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Variability of the winter atmospheric circulation over the Pacific-North-American sector in the last 500 years as reconstructed from a combined proxy-model approach

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Model simulations over the past millennium have been combined with proxy-based reconstructions of summer soil moisture, winter precipitation and winter air temperatures over Western North America, with the goal of reconstructing the winter atmospheric circulation over the Pacific-North American sector over the past 500 years. The skill of the reconstruction method is tested against the 20CR meteorological reanalysis. All three types of proxy sets individually contribute to the skill in the reconstruction of the winter atmospheric circulation.
The strategy is the assimilation of the proxy data into the climate simulations with the aim to reconstruct the complete 3-dimensional trajectory of the atmospheric circulation. This strategy is based on the analogue method: the spatial configuration of summer soil moisture, regional winter temperature and regional winter precipitation in a particular year in the past is compared to the corresponding configuration in all years in the model simulation, and the model year with the most similar configuration is selected. That model year provides the 3-dimensional reconstruction of the atmospheric circulation.
The reconstructed circulation has been analysed in terms of the position of the jet-stream at 200 mb height in extreme dry and wet winters, as defined by independent reconstructions of precipitation and of fire index in this area. Within the set of extreme wet years, the jet is located at a more equatorward position, has a more zonal structure and smaller variability. Within extreme dry years, the jet is located at a more poleward position, has a meandering structure, and is more heterogeneous, with the position of the zonal wind maximum spreading over a larger latitudinal range.
We do not identify a clear connection between the atmospheric circulation in extreme hydrological years and external climate forcing over the past 500 years.
We conclude that, in the past, wet winters in the North American South-West have been caused by similar atmospheric anomalies, whereas dry extreme years may have had multiple dynamical causes.