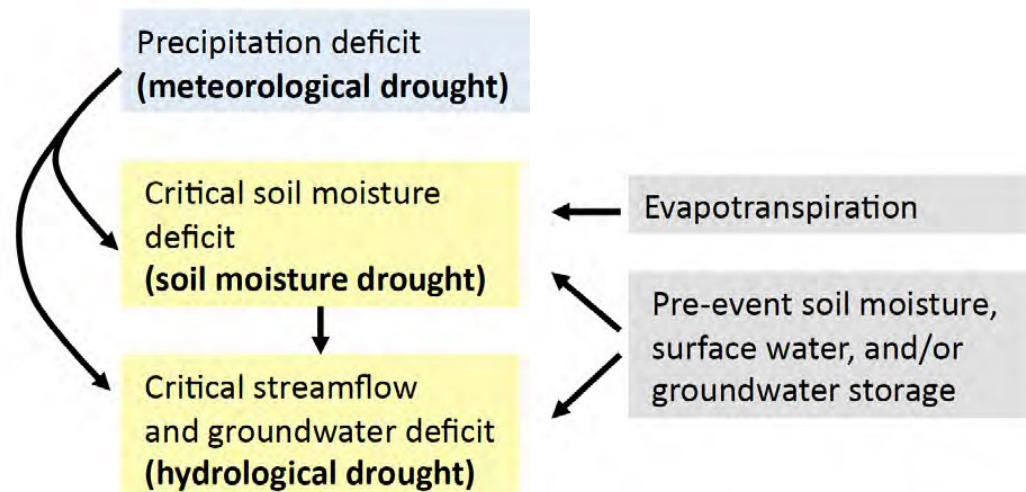
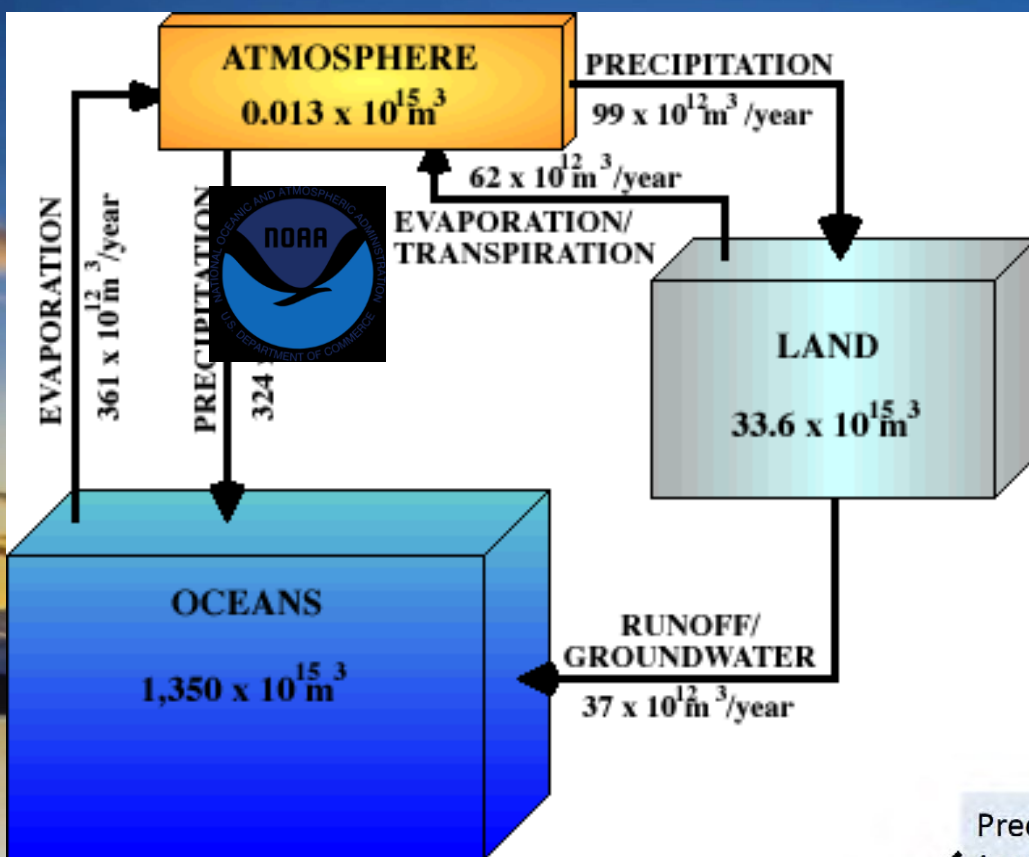
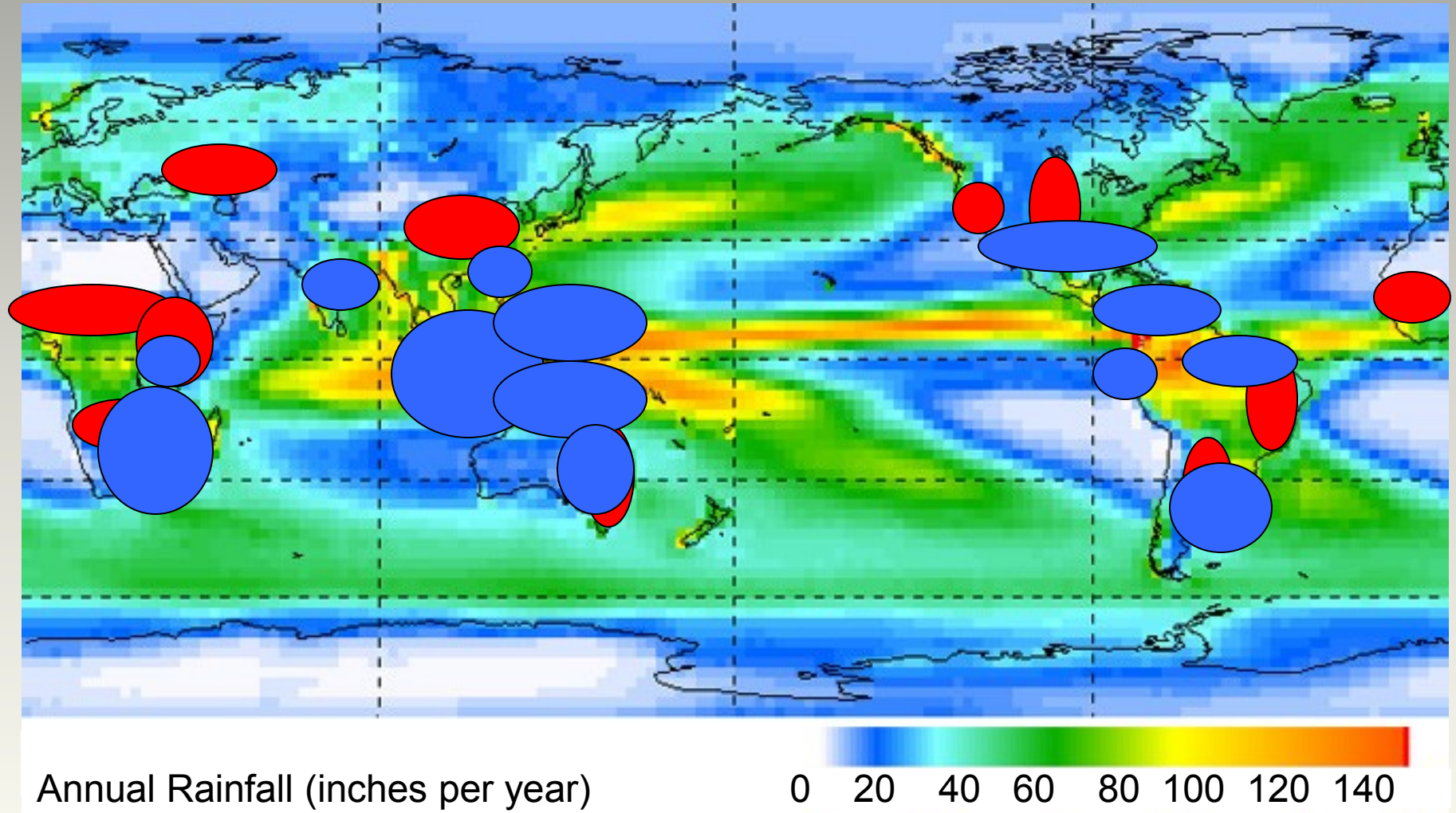


# U.S. Drought: Forecasting and Prediction

**Robert (Robin) Webb**  
Physical Sciences Division  
NOAA Research  
Boulder, Colorado

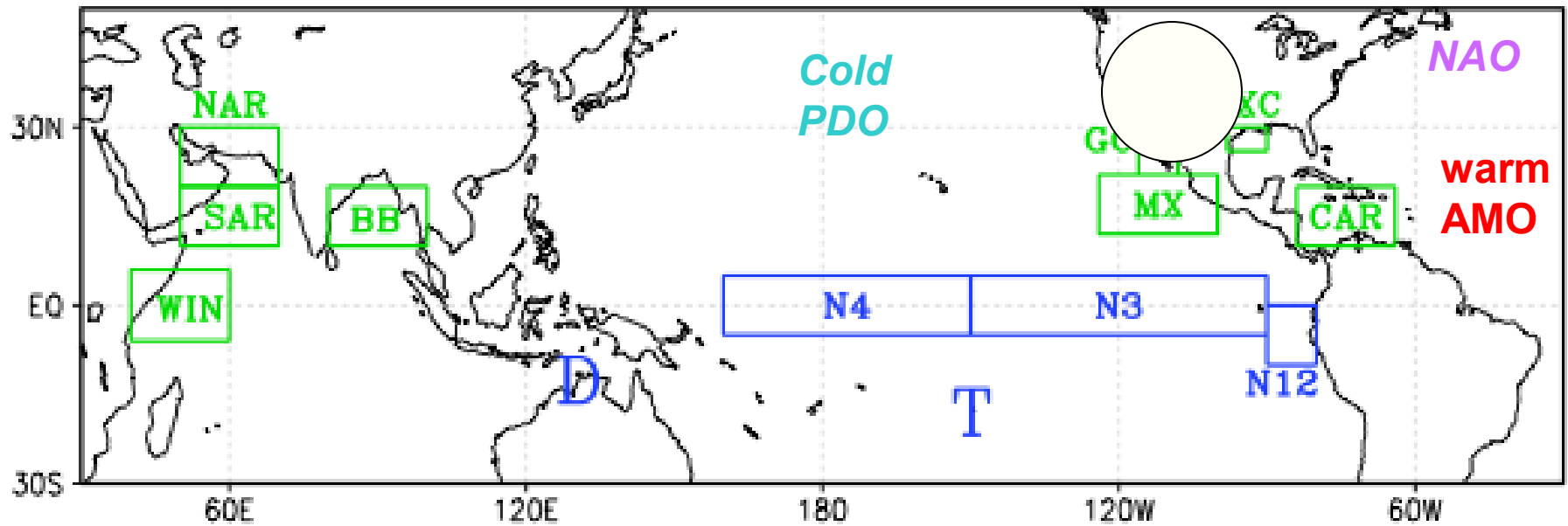


# Why do some places get more drought than others?

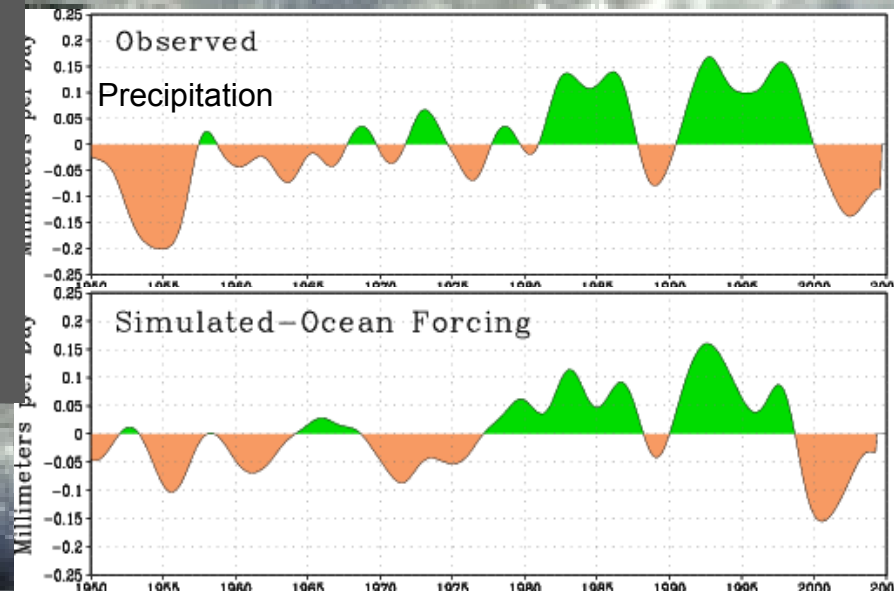


Rainfall tied to sea surface temperatures: ENSO

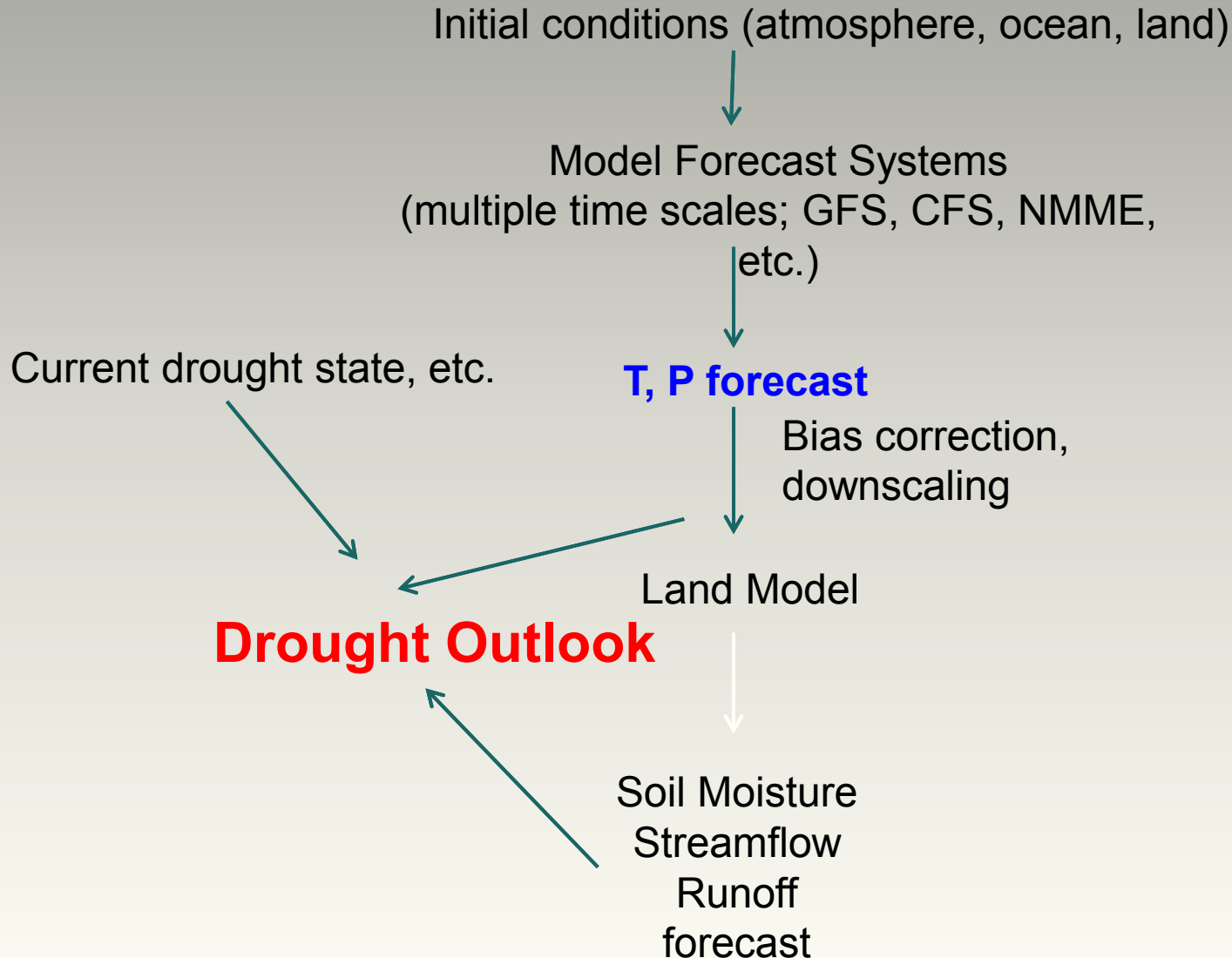
# Drought Early Warning-Useful monitoring regions for the US Southwest



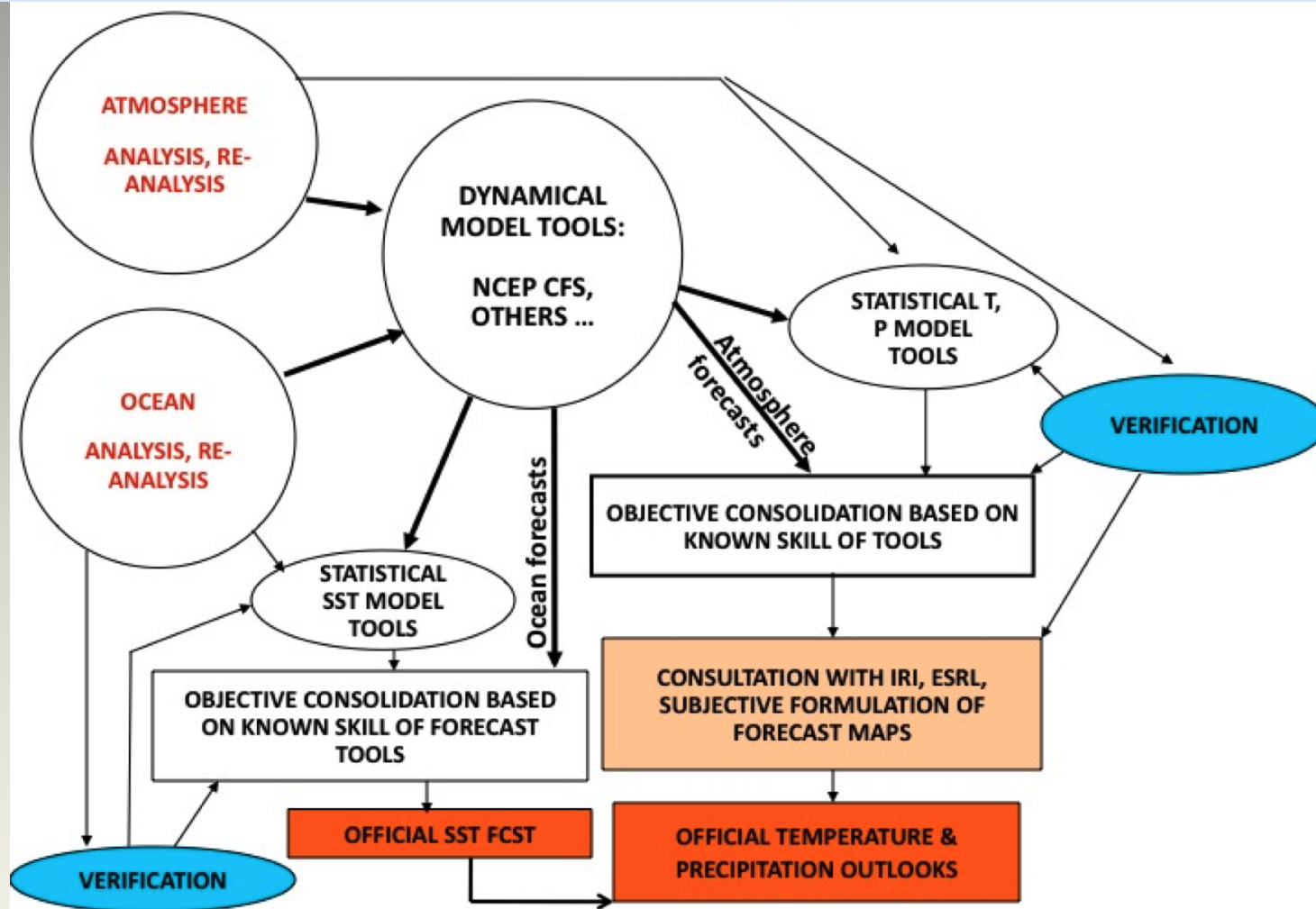
Improved monitoring and projections of the ocean surface temperatures are critical for the future predictions of drought in the semi-arid western USA.



# Drought Prediction: High-level Schematic Diagram



# NCEP-CPC Seasonal Forecast System

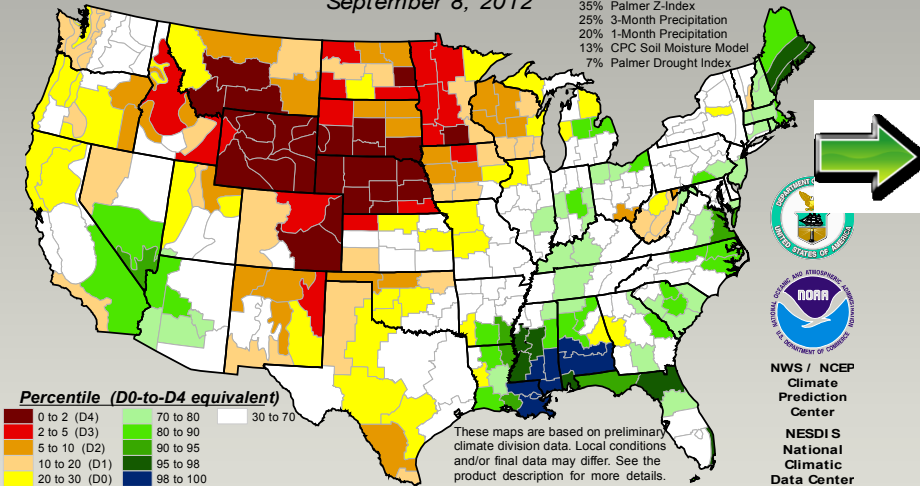


Graphical representation of the NCEP forecast system, showing the relationship among observations, climate system models, and data assimilation schemes as well as the steps where subjective judgment and verification are used.

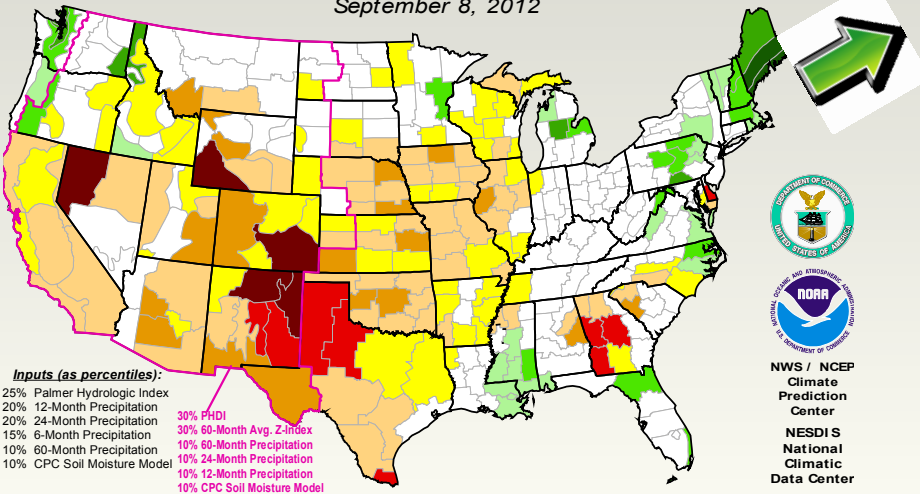
SOURCE: John Gottschalck, NCEP, personal communication.

# Bi-Weekly NOAA Drought Outlook Seasonal Assessment and Discussion

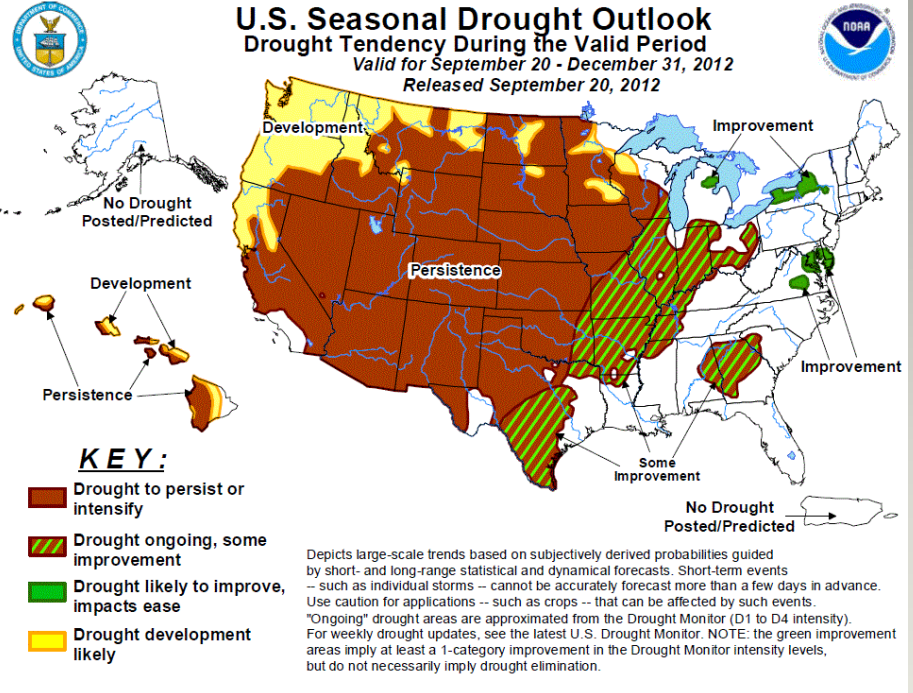
## Objective Short-Term Drought Indicator Blend Percentiles September 8, 2012



## Objective Long-Term Drought Indicator Blend Percentiles September 8, 2012



## U.S. Seasonal Drought Outlook Drought Tendency During the Valid Period Valid for September 20 - December 31, 2012 Released September 20, 2012

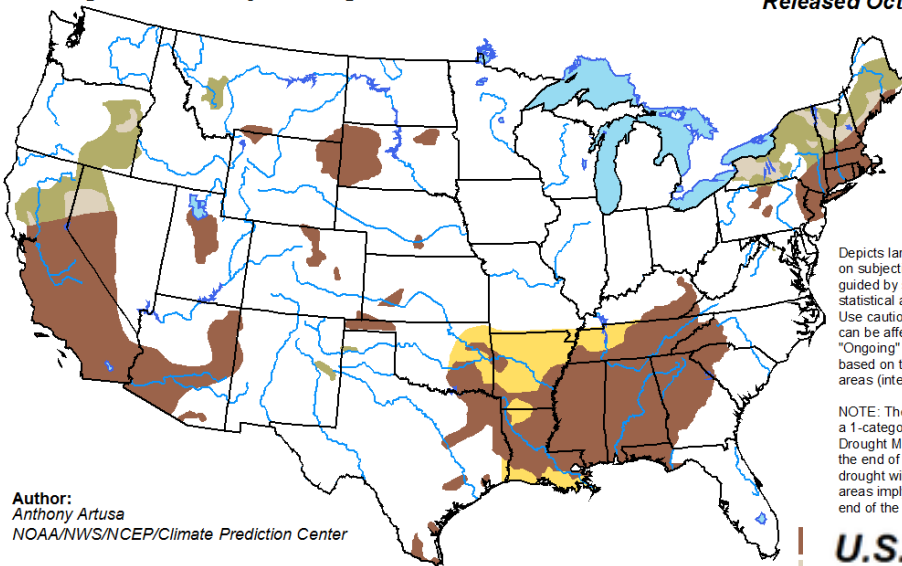


Tools include official CPC one month and seasonal temperature and precipitation outlooks, various medium- and short-range forecasts and models such as the 6-10 day and 8-14 day forecasts, the most recent 384-hour GFS total precipitation amounts, the soil moisture tools based on the Constructed Analog on Soil (CAS) moisture, the Climate Forecast System (CFS), the four-month Palmer drought termination and amelioration probabilities, climatology, initial conditions, and NLDAS

# U.S. Monthly Drought Outlook

## Drought Tendency During the Valid Period

Valid for November 2016  
Released October 31, 2016



Depicts large-scale trends based on subjectively derived probabilities guided by short- and long-range statistical and dynamical forecasts. Use caution for applications that can be affected by short lived events. "Ongoing" drought areas are based on the U.S. Drought Monitor areas (intensities of D1 to D4).

NOTE: The tan areas imply at least a 1-category improvement in the Drought Monitor intensity levels by the end of the period, although drought will remain. The green areas imply drought removal by the end of the period (D0 or none).

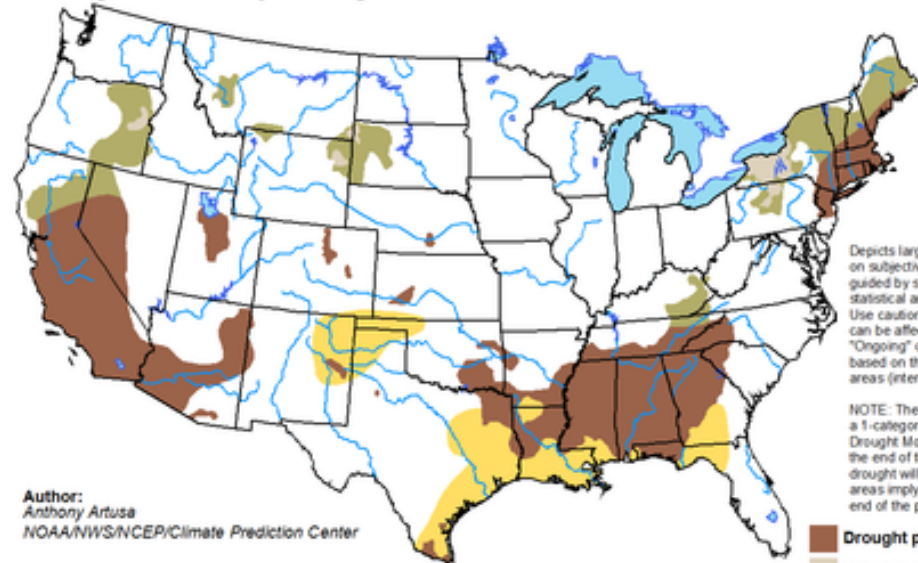
Author:  
Anthony Artusa  
NOAA/NWS/NCEP/Climate Prediction Center



# U.S. Seasonal Drought Outlook

## Drought Tendency During the Valid Period

Valid for October 20 - January 31, 2017  
Released October 20, 2016

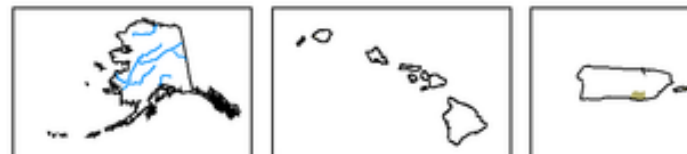


Depicts large-scale trends based on subjectively derived probabilities guided by short- and long-range statistical and dynamical forecasts. Use caution for applications that can be affected by short lived events. "Ongoing" drought areas are based on the U.S. Drought Monitor areas (intensities of D1 to D4).

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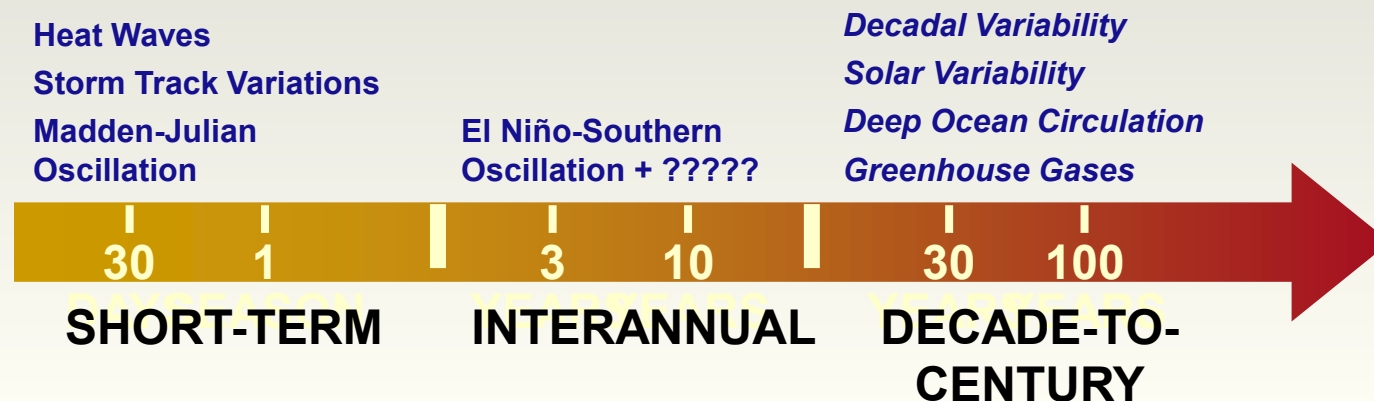
- Drought persists
- Drought remains but improves
- Drought removal likely
- Drought development likely



<http://go.usa.gov/3eZ73>

# Drought Forecasting Tools

- Updated Optimal Climate Normals (Temperature & Precipitation Trends)
- Improved Understanding of Drought and Ocean Conditions
- ENSO Plume Model Forecasts
- Improved Understanding of Drought and Land Conditions
- Reliability Conditioned on Decadal Variability
- National MultiModel Ensemble (NMME)
- Land-Data Assimilation System (LDAS)
- NOAA Drought Outlook
- Experimental Climate Divisions and Regional Drought Forecasts



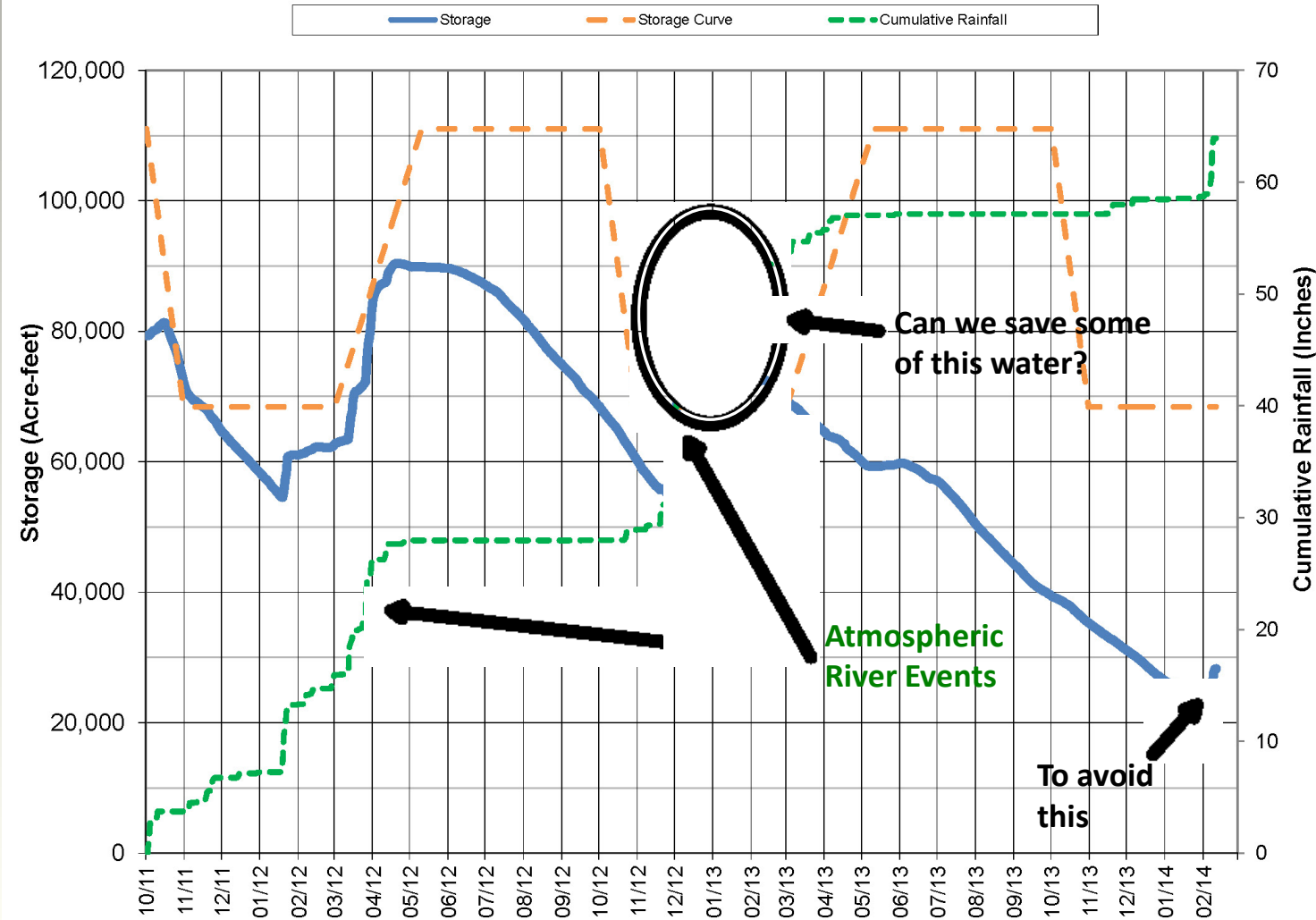
# Drought Forecasting and Prediction Priorities

- Simulations of climate variability and their impact on U.S. drought
  - ➔ How well do operational systems exploit known climate variability - drought relationships?
- Flash droughts
  - ➔ Subseasonal to seasonal timescales- Are some flash droughts more predictable than others? Why is this the case?
- Post-processing strategies
  - ➔ Can precipitation predictions, drought forecasts be improved by methodologies utilizing large scale model information and downscaling?
- Land initial conditions and modeling
  - ➔ Need for continuous incorporation of the latest state of the art land surface datasets in operational modeling platforms
- Communication and linkages
  - ➔ Maintain iterative dialogue with operational forecasters

# Forecast Informed Reservoir Operations (FIRO)

***Improved use of forecast guidance to optimize the availability of water resources without increasing flood risk***

Lake Mendocino Water Years 2012 - 2014



*Near-term  
incorporate  
skillful and  
reliable  
forecasts for  
periods of low  
risk of heavy  
rainfall events*

*Long-term  
incorporate  
skillful and  
reliable  
forecasts for  
the location  
and intensity of  
extreme  
rainfall events*