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Multi-proxy reconstructions of precipitation field in China over the past 500 years

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The dominant modes of variability of precipitation for the whole of China over the past millennium and the mechanism governing their spatial structure remain unclear. The first reason is probably that it is difficult to reconstruct the precipitation field in western China because the published high-resolution proxy records for this region are scarce. Numerous tree-ring chronologies have recently been archived in publicly available databases through PAGES2k activities, and these provide an opportunity to refine precipitation field reconstructions for China. Based on 600 proxy records, including 491 tree-ring chronologies, 108 drought/flood indices, and a long-term instrumental precipitation record from South Korea, we revised the precipitation field reconstruction for China for the past half millennium using the optimal information extraction method. A total of 3971 of 4189 grid points in the reconstruction field passed the cross-validation process, accounting for 94.8% of the total number of grid points. The first leading mode of variability of the reconstruction shows coherent variations over most of China. The second mode, a north–south dipole in eastern China with variations of the same sign in western China and southeastern China, may be controlled by the El Niño-Southern Oscillation (ENSO) variability. The third mode, a “sandwich” triple mode in eastern China with variations of the same sign in western China and central China. Five of the six coupled ocean-atmosphere climate models (BCC-CSM1.1, CCSM4, FGOALS-s2, GISS-E2-R and MPI-ESM-P) of the Paleoclimate Modeling Intercomparison Project Phase III (PMIP3), can reproduce the south-north dipole mode of precipitation in eastern China, and its likely link with ENSO. However, there is mismatch in terms of their time development. This is consistent with an important role of the internal variability in the precipitation field changes over the past 500 years.