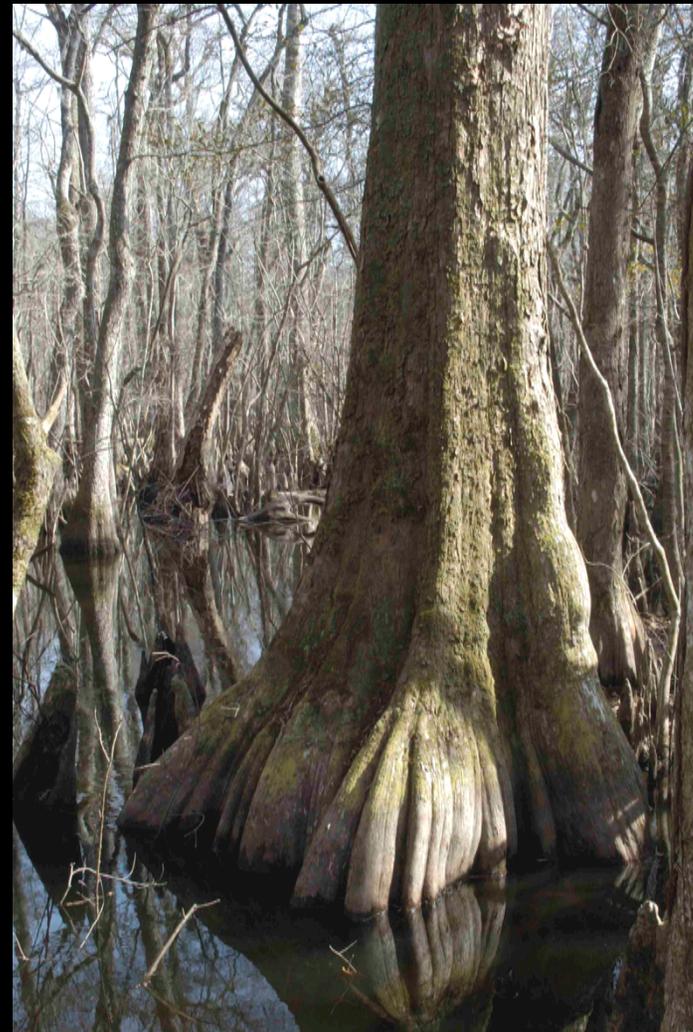


North American Tree-Ring Record of Drought and Social Impacts

Dave Stahle, Ed Cook, Jose Villanueva, Rodolfo Acuña, Falko Fye, and Jeff Dean



Pinus Longaeva, White Mountains, CA
Jack Dykinga



Taxodium distichum, Four Holes Swamp, SC

Dendrochronology

Taxodium distichum
Blackwater River, Virginia

Lost Colony Drought
↓ 1587

↓ 1531

↓ 1600

Jamestown Drought ↑
1606 - 1612

Tree-Ring Dating = the most accurate and precise dating method in geochronology

'integrating pluviometers'

North American Tree-Ring Chronologies

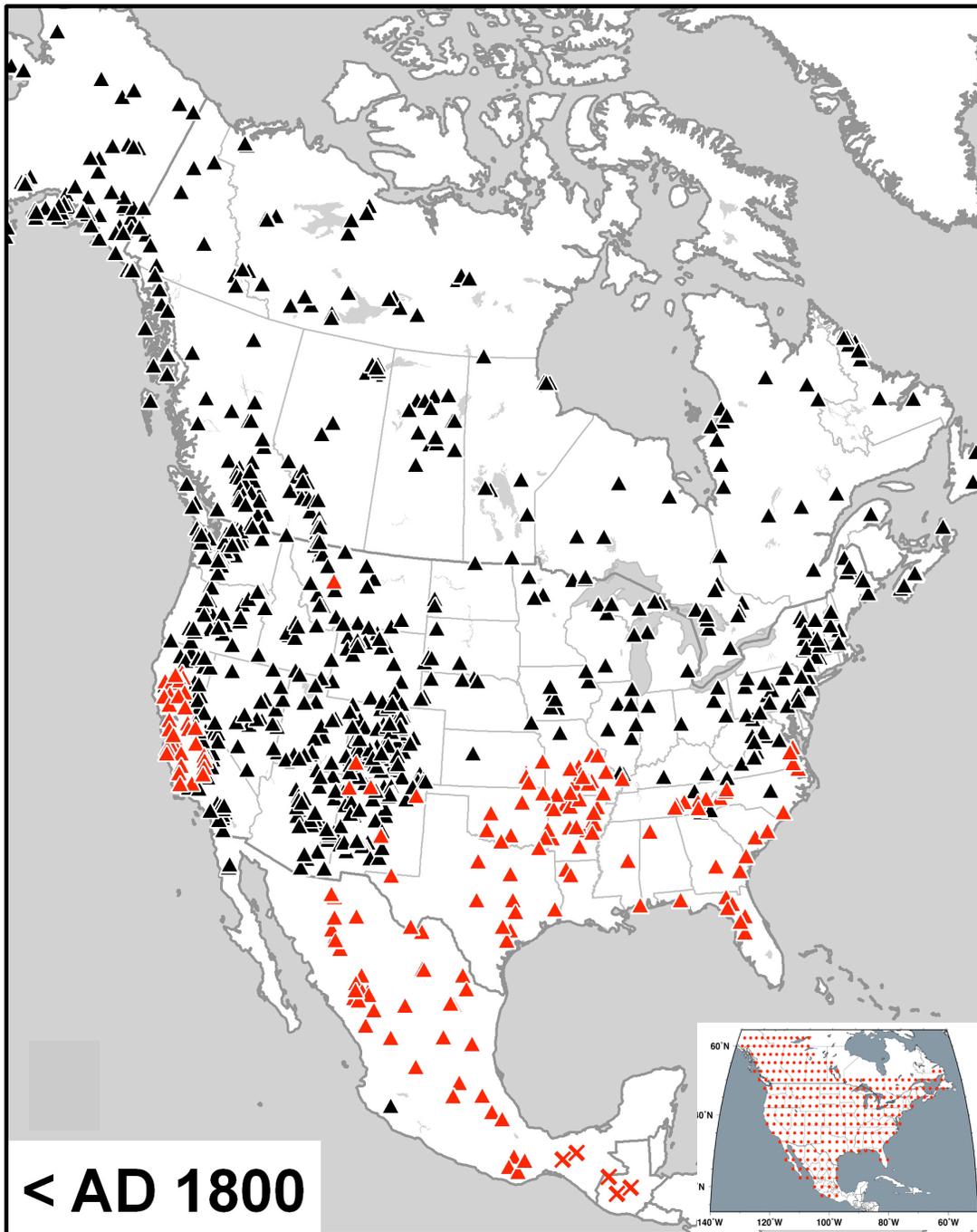
Eastern species

- White Oak Group
- Hemlock
- Baldcypress
- Tulip Poplar
- Overcup Oak
- Northern Red Oak
- American Chestnut (relict wood)
- Eastern Red Cedar
- Northern White Cedar
- Red Pine
- Shortleaf Pine
- E. White Pine
- Red Spruce

Western species

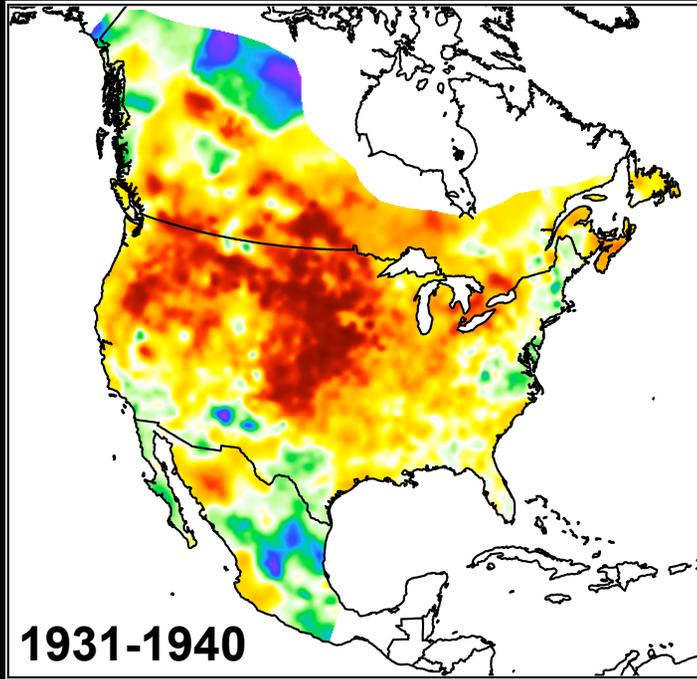
- Ponderosa Pine
- Douglas-fir
- Big Cone Douglas-fir
- High Elevation Conifer
- Mountain Hemlock
- Other Conifer
- Pinyon Pine
- Western Juniper
- Blue Oak / Valley Oak

Red = University of Arkansas & INIFAP (Mexico).
1850 sites, complex species & climate response,
Cook 2007, PDSI grid, PPR & PCREG, validation

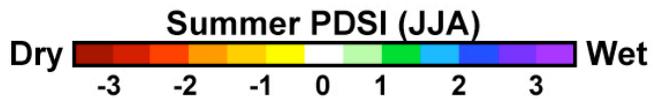
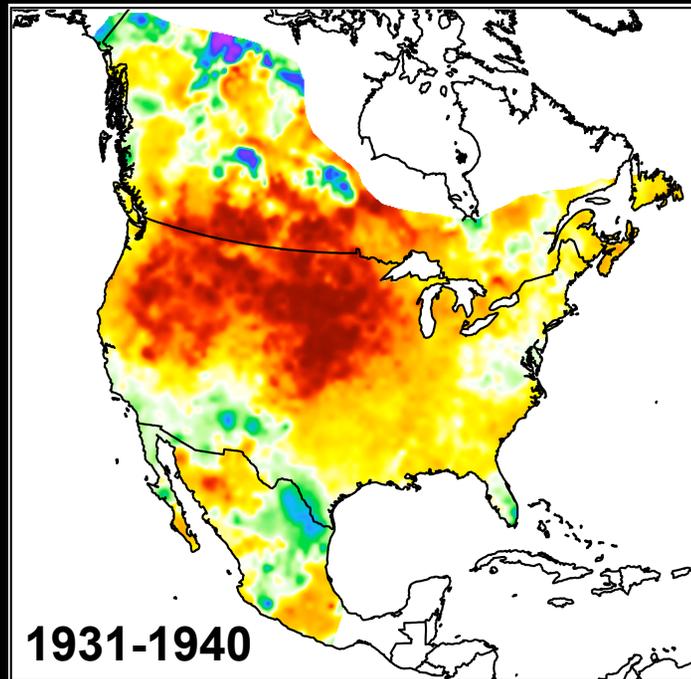


The Dust Bowl Drought

Instrumental PDSI



Tree-Ring Reconstructed PDSI



Palmer Drought Index (PDSI)

Spatial fidelity

Coast-to-coast dryness

Worst drought in 350 years

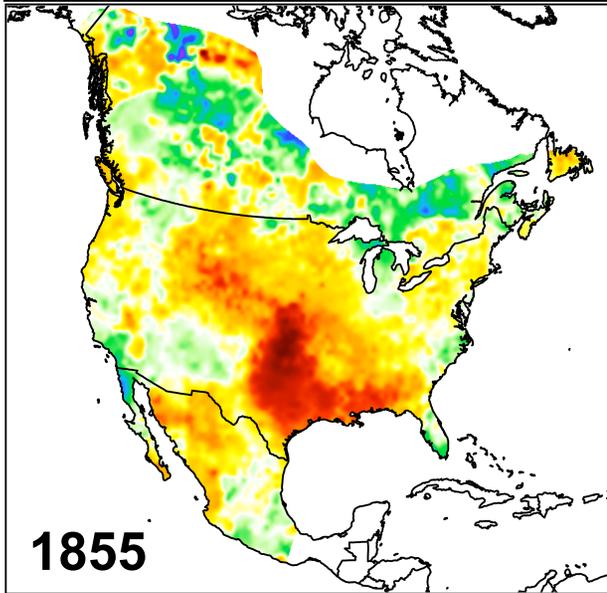
Impact & drought itself aggravated by poor land use practices?

Environmentally-mediated migration



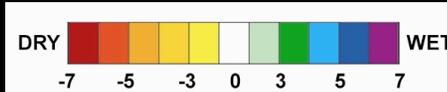
Historical Verification of the Tree-Ring Reconstructions?

Kiowa "Sitting Summer"

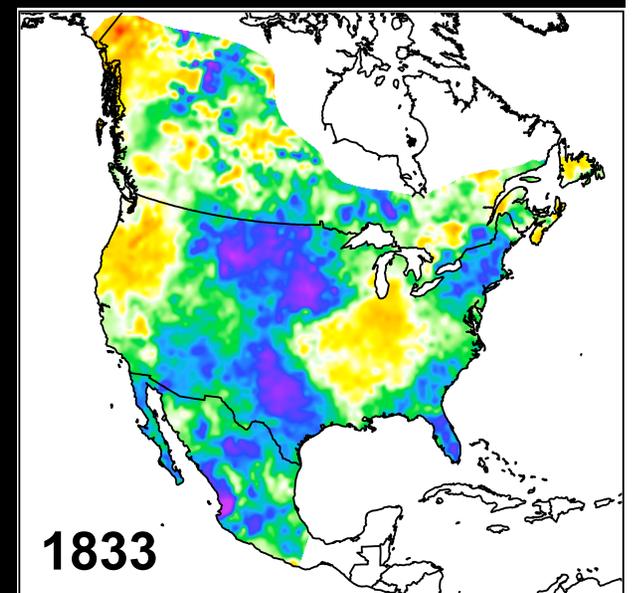


1855

Summer PDSI



Wettest Summer in 500 years



1833



1855

"The Sitting Summer"

extreme heat & dry prairies across the Southern Plains, Kiowa ponies too weak to ride.

Kiowa Summer-Count Calendar

June 1833

"The Great Overflow"

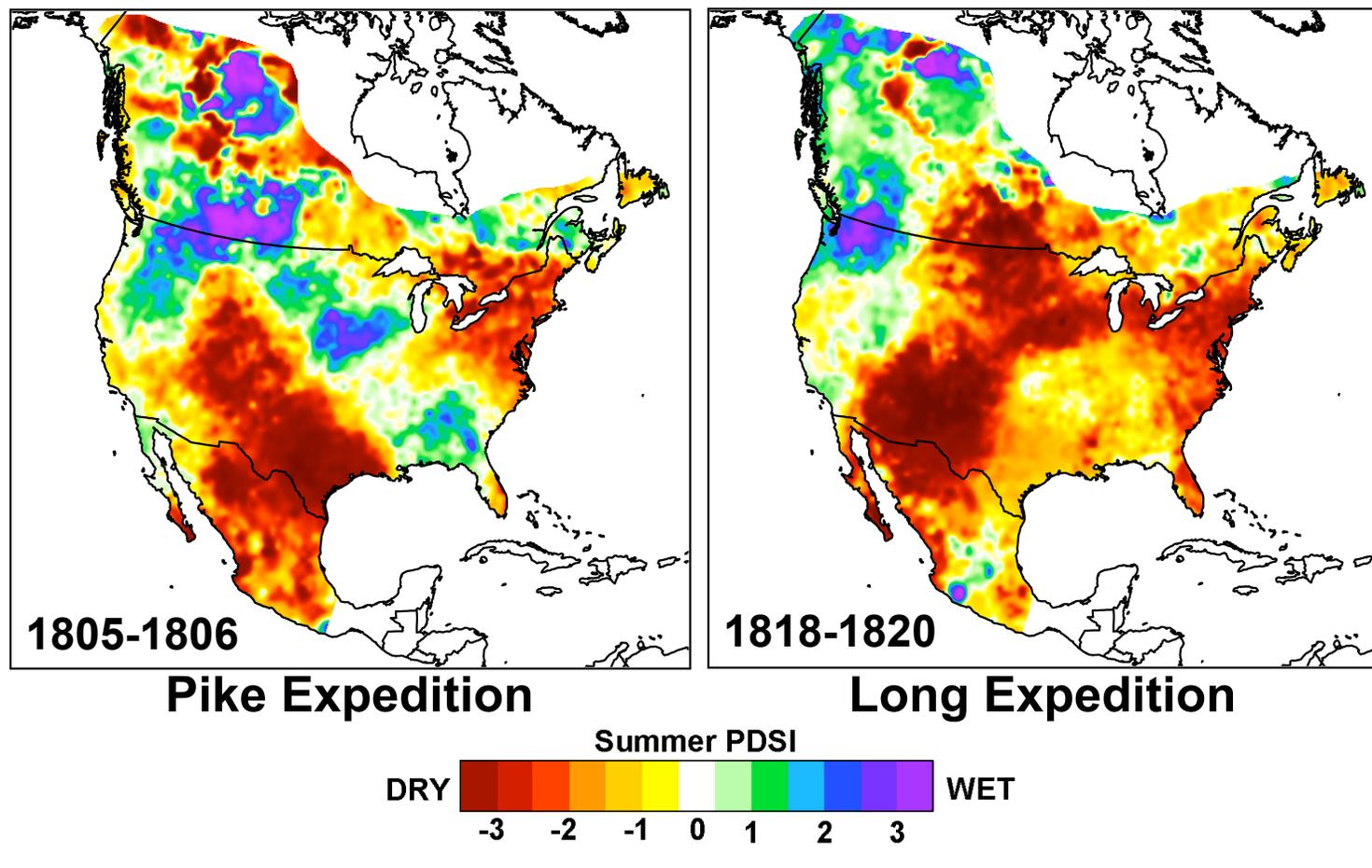
all-time record flooding on Arkansas, Canadian, and Verdigris Rivers in Oklahoma.

950 displaced Creek and Seminole drown on floodplain farmsteads.



Seminole

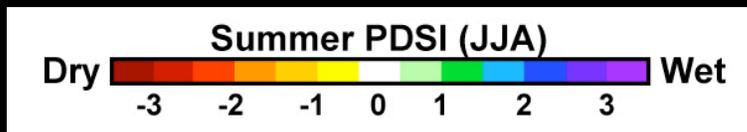
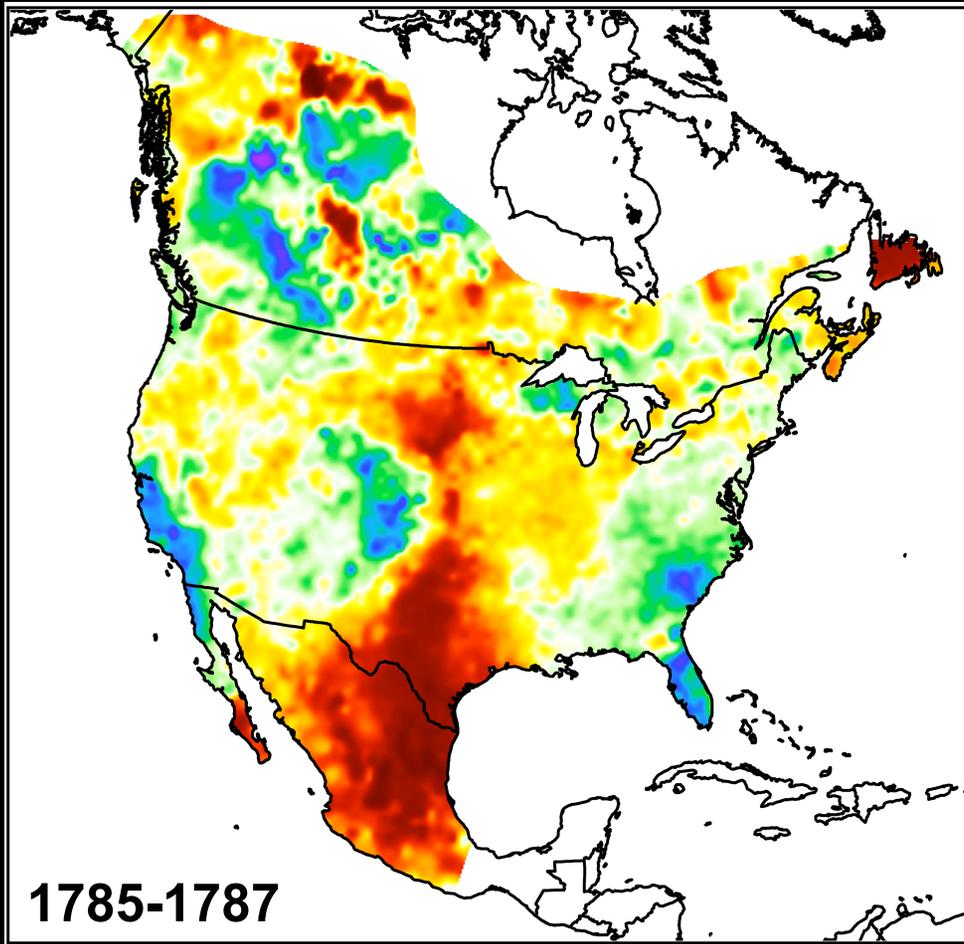
The Great American Desert



Zebulon Pike (1806-1807) “these vast plains of the western hemisphere, may become in time equally celebrated as the sandy deserts of Africa.”

Stephen H. Long (1820) labeled the central Great Plains as “the Great American Desert.”
The region “is almost wholly unfit for cultivation...the scarcity of wood and water, almost uniformly prevalent, will prove an insuperable obstacle in the way of settling the country.”

“El Año del Hambre”



Tree-ring reconstructed summer PDSI indicates three-consecutive years of drought in the late 18th century, 1785-1787.

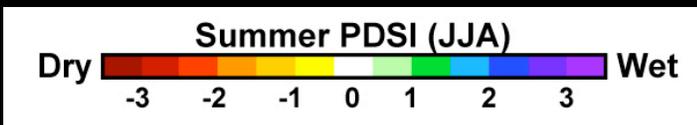
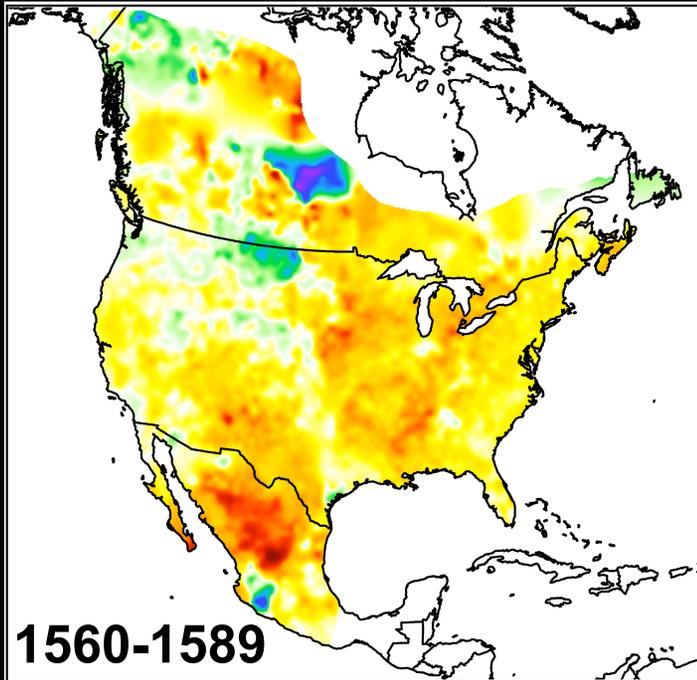
Classic Tex-Mex drought anomaly pattern, most intense from Zacatecas into Texas.

Included infamous El Año del Hambre, one of the worst famines in Mexican history.

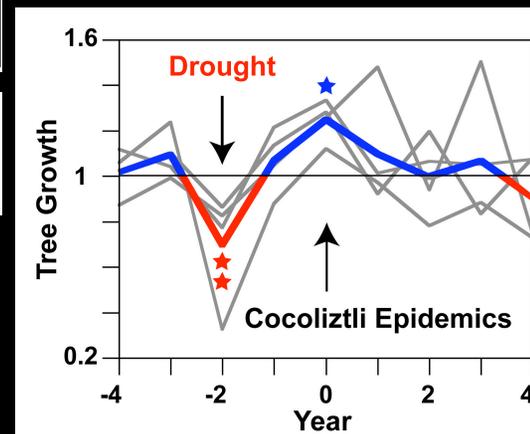
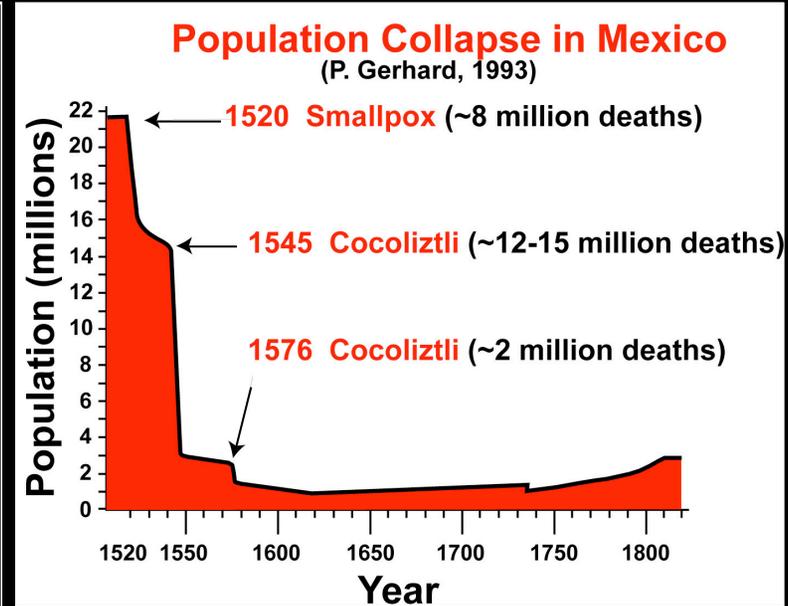
Drought and crop failure caused many deaths, and dramatic economic inflation, especially during 1786-1787, the most extreme years of drought.

The 16th Century Megadrought

The most severe-sustained North American drought of the past 500 years?
50-years of incipient to severe drought in Mexico, 1540-1589



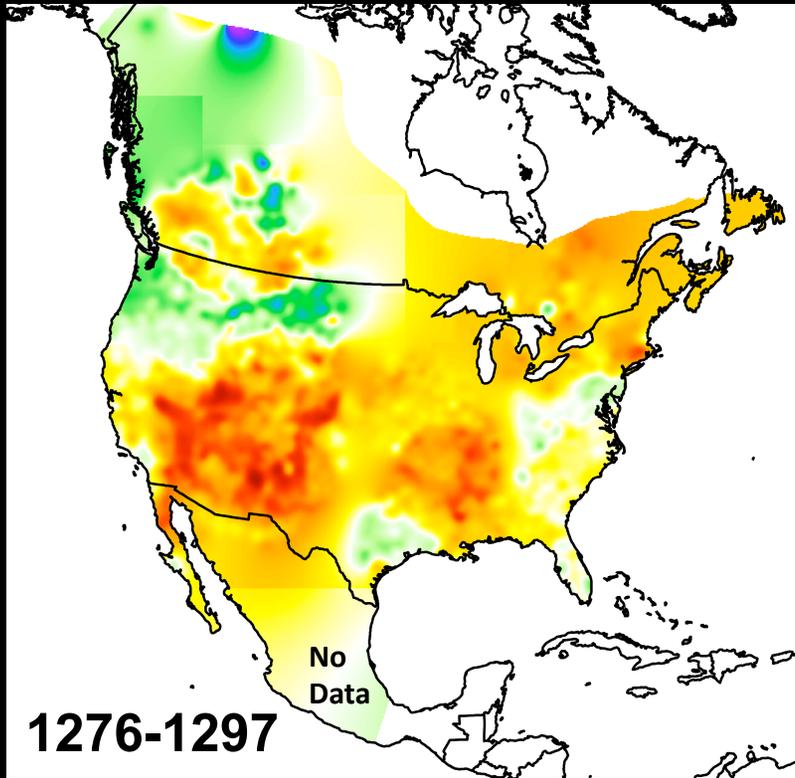
Worst 30-years = 1560-1589
Demographic catastrophe
Cocoliztli: indigenous hemorrhagic fever
Dr. Francisco Hernandez & symptoms
Social order of mortality
Encomienda system of New Spain



Sequence of climatic extremes, 4 largest epidemics.
Disease agent unknown, leading hypothesis: rodent reservoir amplified by climate & ecological extremes.

Great Pueblo Drought

A.E. Douglass (1929)



Square Tower House

Mesa Verde, Colorado



North American dendrochronology begins with Douglass, and famous dating of Anasazi ruins.

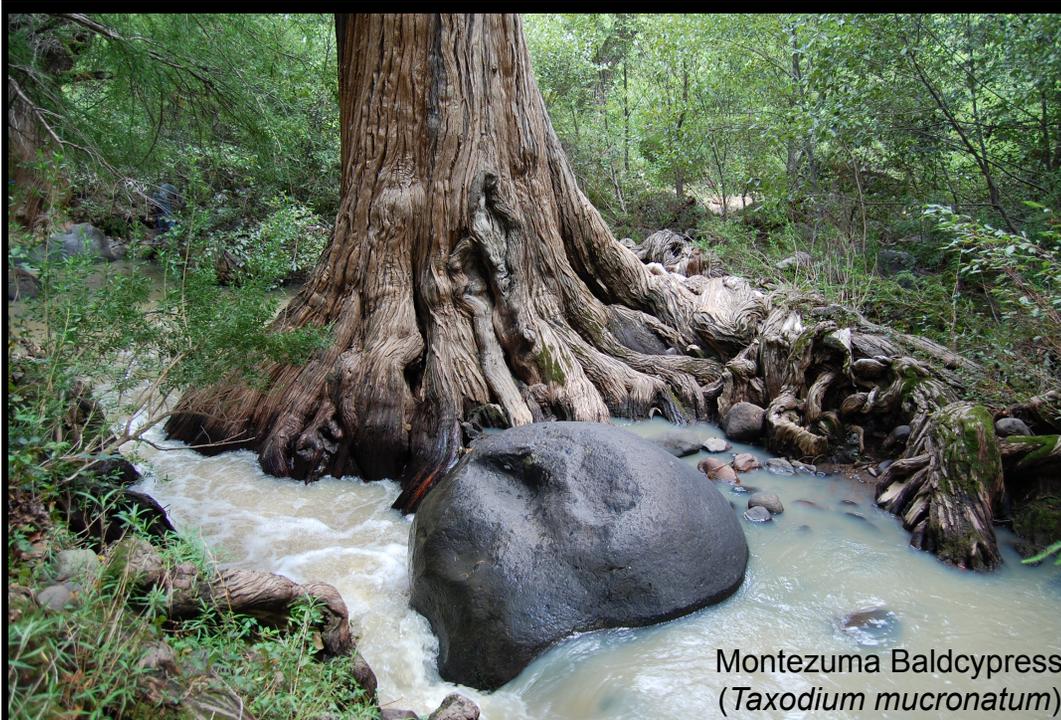
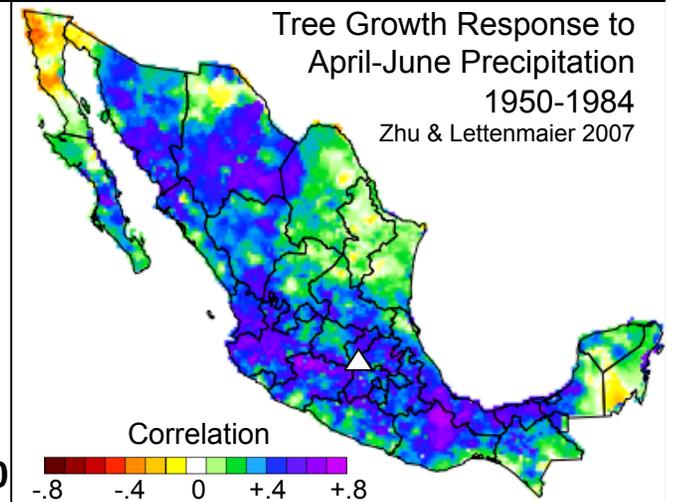
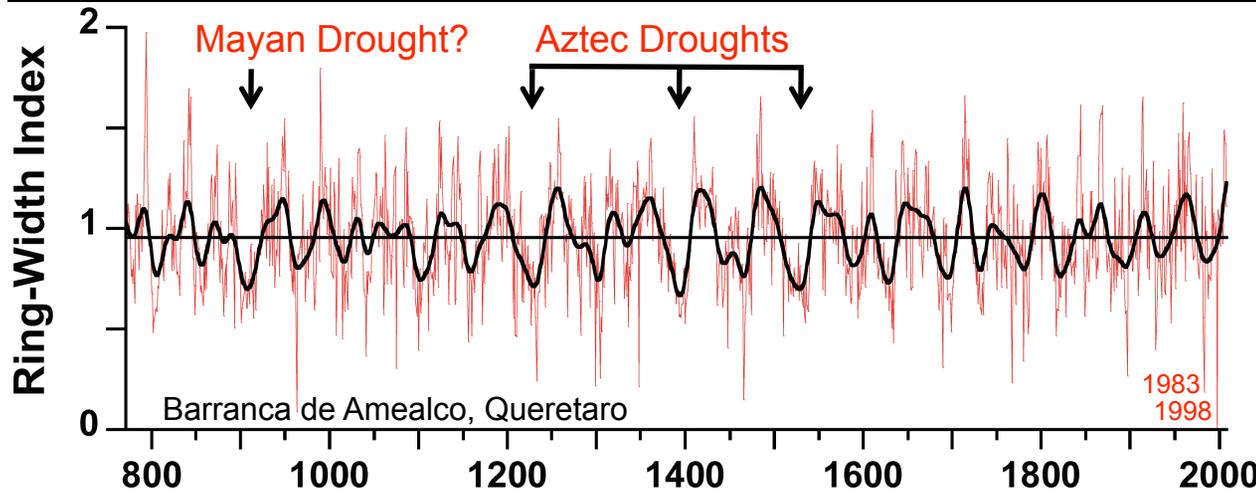
Noted late 13th Century drought and the apparent de-population of large areas of Colorado Plateau.

The Douglass 'Great Pueblo Drought' is confirmed by new PDSI reconstructions:

20 of 22 years dry from 1276-1297 over Four Corners.

Cause of Anasazi abandonment still debated (drought, over-exploitation, arroyo cutting), we will never truly know, but hundreds of new chronologies confirm the 'Great Drought' centered on the Anasazi cultural heartland.

Mesoamerican Dendroclimatology: AD 771-2008



No high resolution proxies for central Mexico during height of Mesoamerican civilization; tropical forests & dendro; Precip response = AMJ over Mesoamerica; ENSO signal; Aztec Droughts; Classic Drought & Mayan decline?

