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Dwarf shrub δ18O from the Top of the World / Everest region record large-scale climate signals

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Oxygen isotopes ($\delta^{18}O$) derived from tree-rings are an excellent and frequently utilized annually resolved climate proxy. Above the tree-line, woody (dwarf) shrubs can further densify the still fragmentary global paleoclimatic network, which is particularly relevant for the high altitudes of the Himalayan Arc. Still, few studies have investigated the suitability of $\delta^{18}O$ from shrubs for climate reconstructions, specifically on the windward southern slopes of the Central Himalayan Arc. In this study, we evaluated the climate imprints on juniper dwarf shrubs located above 4,000 m asl in the Mount Everest region, Nepal. Three gridded climate data sets (CRU TS, ERA-5 and CHELSA) with a spatial resolution between 0.5° and 0.08° were used to evaluate the respective climate-proxy relationships. The strong influence of variations in temperatures and moisture (precipitation, rH, VPD) on our $\delta^{18}O$ time series are most evident during the summer monsoon season. Spatial correlation analyses further confirm a strong supra-regional representativity of our proxy across large parts of the Himalaya and northern India. The dependency on large-scale atmospheric circulation is underlined by significant correlations between $\delta^{18}O$, various monsoon indices and more complex and coupled (tropical) ocean-atmospheric oscillation patterns such as the Southern Oscillation Index and the Madden-Julian Oscillation. By analyzing synoptic weather patterns of the Indian Subcontinent we can further demonstrate, that our $\delta^{18}O$ series is strongly influenced by climate conditions during the break monsoon periods than to conditions during the active monsoon period. During the breaking periods, two weather patterns are predominantly influencing our $\delta^{18}O$ series when i) air masses are increasingly originating from (North)West, leading to a sharp decrease in precipitation and higher temperatures or when ii) a shift of the monsoon trough towards the North results in a decrease of rainfall over the India subcontinent and an increase in precipitation over the Himalayan region.