

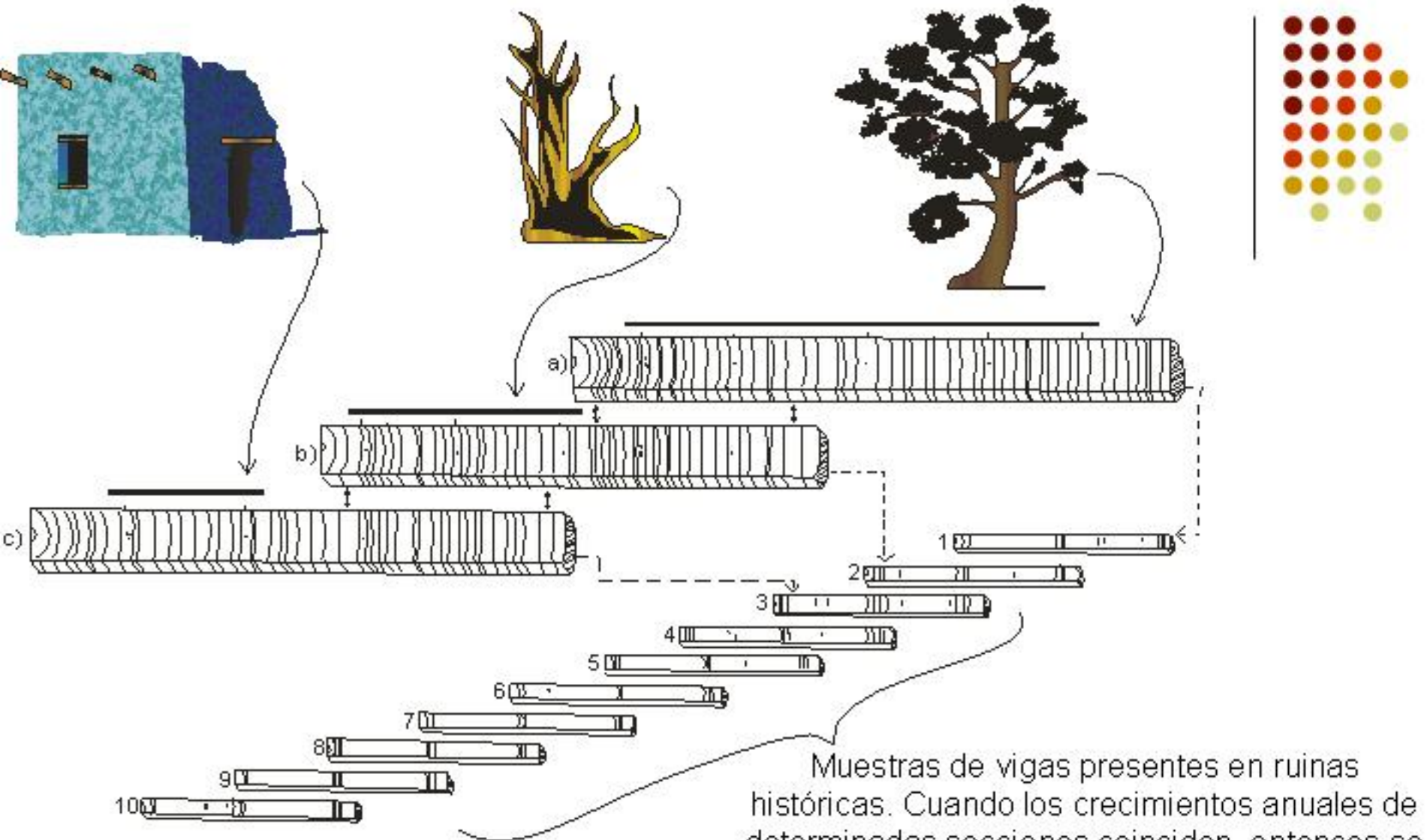
Historical Droughts in North-Central Mexico



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CONTENT OF PRESENTATION

- **Introduction**
- **Dendrochronological technique description**
- **Most important species for dendroclimatic studies in Mexico**
- **Precipitation reconstructions for north-central Mexico using tree rings**
- **Drought distribution**
- **ENSO Influence**
- **Conclusions**
- **Future research needs**



Principios de la dendrocronología: a) árbol vivo, b) árbol muerto y c) madera de ruinas arqueológicas.



Site and species selection

- Douglas-fir (wide distribution)
- Low site index
- Old looking trees; subfossil wood
- Earlywood, Latewood, Total ring width

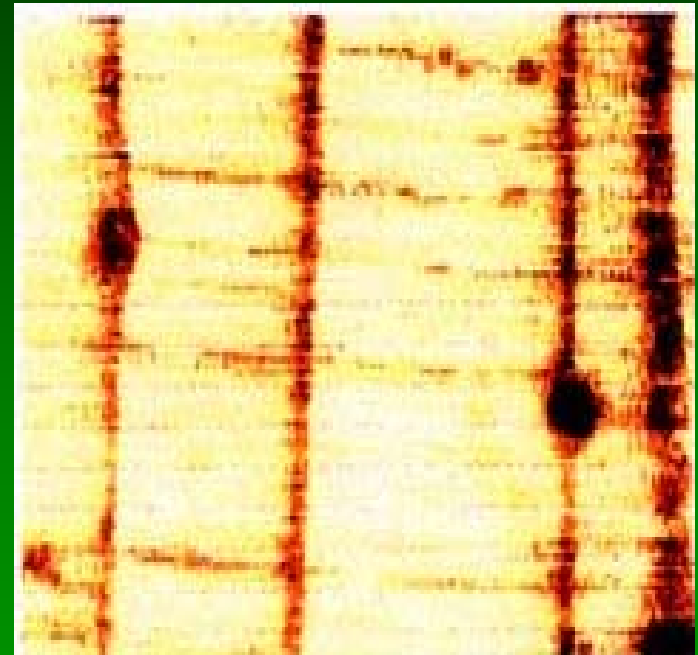
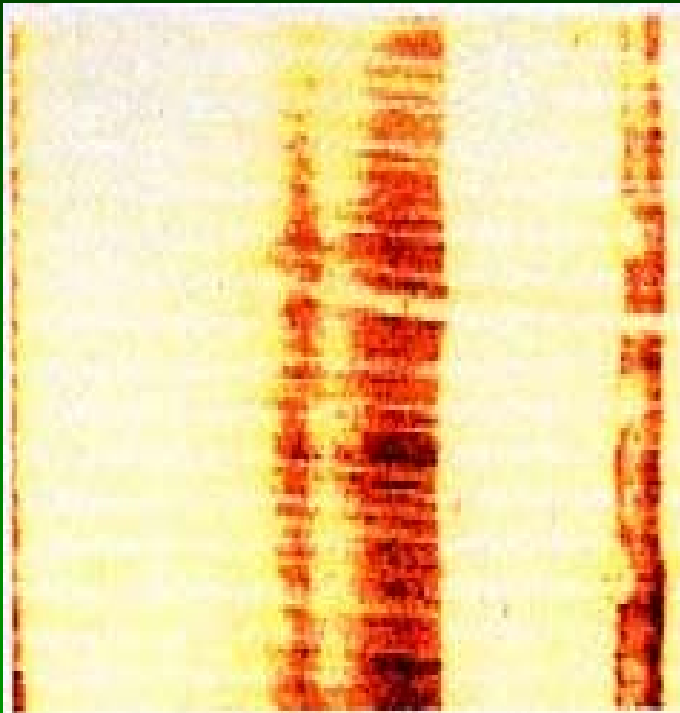


Annual Ring and Growth Bands

Earlywood

Latewood

False ring



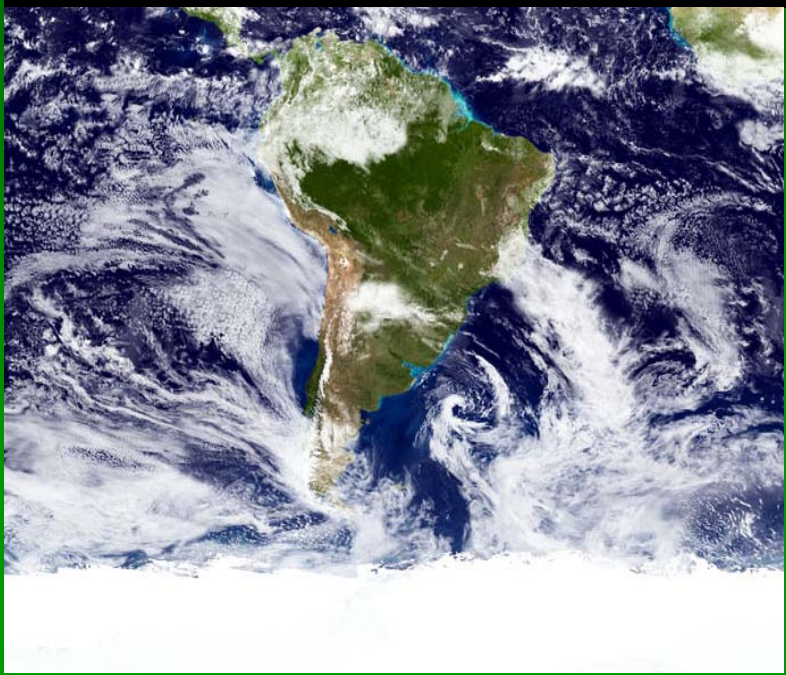
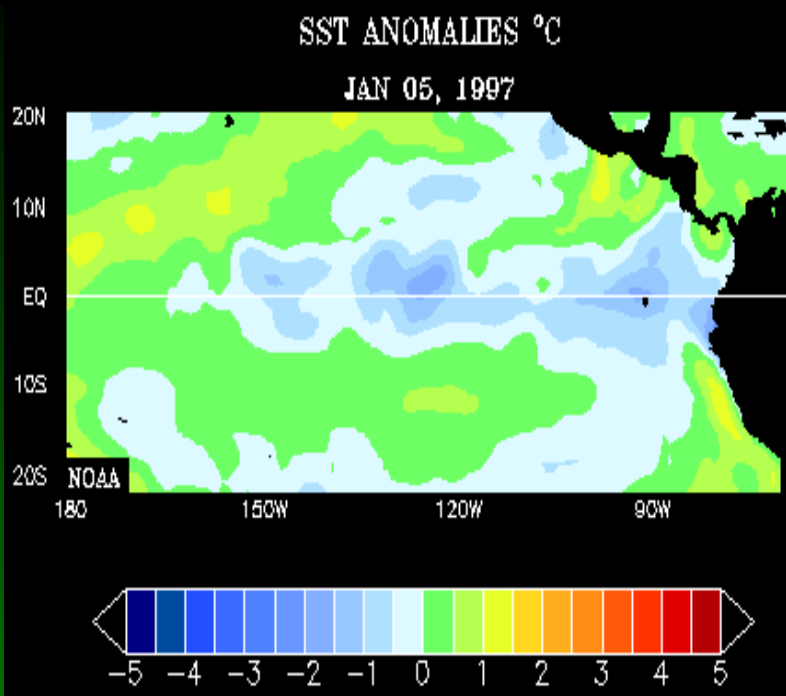
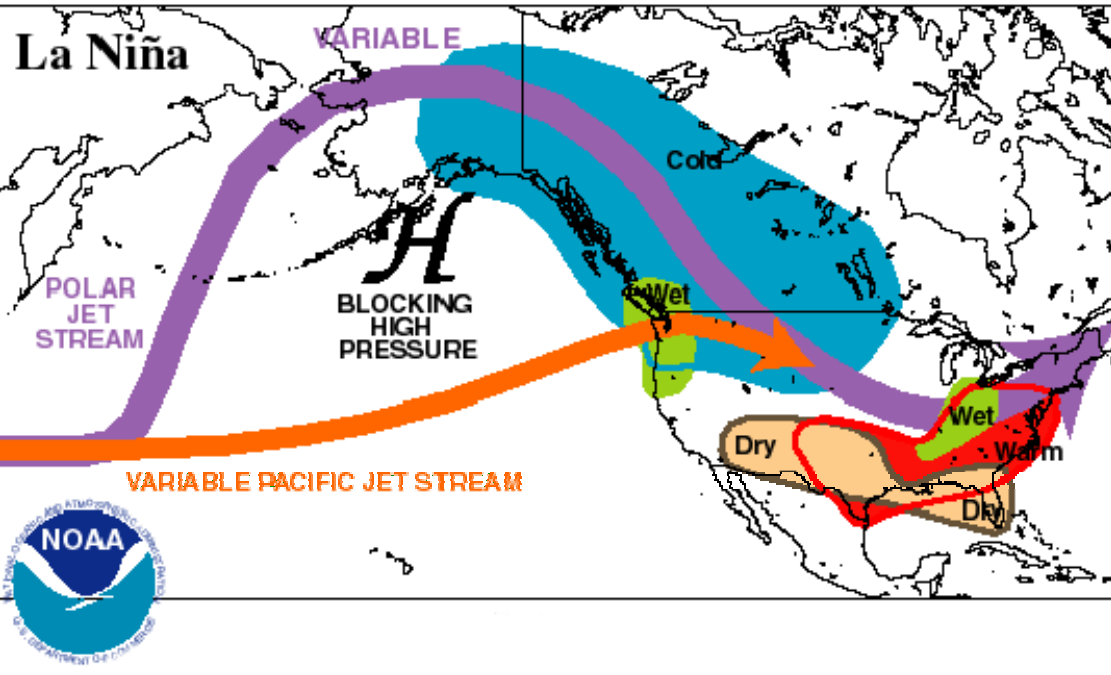
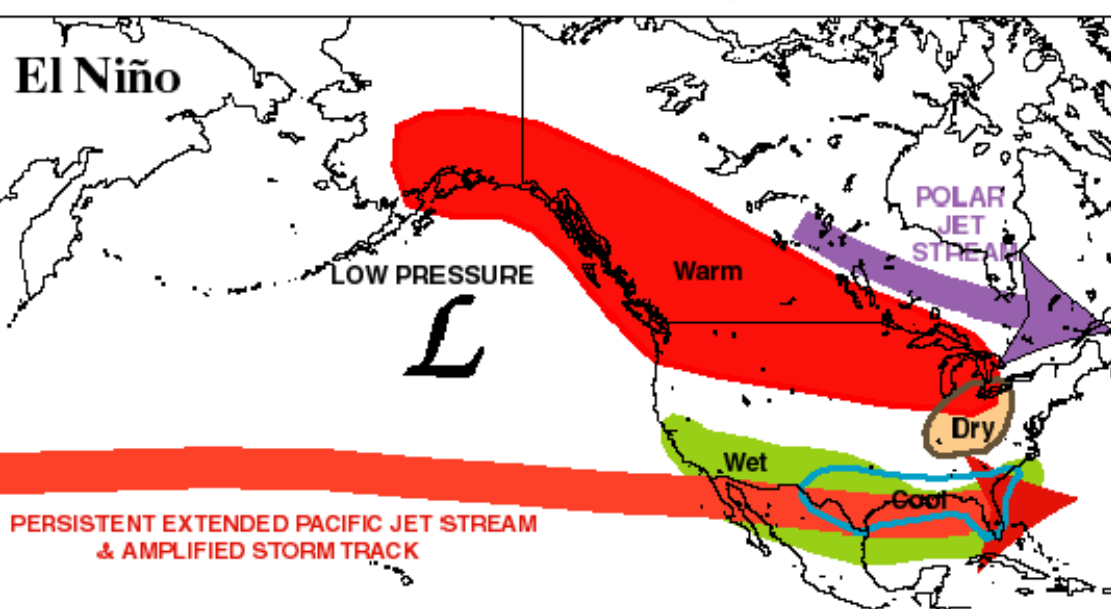
Ring Width

Ahuehete, Sabino, Montezuma Baldcypress (*Taxodium mucronatum*)

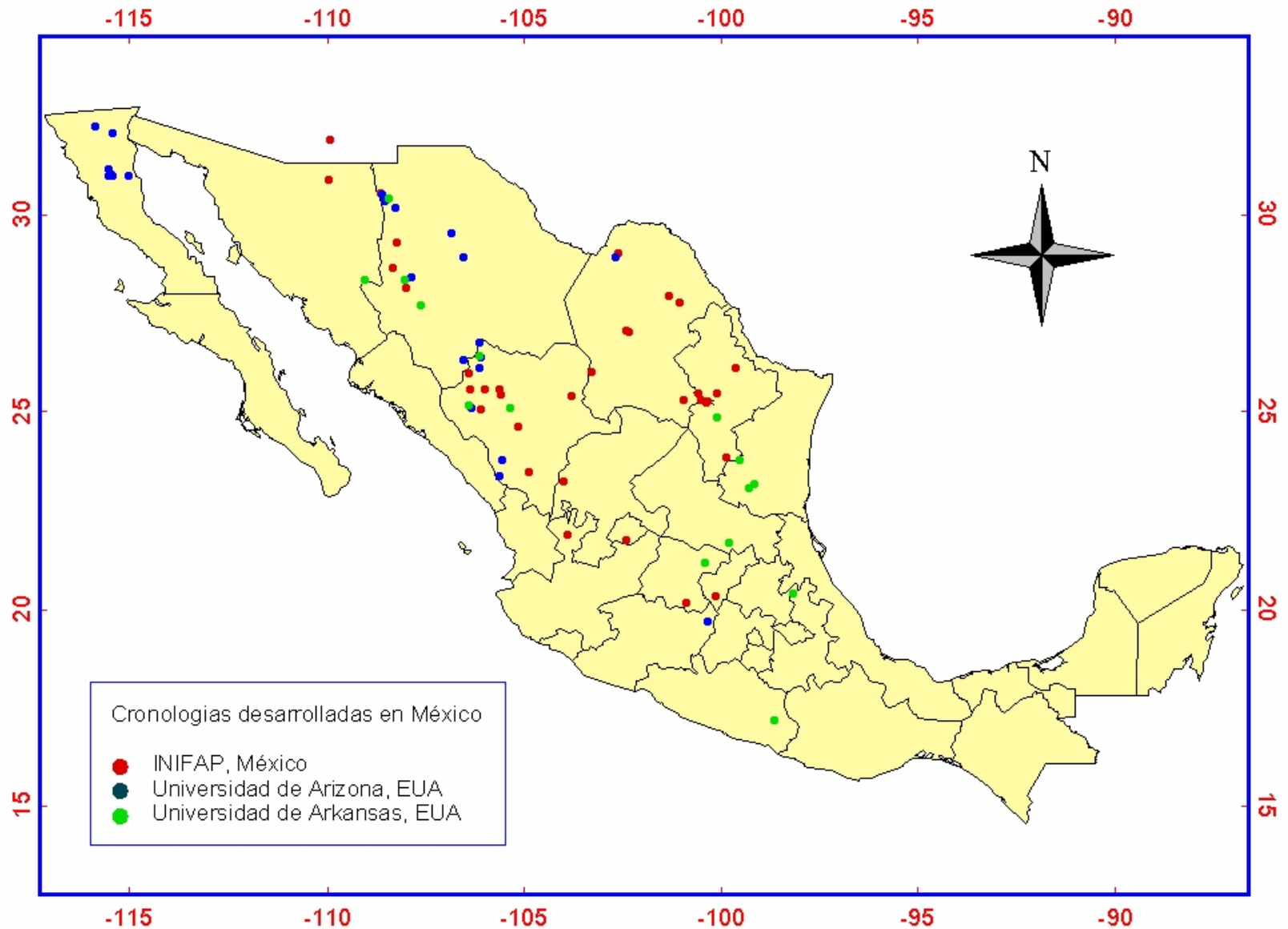


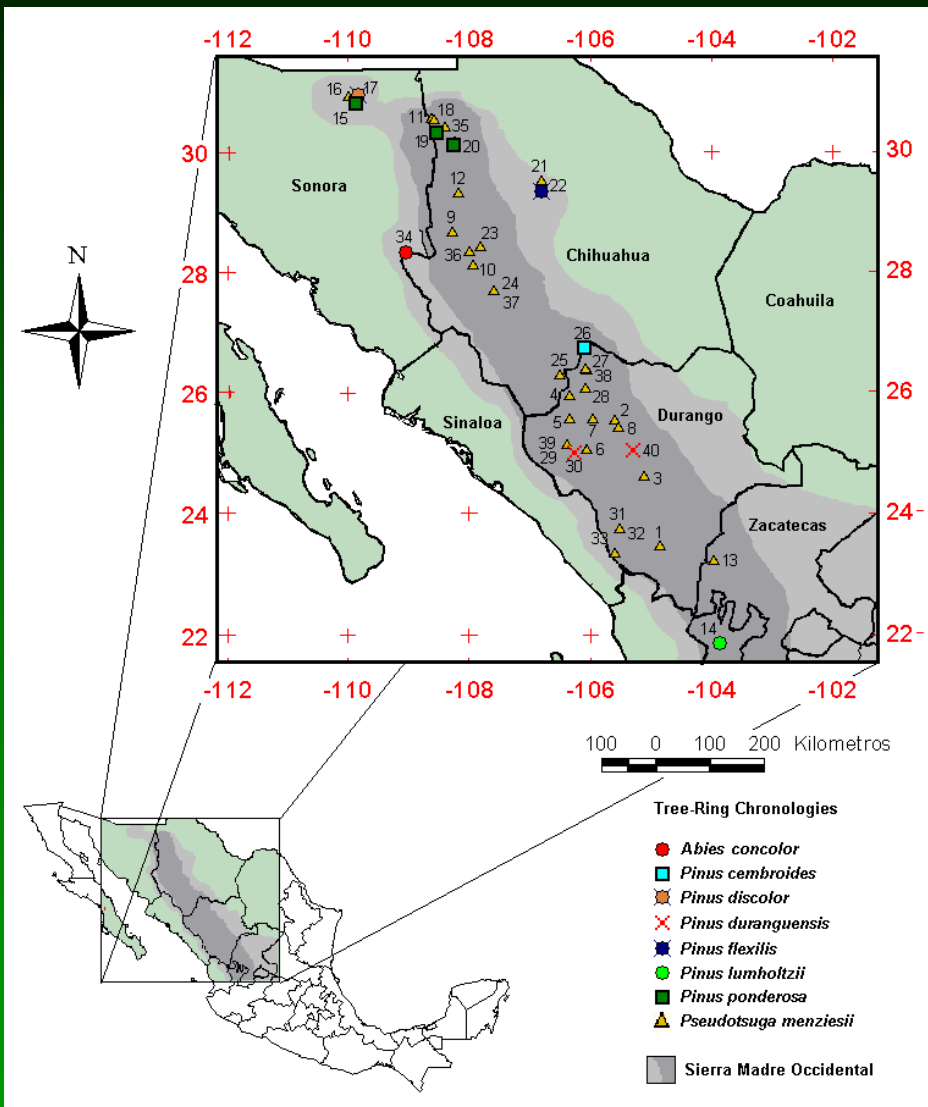
Pino piñonero (*Pinus cembroides*; *Pinus pinceana*); *Pinus lumholtzii*





Distribution of Tree-Ring Chronologies in Mexico





Network of tree-ring Chronologies in the SMO

- ✓ Mostly Douglas-fir Chronologies
- ✓ Lot of potential for development of new chronologies of baldcypress, Pines, Pinyon, Oaks, and other species
- ✓ >600 year chronologies
- ✓ Sensitive to winter-spring precipitation
- ✓ Warm phase of ENSO
- ✓ Precipitation and streamflow reconstructions

Sierra Madre Occidental



The SMO is the rhyolitic formation of greater dimension in the world. Geographically is located at the western region of Mexico and spreads over 1500 km length and 200 to 400 km wide.

The SMO is highly variable in terms of elevation with a mean of 2,500 m to over 3,300 m.

This mountain range limits to the east by the Chihuahuan desert highlands and to the west by the Pacific coast.

The annual total precipitation ranges from 500 to 1500 mm, near to 70% fall in the summer season. The watersheds of the SMO drain either to the Pacific or to desert highlands.



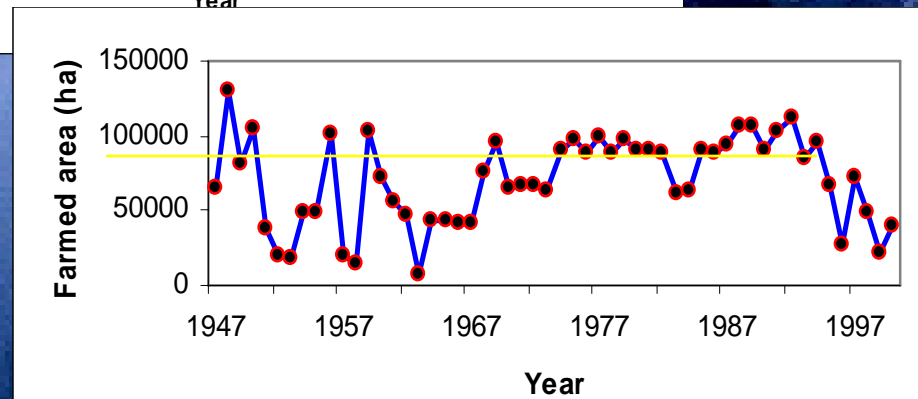
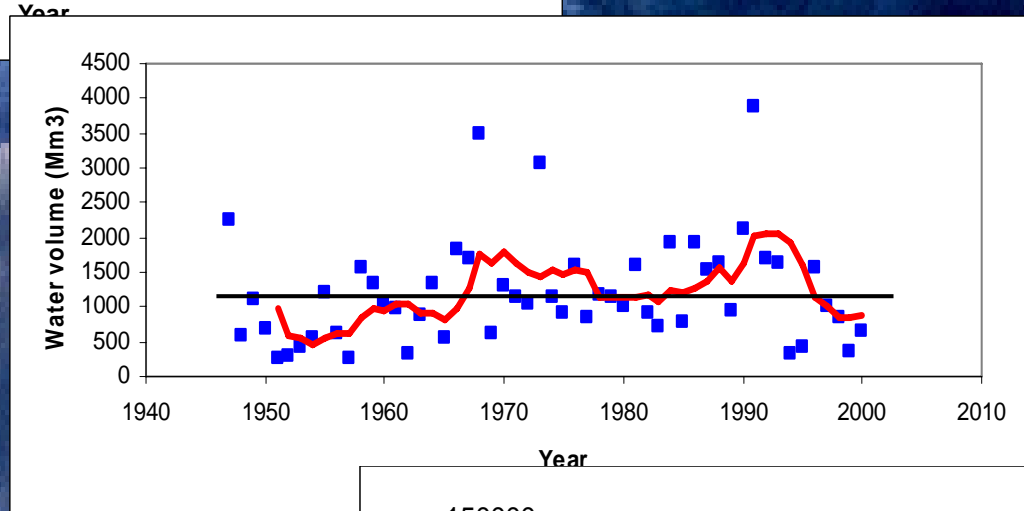
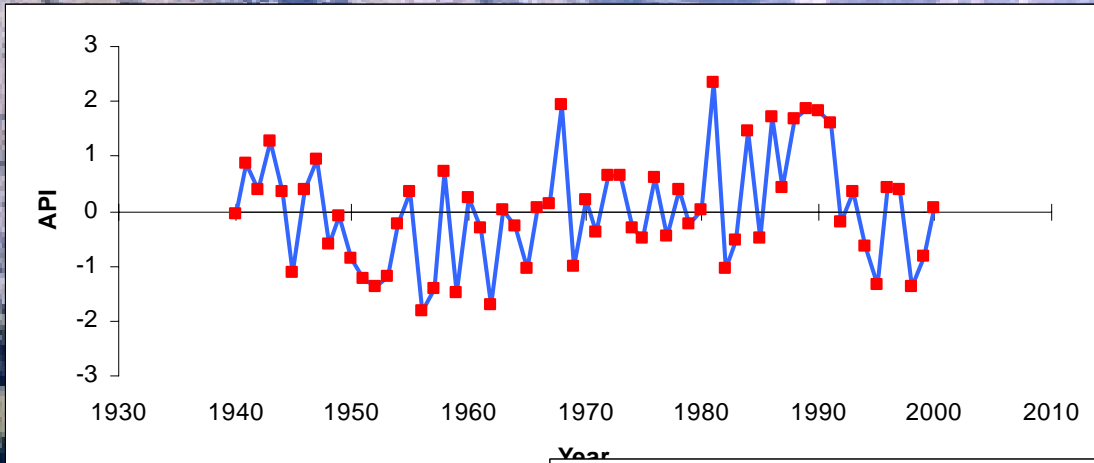
Watershed management in the SMO

All the important rivers of the SMO were dammed, except the southern part, where rainfall is of greater magnitude and irrigation is less important.

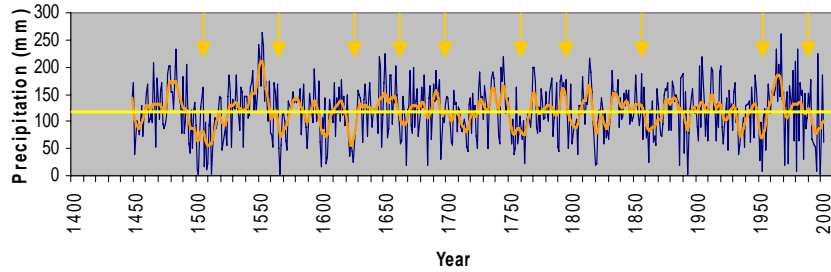
The dams have an important storage capacity over 3 km³ for most of them.

The irrigation districts are of great extension and most of the crops are grown for industrial purposes.

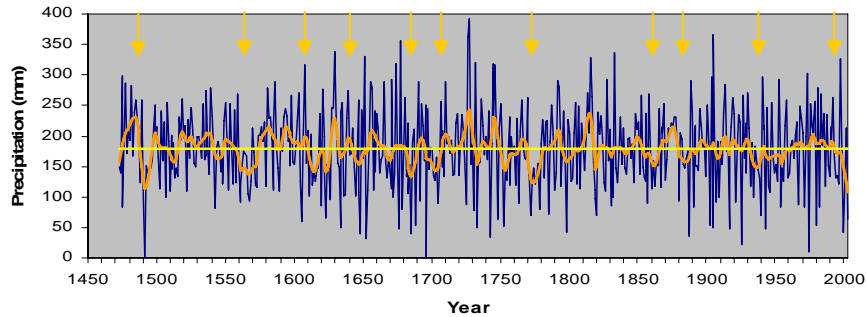
Agricultural Activities Linked to Water Availability



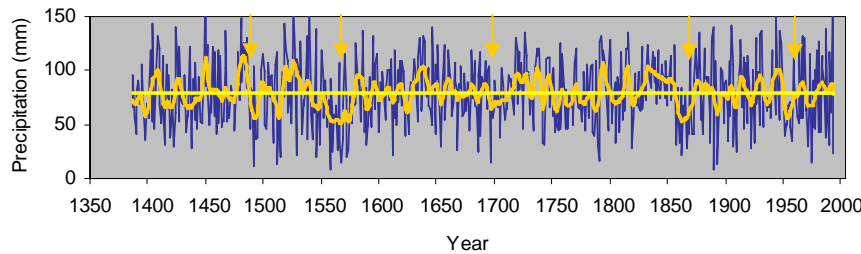
Seasonal (Nov-May) reconstructed precipitation for Durango, Chihuahua, and Sinaloa



Seasonal October-May precipitation for grid 4532 (Sonora-Chihuahua)



Seasonal November-March precipitation for Durango, Mexico



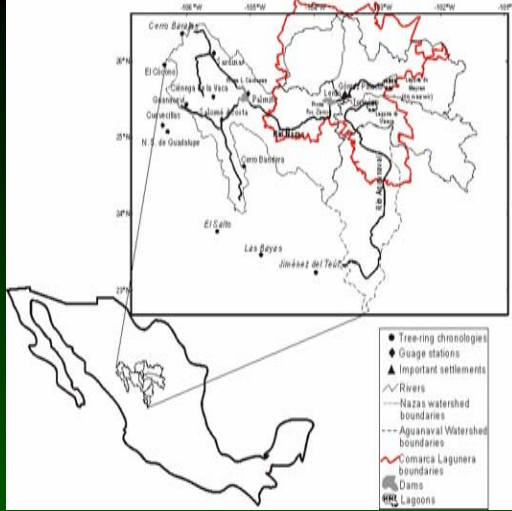
Winter-spring precipitation reconstructions for different regions of the SMO

✓ Precipitation reconstructions over 500 years

✓ Common dry periods for 1490s, 1560s, 1690s, 1760s, 1790s, 1800s, 1860s, 1890s, 1950s, 1990s

✓ Impact of atmospheric circulatory patterns





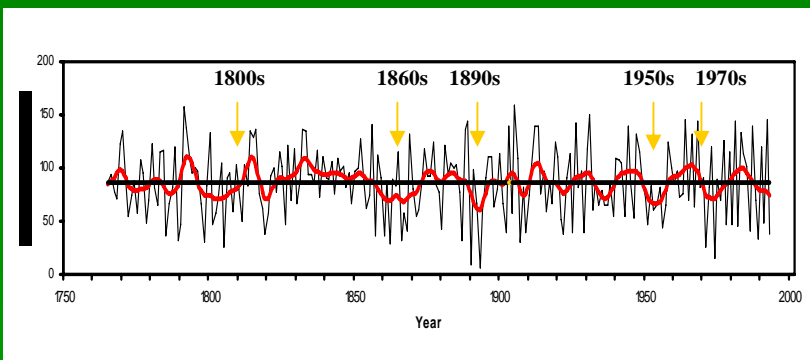
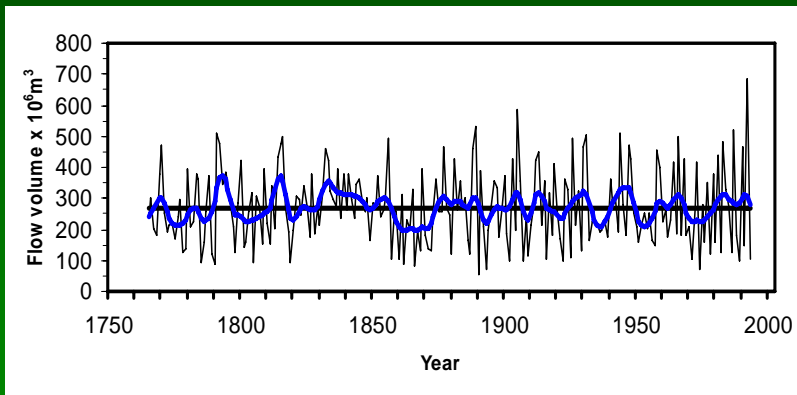
Streamflow reconstruction of the upper forested Nazas watershed

✓ Historical streamflow variability significantly related to ENSO

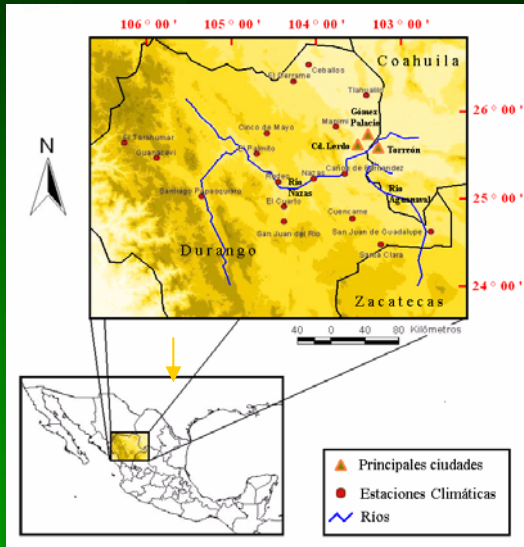
✓ Extreme dry events (1800s, 1860s, 1890s, 1950s, and 1970s) common to other climatic reconstructions for the region.

✓ Irrigated area in the Comarca Lagunera highly dependant on the Nazas streamflow

✓ Potential to predict in advance streamflow as function of ENSO, important information for allocating water volumes for agricultural purposes

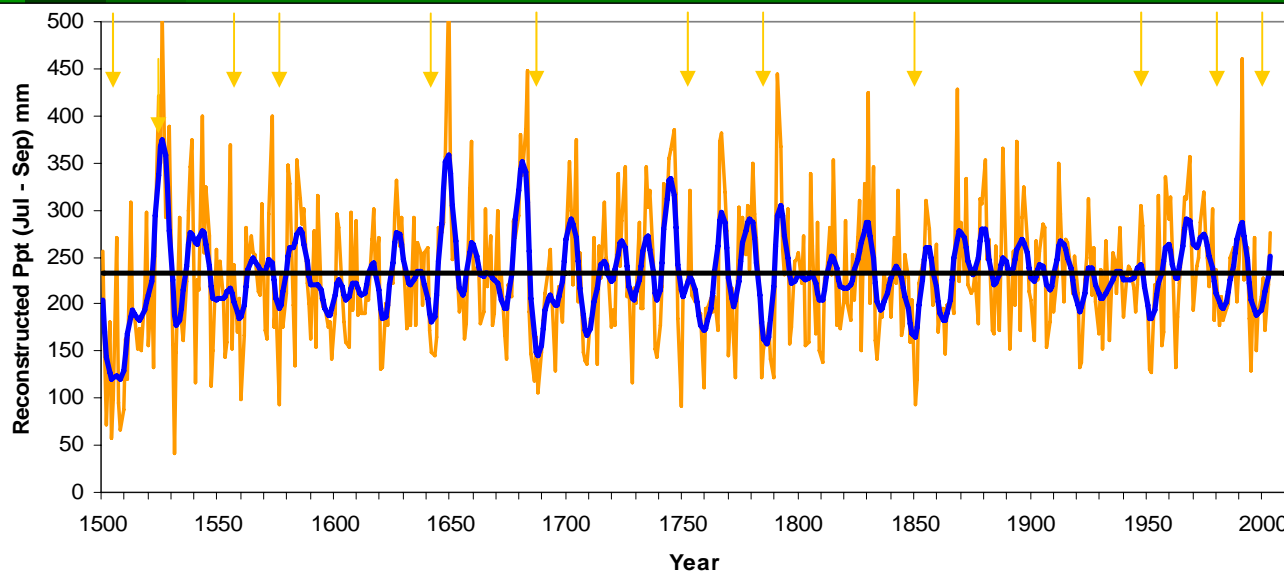


Reconstructed seasonal (July-September) precipitation for the lower Nazas basin, Durango



Cypress chronology

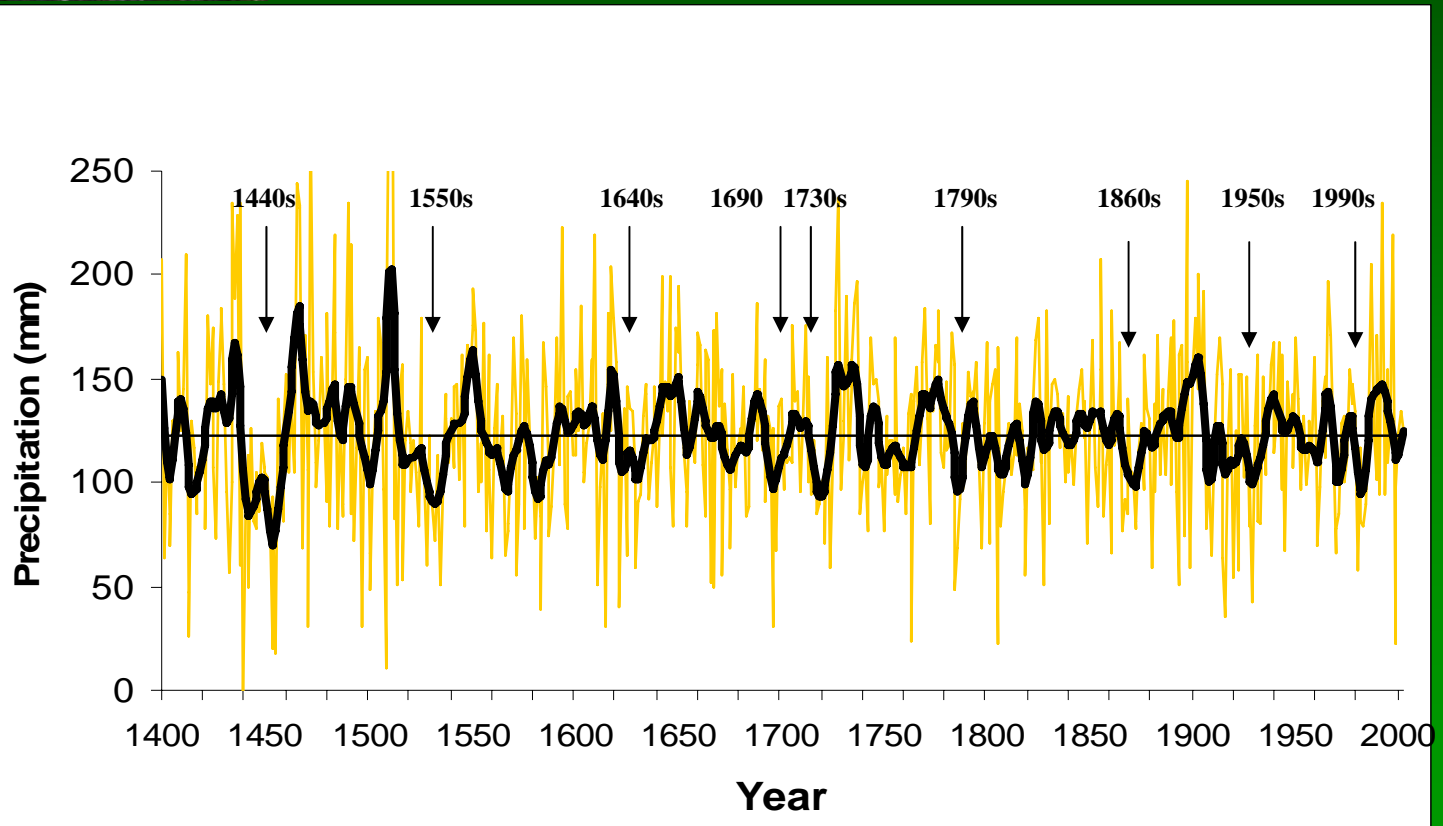
Droughts: 1500s, 1560s,
1580s, 1640s, 1690s,
1760s, 1780s, 1860s,
1950s, 1990s



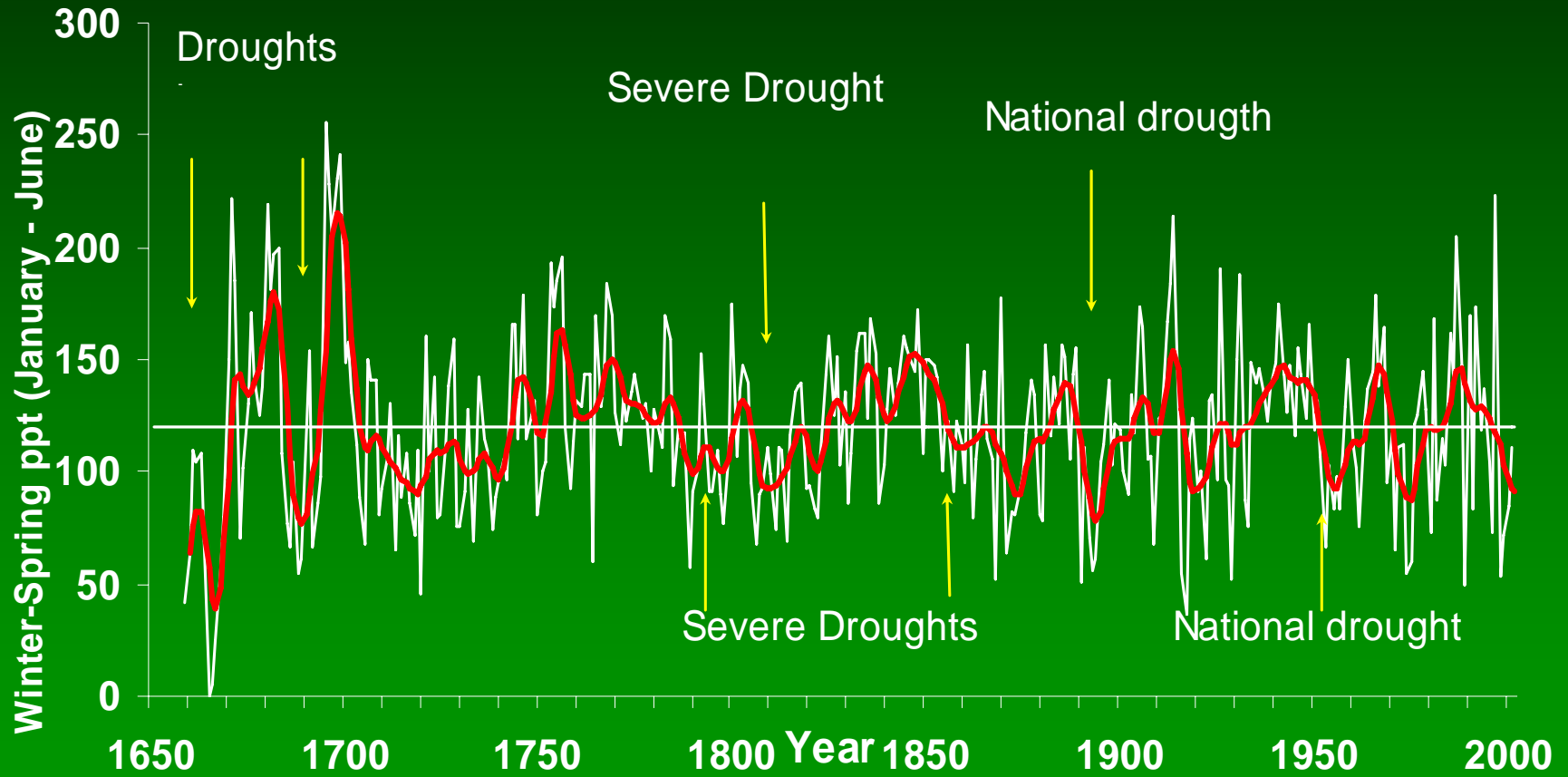


SIERRA MADRE ORIENTAL

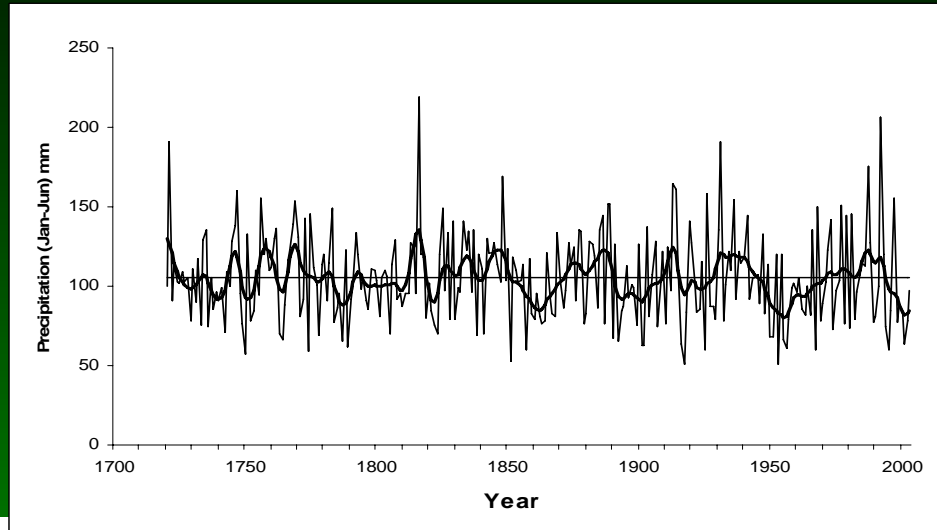
Reconstructed winter-spring precipitation. Peña Nevada, Nuevo León



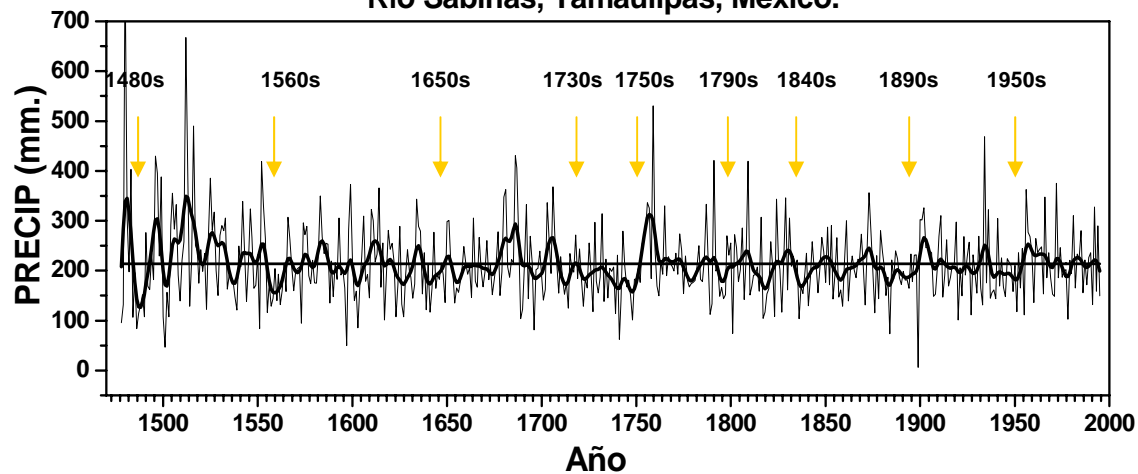
Precipitation reconstruction. Saltillo, Coahuila



Reconstructed winter-spring precipitation western Tamaulipas and Cuatrociénegas, Coahuila

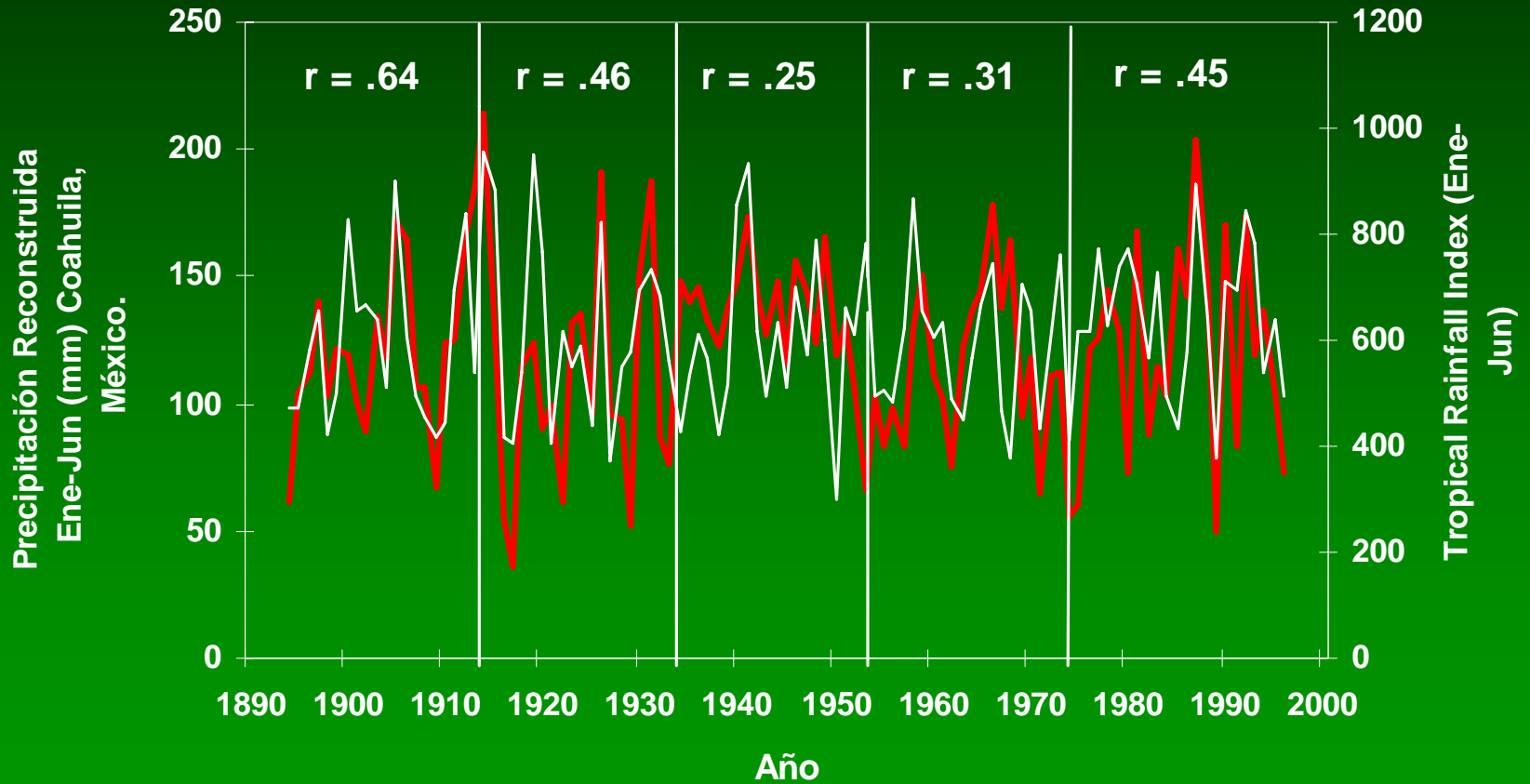


Reconstrucción de precipitación NOV-MAY 1478-1995
Río Sabinas, Tamaulipas, México.

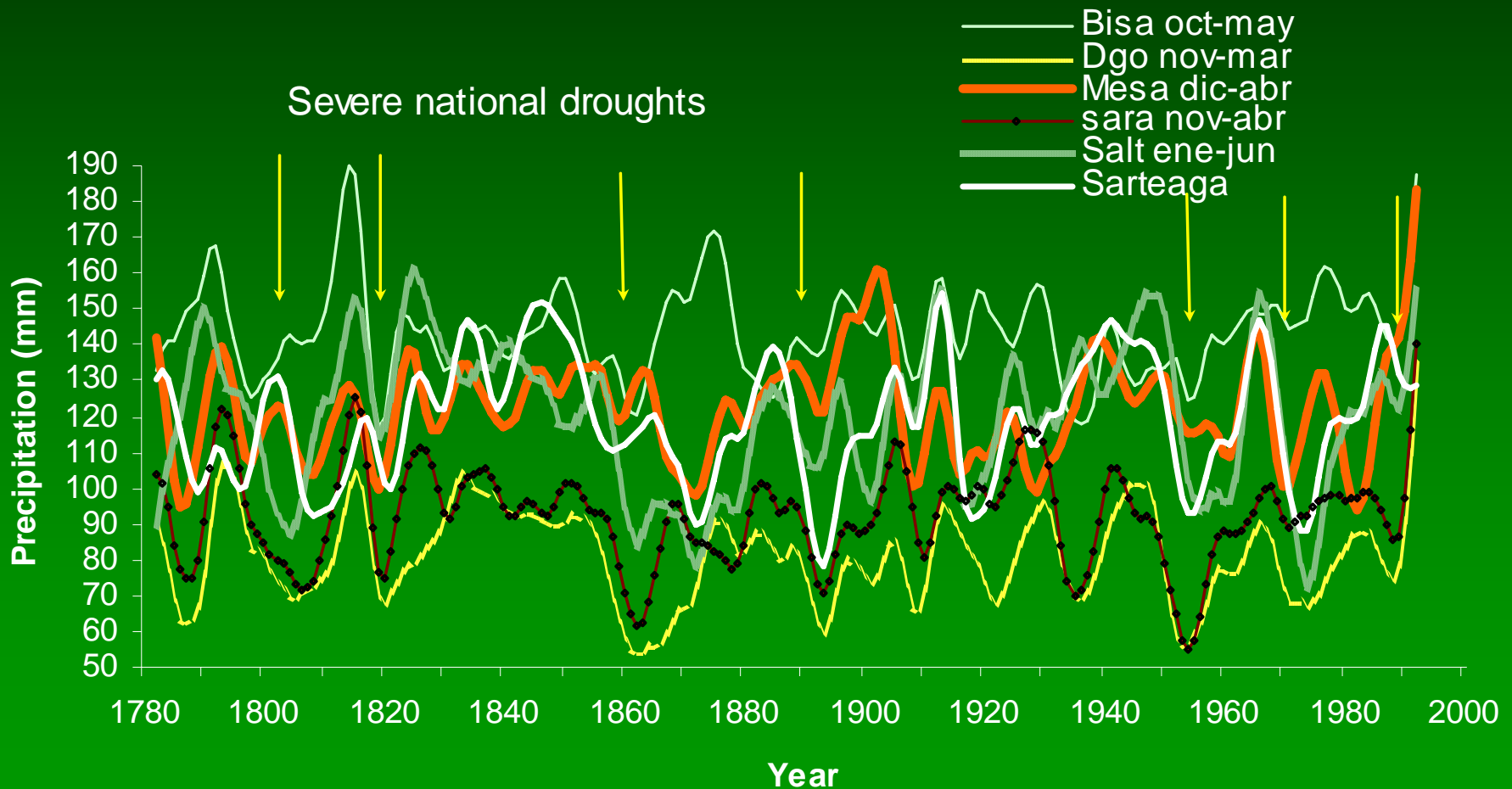


Precipitation reconstructed and the correlation with ENSO

— Precipitación Reconstruida
- - - Tropical Rainfall Index

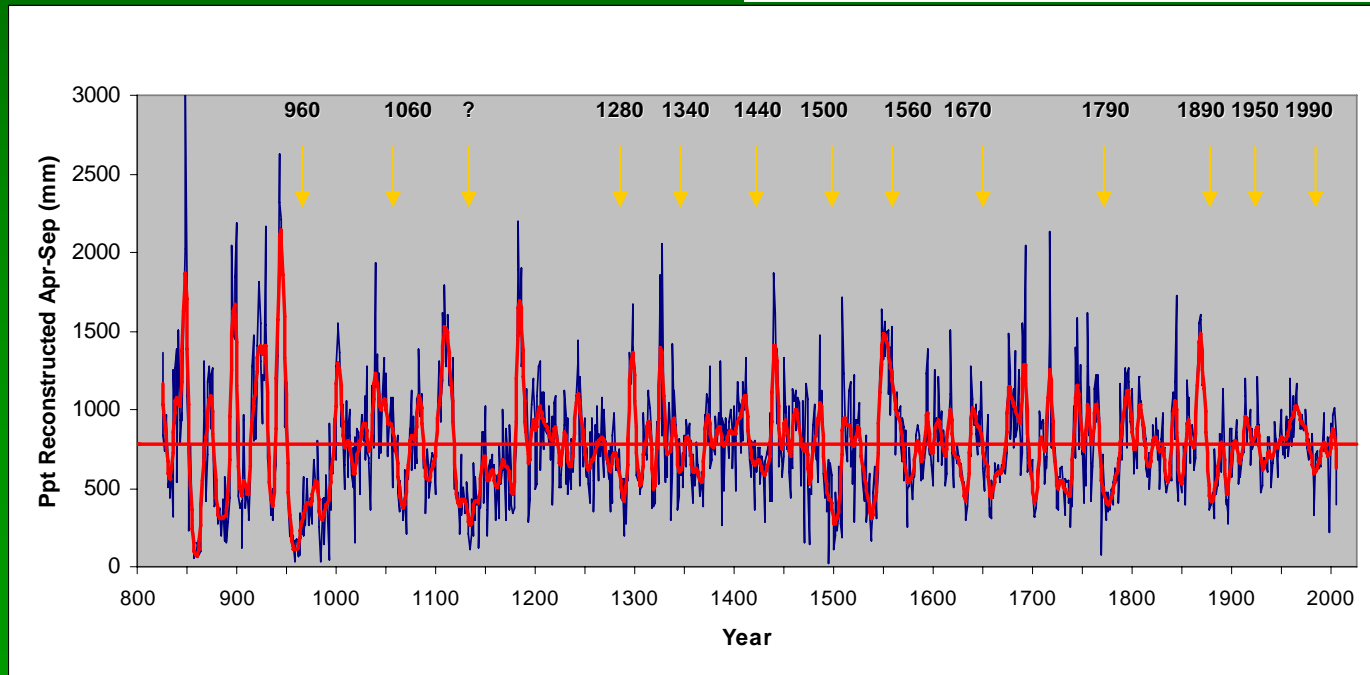
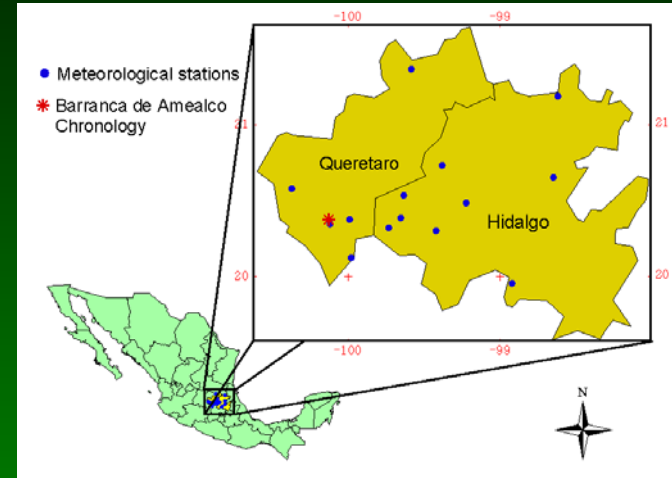


Low frequency events common to some precipitation reconstructions

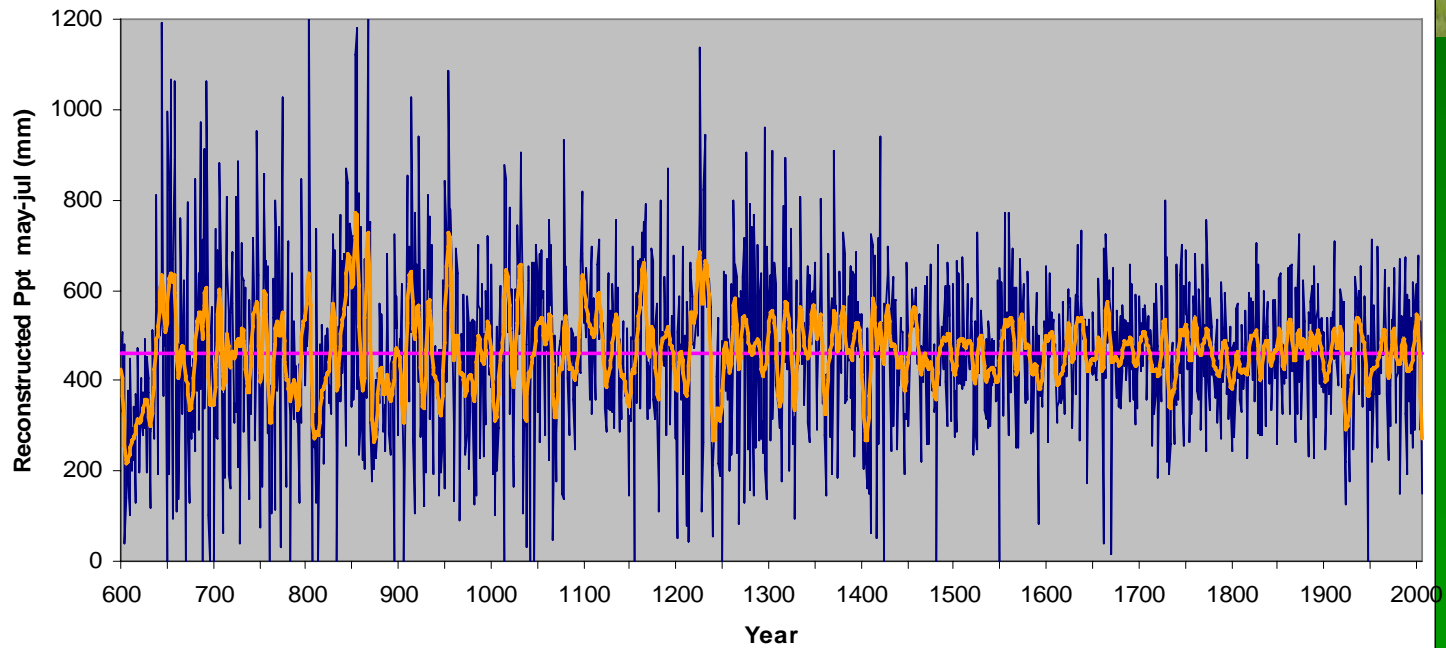


CENTRAL MEXICO

Barranca de Amealco Precipitation Reconstruction

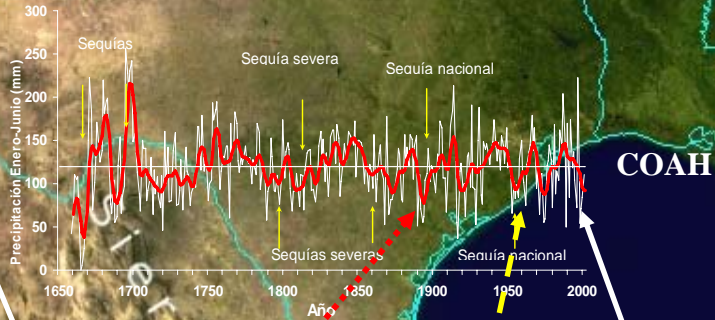
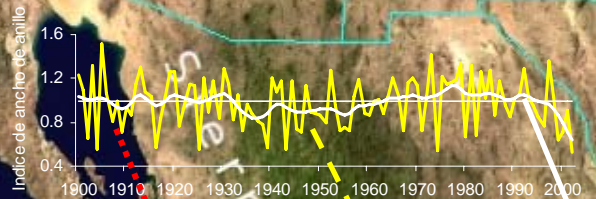


Los Peroles Seasonal Precipitation Reconstruction



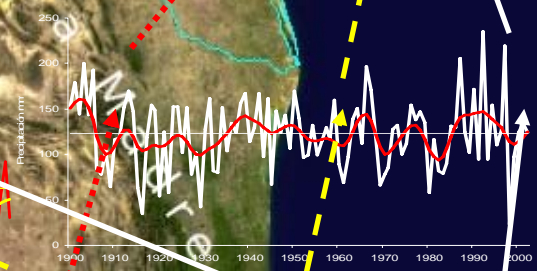
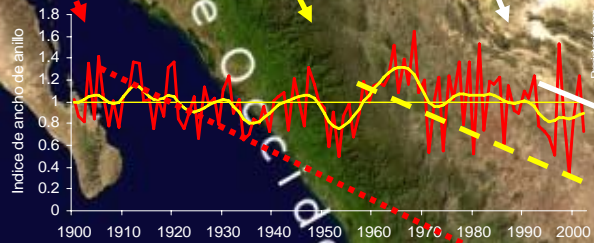
Droughts in the 20th Century

CHIH

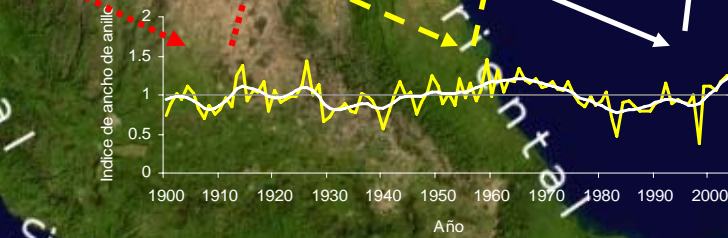


COAH

DGO



NL



QRO

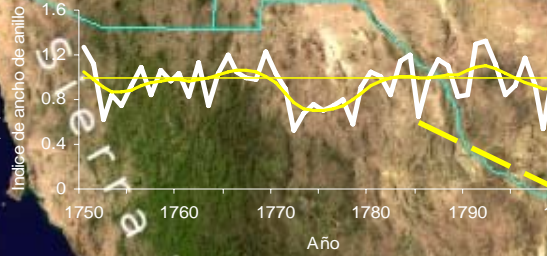
Sierra Madre Occidental

Sierra Madre Oriental

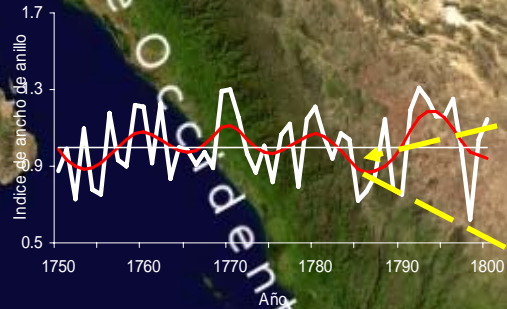
Sierra Madre del Sur

EL AÑO DEL HAMBRE 1785 - 1786

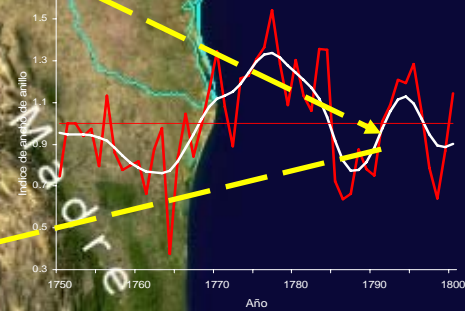
CHIH



DGO



NL



QRO



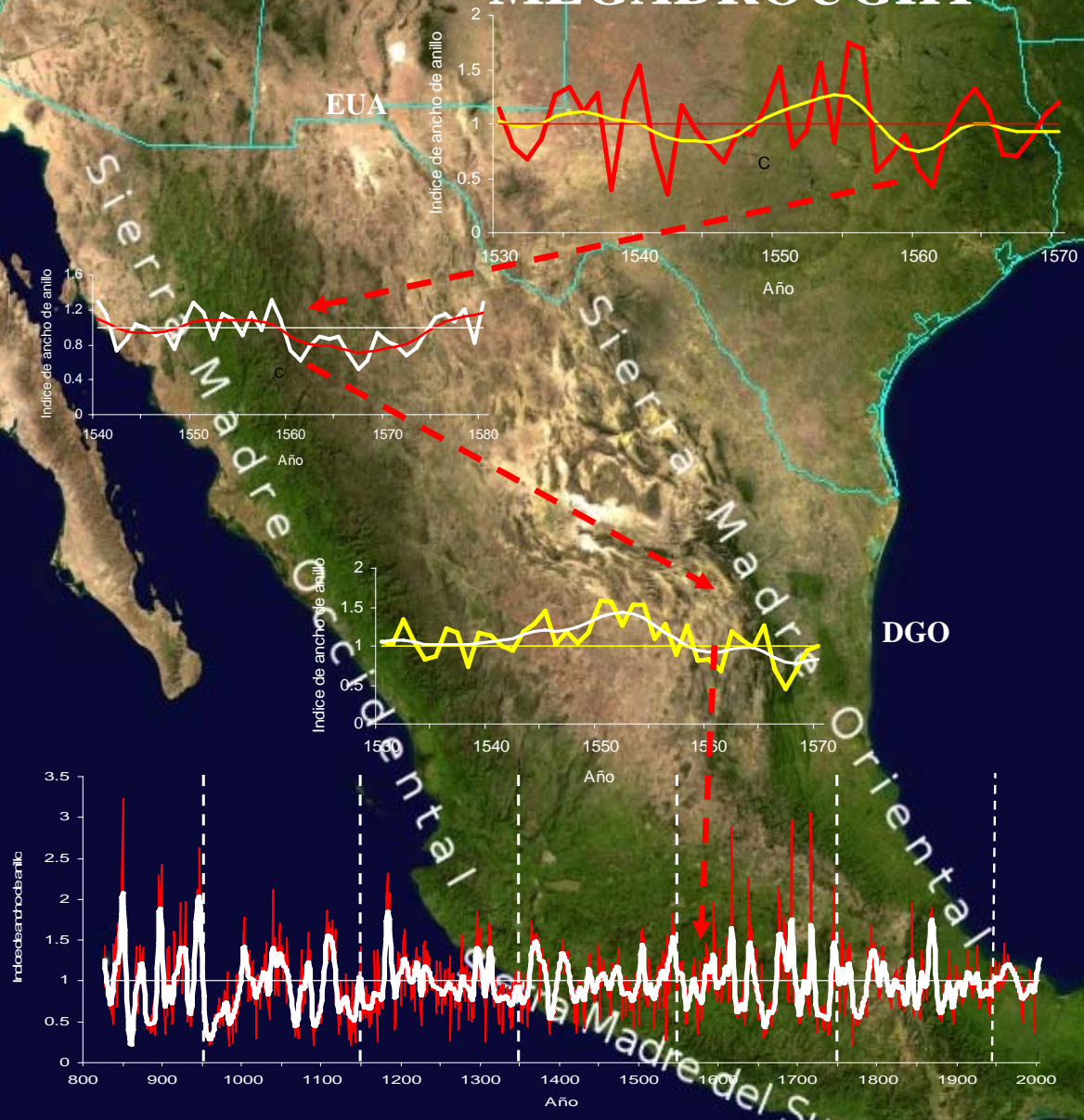
MEGADROUGHT

CHIH

EUA

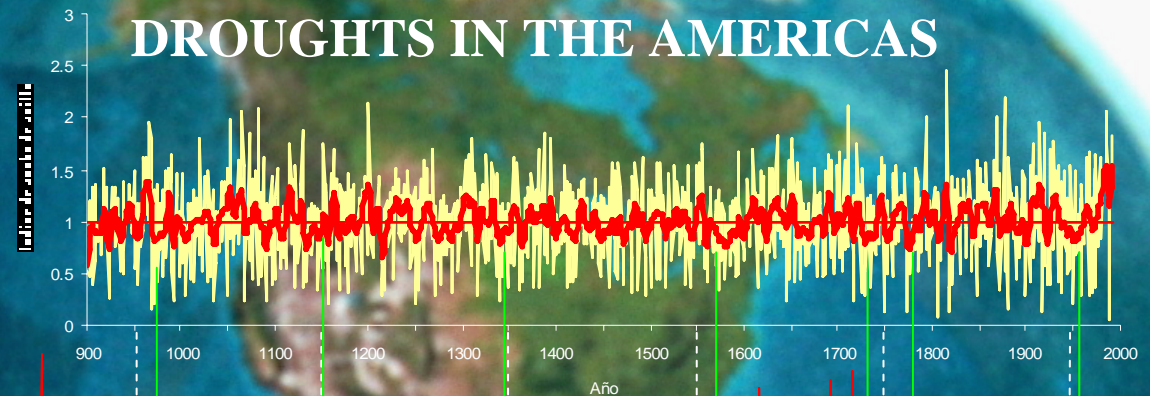
DGO

QRO

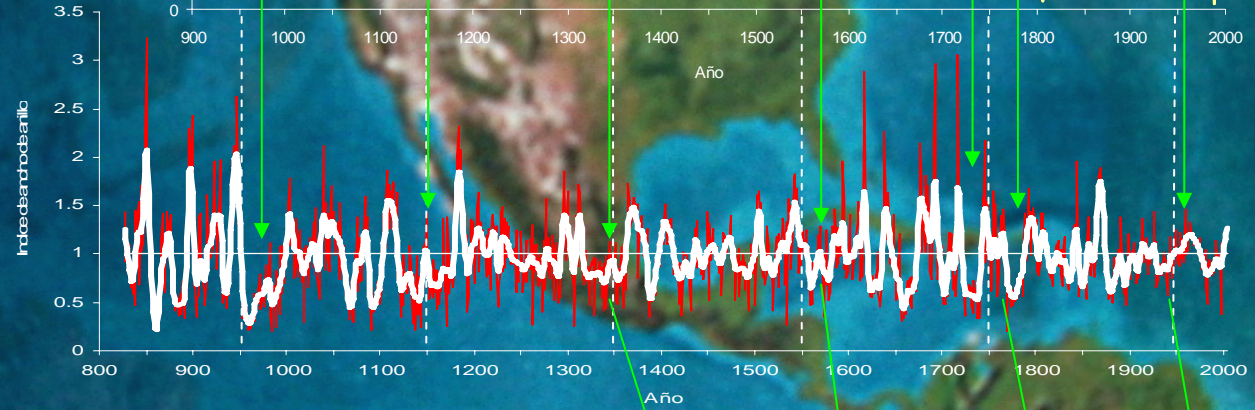


DROUGHTS IN THE AMERICAS

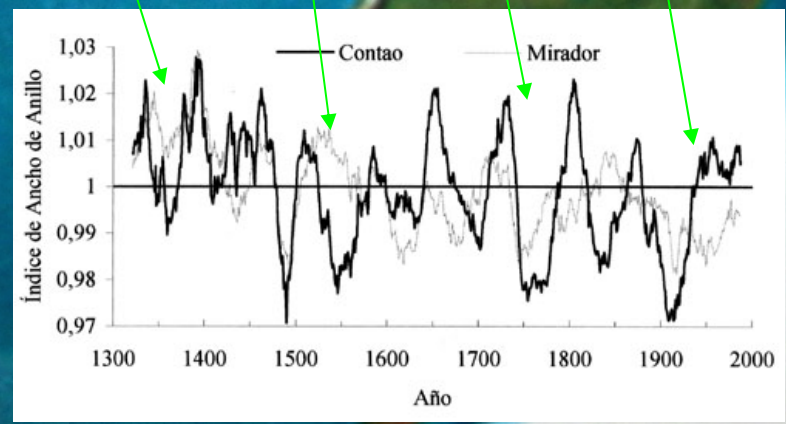
EUA



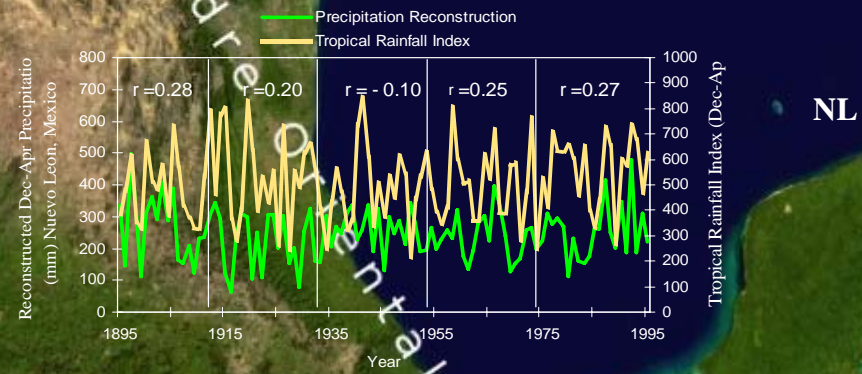
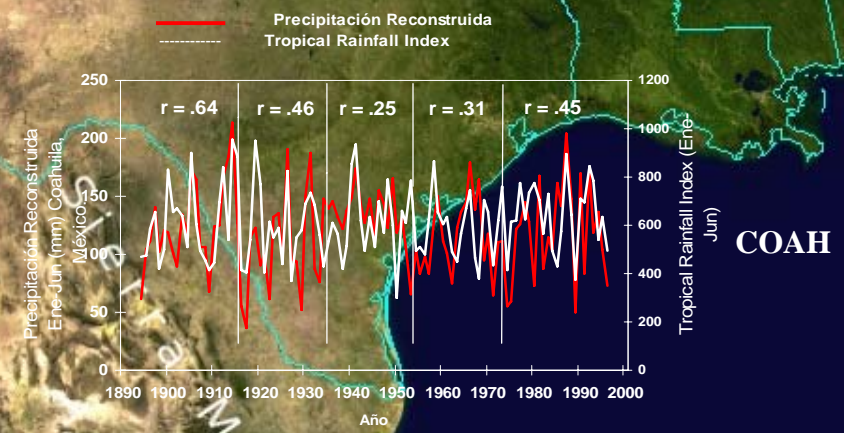
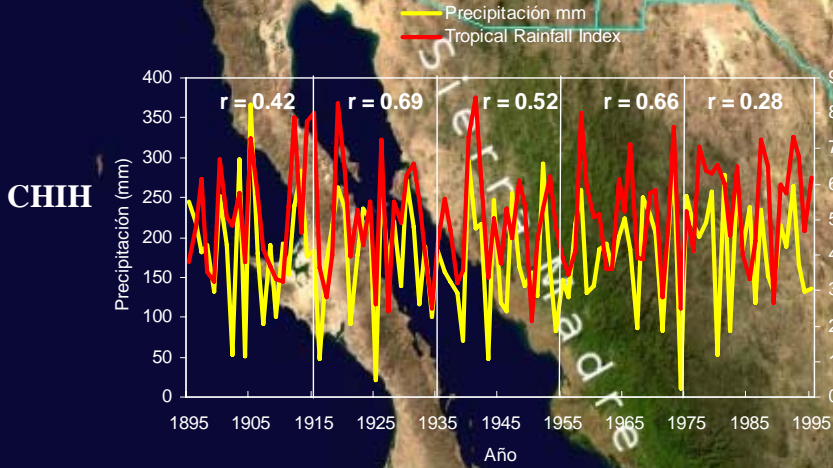
MEXICO



CHILE



ENSO IMPACT IN MEXICO



Future research activities



To expand the network of tree-ring chronologies

To analyze the dendrochronological potential of new species in temperate and tropical areas

To develop summer precipitation reconstructions and to analyze the influence of NAMS, tropical storms and hurricanes on water availability

Research collaborations to study specific issues on climate change



Runoff analyses and changes in base flow for basins in .

Streamflow and precipitation reconstructions with tree-ring data.

Historical analysis of atmospheric circulatory patterns and their influence on water availability

To analyze water availability under extreme climatic events and their potential impact on society

To provide decision makers with hydrological information for planning water resources in the central-northern Mexico

Collaborative work to address issues in climate change and socioeconomical impacts



¡Muchas gracias!