



A tree-ring reconstruction of the South Asian summer monsoon index over the past millennium

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The South Asian summer monsoon (SASM) is a major atmospheric synoptic climate system affecting nearly a quarter of the human population. Climate proxy data derived from tree rings, ice cores, speleothems, and other sources can all contribute to an understanding of SASM variability prior to instrumental period. Here, we develop an optimal information extraction (OIE) method, which we use to reconstruct the SASM index (SASMI) over the last millennium using 15 tree-ring chronologies. The record generated is significantly correlated ($r=0.7$, $p>0.01$) with the instrumental SASMI record on annual timescales; this correlation is higher than that obtained in any previous study. The reconstructed SASMI captures 18 of 26 (69%) reordered historical famine events in India over the last millennium; notably, 11 of 16 short events with durations of 1–3 years are accurately depicted in our reconstruction. Moreover, the reconstructed SASMI is positively correlated with variations in total solar irradiance (TSI) on multi-decadal timescales implying that variations in solar activity may influence the SASM. Based on the response of SASM to 34 significant volcanic events using the superposed epoch analysis, the volcanic forcing may drive a weak SASM in the second year of an eruption.