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A PNA index based on upper-level data back to 1922

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The Pacific-North American (PNA) pattern represents a large-scale pattern of atmospheric variability with centers of action over the North Pacific Ocean and North America. The corresponding PNA index is a useful measure of large-scale circulation variability on different time-scales. However, the index is defined based on 500 hPa geopotential height data, which are normally available only back to 1948. Although surface data can be used to study circulation variability further back in time, data from higher atmospheric levels are required to understand the dynamical processes that govern large-scale patterns. Upper air data reaching back to the 1920s can still be found today on paper at various archives, most of which have never been digitized and made available to the scientific community.

In this paper, we present reconstructions of a PNA index from historical upper level air data for the period 1922-47. The data have been compiled from a number of sources and cover the Pacific-North American sector fairly well. We have digitized, controlled, corrected and validated temperature and geopotential height profiles from aircraft, kite and radiosonde ascents back to 1922. Wind speed and direction from pilot balloon data back to the early 1920s provided by NCAR have also been used. A statistical regression approach is used for the reconstruction and calibrated in the post-1948 period using NCEP/NCAR reanalysis data. We present the reconstruction and validation results as well as an analysis of the reconstructed index series.

Analyses of the reconstructed series are presented with respect to low-frequency variability and persistence and with respect to its relation with the North Atlantic Oscillation, the Pacific Decadal Oscillation and El Niño / Southern Oscillation.