



Extreme events and spatiotemporal changes in the westerlies and Indian summer monsoon during the early-mid Holocene in NW Himalayas

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Reconstructions of past environmental changes are critical for understanding the physical mechanisms behind present day extreme events i.e. randomly occurring floods and drought and for providing context for future climate change. We undertook high resolution studies on radiocarbon dated lake sediments from upper Spiti valley, NW Himalayas situated near the present day limit of the Indian summer monsoon to reconstruct the extreme climate events and changes in precipitation regimes (westerlies and Indian summer monsoon). The investigation of lake sediment reveals distinct lithofacies that provide evidence of changes in climate and depositional environment during early-mid Holocene (8.7-6.1 cal ka). The period (8.7-7.6 cal ka) is marked by lake establishment with discrete cold intervals during ~8.7 and 8.3-8 cal ka. A sustained cold period with weakened summer monsoon is observed during ca.7.6-6.8 cal ka. During ~6.8-6.1 cal ka an increase in the frequency of sand layers and turbidites suggests a shift from colder to warmer climate with enhanced Indian summer monsoon activity. Based on the an overview of climate variability we suggest that solar insolation influenced the Indian monsoon possibly along with internal factors such as changes in snow cover in the Himalayan and Tibetan plateau.