

Proceedings of the Sixteenth Annual Pacific Climate Workshop

The Wrigley Institute for Environmental Studies
Two Harbors, Santa Catalina Island, California
May 24-27, 1999

Edited by
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Technical Report 65
of the
Interagency Ecological Program for the
Sacramento-San Joaquin Delta

May 2000

PACLIM



**Climate Variability
of the
Eastern North Pacific
and
Western North America**

Climate Variability in the Southwest: An Integrated Assessment

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Expanded Abstract

As part of a multidisciplinary study of climate and its societal impact, instrumental meteorological records and “natural archive” paleoclimate records are reviewed and synthesized into a white paper and web-supported database. The purpose of the white paper is to summarize understanding of climate variability in this region on seasonal to multi-decadal and longer time scales in a form accessible to the science-literate non-climatologist. This study builds upon existing climate variability research and will ultimately be integrated with other regional assessment information for the Southwest Climate Assessment Project. The companion database, which forms part of the ongoing research activity on Southwest Climate Assessment, is currently under development. The database provides references and links to research literature and other readings, as well as to instrumental and reconstructed climate data and metadata (<http://www.ispe.arizona.edu/swclimate/index.html>).

Low annual precipitation, clear skies, and year-round warm weather over much of the Southwest are due in large part to a quasi-permanent subtropical high-pressure ridge over the region. However, the Southwest is located between the mid-latitude and subtropical atmospheric circulation regimes, and this positioning relative to shifts in these regimes is the fundamental reason for the region’s climatic variability. Additionally, climate variation within the region results from overall physiography and topographic relief, along with proximity to the moist air mass sources of the Gulf of Mexico, the Gulf of California and the eastern Pacific waters. El Niño has a well-developed teleconnection with the Southwest, typically resulting in cooler, wetter winters. The North American monsoon, which, in the United States, is most noticeable in Arizona and New Mexico, is the major summer season event that distinguishes the Southwest’s climate from the rest of the US.

This paper examines the instrumental period (i.e., the 20th century) in the context of longer-term patterns from the natural archive paleoclimate record. Instrumental meteorological records extend back about 100 to 120 years in the Southwest, while the tree-ring archive extends the climate record to up to 1000 years or more. Tree-ring data collection sites are widespread throughout the Southwest. Tree rings are annually resolved and integrate well the influences of both temperature and precipitation. A commonly used climate variable in paleo-precipitation studies, including tree-ring analysis, is Palmer Drought Severity Index (PDSI), a single variable derived from variation in precipitation and temperature. The combined paleo-modern climate record for the Southwest shows at least three occurrences of a multi-decadal pattern of variation of alternating below to above average PDSI (Figure 1).

Should this pattern persist, then perhaps the American Southwest will next enter an extended period of declining to below average PDSI. The most obvious feature of the temperature record is its current increase to an extent unprecedented in the last four hundred years (Figure 2). Because this warming trend is outside the varia-

tion of the natural archives, it is possible that anthropogenic impacts are playing a role in climate change in the Southwest.

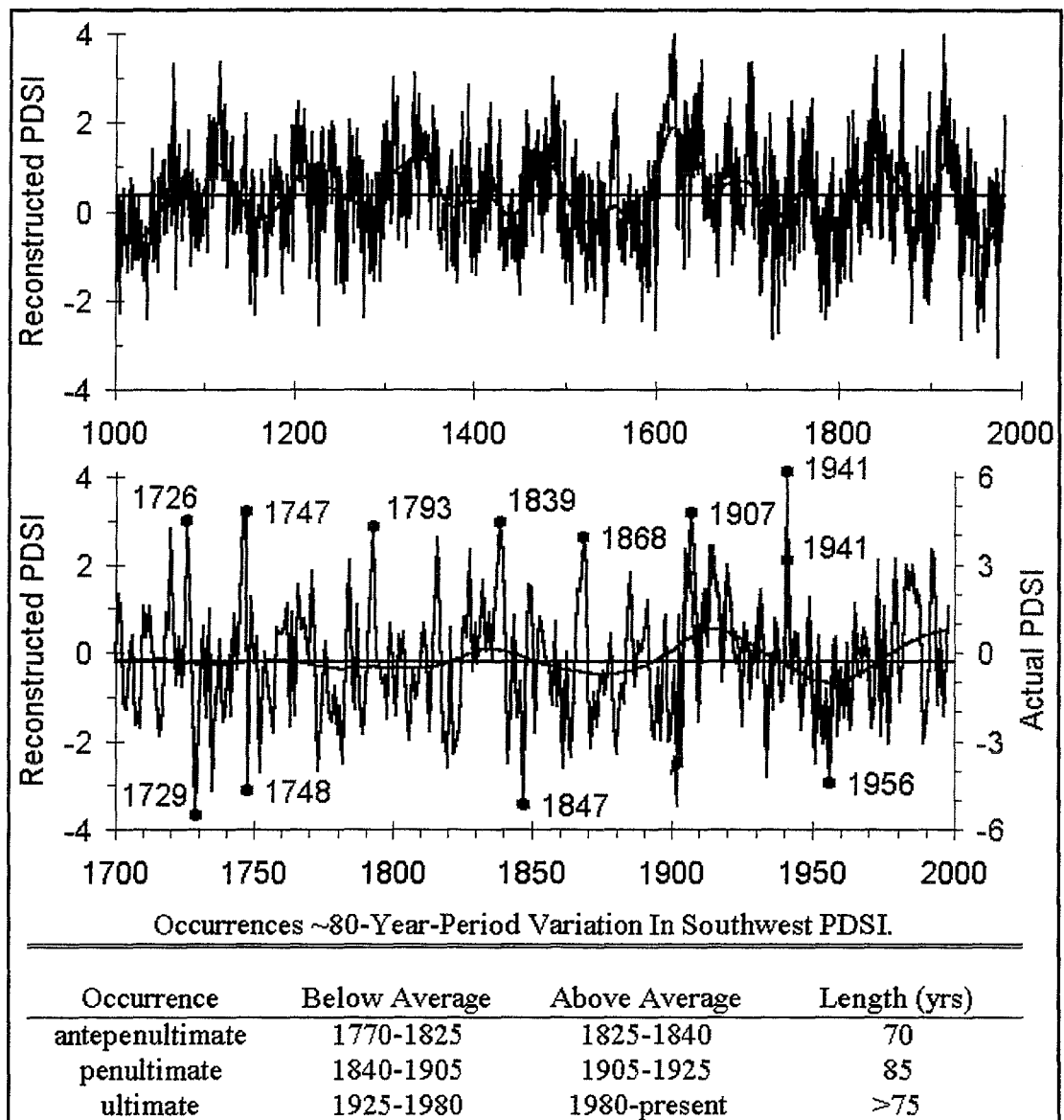


Figure 1 Southwest PDSI. Tree-ring reconstructed PDSI (blue) since AD 1000 (top) and since 1700 (middle) with actual PDSI (green). During the period of overlap (1900 to 1978), the two series correlate strongly but have different ranges (note the different y-axis scales). The reconstructed series show an approximately 80-year variation, one that has been increasing in amplitude with time since the late 18th century. The dates of the most recent periods of this multi-decadal variation are given in the table.

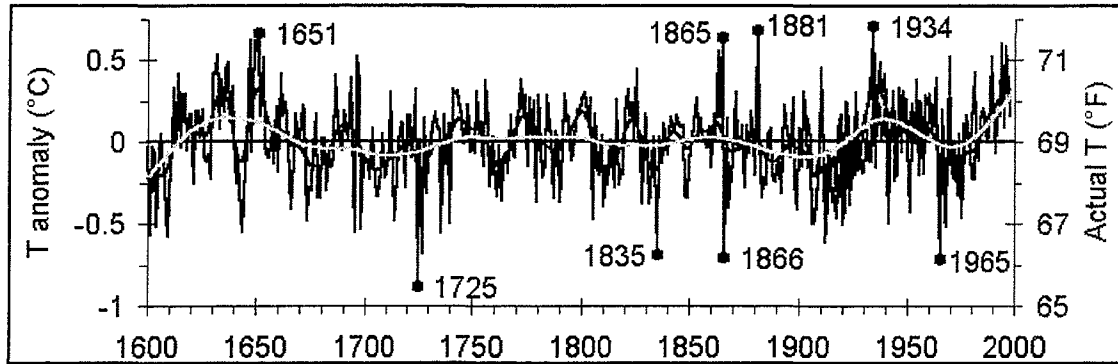


Figure 2 Southwest Temperature. Tree-ring reconstructed temperature (blue) and actual temperature (green). During the period of overlap (1900 to 1980), the two series correlate strongly. Red line shows 20-year variation, and yellow line shows 80-year variation.