

The Problem (The Long View) – Drought Cycles Over the Last 1,000 Years

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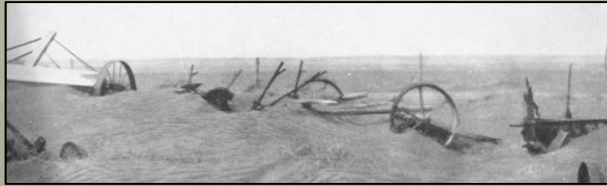
Introduction

- Drought is one of the greatest recurring natural disasters in North America
- Costs on average \$6-8 billion each year
- “A period of **abnormally** dry weather that **persists long enough** to produce serious economic, environmental or social impacts”



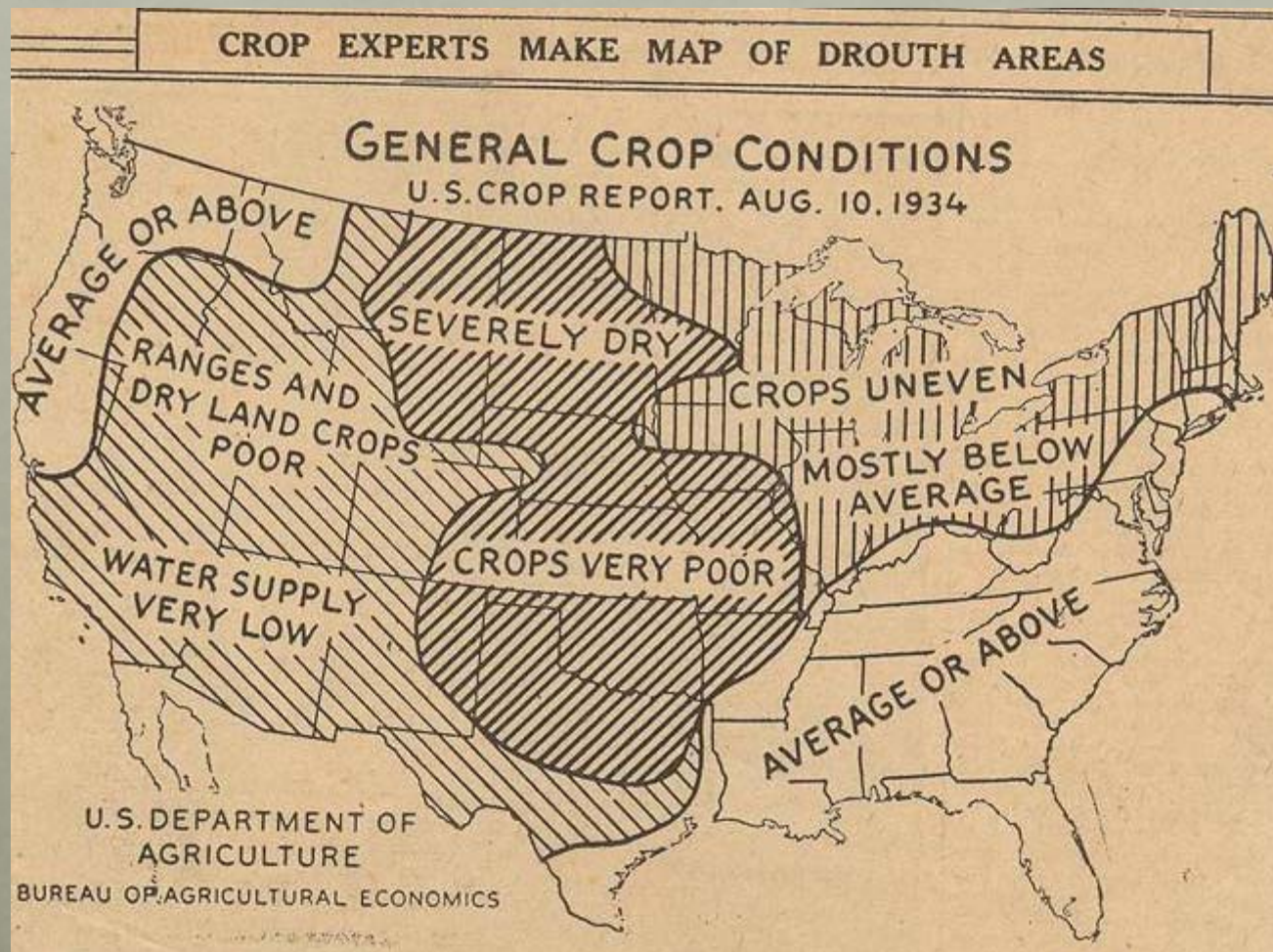
Introduction

- Historic droughts of the 1930s and 1950s remain the benchmark



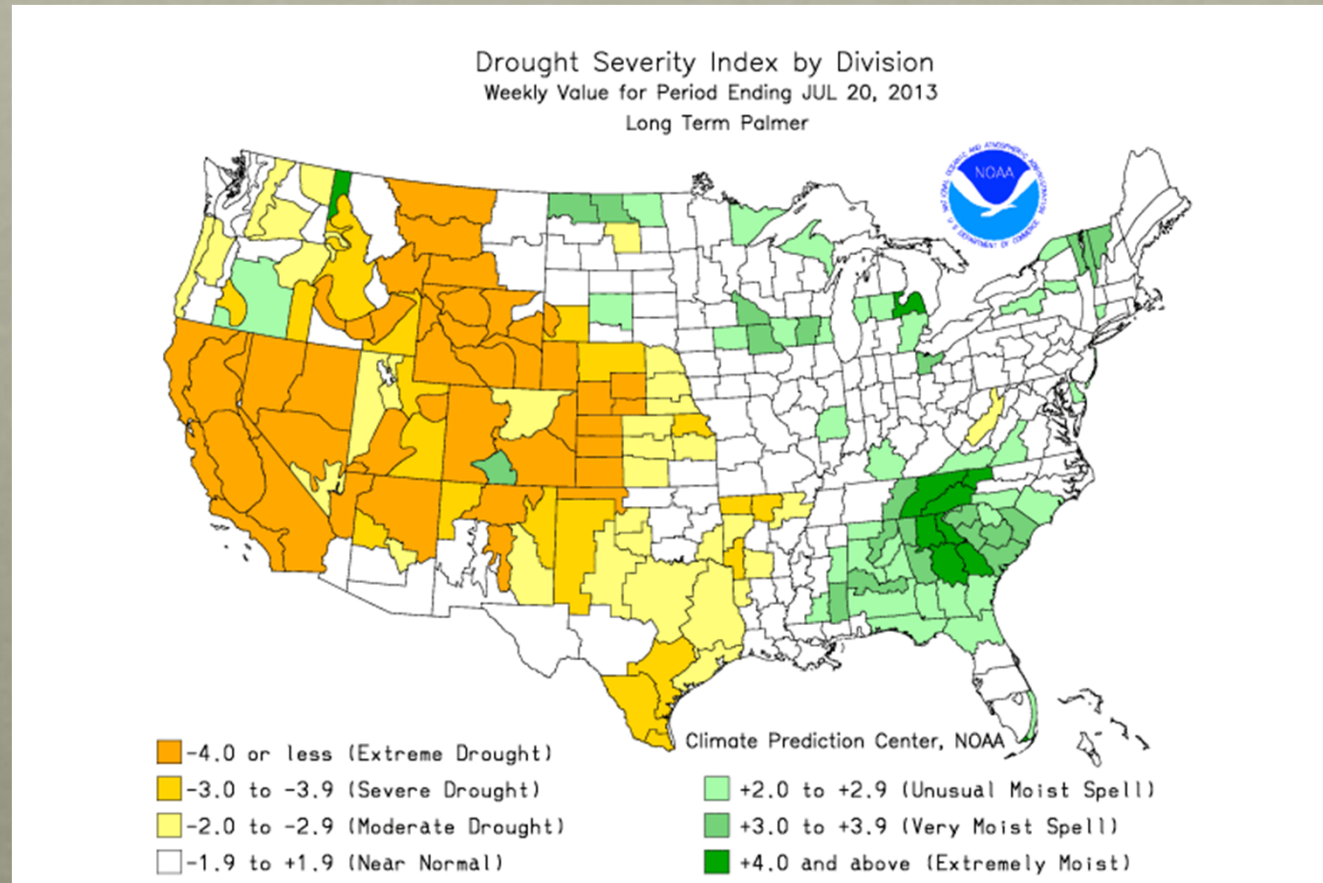
How representative are these historic droughts?

Measuring drought



Measuring drought

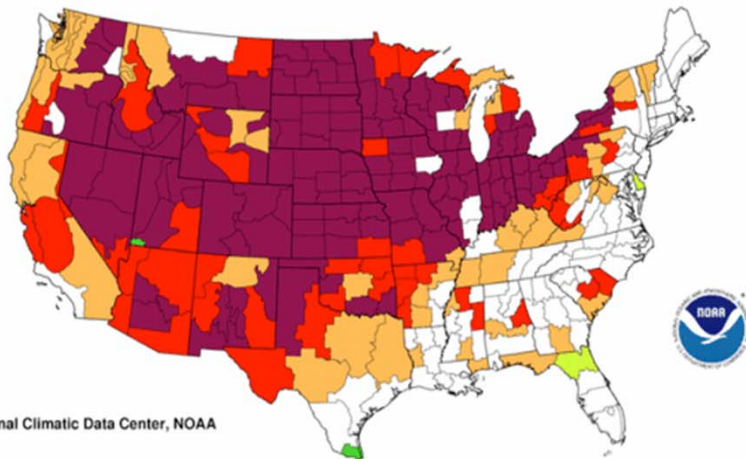
- Palmer Drought Severity Index (PDSI)
 - Precipitation, temperature, soil moisture data
 - Relative wetness and dryness over a given period



Measuring drought

- Palmer Drought Severity Index (PDSI)

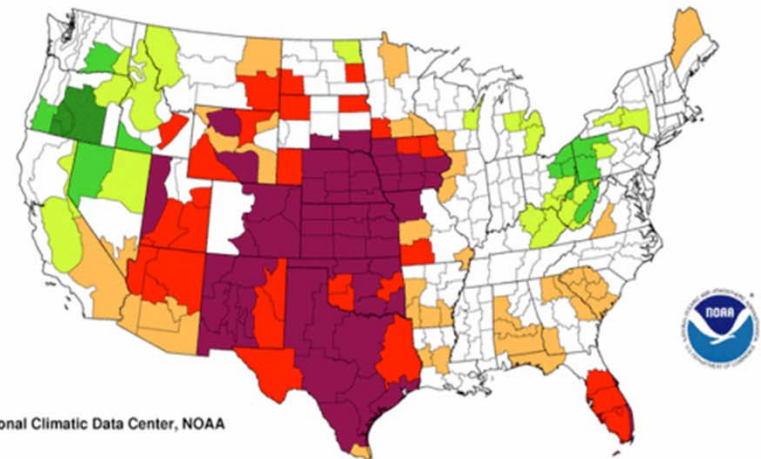
Palmer Drought Severity Index
July, 1934



National Climatic Data Center, NOAA



Palmer Drought Severity Index
July, 1956



National Climatic Data Center, NOAA



Measuring drought

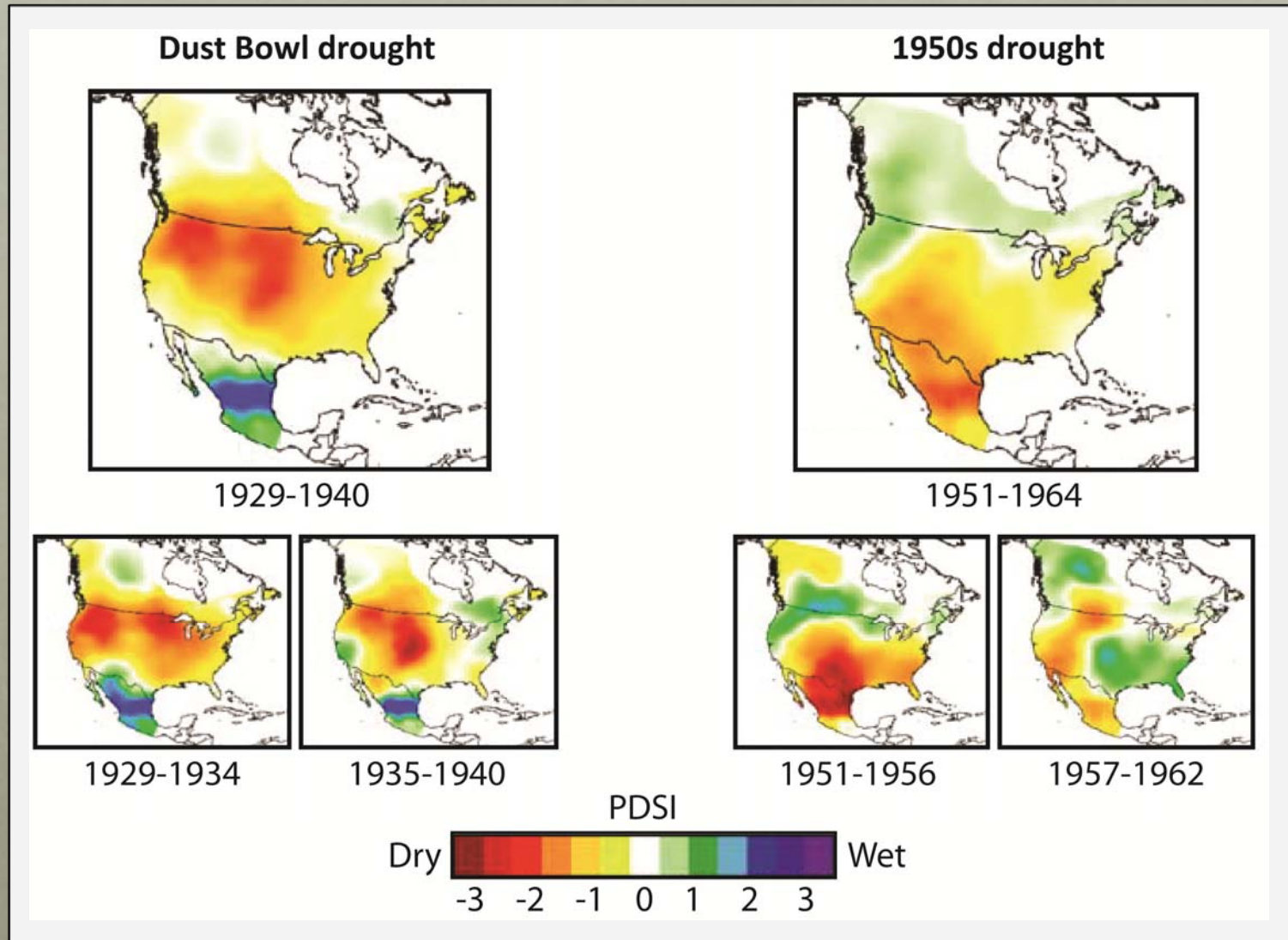


Figure modified from Stahle et al. (2007)

Measuring drought

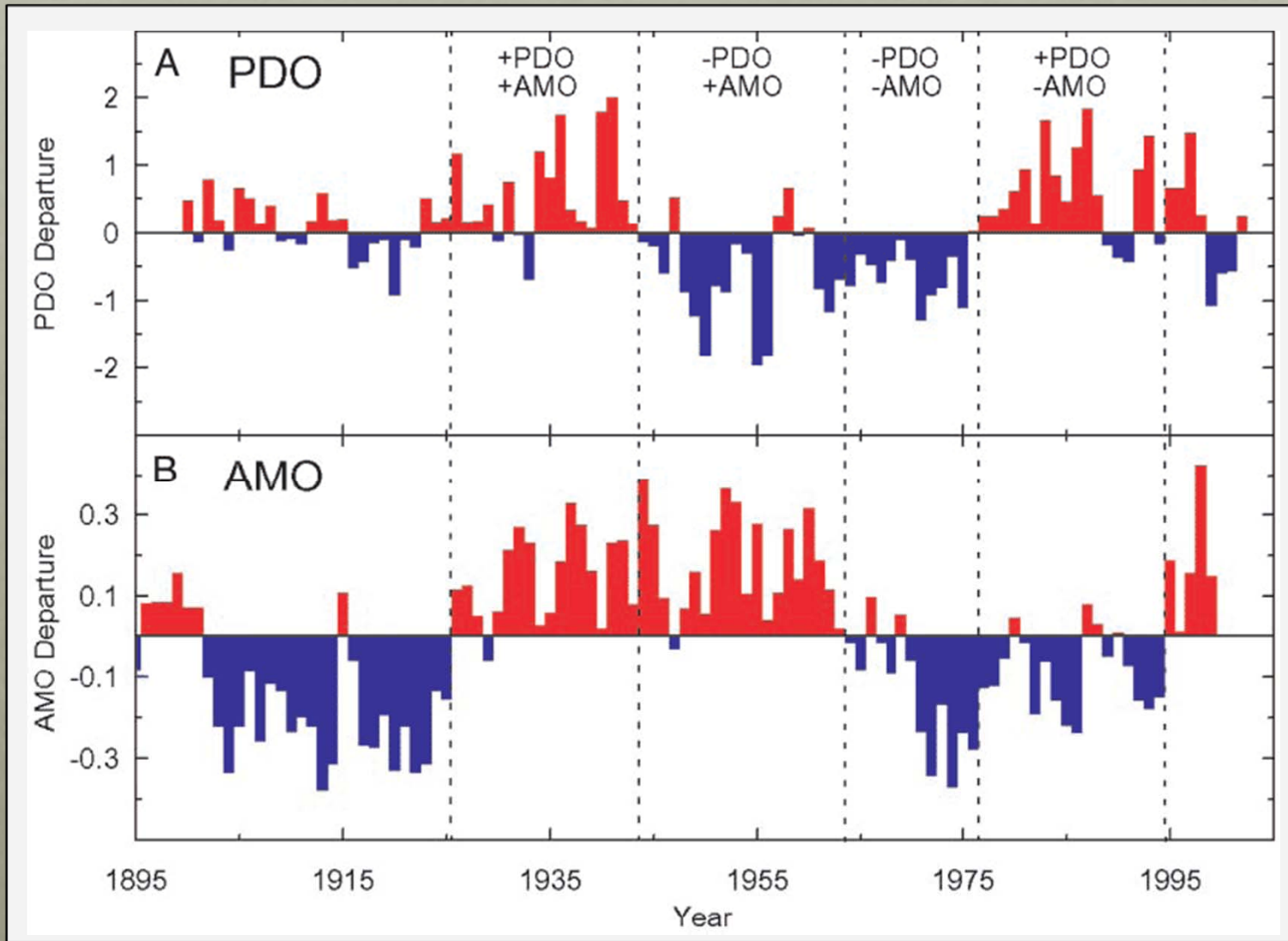


Figure from McCabe et al. (2004)

Measuring drought

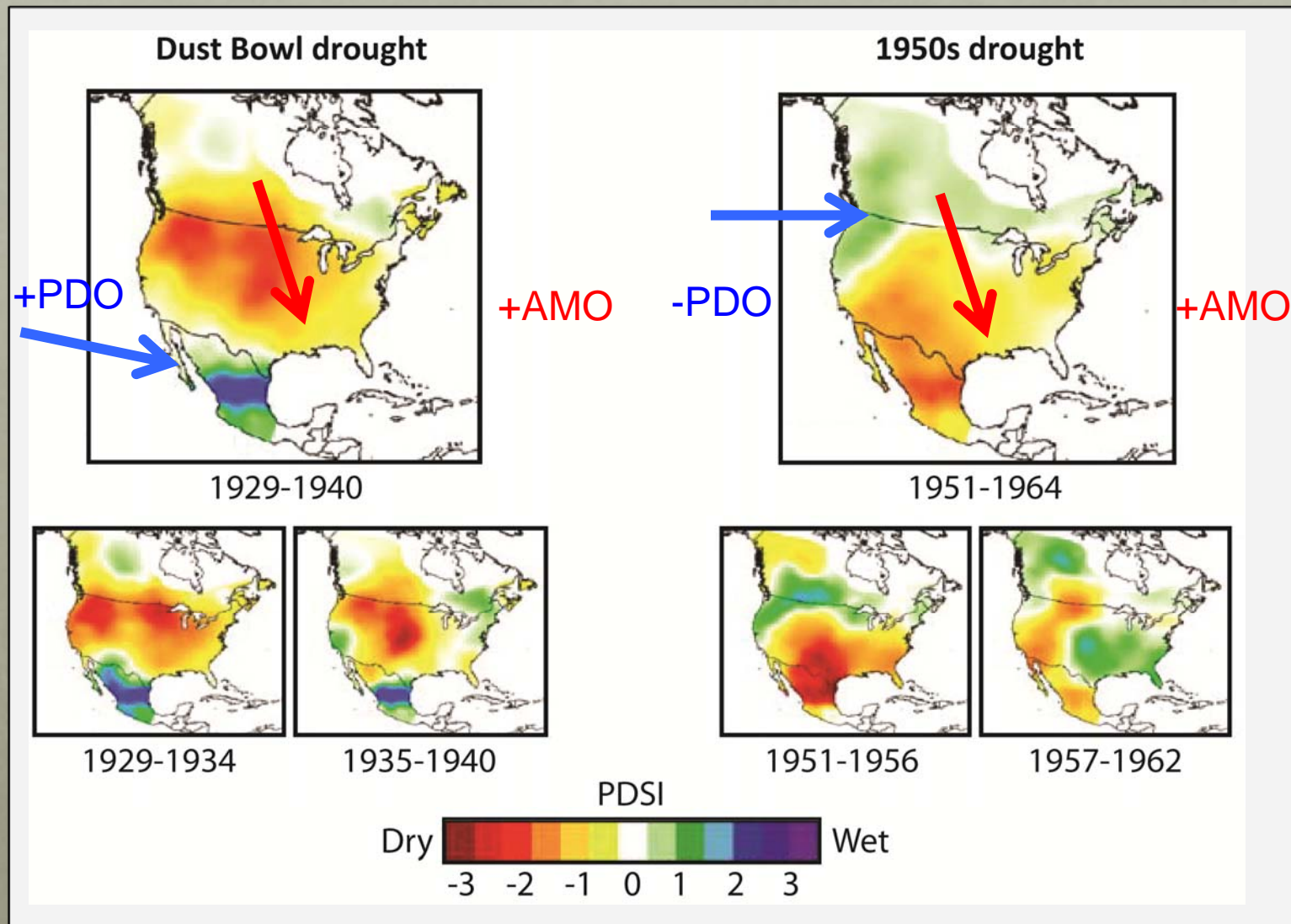
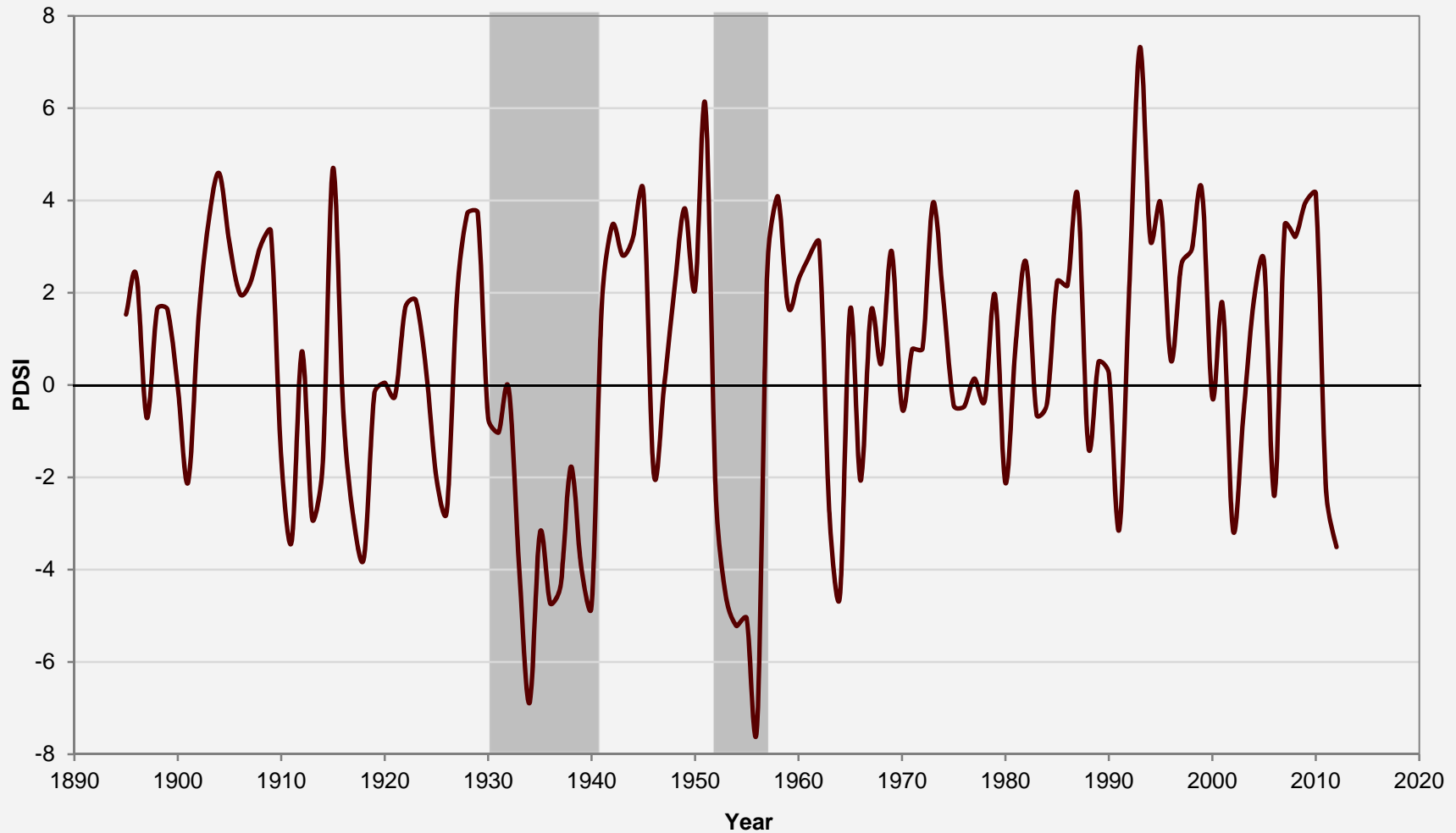


Figure modified from Stahle et al. (2007)

Measuring drought



- Historical data restricted to last 100 years
- Important to assess the full range of drought variability

Tree-ring chronologies

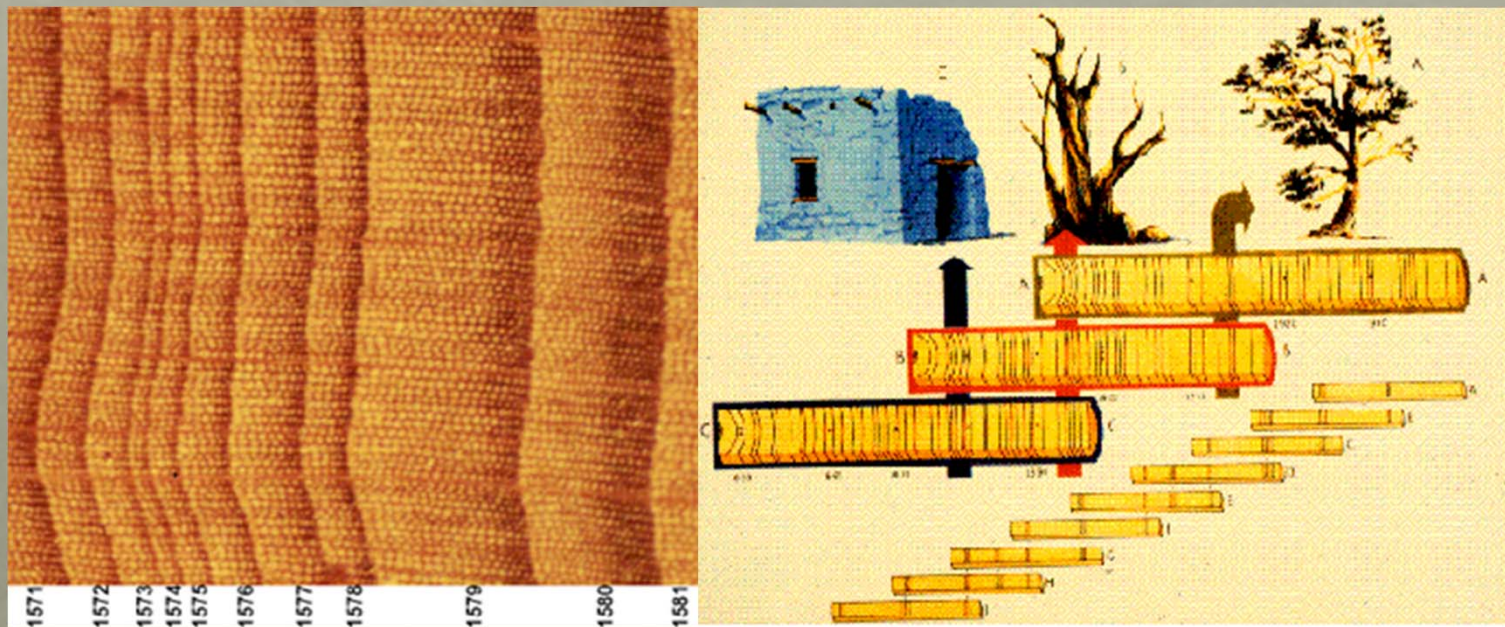
- Plant processes are constrained by environmental variables
 - Precipitation, temperature, soil moisture etc.

Favorable conditions = wide tree-ring
Unfavorable conditions = narrow ring



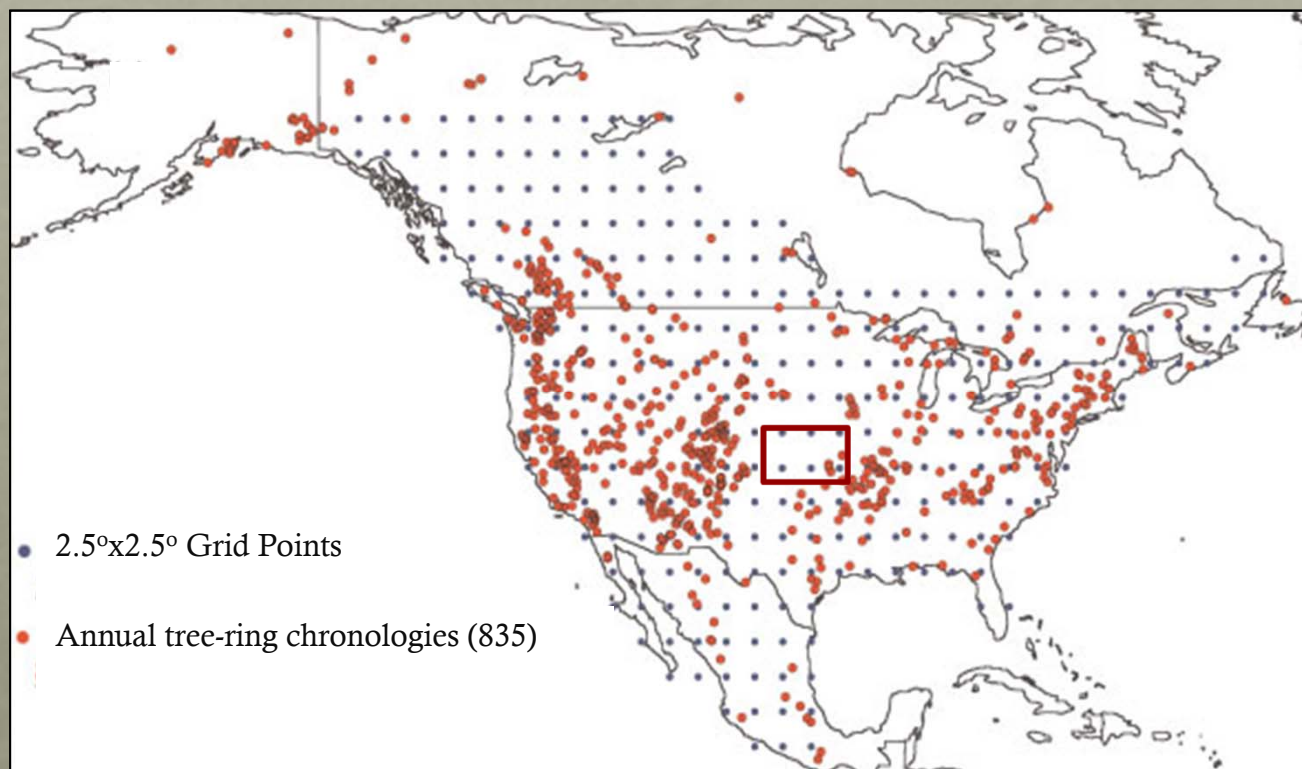
Tree-ring chronologies

- Dating tree-rings
 - Individual tree-rings can be dated to an exact calendar year
 - Cross-matching
 - Match ring-growth across multiple samples in a given area (similar environmental conditions)



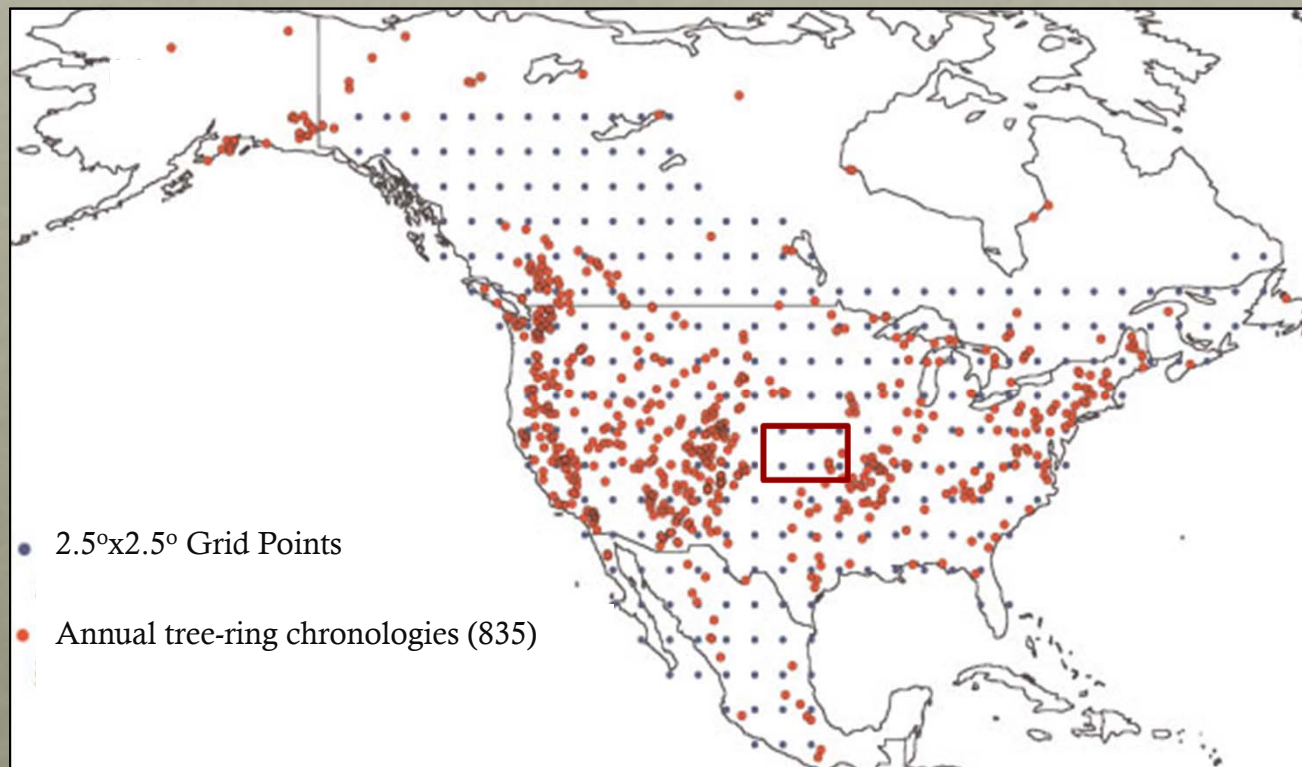
North American Drought Atlas

- Extensive network of annual tree-ring chronologies (International Tree-Ring Data Bank)
- Cook and Krusic (2004) developed annual PDSI reconstructions

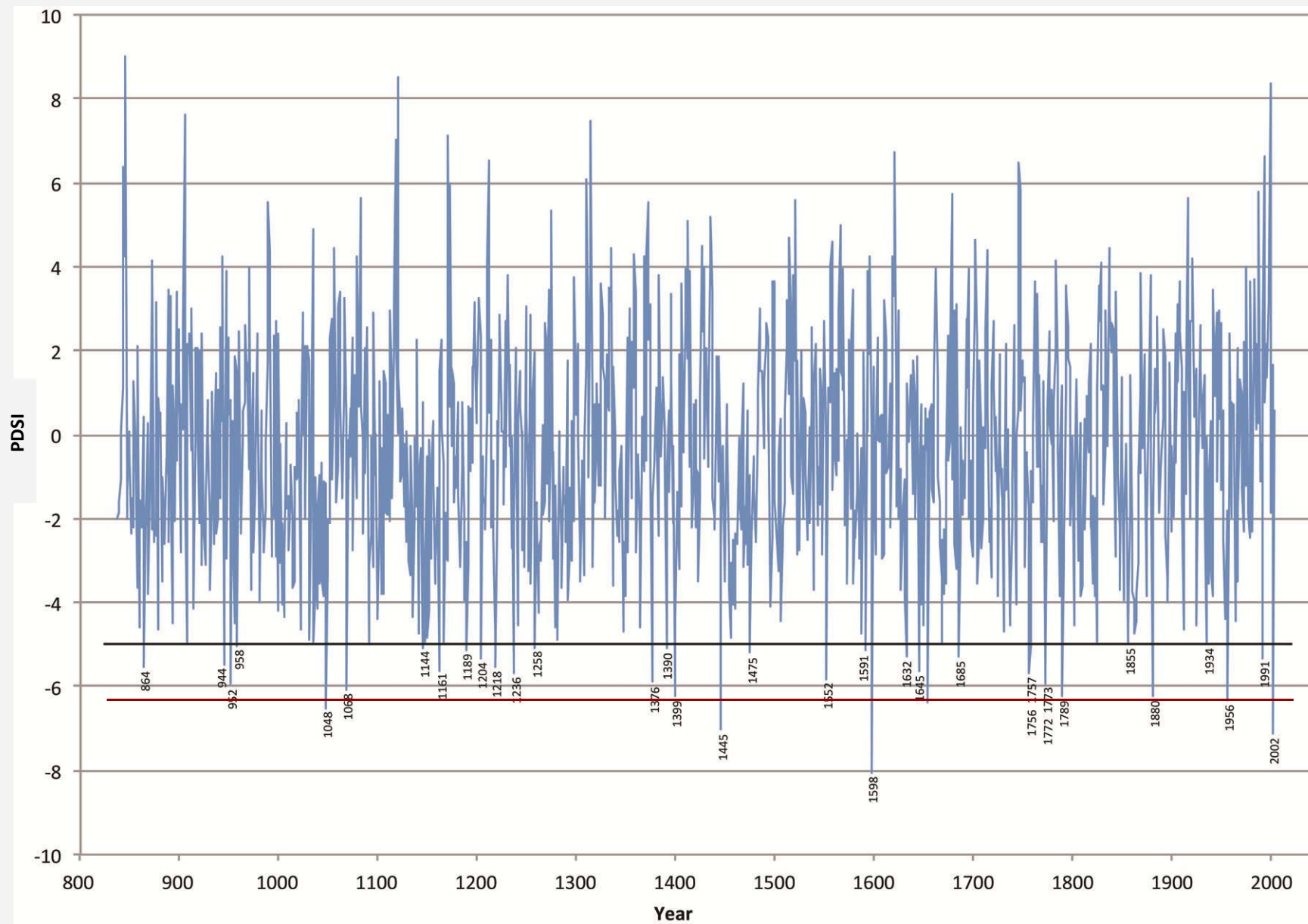


North American Drought Atlas

- Calibration period (1928-1978)
- Verification period (1900-1927)
- 4 different statistical tests

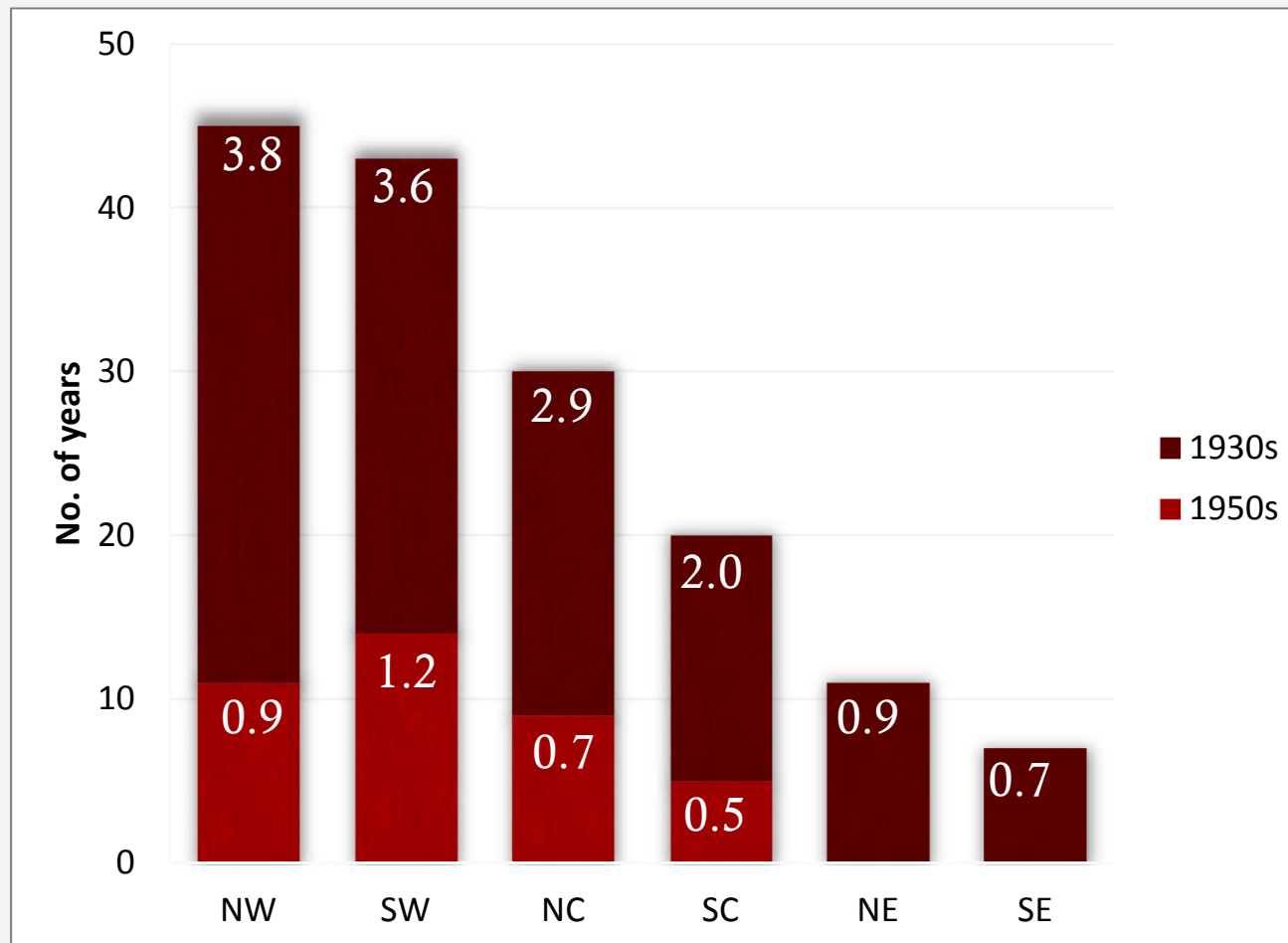


Drought severity – SW Kansas



Drought severity – SW Kansas

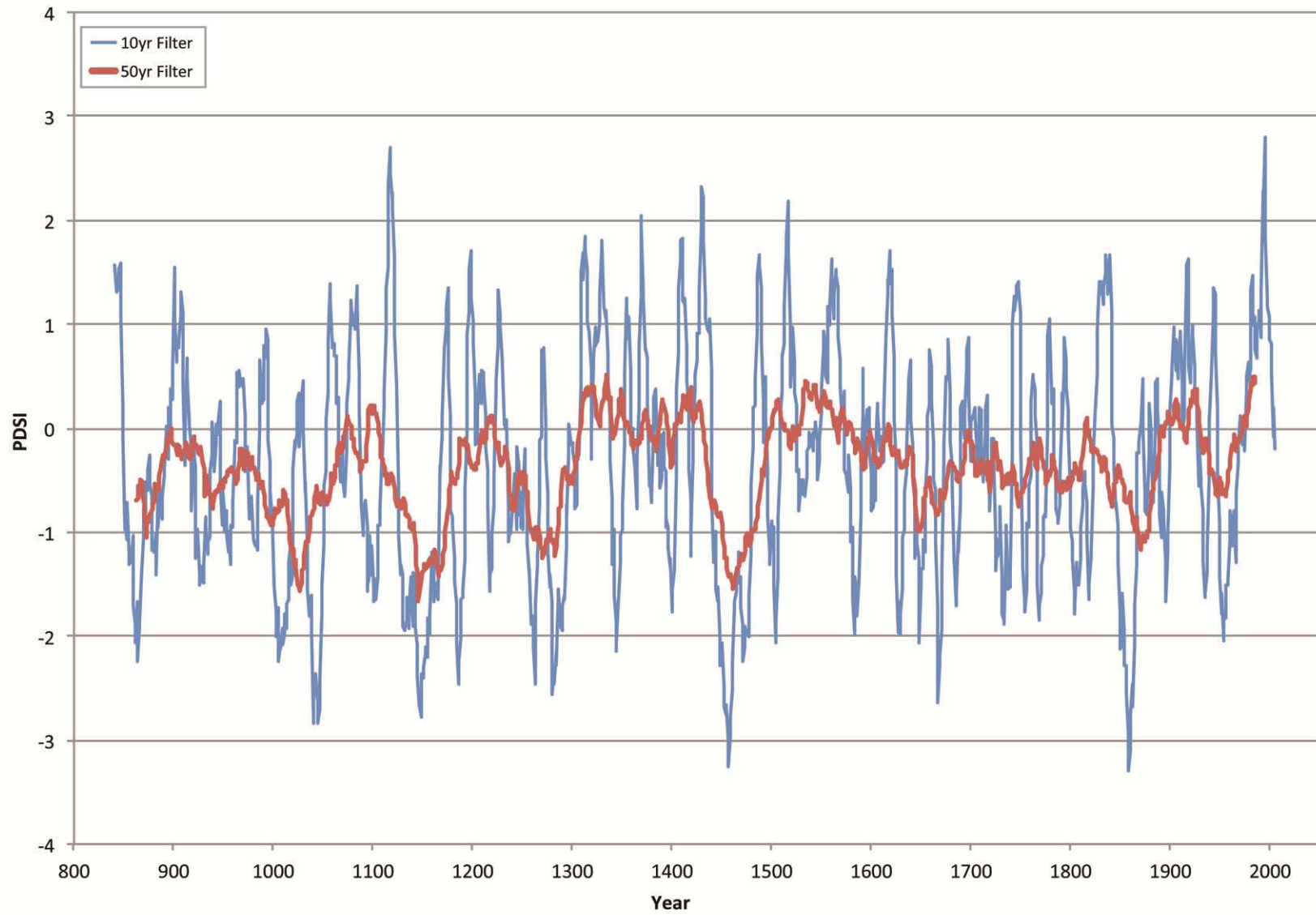
37% in any decade, 74% chance over a 20 yr period, 100% chance over a 40 yr period



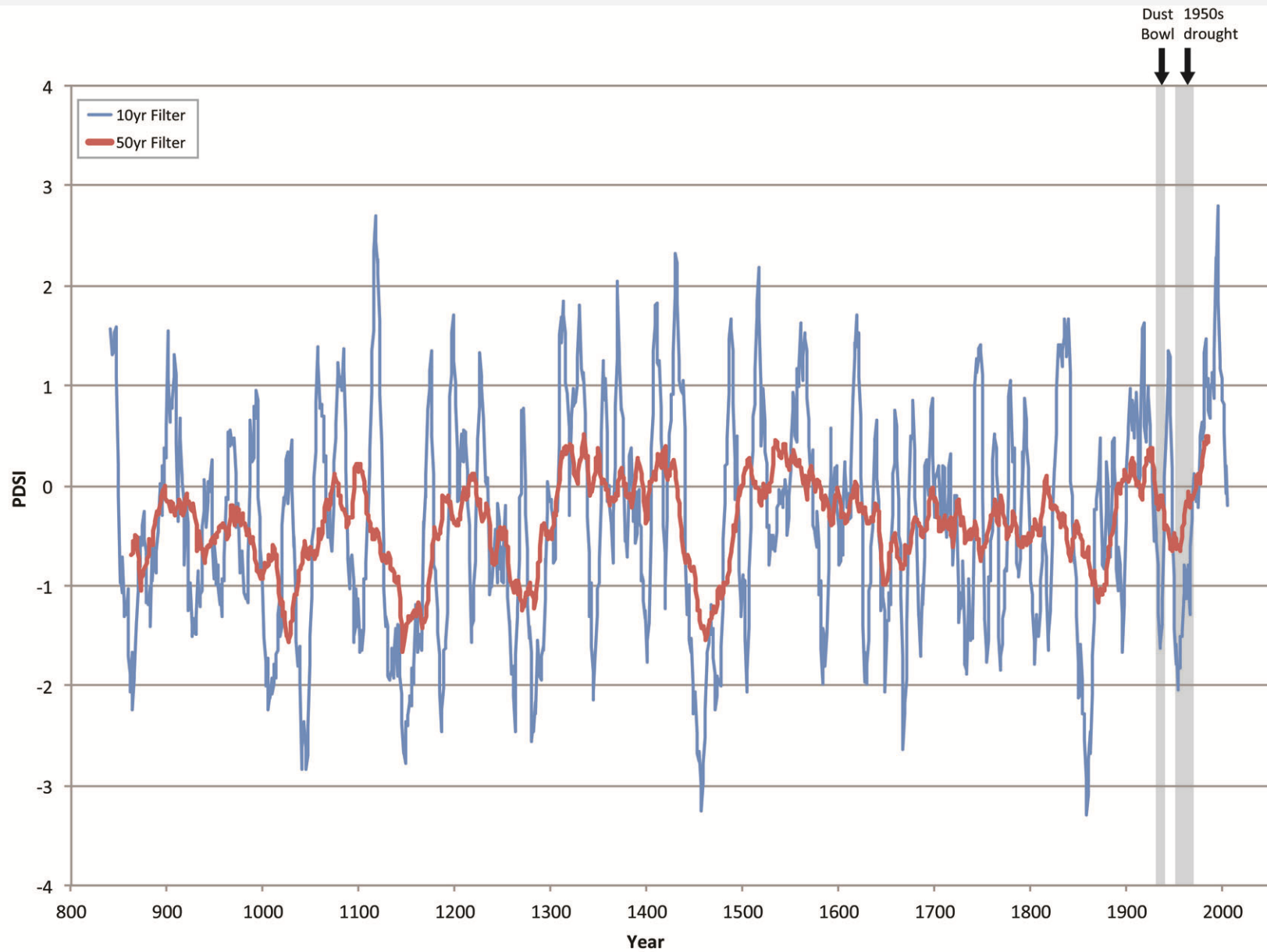
Drought conditions 60% of the time

Drought duration – SW Kansas

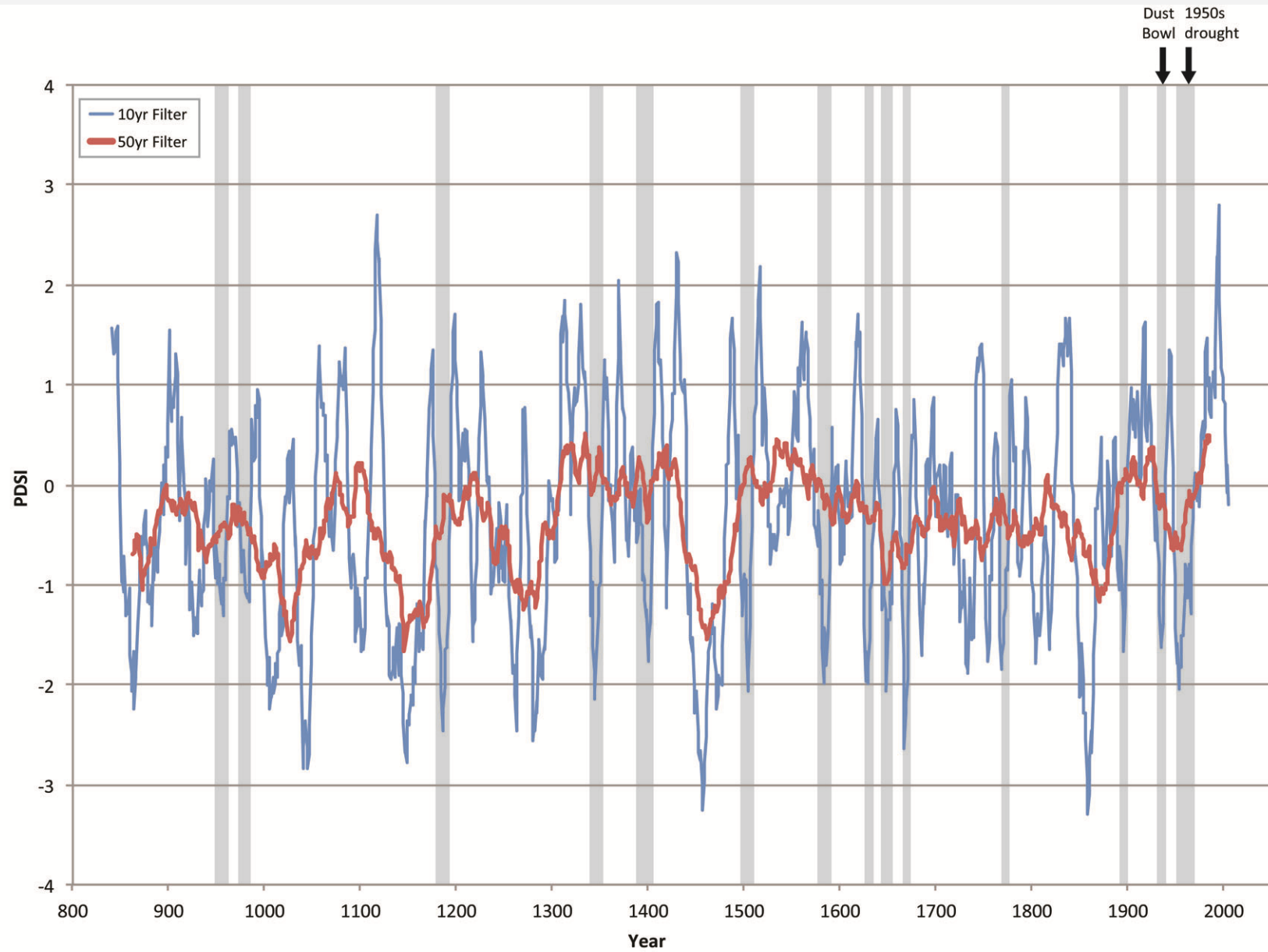
Drought duration – SW Kansas



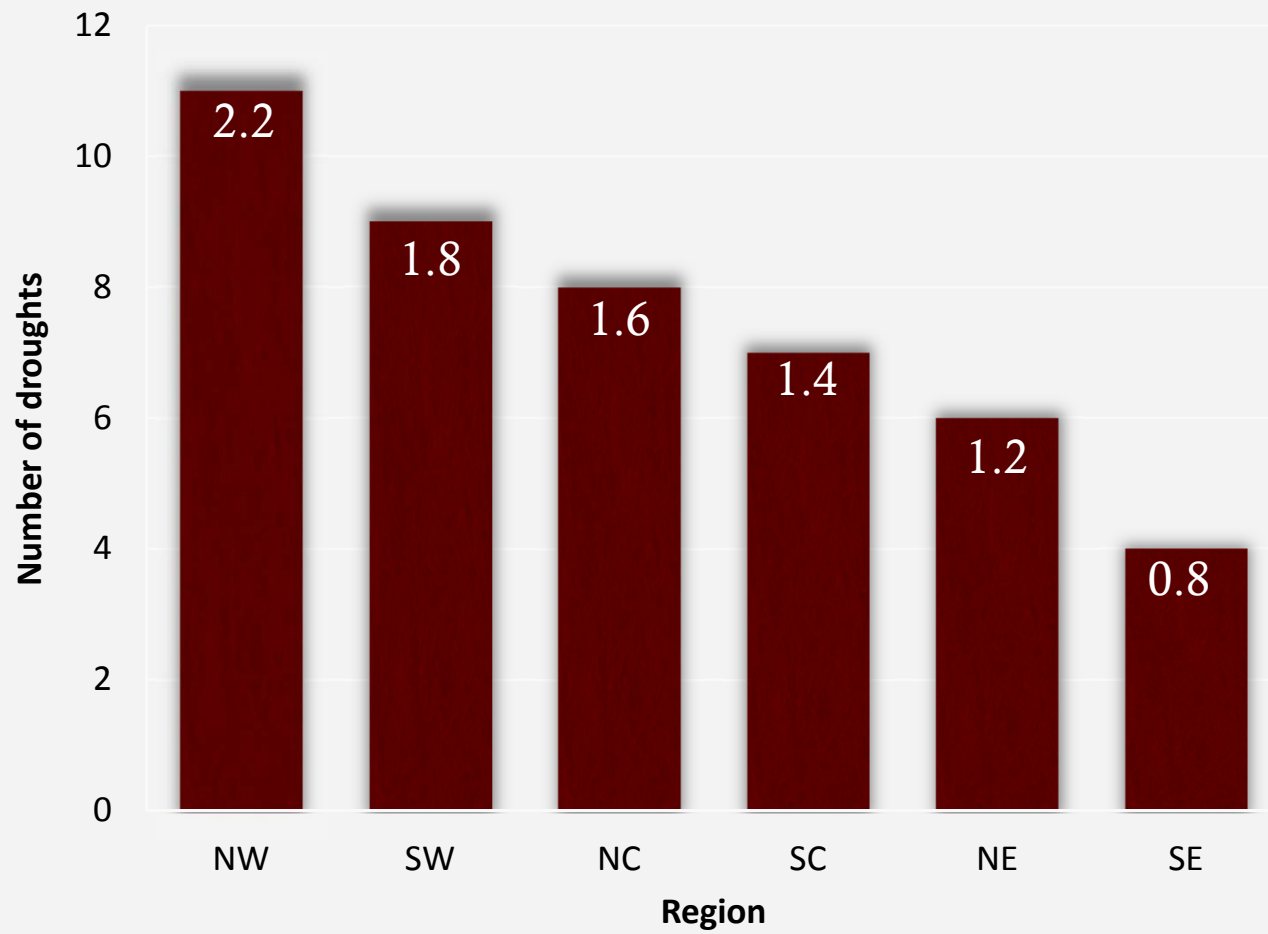
Drought duration – SW Kansas



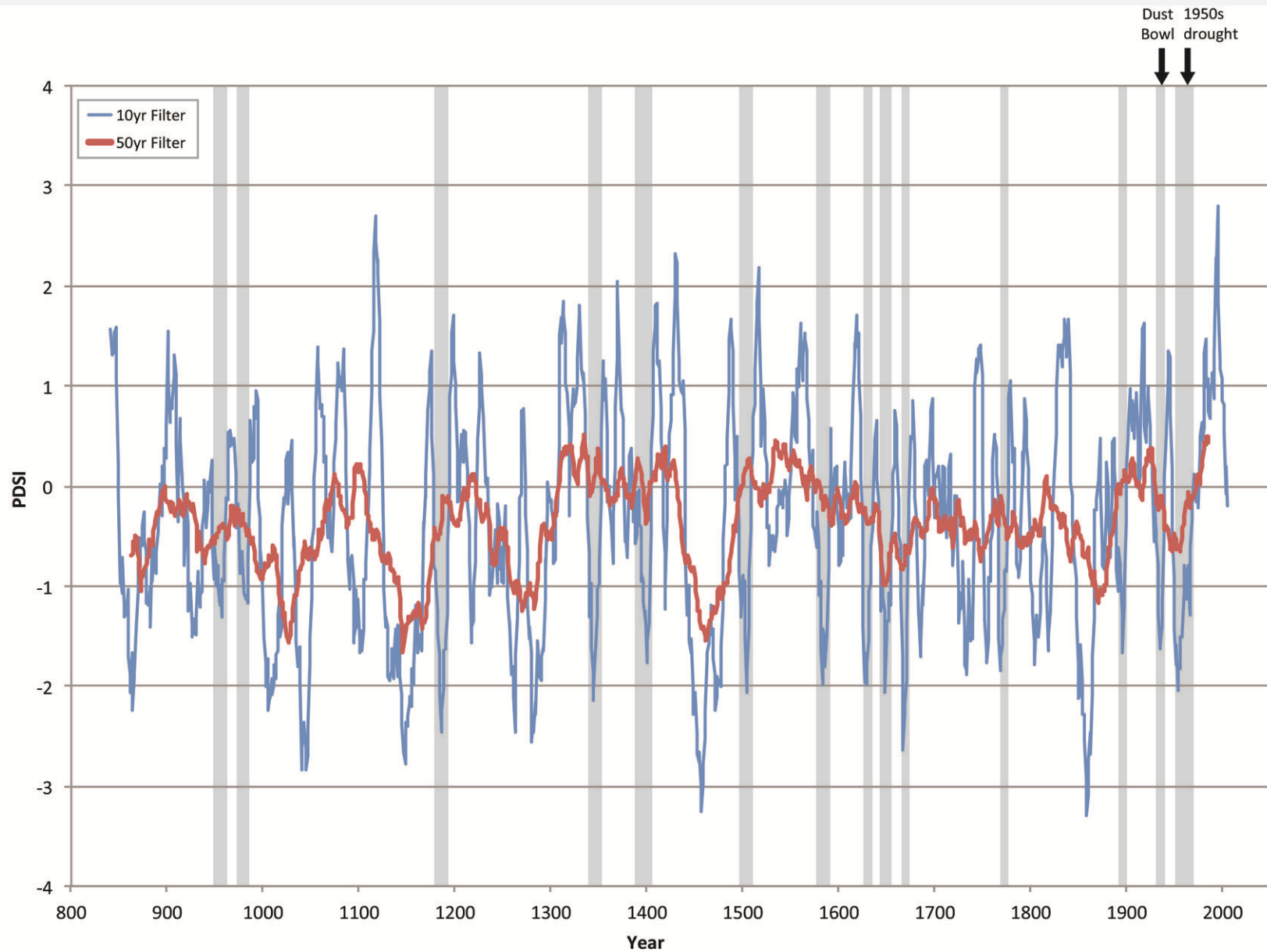
Drought duration – SW Kansas



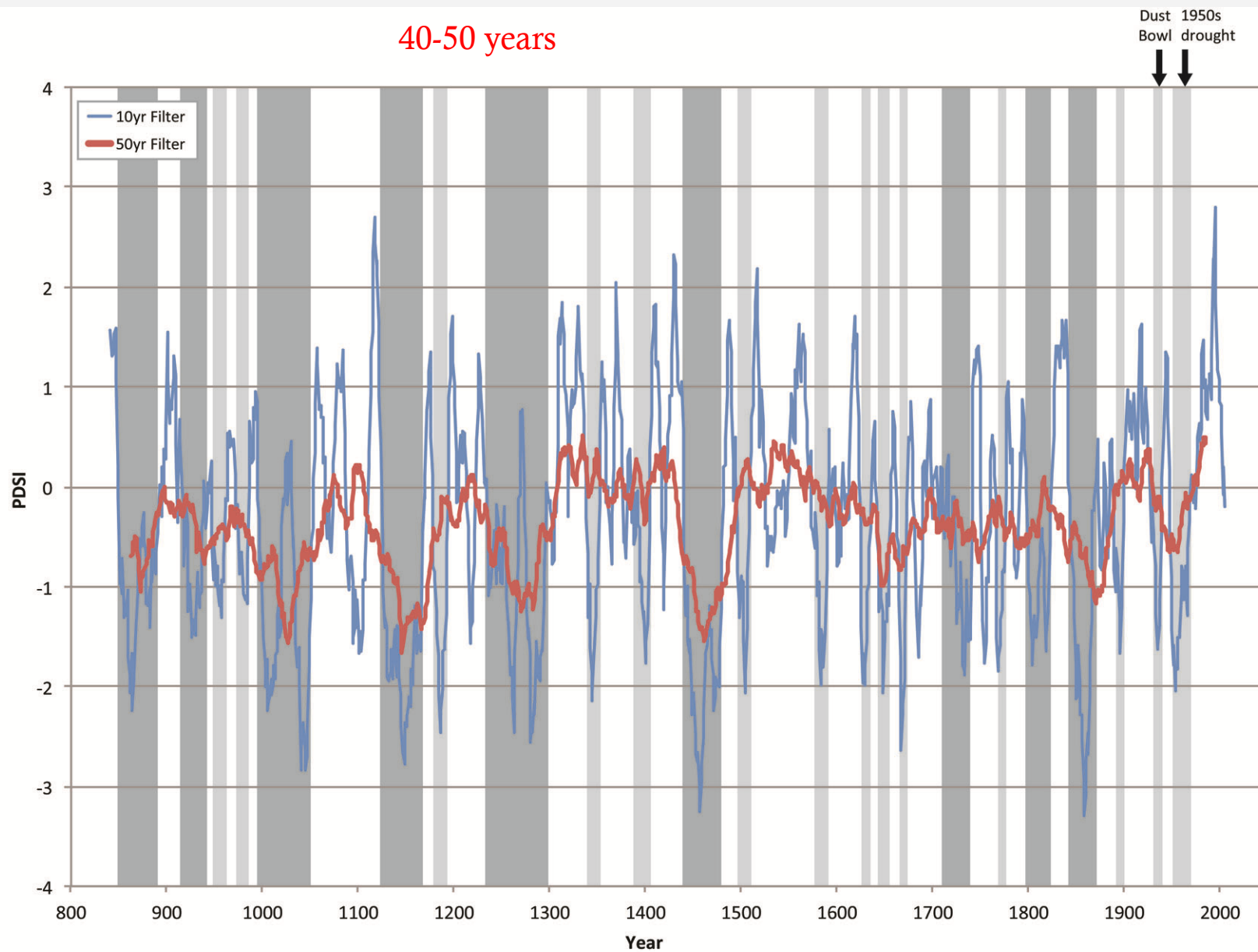
Drought duration



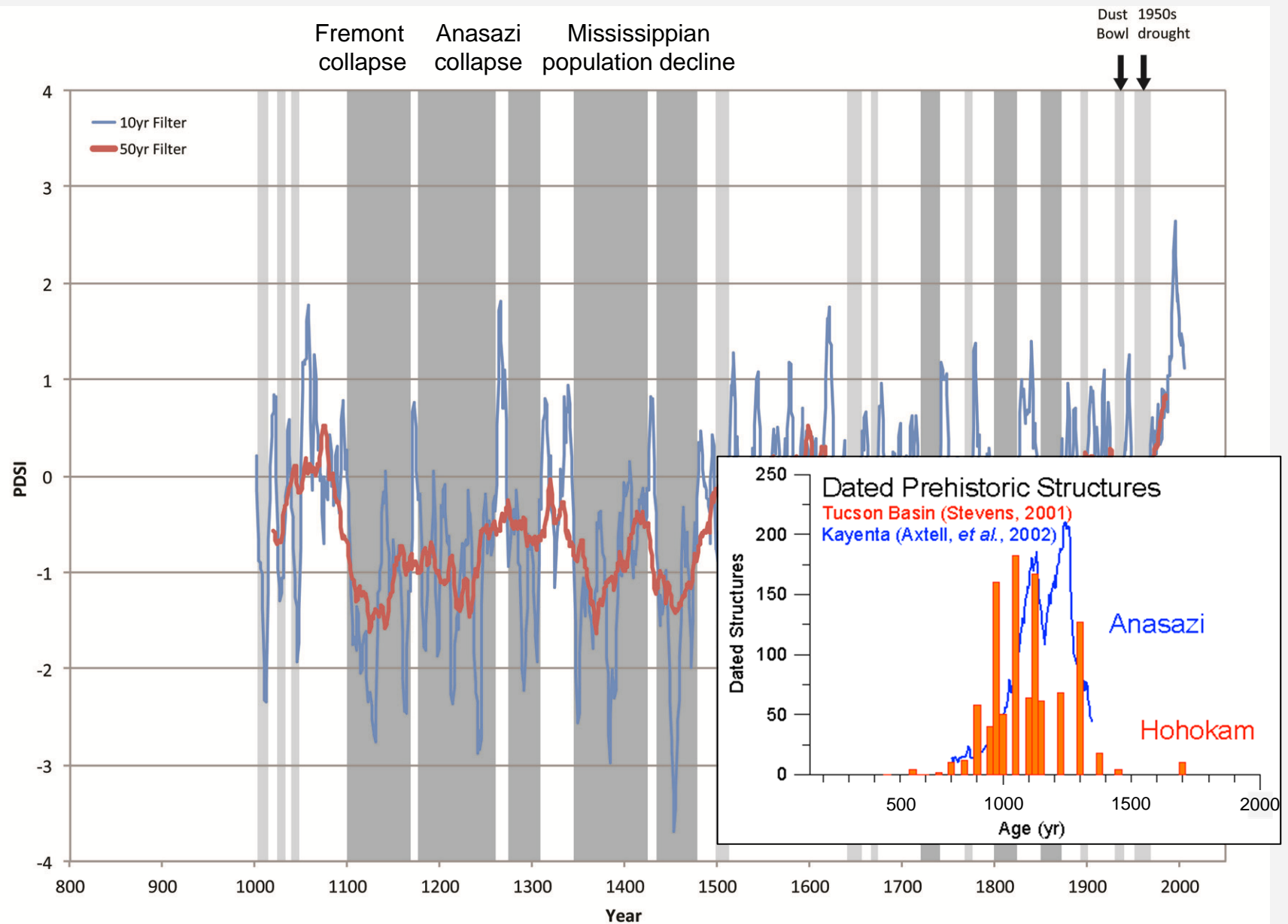
Drought duration – SW Kansas



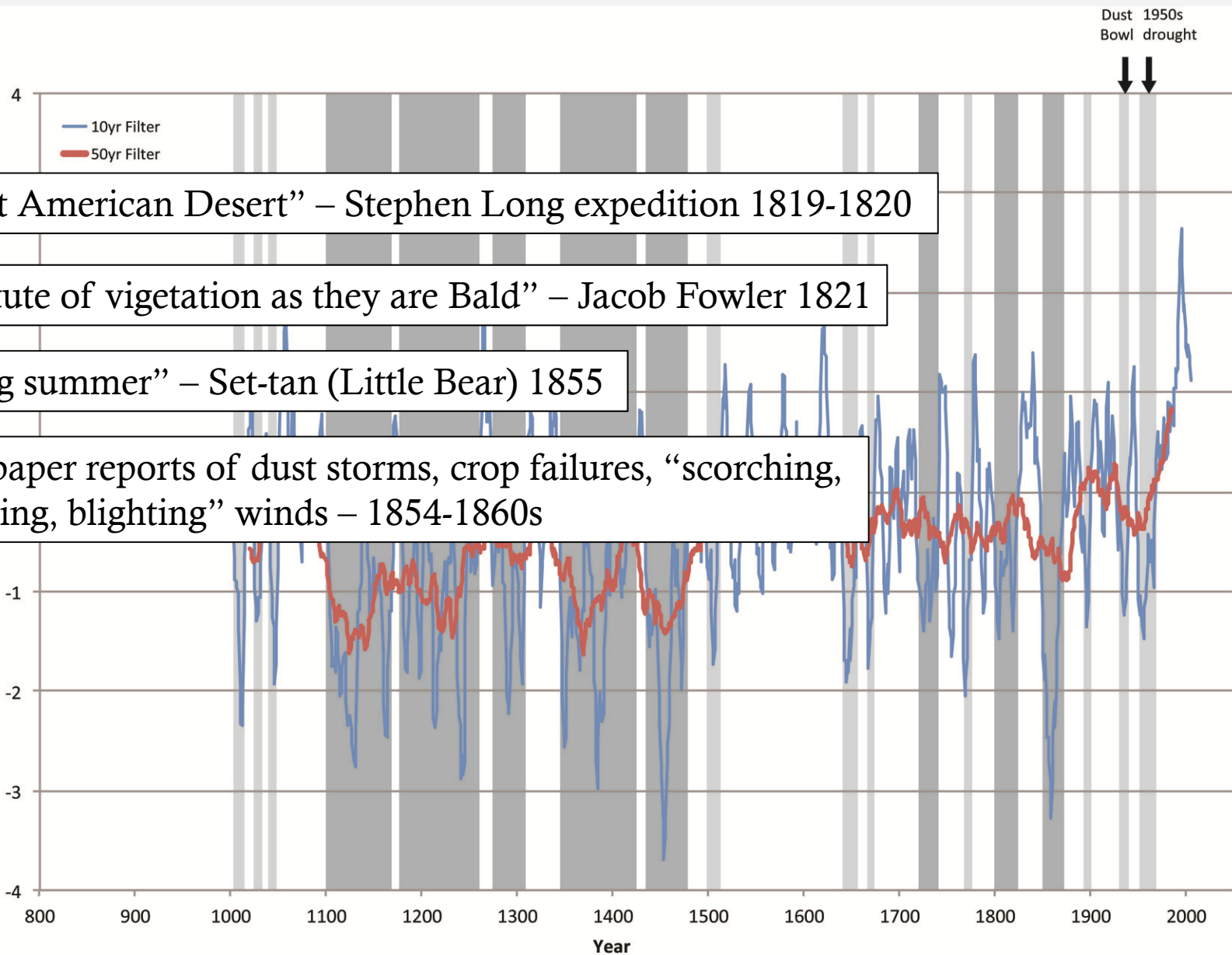
Drought duration – SW Kansas



Drought duration – SC Kansas



Drought duration – SC Kansas



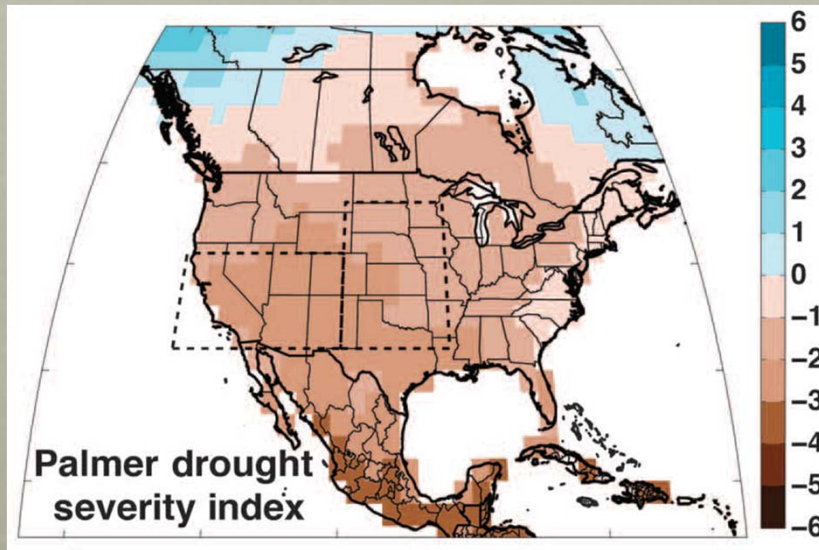
“Great American Desert” – Stephen Long expedition 1819-1820

“distetute of vigeatation as they are Bald” – Jacob Fowler 1821

“sitting summer” – Set-tan (Little Bear) 1855

Newspaper reports of dust storms, crop failures, “scorching, withering, blighting” winds – 1854-1860s

CMIP5 Drought projections, 2050-2099



How representative are these historic droughts?

