Monitoring Drought and Its Impacts

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Outline

- Trying to define drought
- Trying to measure drought
- Trying to predict drought
- Trying not to give up completely

Definitions of drought

- Surprisingly hard to define
- Let us consult the Oracle…

Definitions of Drought

- Wikipedia:
  - **Drought** is an extended period of months or years when a region notes a deficiency in its water supply whether surface or underground water. Generally, this occurs when a region receives consistently below average precipitation.

Measuring Drought

Weather and climate variability

Are weather and climate the cause of the deficiency?

How did weather and climate cause the deficiency?

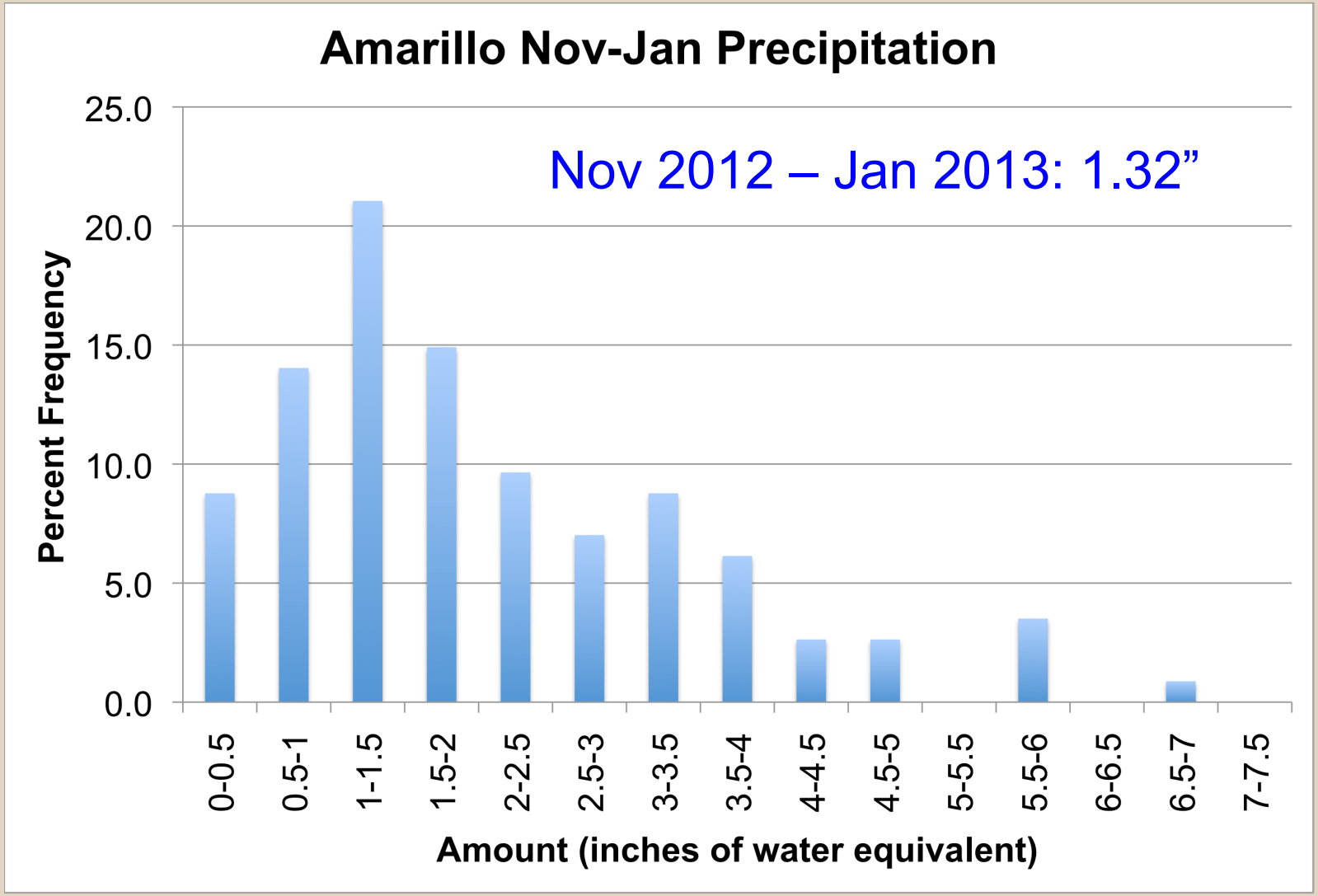
Consequences of water deficiency

Measuring Drought

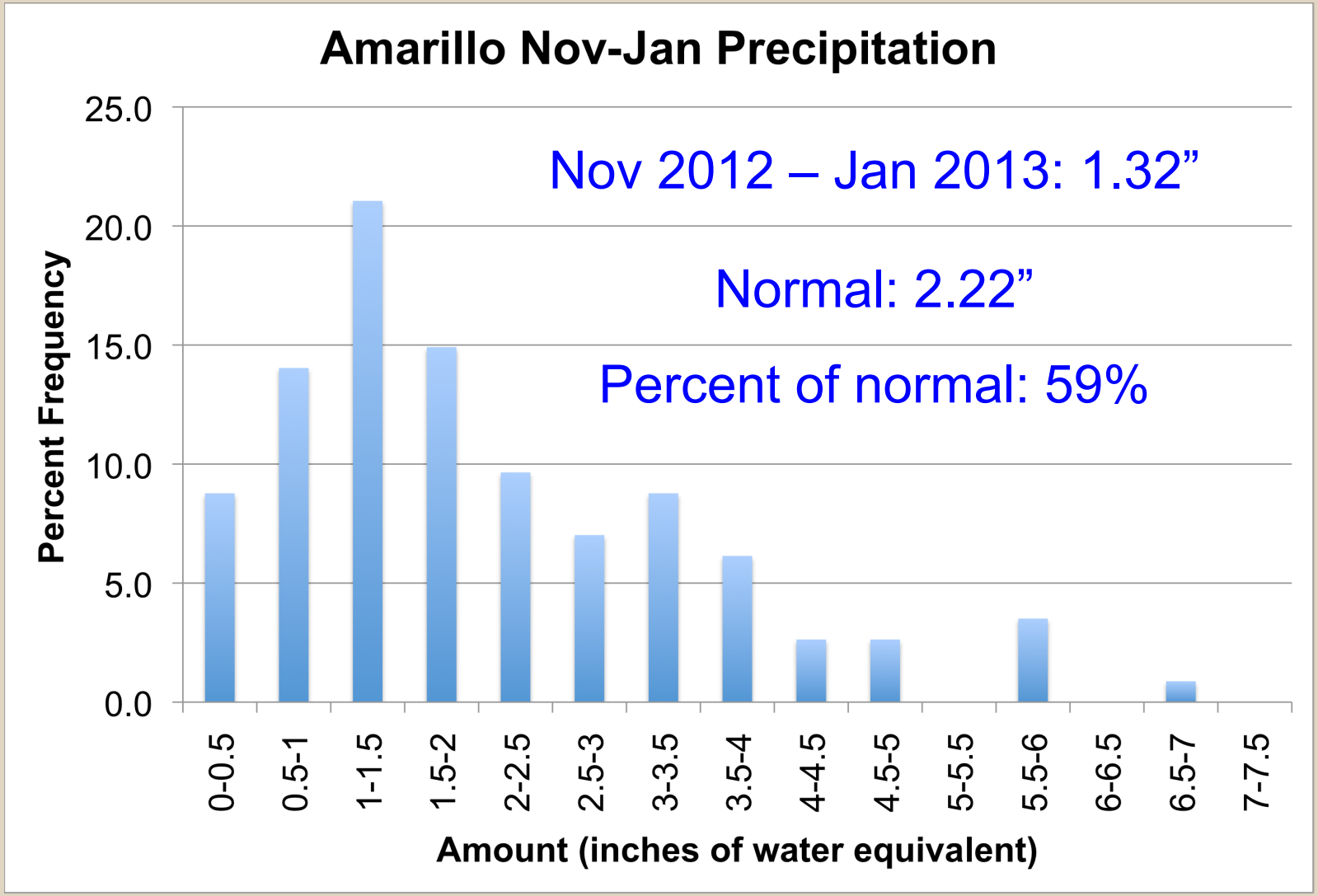
Weather and climate variability

Winter wheat in the Panhandle

Measuring Drought



Measuring Drought



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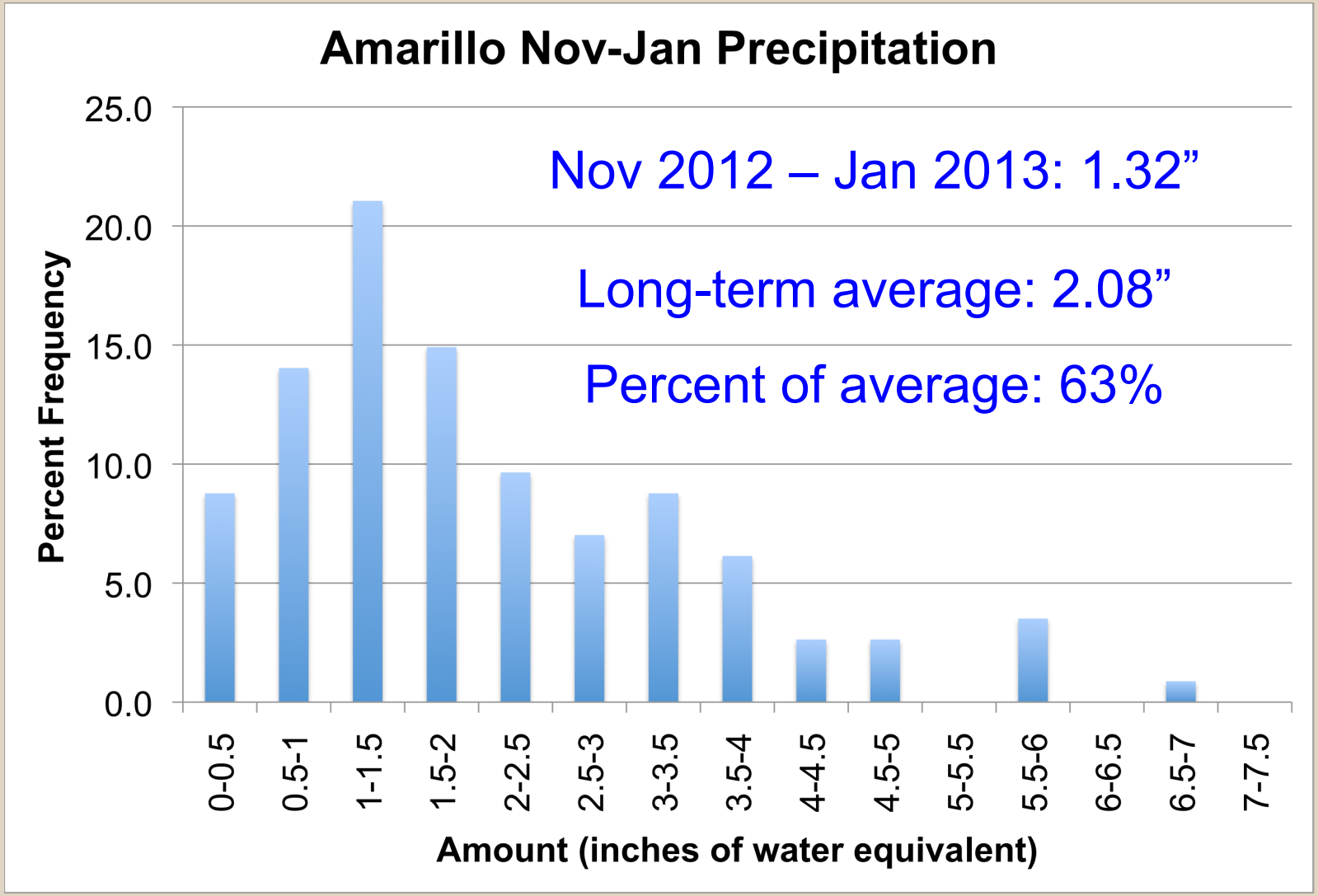

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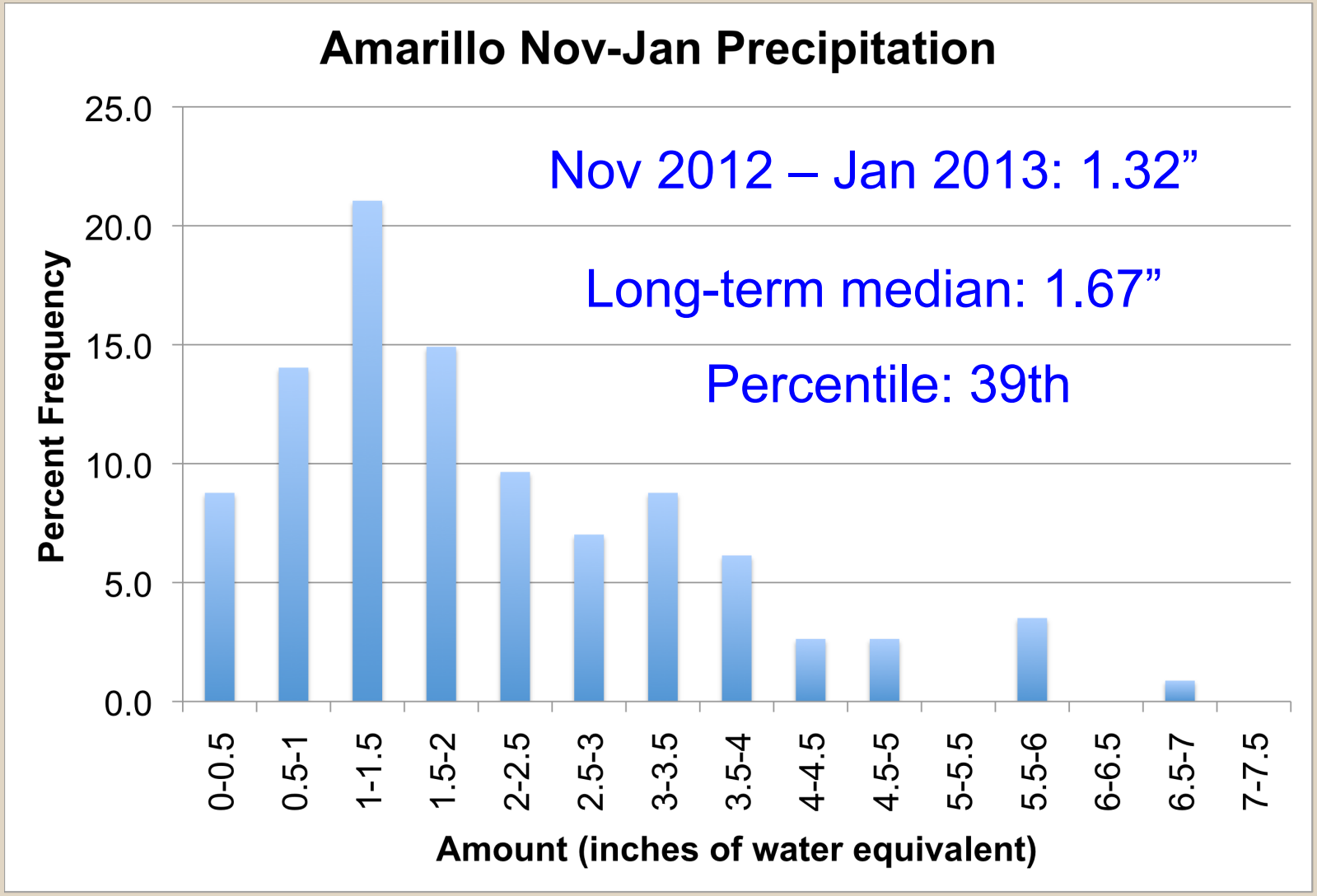
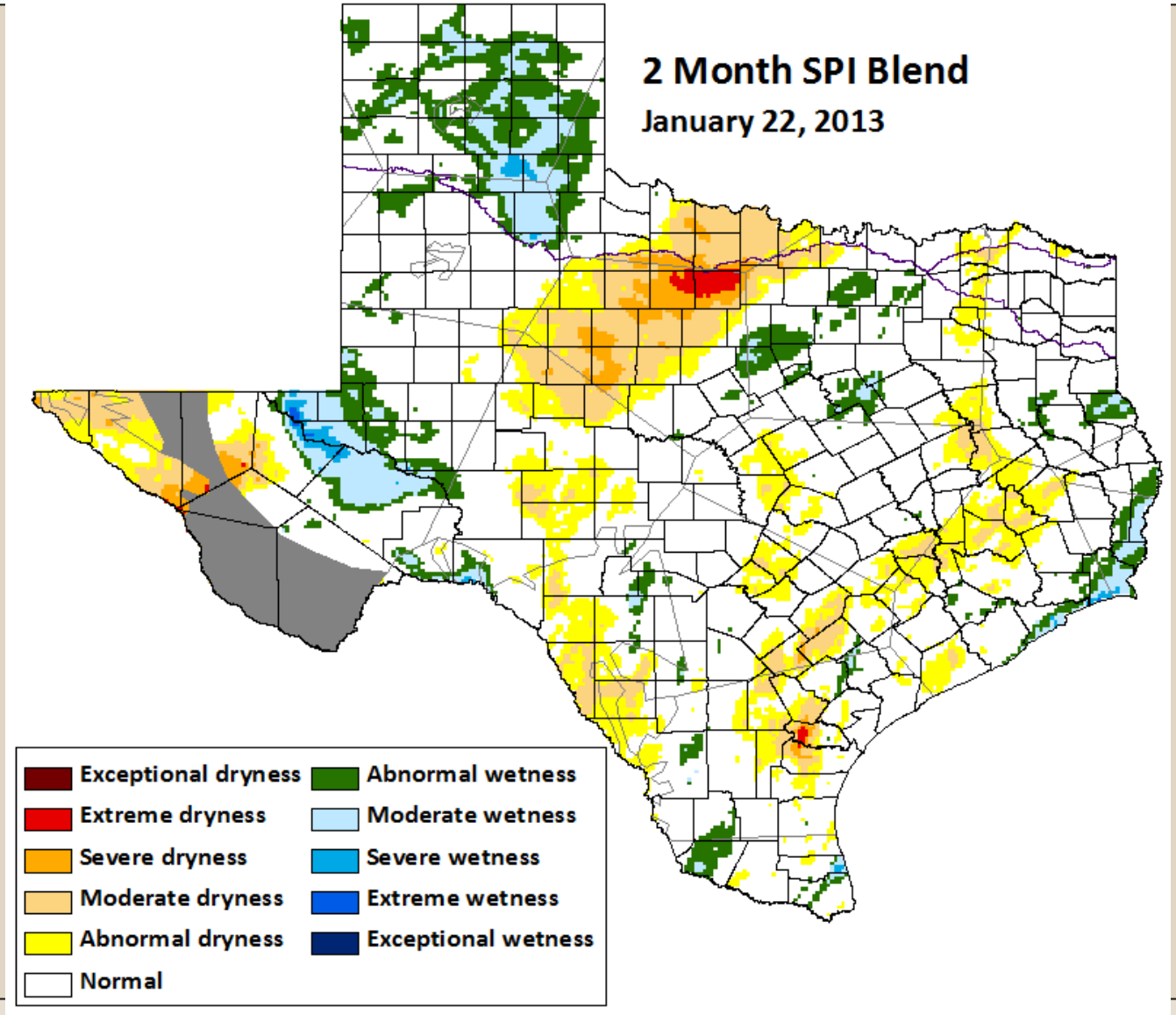


http://atmo.tamu.edu/osc/drought



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- Product inputs
  - Stage 4 MPE radar-gauge analyses
  - PRISM high-resolution climatology
  - COOP network statistical variability
- Coming soon
  - Additional bias correction
  - Expansion to S and E United States

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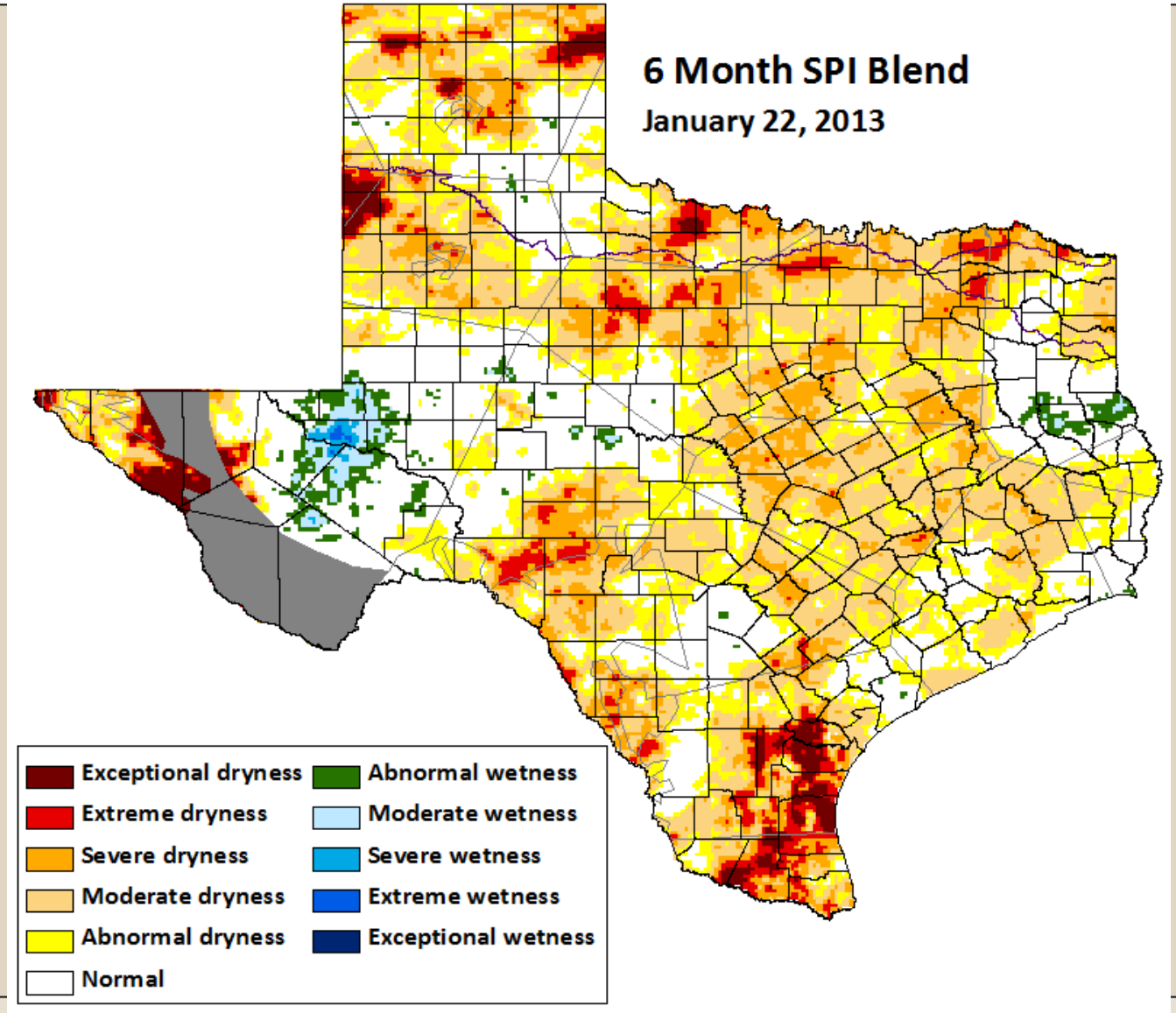

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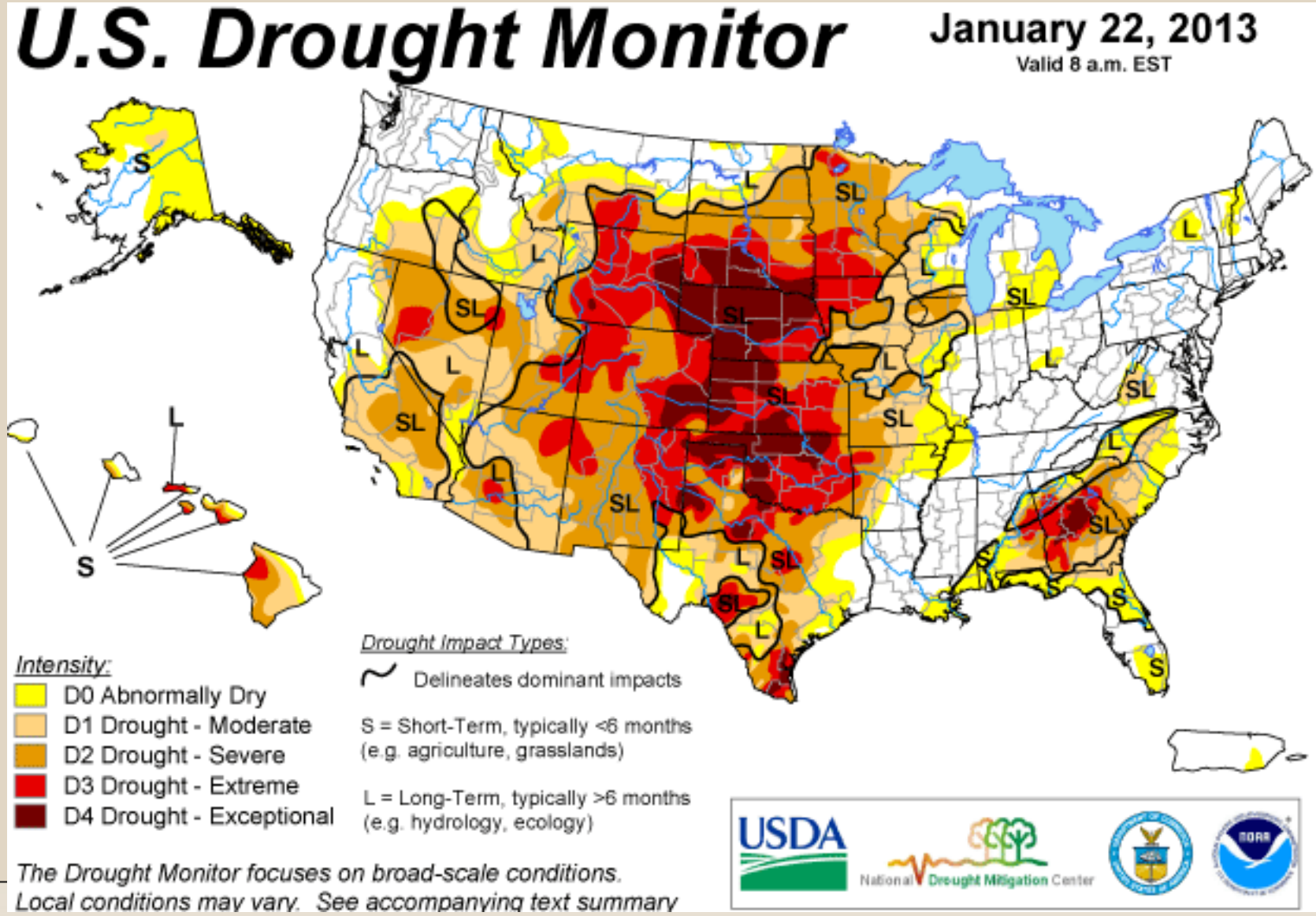


Measuring Drought

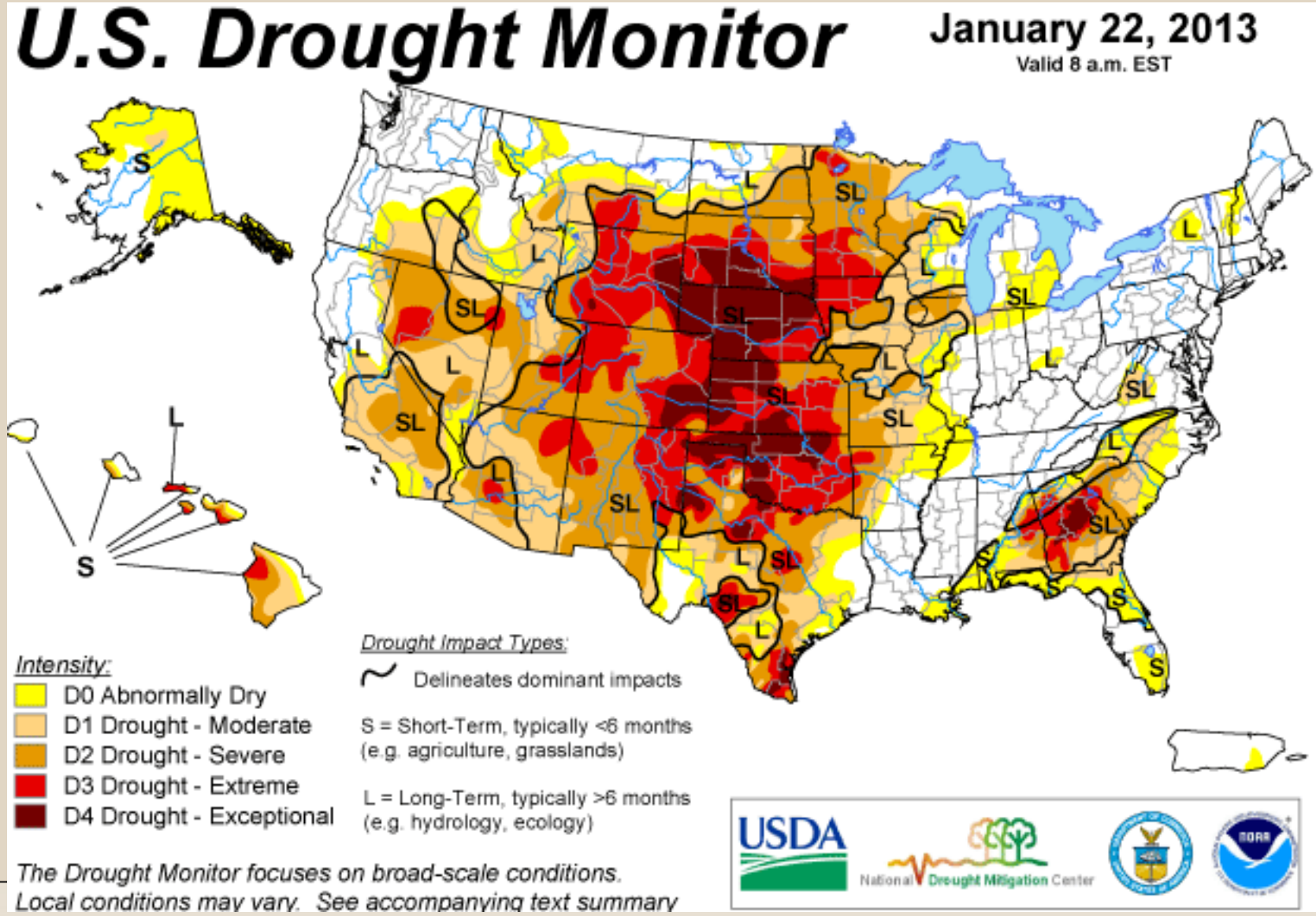
Drought Severity Classification

			Ranges			
Category	**Description**	**Possible Impacts**	**Palmer Drought Index**	**CPC Soil Moisture Model (Percentiles)**	**USGS Weekly Streamflow (Percentiles)**	**Standardized Precipitation Index (SPI)**
D0	Abnormally Dry	Going into drought: short-term dryness slowing planting, growth of crops or pastures. Coming out of drought: some lingering water deficits; pastures or crops not fully recovered	-1.0 to -1.9	21-30	21-30	-0.5 to -0.7
D1	Moderate Drought	Some damage to crops, pastures; streams, reservoirs, or wells low, some water shortages developing or imminent; voluntary water-use restrictions requested	-2.0 to -2.9	11-20	11-20	-0.8 to -1.2
D2	Severe Drought	Crop or pasture losses likely; water shortages common; water restrictions imposed	-3.0 to -3.9	6-10	6-10	-1.3 to -1.5
D3	Extreme Drought	Major crop/pasture losses; widespread water shortages or restrictions	-4.0 to -4.9	3-5	3-5	-1.6 to -1.9
D4	Exceptional Drought	Exceptional and widespread crop/pasture losses; shortages of water in reservoirs, streams, and wells creating water emergencies	-5.0 or less	0-2	0-2	-2.0 or less

Question

- D4 “Exceptional Drought” corresponds to the <2 percentile of drought severity. What percent of the time should D4 conditions occur in a particular location?
- Answer: From 0% to ~5%, depending on the location!

Measuring Drought



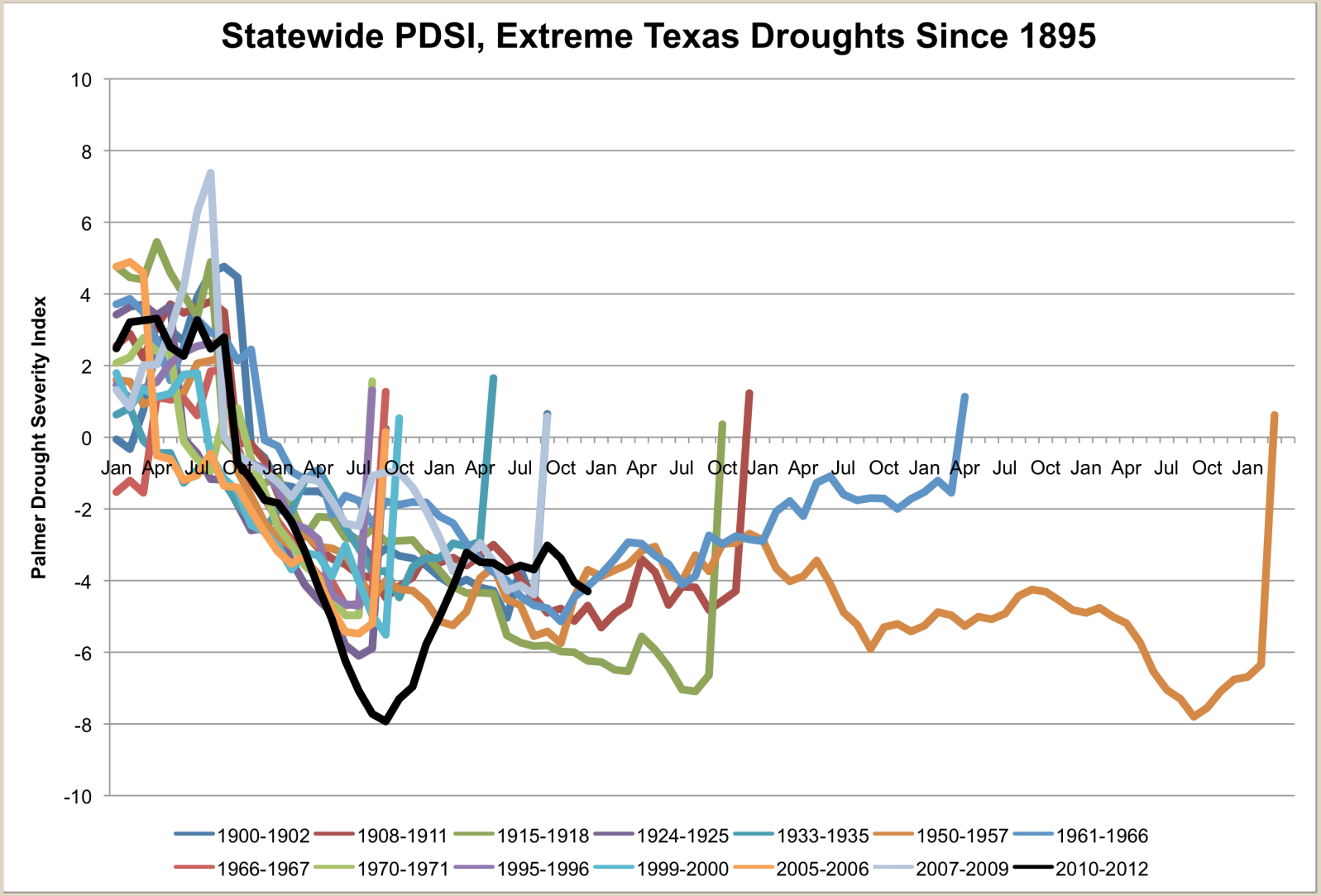
Measuring Drought

- No drought indices will correlate perfectly with the impact you care about
  - …but some will be better than others
- SPI and SPI blend use precipitation
- What about temperature?
  - Water availability: added - removed

Measuring Drought

- Classic precipitation + temperature index: Palmer Drought Severity Index
  - Estimates potential evapotranspiration
  - Temperature rules
- Also: SPEI
- The wrong estimate of E can cause problems

PDSI and Texas Droughts



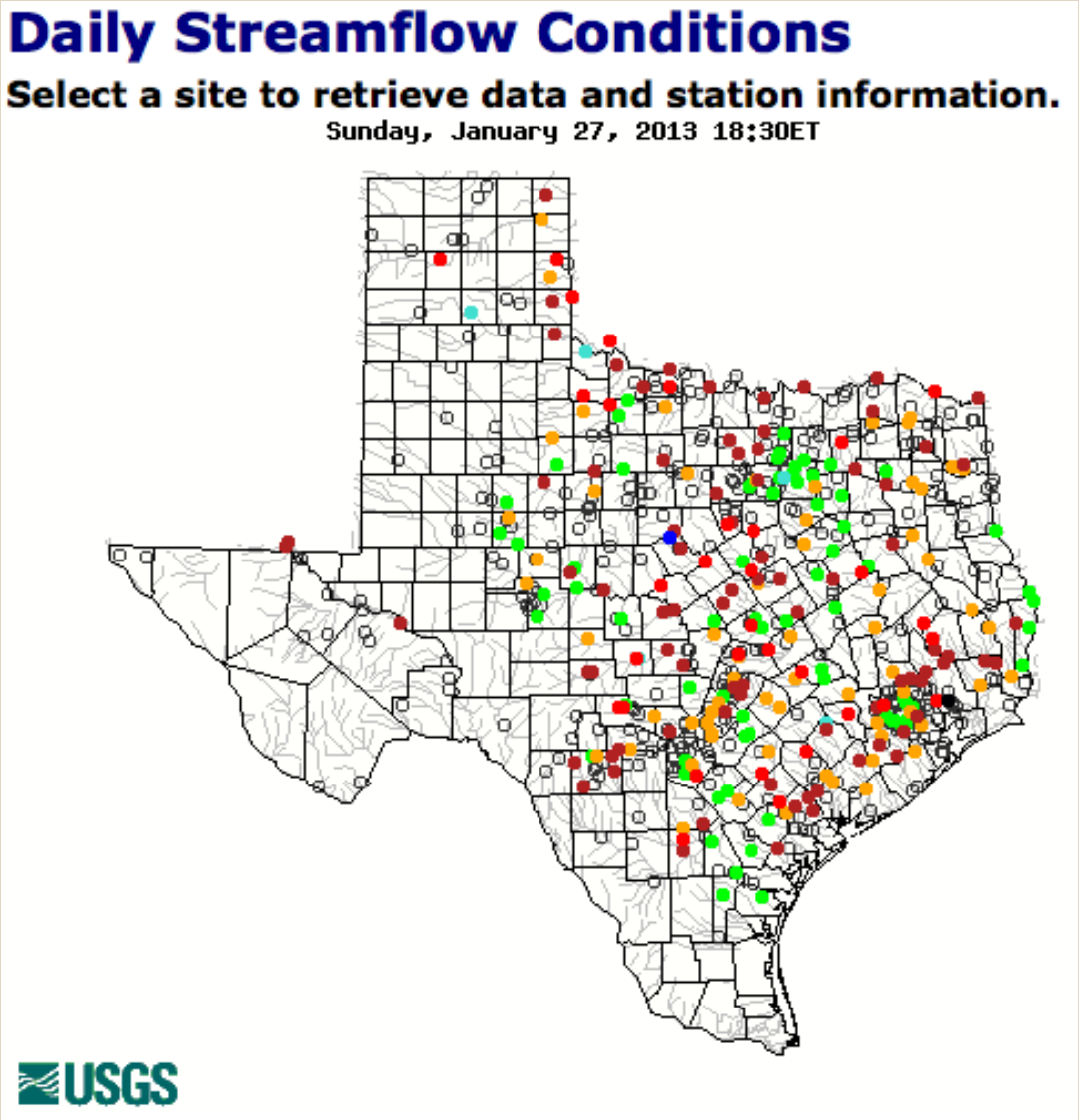
Measuring Drought

- Why rely on drought indices when you can cut to the chase?
  - Direct simulation of soil conditions with LSM
  - Use historic simulations for PDF
  - Direct simulation of streamflow with hydrologic model
  - Direct simulation of reservoir levels with reservoir management model

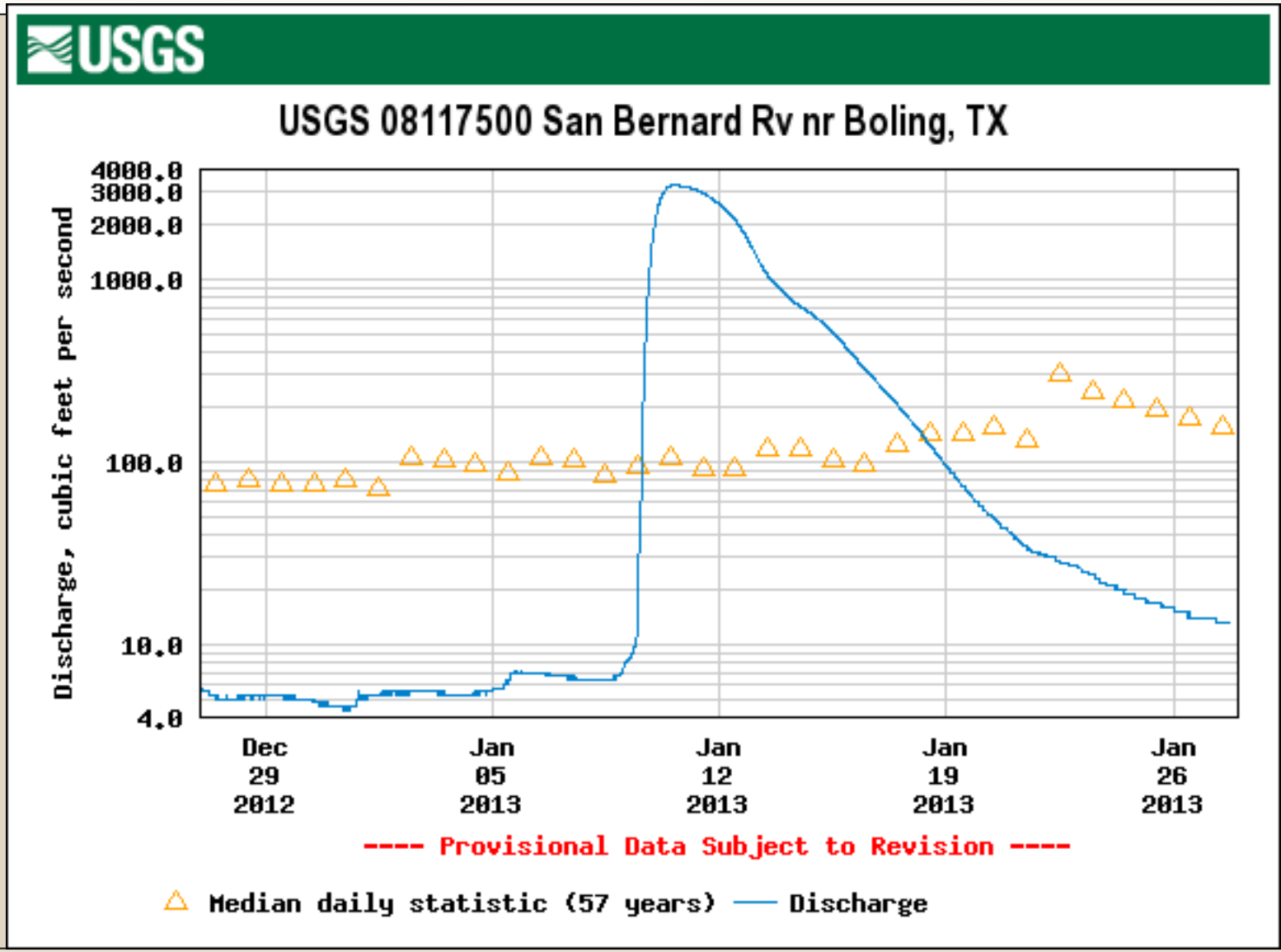
Measuring Drought

- Why rely on models?
  - Satellite observations of vegetation health
  - Streamflow observations
  - Current reservoir levels

USGS Streamflow



USGS Streamflow



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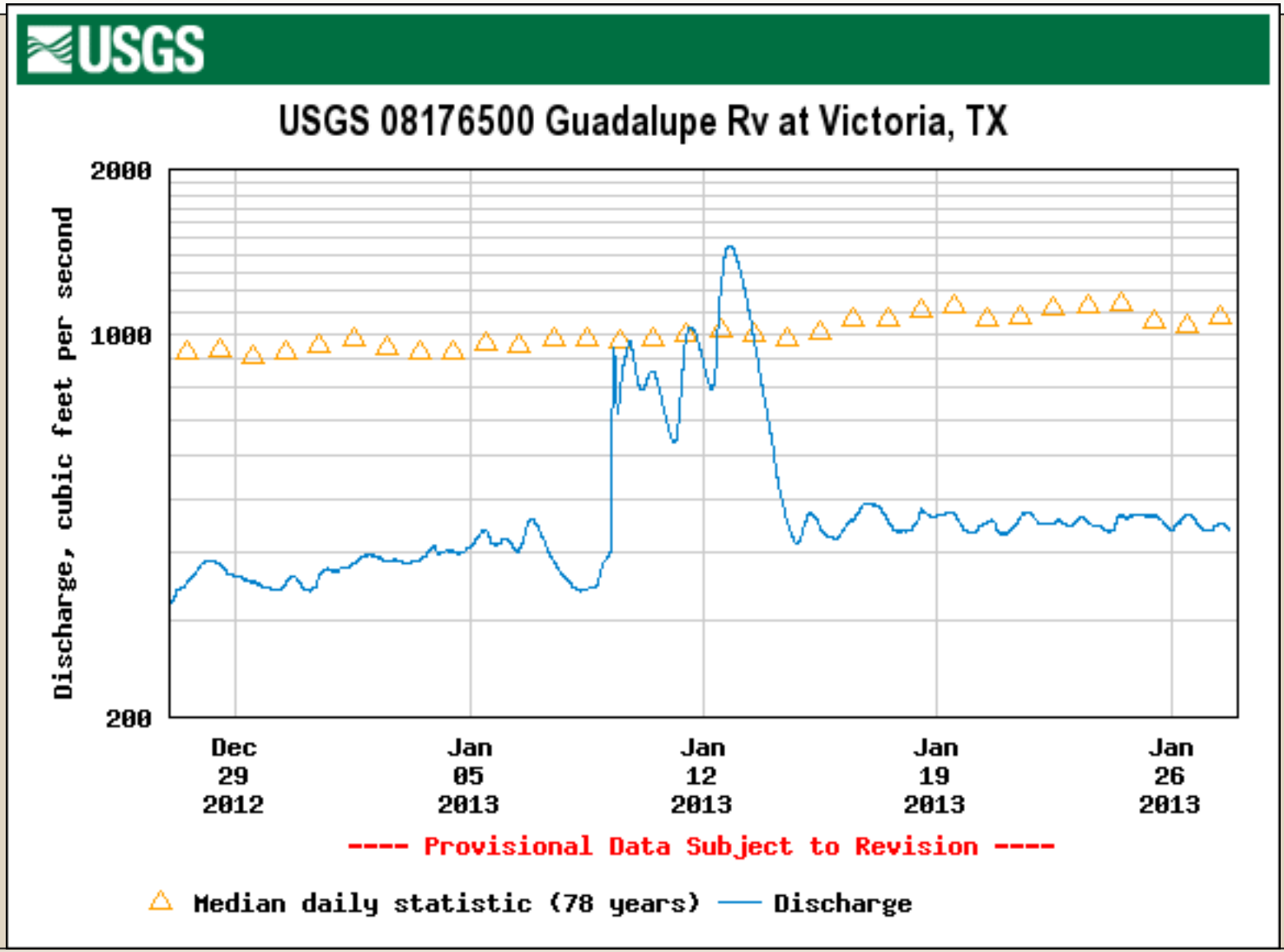
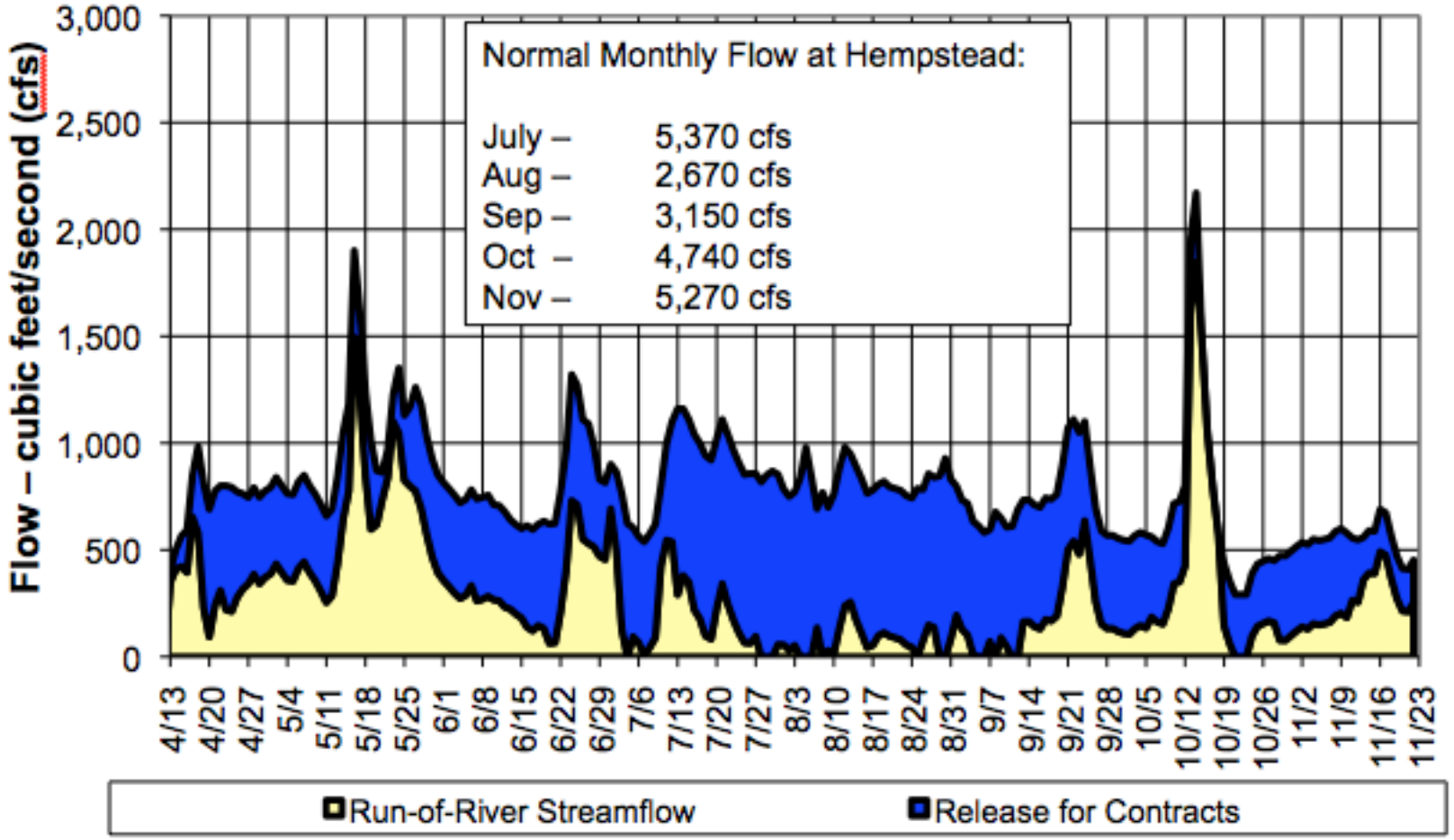


Brazos River Authority

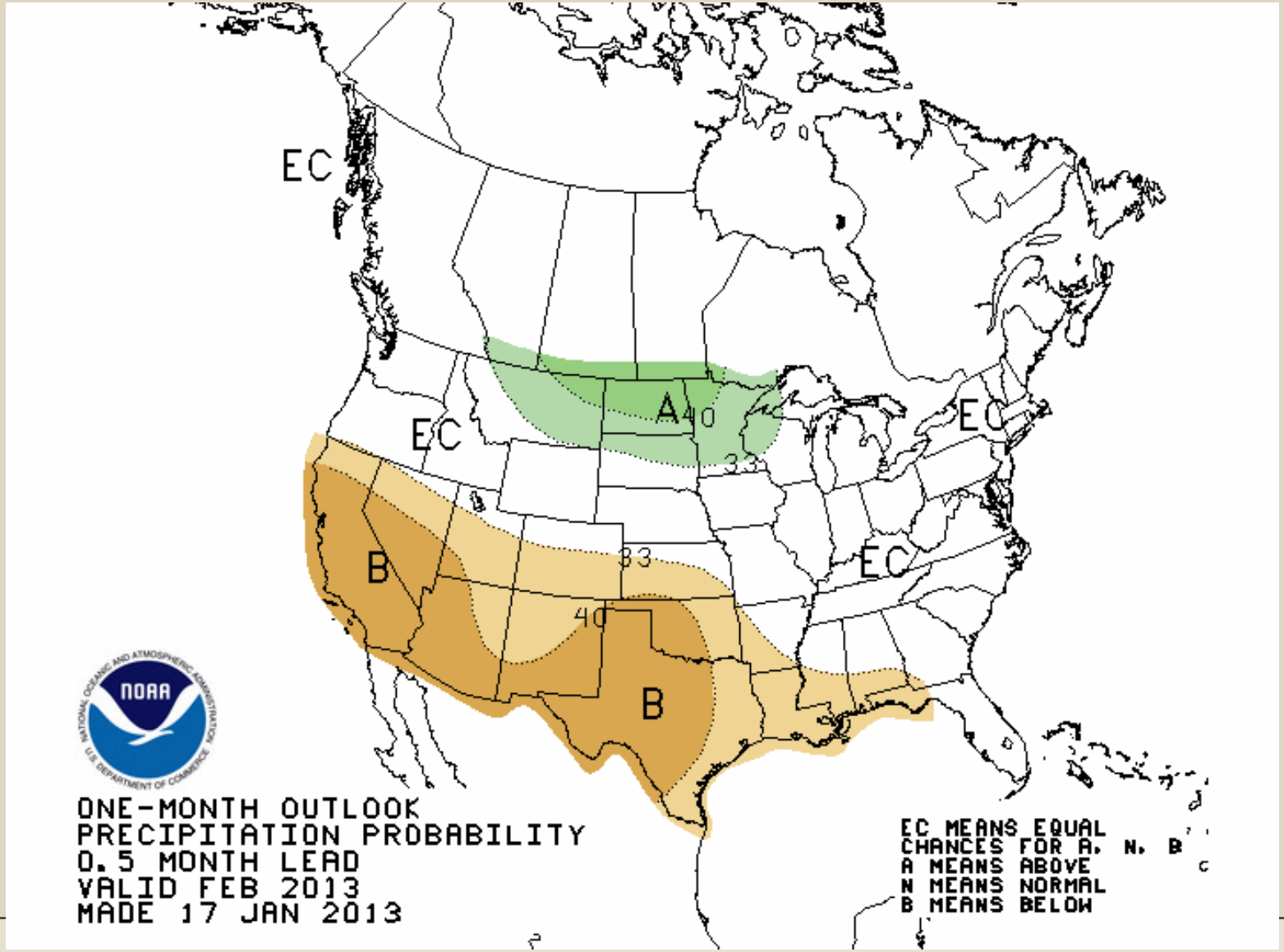
Reservoir Releases Dominate Streamflow
Brazos River near Hempstead



What do you care about?

- The severity of the meteorological drought
- The severity of the actual temperatures and inflows
- Impact of future climate change: it's not just meteorological

Trying to Predict Drought



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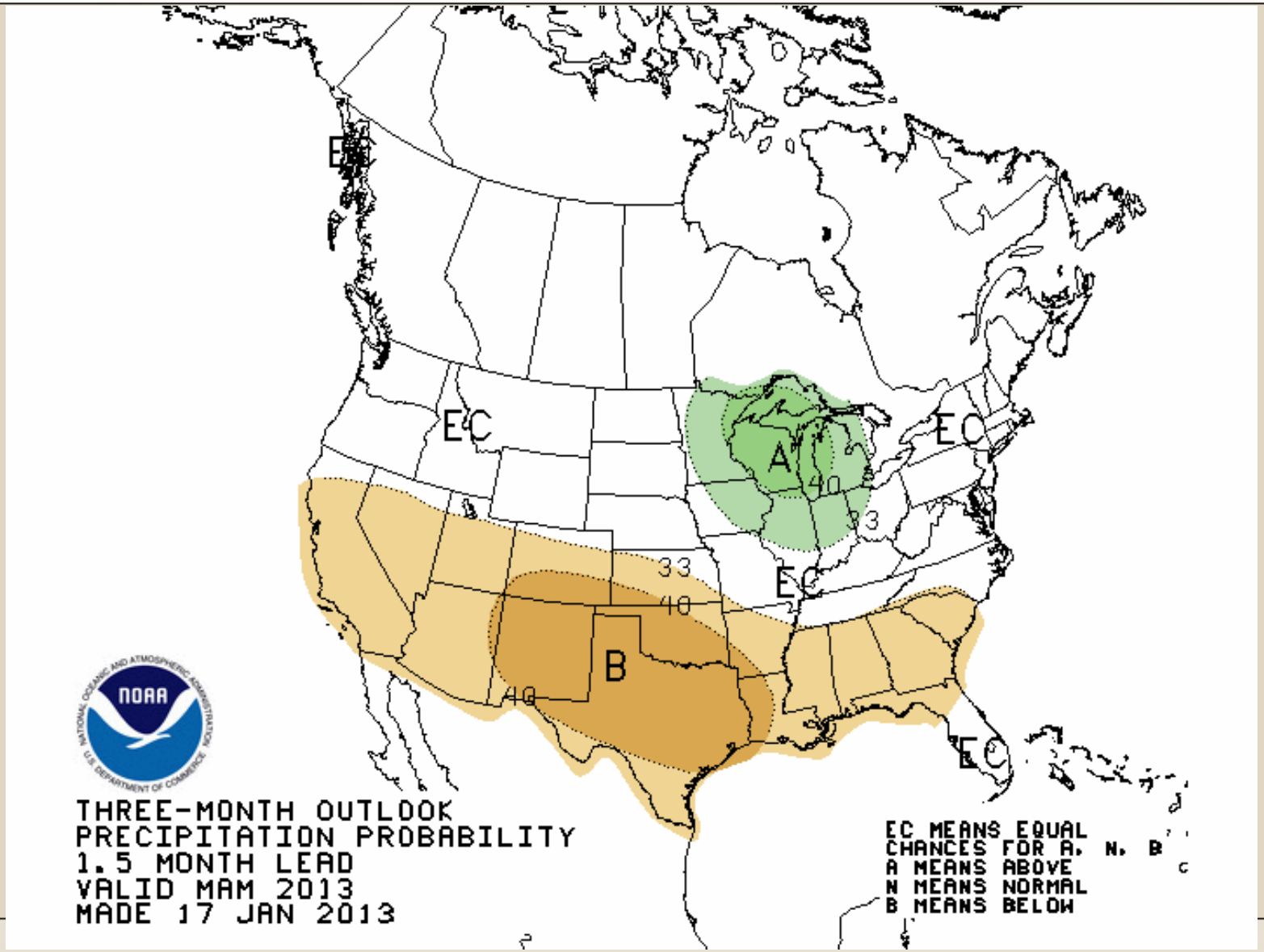

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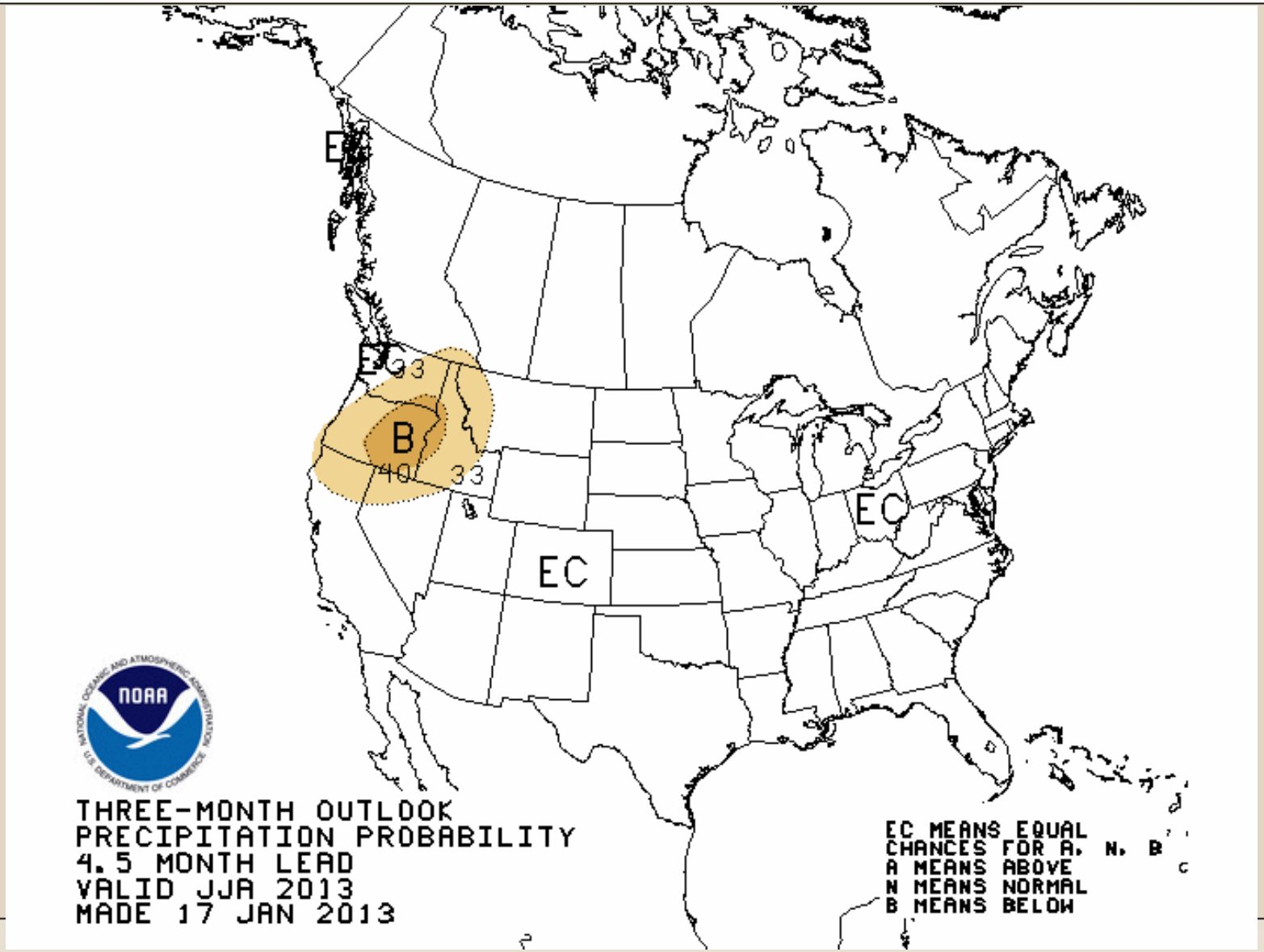

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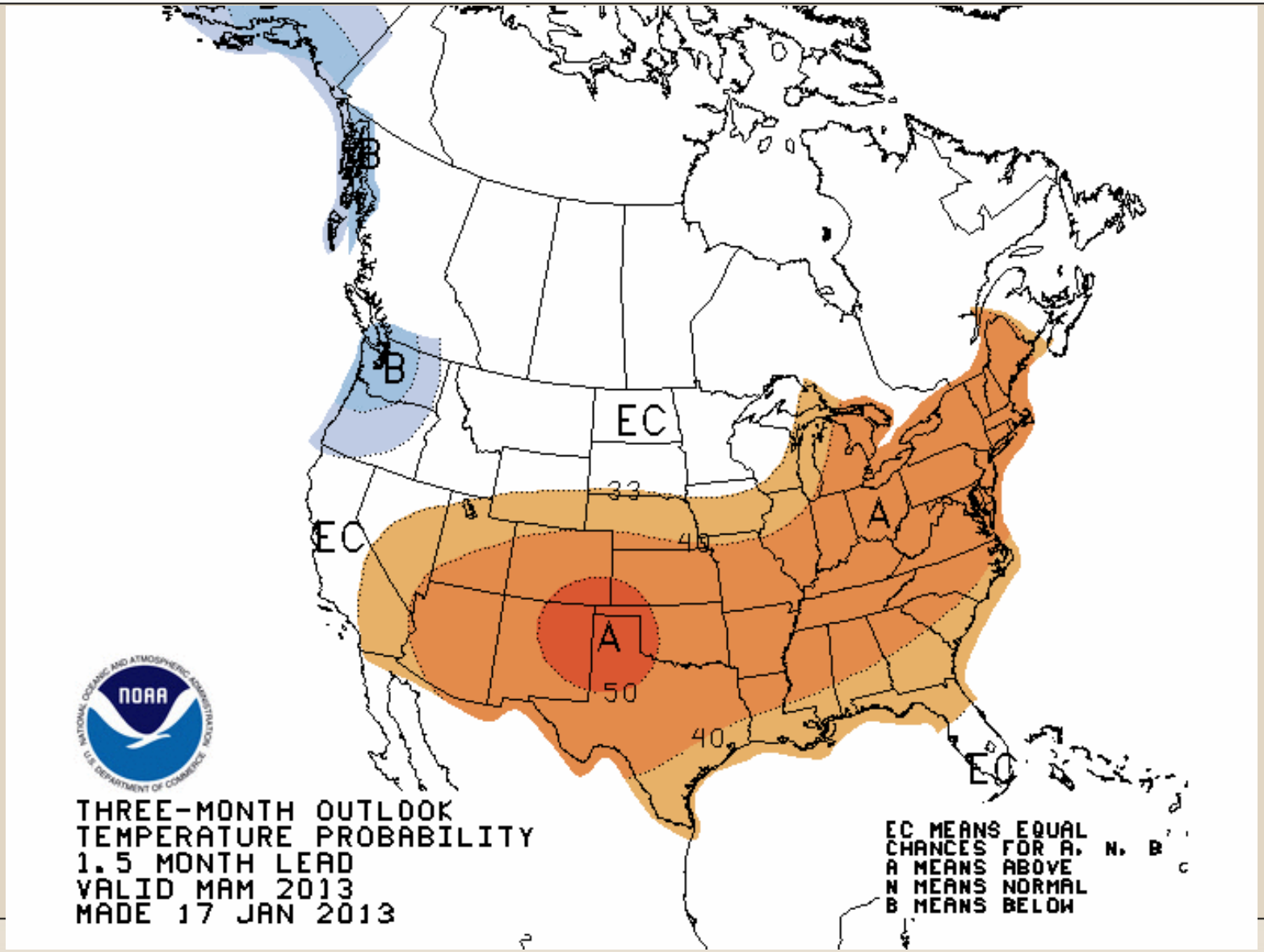

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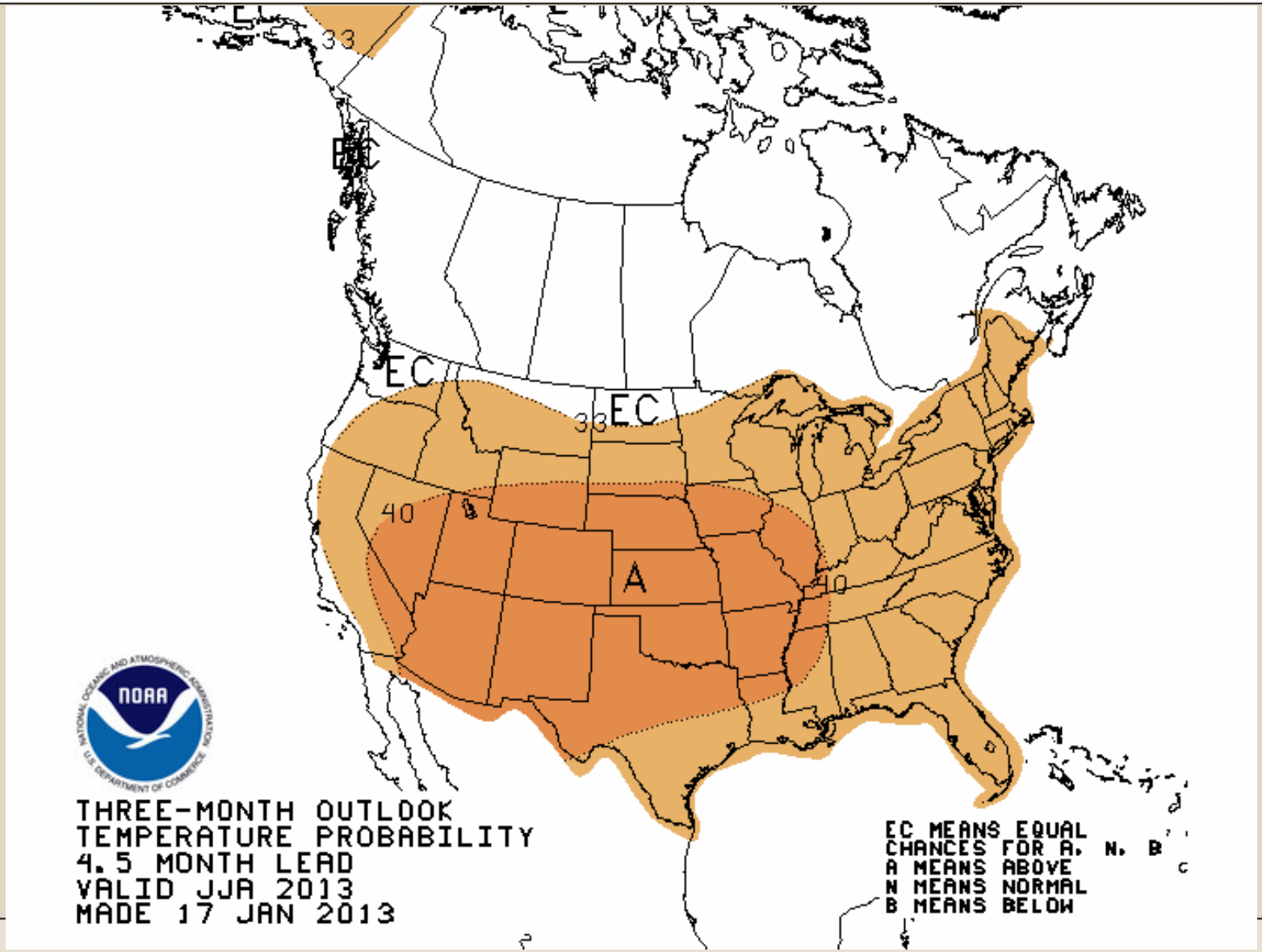

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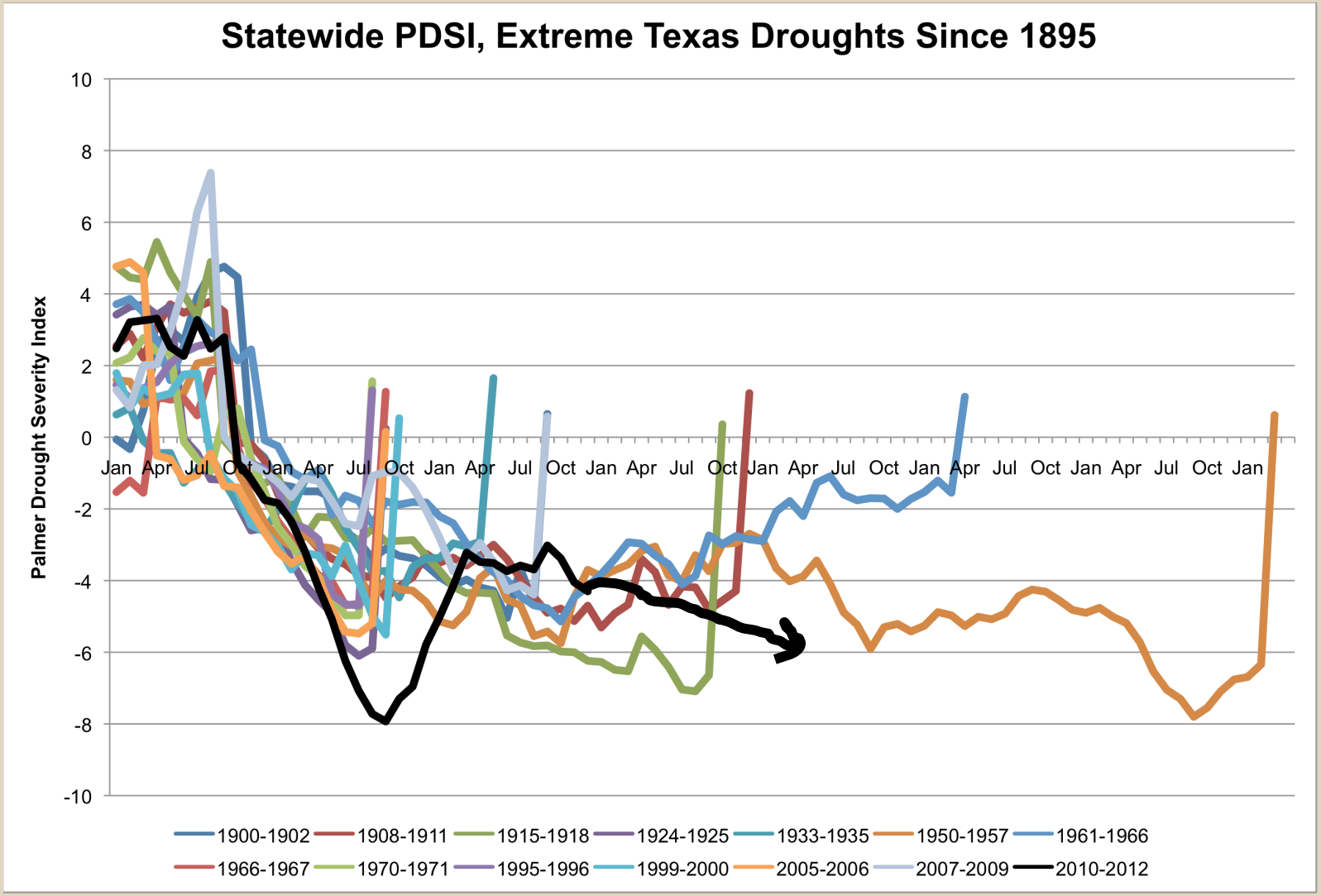

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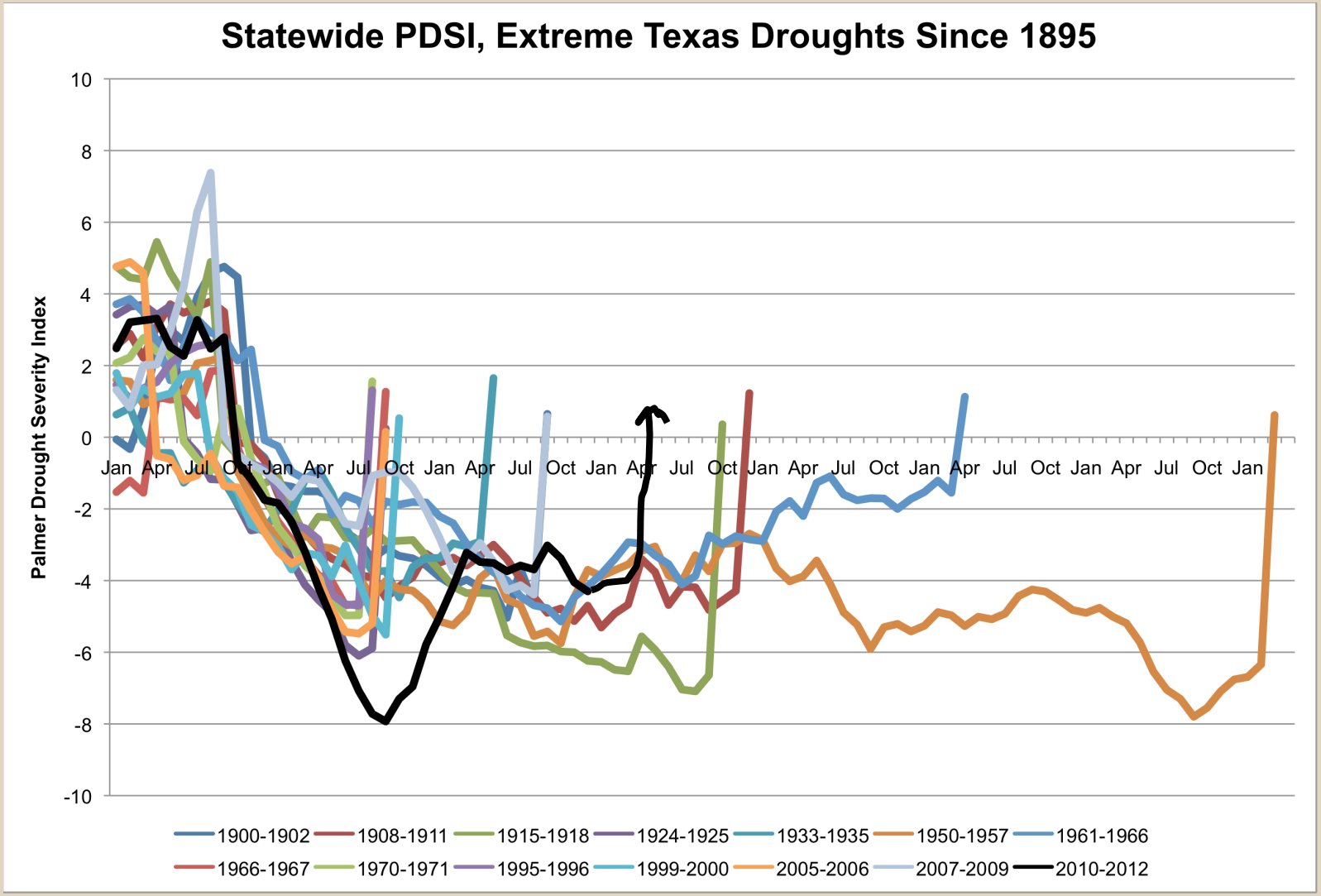

Trying to Predict Drought

- Atlantic Ocean: favors drought since 1995
- Pacific Ocean: favors drought since 1998
- “Period of drought susceptibility”

Summary

- Drought is:
  - Too complex to define
  - Too complex to measure with a single index
  - Too difficult to untangle from water management and other man-environment interactions
  - Too hard to predict

Time to give up completely

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