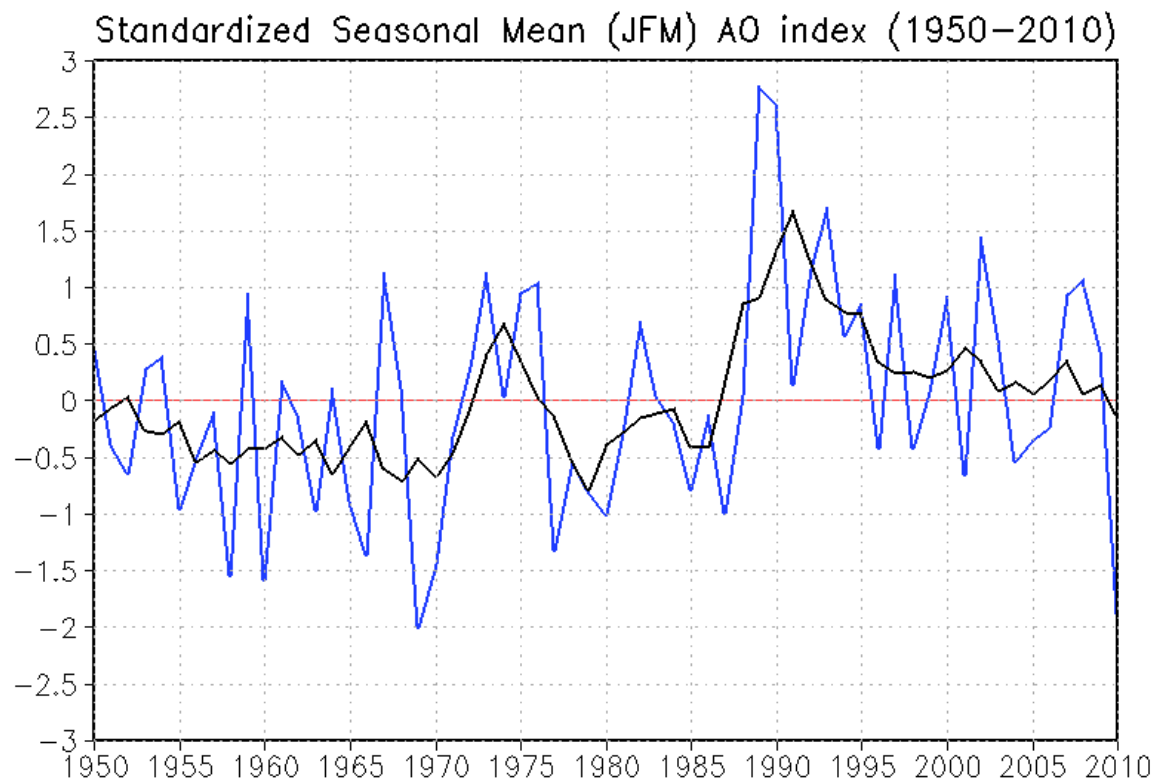
Arctic Sea Ice and the AO Phase

- **Arctic sea ice has been decreasing since 1970.**
- **Extreme minimum sea ice extent was observed in late 2007 during a period of positive AO values.**
- **Sea ice extent for winter 2010-2011 has been lower than during 2007-08 since mid-October, and with negative AO phase.**

Arctic Sea Ice Extent Standardized Anomalies
Jan 1953 - Sep 2010
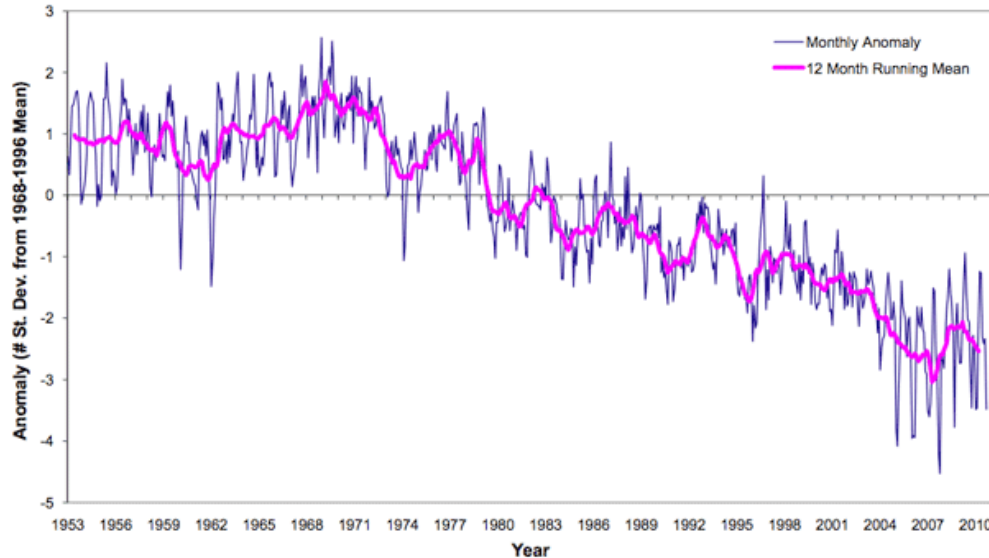
Arctic Sea Ice Extent
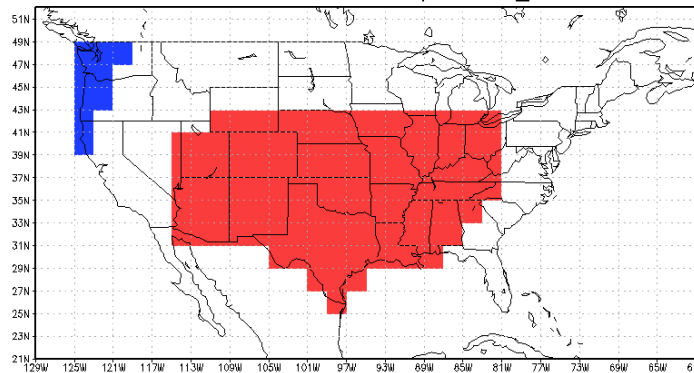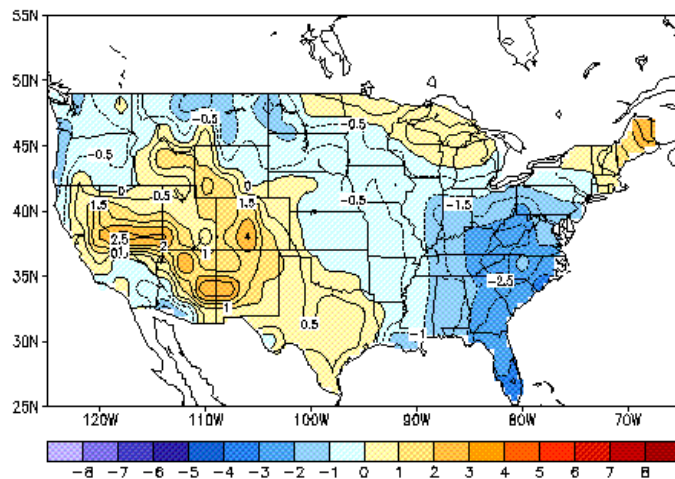(Area of ocean with at least 15% sea ice)
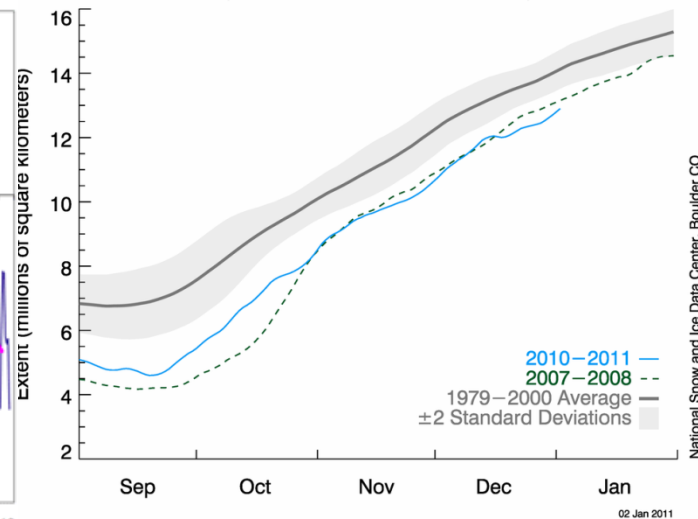
Preliminary Verification
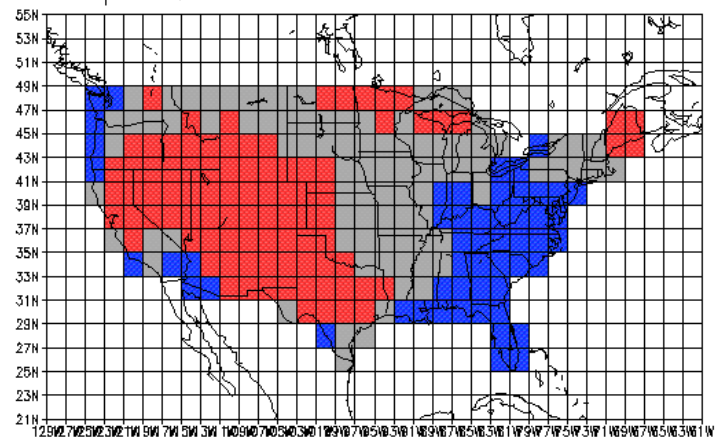
NDJ 2010-2011 Temperature Outlook (Verification to date)

Nov-Dec-Jan 2010-11 Temp Official_Forecast

Mean Temp (C) Anomaly Nov 1 - Jan 12 2011

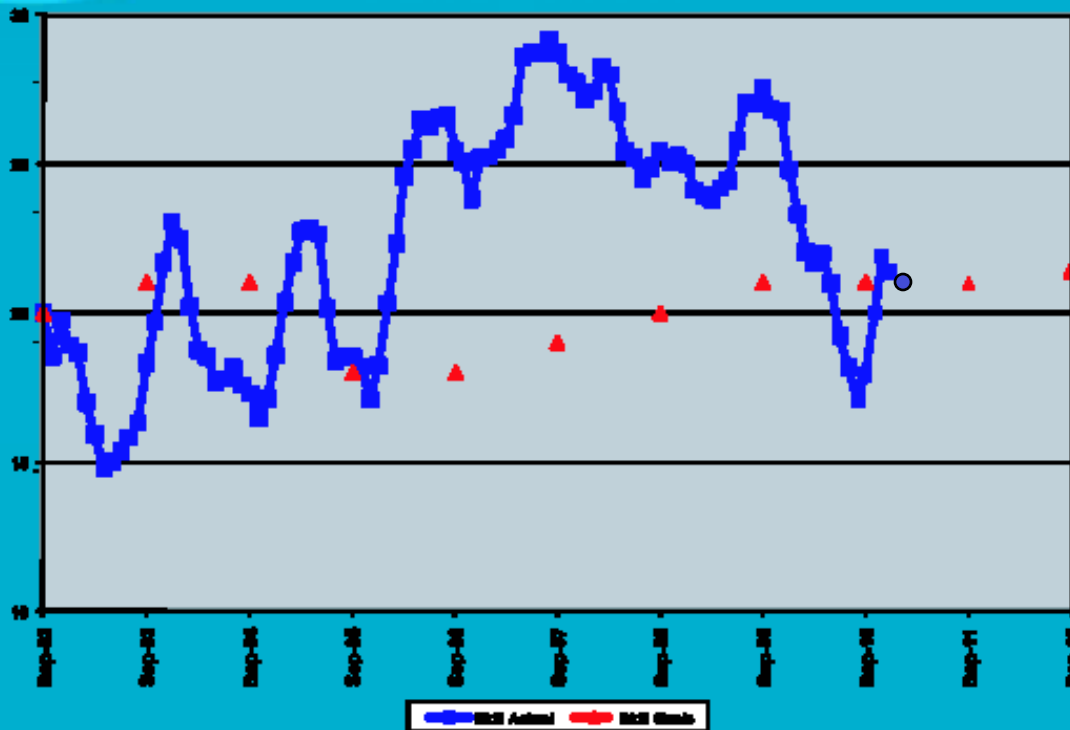Temperature Verification Nov 1 - Jan 12 2010

U.S. Seasonal Temperature - Skill

NDJ running near 0, will drop GPRA to 20.6 (slightly below target)

"America's Weather Enterprise: Protecting Lives, Livelihoods, and Your Way of Life"

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Framing Performance Outcomes for Seasonal Predictions

Areas where the CWG can help CS work with external partners to frame performance outcomes (for seasonal outlooks)

- **Improve evaluation:**
  - ➤ **Performance metrics**
    - ➤ **Verification techniques**

- **Explain scientific basis:**
  - ➤ **Uncertainties**
  - ➤ **Probabilistic nature**
  - ➤ **Predictability**

- **Engage in problem focused assessments:**
  - ➤ **Provide context and perspective on what is occurring and why it is occurring (inc. case selection, attribution reports, reviews, etc.)**
  - ➤ **Provide advice on research directions to improve predictions (inc. observations, modeling, predictability and prediction)**

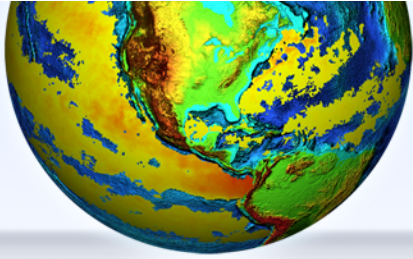# Framing Performance Outcomes for Seasonal Predictions

Performance Metrics

- How can we make PM's an integral part of the climate story?

    - Connect what we are measuring to a broader outcome

    - Assist users in decision making

    - Communicate levels of uncertainty

    - Include progress and value of climate services

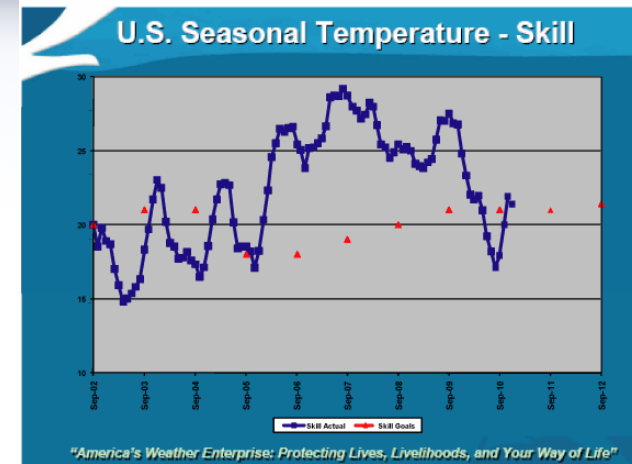   - Demonstrate how close we are getting to desired outcomes

CPC Performance Measures
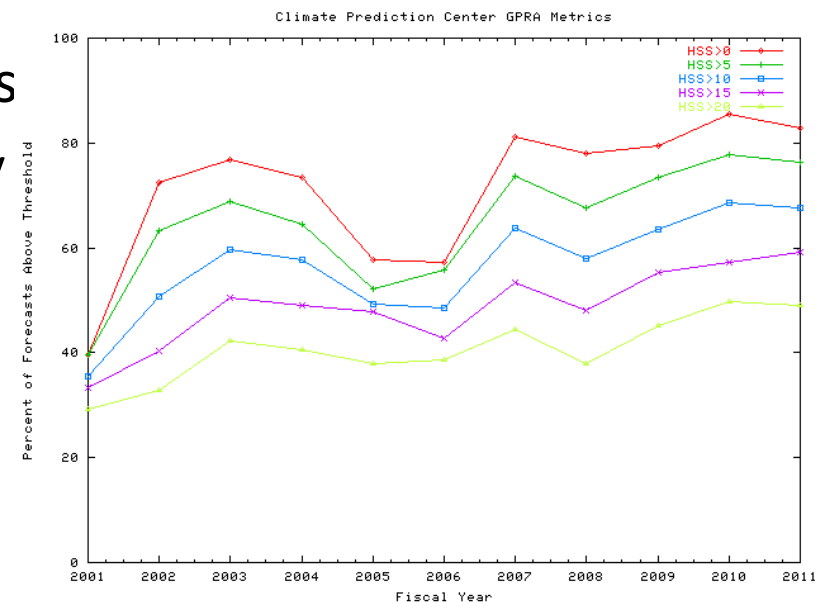
Old

- Skill of US seasonal temperature outlooks (GPRA)
  - A measure of **Progress** in seasonal forecasts

U.S. Seasonal Temperature - Skill

"America's Weather Enterprise: Protecting Lives, Livelihoods, and Your Way of Life"

New (Proposed)

- % of CPC forecasts above thresholds
  - Combines US extended range, monthly and seasonal temperature and precipitation outlooks
  - The trend shows **Progress**
  - The thresholds allow users to determine what fraction of CPC forecasts may be useful for their decisions.

Climate Prediction Center GPRA Metrics