Large-scale atmospheric convection governs summer and winter precipitation isotopic composition at Srinagar, Kashmir

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The stable isotopic measurements of hydrogen and oxygen in atmospheric waters are useful tracers to investigate and understand the mechanisms governing the present and hence past climate. Distinct meteorological conditions at the moisture source regions impart isotopically discernible signals to precipitation. Limited isotope measurements in the western Himalayas constrain our interpretations of the proxy climate records from the region. In this study, oxygen and hydrogen isotopic composition of event precipitation samples collected from March 2015 until April 2017 at Srinagar, Kashmir, is presented. A systematic drop in stable heavy isotope contents of precipitation is recorded during both winter and summer. While the local meteorological factors exert a minor influence, time integrated large-scale convective activity over several days majorly governs the event precipitation isotopic composition during both seasons. Precipitation received at Srinagar is a consequence of tropical and sub-tropical weather phenomena brought about by the seasonal migration of the global wind patterns. Moisture from diverse oceanic sources is transported due to this seasonal shift in atmospheric regimes from the Subtropical Westerly Jets (active from October-May) to the Indian Monsoon (active from June-September). A simple box model is used to simulate this seasonal transport to quantify the moisture sources contributing to precipitation at Srinagar. Finally, discrepancies are detected on comparing the observed and the isotope-enabled general circulation model simulated precipitation isotopic composition thus raising concerns about the use of such global model simulations for the Himalayan region. These results imply that heavy isotope depletions in summer and winter precipitation, are caused by shifts in the circulation patterns involved therefore, the hydrological isotope proxy data should be used with caution for reconstructing past monsoonal regime changes in the area.