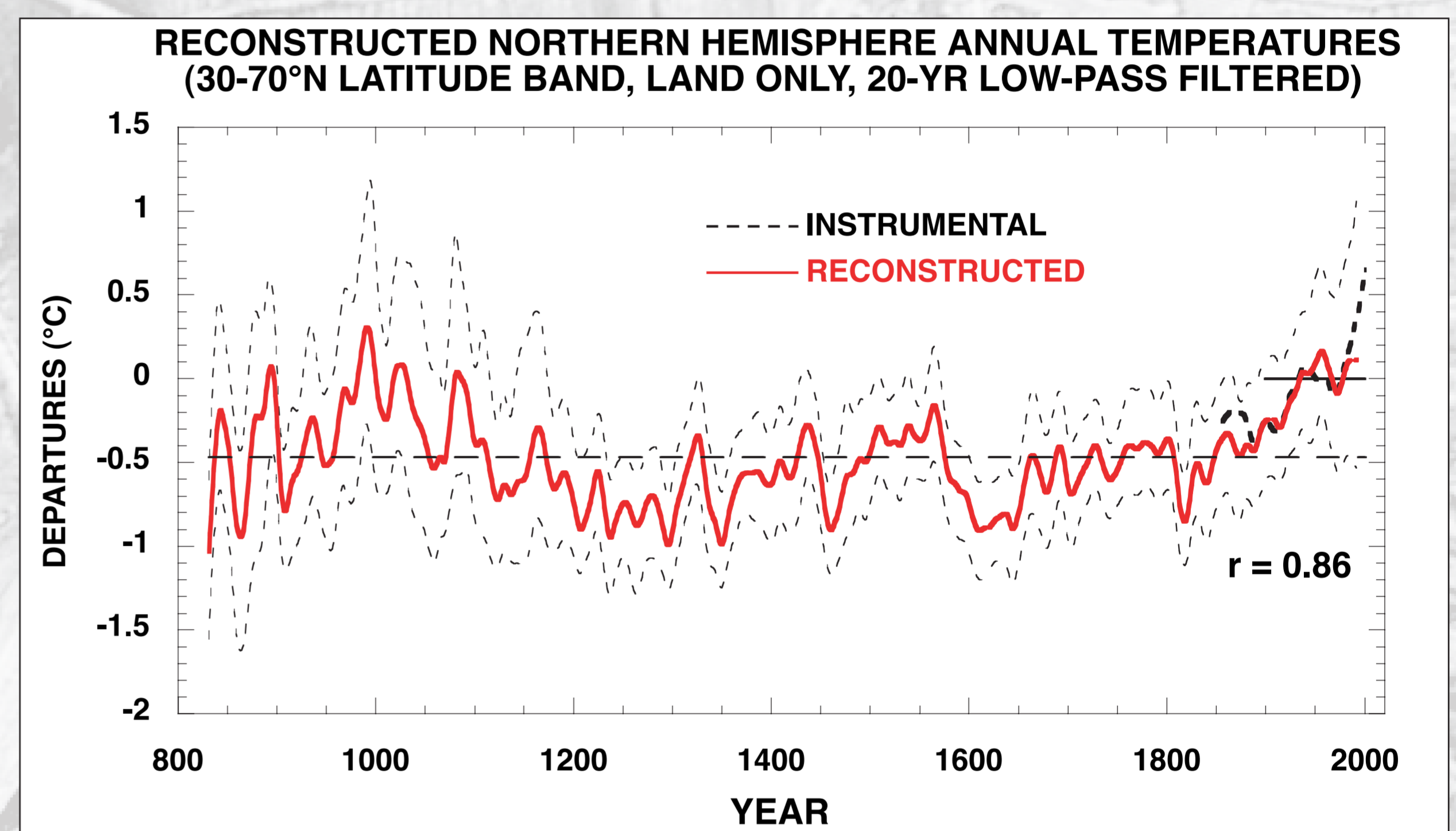
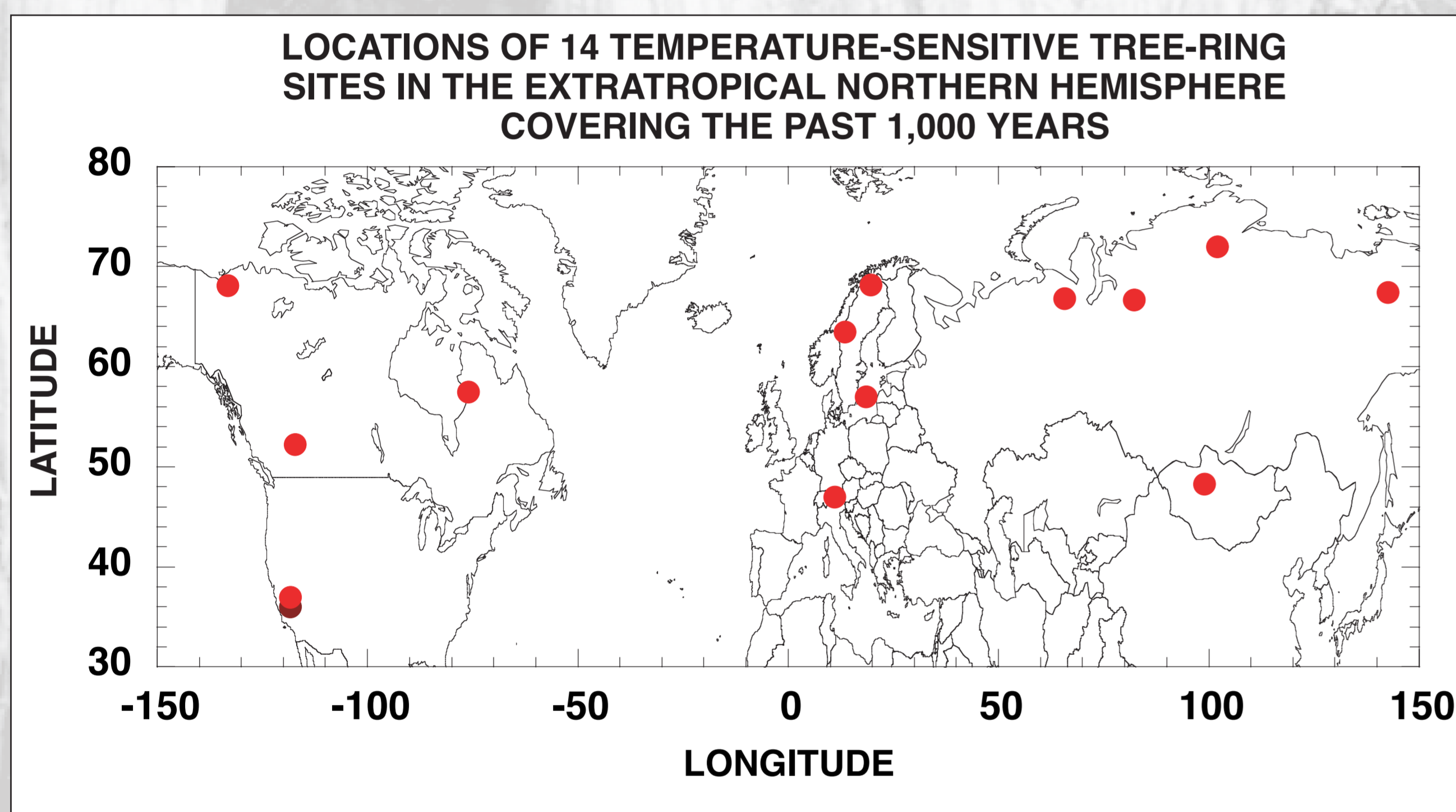


# 1000+ Years of Large-Scale Climate Change

The growth rings of trees represent one of the primary sources of paleoclimatic information for obtaining annually resolved reconstructions of climate over the past millennium. Depending primarily upon the ecological setting of tree growth, these exactly dated annual tree-ring records may reflect environmental influences ranging from temperature to precipitation. Two examples are shown below: I. a 1,170 year annual temperature reconstruction for Northern Hemisphere extra-tropical land areas and II. a 1,204 year drought reconstruction for the western United States.

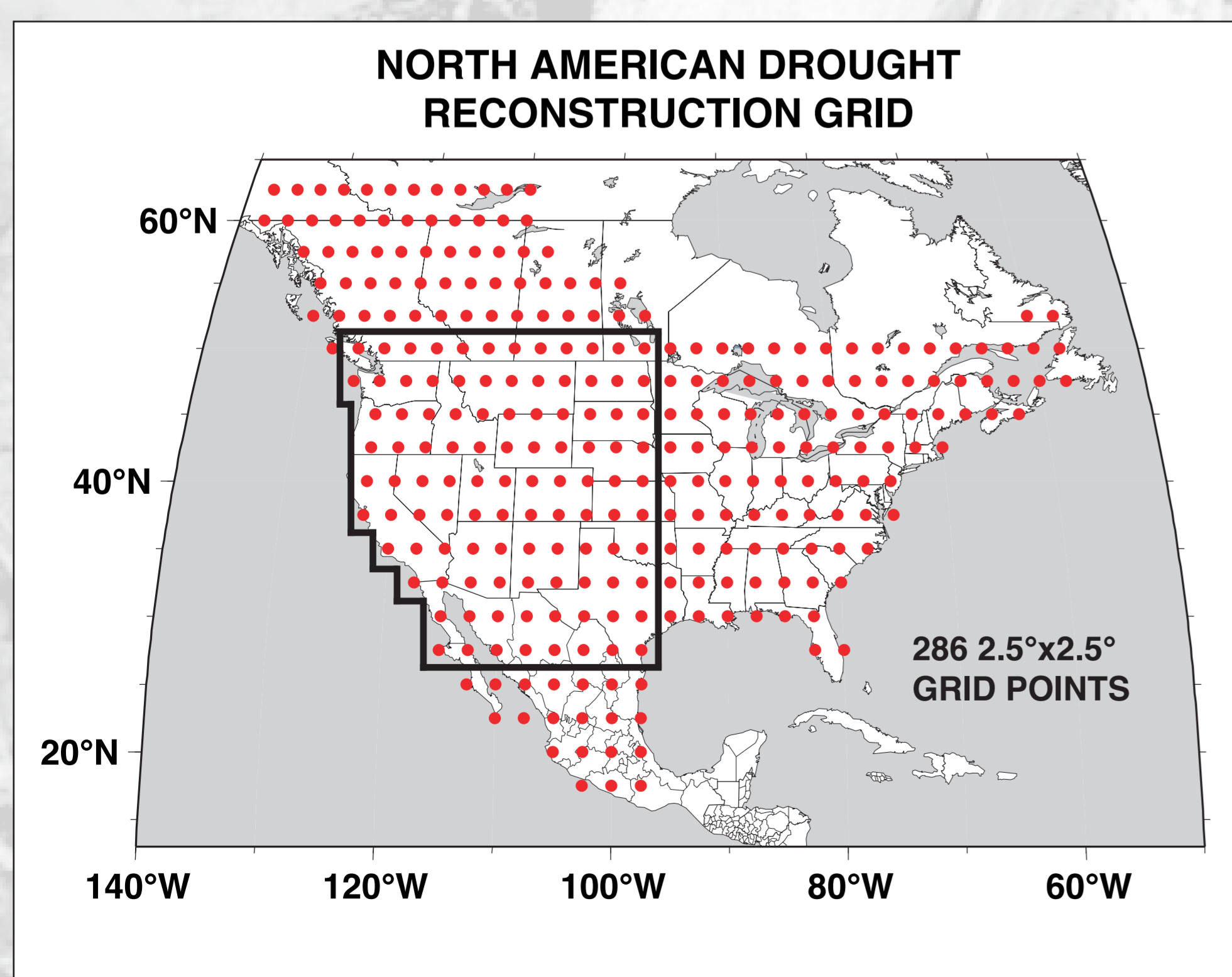
## I. Northern Hemisphere Extra-tropical Temperatures

A network of 14 temperature-sensitive tree-ring chronologies (below left, **red** dots), specifically processed to preserve climatic variations at multi-decadal to multi-centennial timescales, has been used to reconstruct extratropical, land only, Northern Hemisphere annual temperatures. This reconstruction (below right and smoothed to highlight multi-decadal-to-centennial changes) shows warm conditions centered around AD 1000, perhaps reflecting the "Medieval Warm Period", followed by an extended period of cool conditions associated with the "Little Ice Age", and increasing warmth after 1850 up to the present time. When instrumental temperature data are "blended" with the reconstruction to extend it up to 2000, conditions at present are estimated to exceed those of the warmest previous interval (ca. 1000 years ago) by about 0.3°C.



## II. North American Drought

A network of 835 annual tree-ring chronologies distributed across most of North America has been used to reconstruct the Palmer Drought Severity Index (PDSI) over a 2.5 x 2.5 degree grid (below). The PDSI is a widely used measure of drought and wetness in the US.



Over an area in western North America (polygon in left figure) where the reconstructions of drought extend back over 1,000 years, smoothed long-term changes in aridity have been reconstructed (right, upper plot). Large-scale drought was more common in the AD 900-1300 period, with significant drought epochs indicated by the **red** arrows. Generally wetter conditions prevailed after AD 1300 up into the early 20th century, with significant wet epochs indicated by **blue** arrows. Zooming in on the annually resolved 1900-2003 period (lower plot) reveals a century-long trend towards increasing aridity that culminates in the current multi-year drought that is afflicting the western United States now. This trend towards increasing aridity is now at a level that has not been seen in the western United States for over 700 years.

