NOAA/WSWC Workshop on Seasonal Forecast Improvements

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Outline

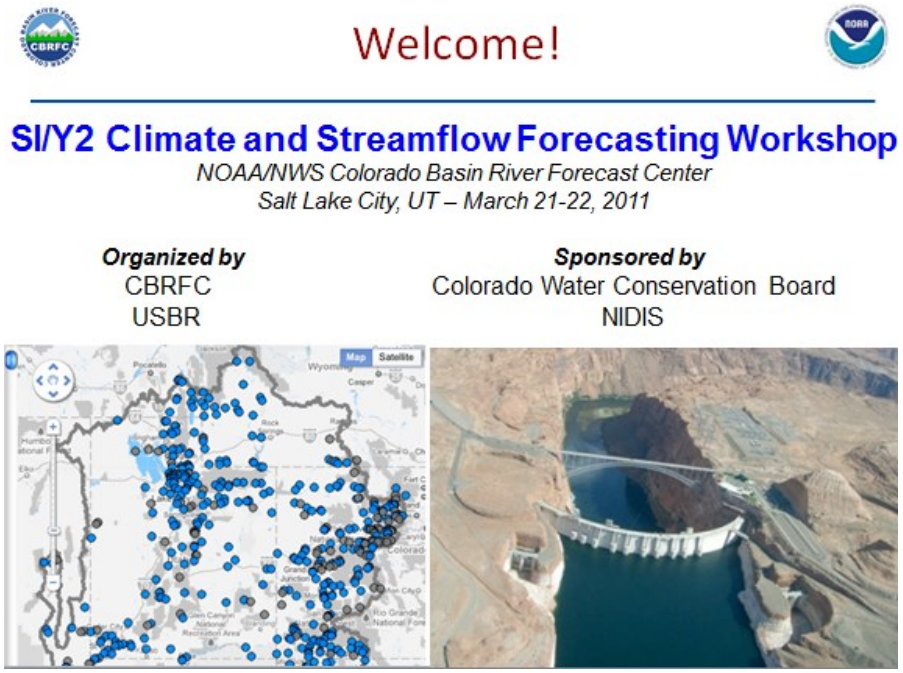
- Workshop motivation
- Goals
- Agenda

Workshop Motivation

- Opportunity for application of improved seasonal forecasts into water resource management is a long standing aspiration of both science and management communities.
  - Colorado River stakeholders
  - NOAA CA drought service assessment
  - Western States Water Council

Colorado River Stakeholders

In response to sustained interest and demand across the River Forecast Center community, a 2011 workshop was convened to tackle this problem



2011 Colorado River Workshop

Where are we now?

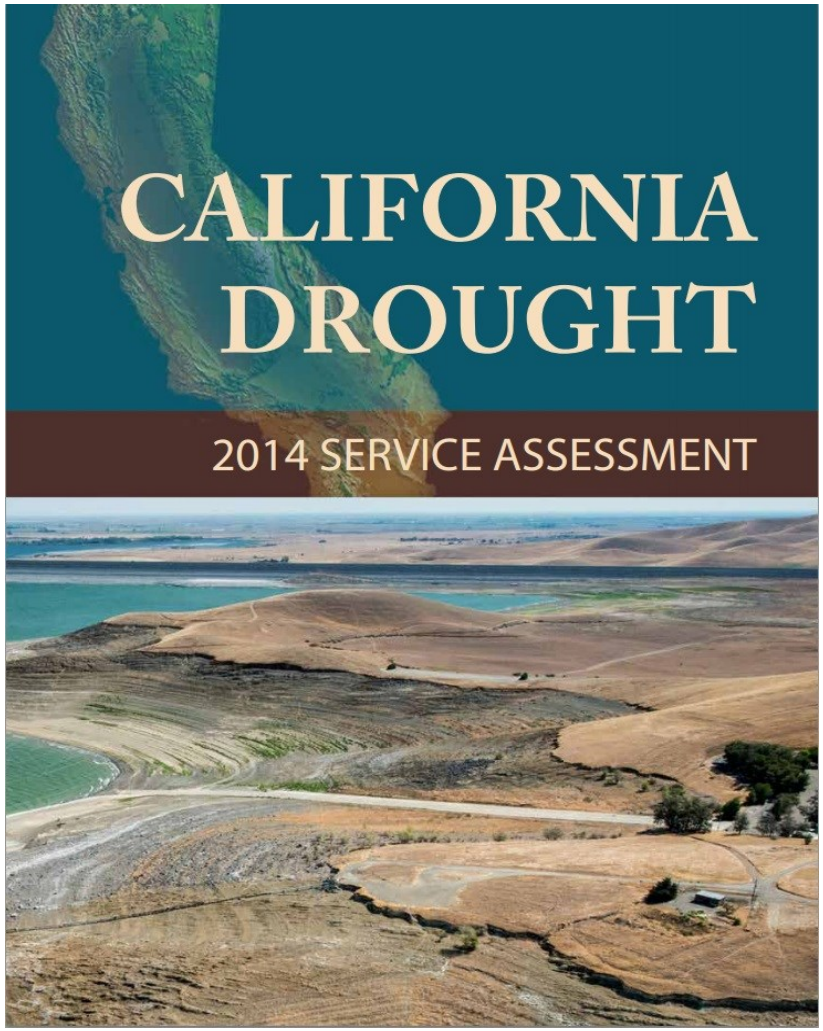
- 15 years of applied climate and flow forecasting research pertaining to western US

Barnston, A.G., et al: 1994, ***Long-lead seasonal forecasts---where do we stand?***, BAMS	Trenberth, K. E. 1997. ***The definition of El Niño***. BAMS
Wood, A. W., A. Kumar, and D. P. Lettenmaier (2005), ***A retrospective assessment of National Centers for Environmental Prediction climate model–based ensemble hydrologic forecasting in the western United States***, *J. Geophys. Res.*	Piechota, T.C., J.A. Dracup, and R.G. Fovell, 1997. ***Western U.S. Streamflow and Atmospheric Circulation Patterns During El Niño-Southern Oscillation (ENSO)***. Journal of Hydrology
Bracken, C., B. Rajagopalan, and J. Prairie (2010), ***A multisite seasonal ensemble streamflow forecasting technique***, *Water Resour. Res.*	Piechota, T.C., Dracup, J.A.,1996, ***Drought and Regional Hydrologic Variations in the United States: Associations with the El Niño/Southern Oscillation***. Water Resources Research
Ropelewski, C.F.; and M.S. Halpert. 1986. **North American precipitation and temperature patterns associated with the El Niño–Southern Oscillation (ENSO)**. MWR	Garen, D.C., 1992, ***Improved Techniques in Regression-Based Streamflow Volume Forecasting***, JWRPM
Bracken, C; Rajagopalan, B; Prairie, J (2010), ***A multisite seasonal ensemble streamflow forecasting technique***. Water Resour. Res.	Hamlet, A. F., Lettenmaier, D. P., 1999: ***Columbia River Streamflow Forecasting Based on ENSO and PDO Climate Signals***, JWRPM
Grantz, K., B. Rajagopalan, M. Clark, and E. Zagona, 2005: ***A technique for incorporating large-scale climate information in basin-scale ensemble streamflow forecasts***. Water Resour.Res.	Piechota, T. C. and Dracup, J. A., "***Long-range streamflow forecasting using ENSO information: Application to the Columbia River Basin***" (1997). *Faculty Publications (CEE)*
Grantz, K; Rajagopalan, B; Zagona, E; Clark, M (2007), ***Water management applications of climate-based hydrologic forecasts: Case study of the Truckee-Carson River Basin***. JWRPM	Wang, S.-Y., R. R. Gillies, J. Jin, and L. E. Hipps (2009), ***Recent rainfall cycle in the Intermountain Region as a quadrature amplitude modulation from the Pacific decadal oscillation***, Geophys. Res. Lett.
Najafi, M., Moradkhani H., and Wherry, S., "***Statistical Downscaling of Precipitation using Machine Learning with Optimal Predictor Selection***", JHE	Moradkhani, H., Meier, M., "***Long-Lead Water Supply Forecast using Large-scale Climate Predictors and Independent Component Analysis***", JHE
Switanek, Matthew B., Peter A. Troch, Christopher L. Castro, 2009: ***Improving Seasonal Predictions of Climate Variability and Water Availability at the Catchment Scale***. JHM	Sankarasubramanian, A., U. Lall, N.Devineni and S. Espunevea,***Utility of Operational Streamflow Forecasts in Improving within-season Reservoir Operation***,JACM

- Variable use of findings within operational water prediction and management
- One of the biggest usage gaps: the upper Colorado River Basin
- Motivation: Increasing scrutiny of Colorado River water management

Credit: Andy Wood

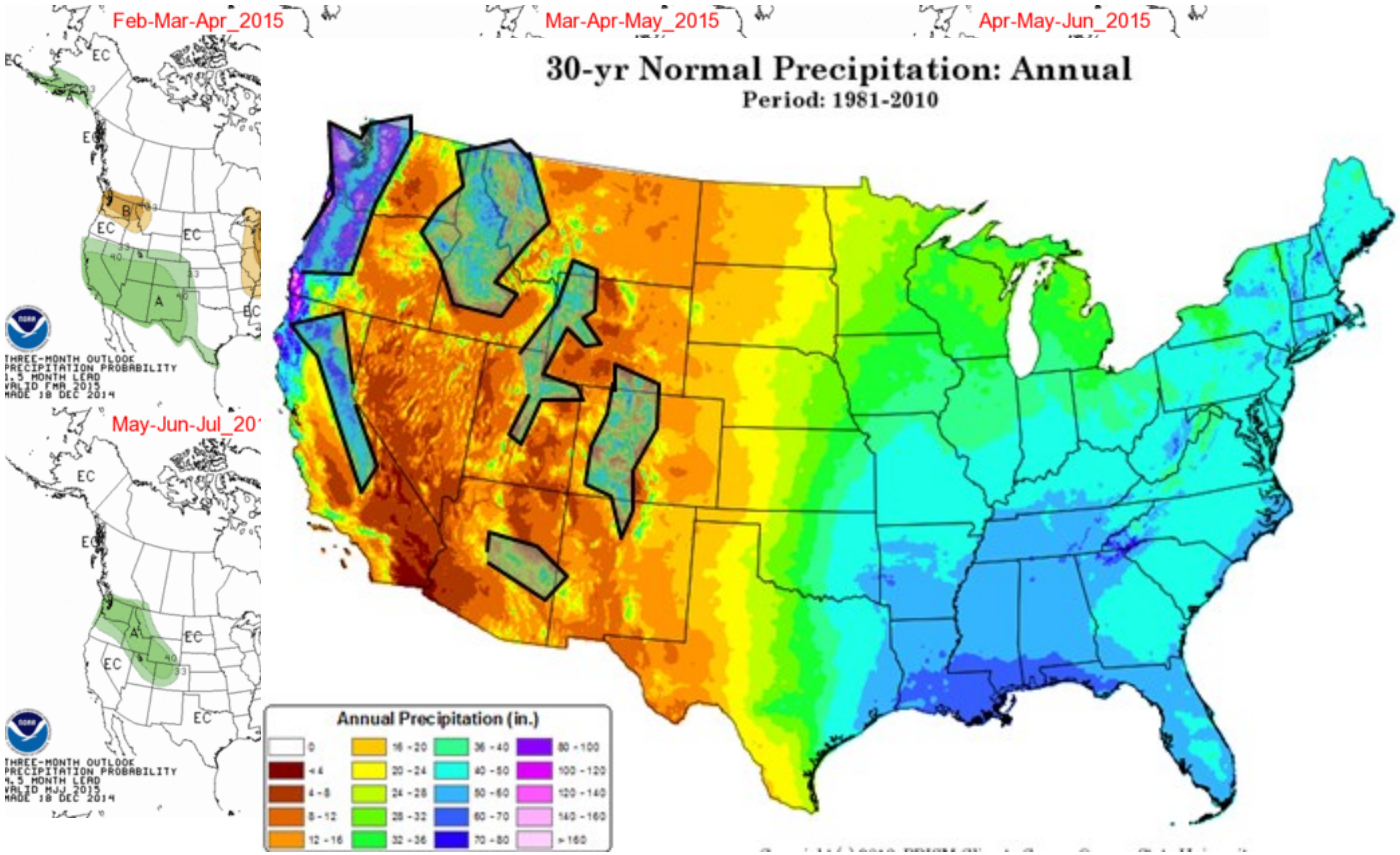
NOAA's CA Drought Service Assessment



- 10 team members
- 43 recommendations
- 100+ interviews
- 40+ reviewers
- 400+ comments
- 62 pages
- 10 months
- 3 focus sectors
- 1 really bad drought

Improved Seasonal Prediction for Water Resources

- #1 Stakeholder request: What is the forecast for the upcoming winter's precipitation?



NOAA's CA Drought Service Assessment

- ***Finding 5.3:*** Accumulated precipitation—typically snow—in the key watersheds of the Cascade, Sierra Nevada, southern California mountains, and groundwater recharge areas are the primary source for water resources in California and the western states, yet no focused seasonal forecast capacity exists for this all-important resource in order for agencies to make effective planning decisions and water allocations.
- ***Recommendation 5.3a:*** NOAA (including CPC, RFCs, NWC, NCDC, and CPO) should invest in developing and operationalizing seasonal forecast techniques targeted at accumulated cool-season precipitation, specifically snowpack accumulation and snowmelt runoff, in the watersheds important for water resources.

NOAA's CA Drought Service Assessment

- ***High Level Finding (HLF) 1:*** Great interest exists for seasonal prediction products and ENSO discussions (monthly), especially for cool-season precipitation. These forecasts, however, typically have very low skill and confidence, rendering them near-useless for most decision makers interviewed. Further, the CPC forecast products were often prone to misinterpretation by both NOAA field offices and external stakeholder agencies.
- ***Recommendation HLF 1a:*** NOAA should acknowledge the major importance of cool-season precipitation in providing water not only for California but for the western United States. As such, Office of Oceanic and Atmospheric Research (OAR) should synthesize the state of research on predictability of accumulated cool-season precipitation in the mountains and scope an operational forecasting capability that is closely linked to supporting the water resource management community.
- ***Recommendation HLF 1b:*** The Climate Prediction Center (CPC) should work more closely with front line offices, especially the RFCs and WFOs in the National Weather Service, to understanding local uses of and needs for seasonal prediction and how to more effectively communicate them to the public. Additionally, the effectiveness of internal education on seasonal prediction products should be assessed. To address this recommendation, NWS should develop a plan for improving two-way communications between CPC and field offices, documenting stakeholder use cases and requirements for seasonal prediction, and assess the effectiveness of internal education on seasonal prediction.

Workshop Goals

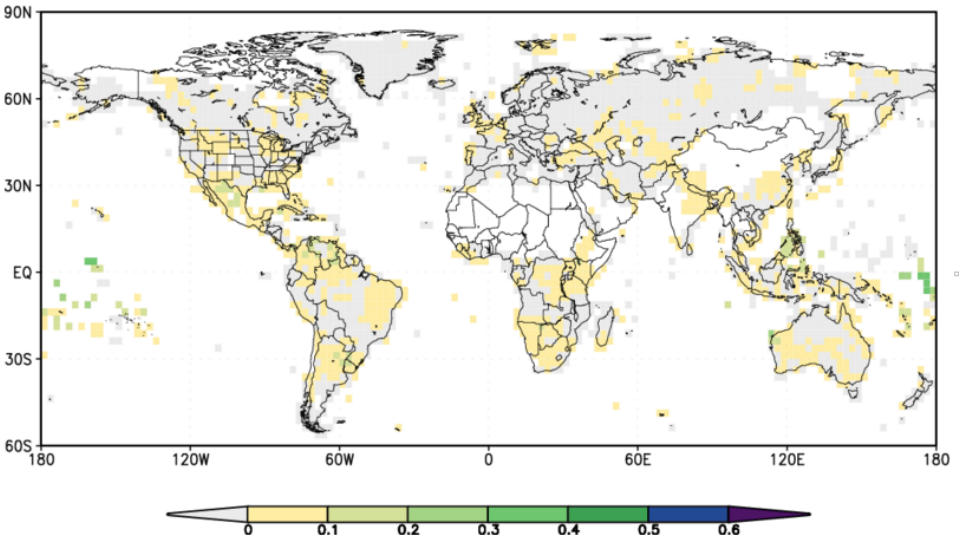
- Identify research and forecasting efforts needed to advance seasonal prediction for western water resources management (ultimately to allow support earlier management of water resources through application of forecasts with improving skill).
- Develop a proposal for advancing seasonal prediction for western water resources, including value proposition, knowledge gaps, and research questions.

Challenges

- Difficult science problem
- Institutional

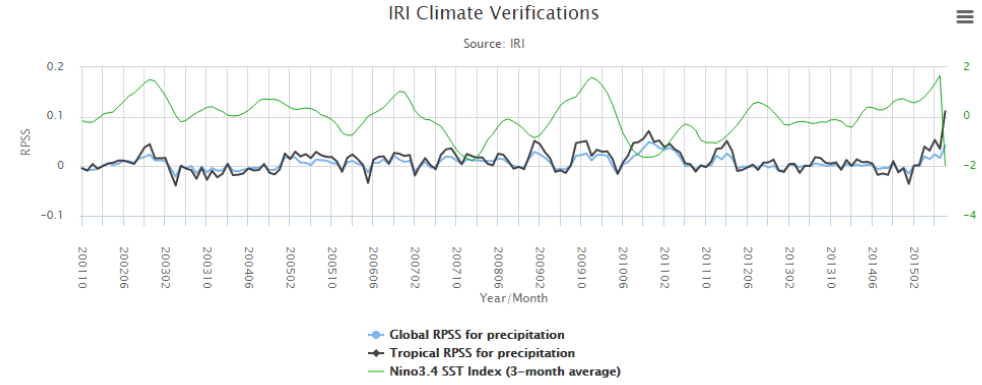
Recent Seasonal Forecast Verification

RPSS: Lead 1.5 months, Precipitation Forecast Skill: DJF



Gray indicates no (or negative) skill, Purple indicates highest skill.

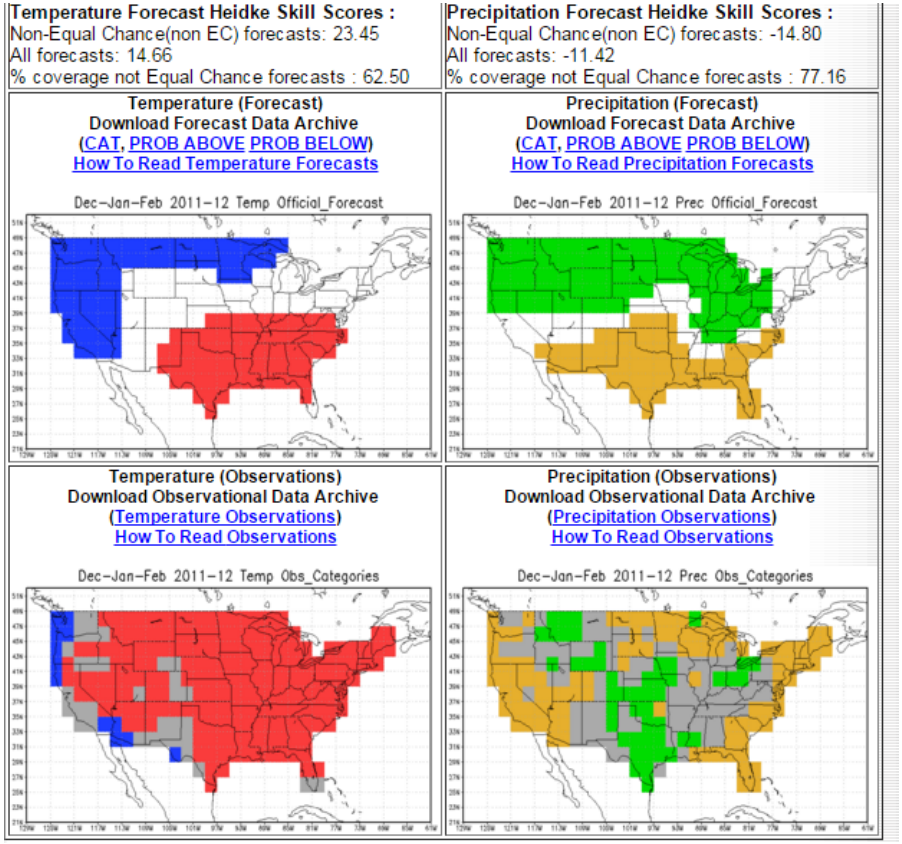
Individual Forecast Score



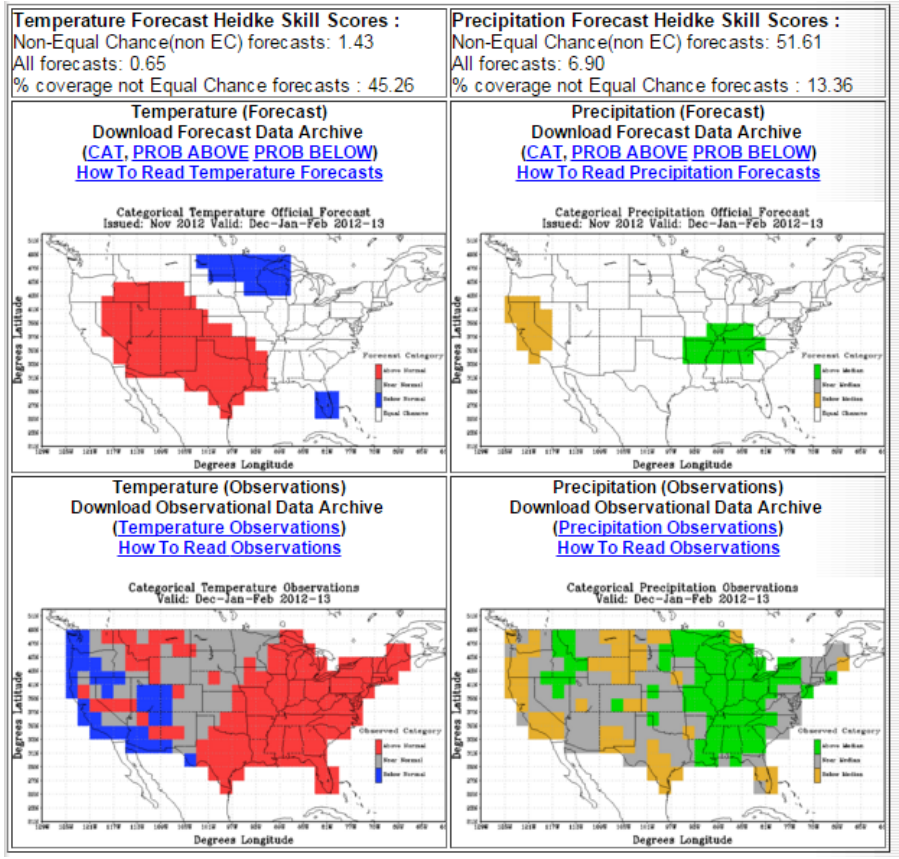
Source: IRI

Recent Seasonal Forecast Verification

DJF 2011/2012



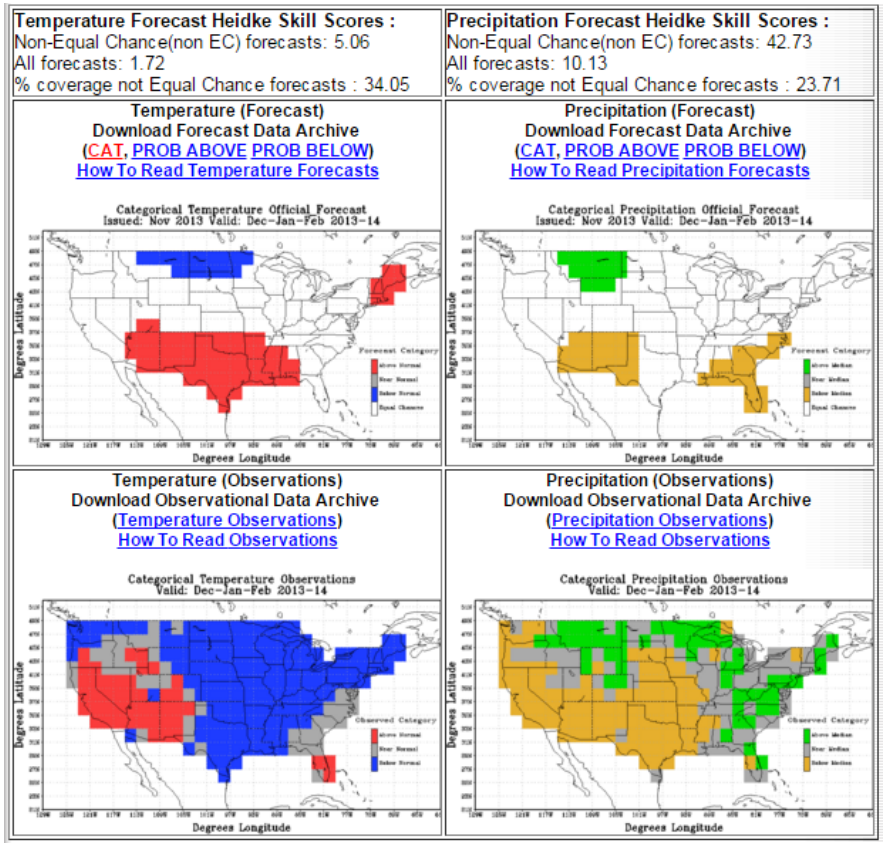
DJF 2012/2013



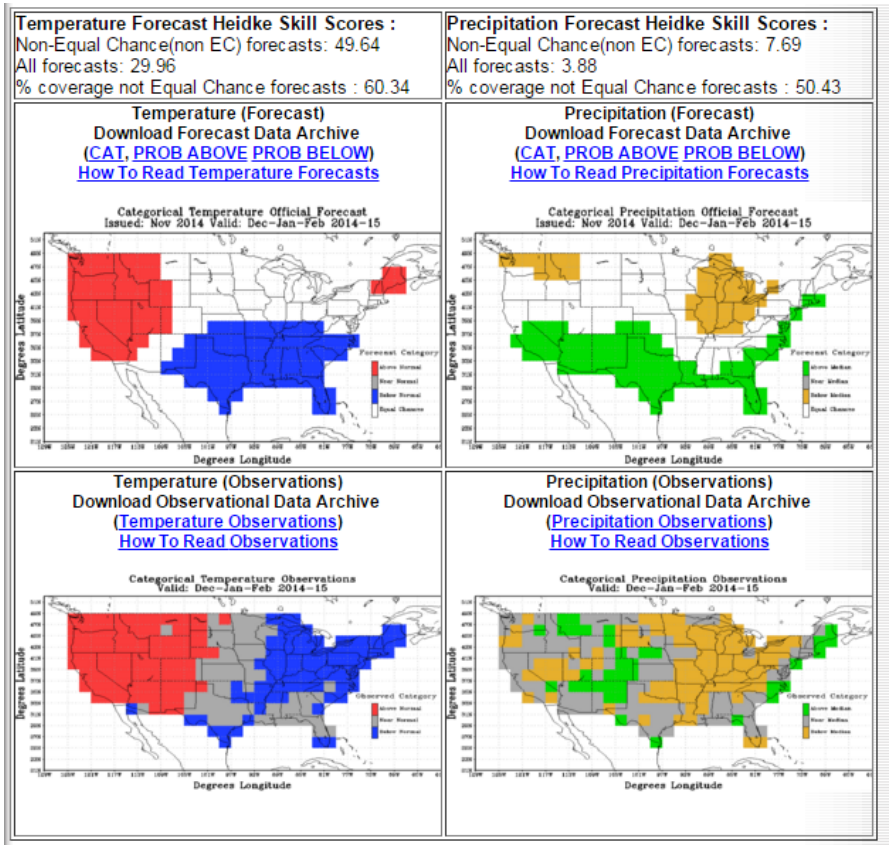
Source: CPC

Recent Seasonal Forecast Verification

DJF 2013/2014



DJF 2014/2015



Source: CPC

Agenda

- Background and Context
- Value Proposition
- Knowledge Gaps and Priority Research
- NWS Tour

Background and Context

- NOAA leadership perspective (Peter Colohan)
- Hurricane Forecast Improvement Project (Fred Toepfer)
- Seasonal Precipitation Forecast Improvement Project (Dave DeWitt)

Questions?