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Indian monsoon precipitation isotopes linked with high level cloud cover on local and regional scales

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Precipitation isotopes preserve information about the histories from evaporation in the source regions, moisture transport, and to precipitation events, and hence was used in revealing the dynamics of regional hydrological cycle and paleoclimate rebuilding. In the monsoon region, quite a few studies emphasized the strong inverse impact of convective activity on precipitation isotope ratio, envoke the debate about the interpretation of these ice core records as temperature proxies on the Tibetan Plateaus. Recent study also showed statistically the inverse influence of the proportions of stratiform to convective precipitation on water isotope in tropical and mid-latitude regions, highlighting the important role of precipitation type on isotope hydrological cycle. The influence mechanism on seasonal and interannual scale remain highly uncertain and poorly understood, which is crucial for the utilization of isotopes in paleoclimate studies. To further address the influence of precipitation pattern, in particular the large regional cloud cover, on water isotopes, here we use a decade of precipitation isotopes from southern Tibetan Plateau (TP) to explore the the close relationship with both the large scale cloud cover and local climate. We calculated the correlation between local precipitation δ18O with different level cloud data archived in ECMWF. Sensitive zone is identified in the northern India subcontinent to the seasonal precipitation isotope in southern TP, and high negative correlation with total cloud cover (TCC) and high cloud cover, indicates high-level convection in the upper stream of moisture transport is among some of the important factors in controlling the seasonal precipitation isotope in southern TP. However, the correlation with local cloud cover in the sampling basin is less significant. The mechanism underlying with the finding is that strong convection activity in the moisture source region and on the route significantly depletes heavy isotopes in the vapor, and subsequently, produces much decreased precipitation δ18O values in the study region. On the interannual scale, there are robust negative precipitation δ18O-TCC correlations, large positive correlations between TCC and Southern Oscillation Index over the Arabian Sea, where is different from the most significant correlative region of the seasonal variation. It indicates that the processes influence the seasonal variations of the precipitation isotopes is different from those which are important for the interannualy means. The interannual to decadal interannual precipitation δ18O record monsoon intensity and upstream rainout resulting from ENSO. The specific study site is located in the Yamdruk-tso basin at an elevation over 4400m, and thus the results from this elevation are of more significance for the higher elevation ice core records in that region. Moreover, these findings throw light on the interpretation of paleoisotope records obtained from the India Summer Monsoon region.

KeywordsPrecipitation isotopes; Cloud cover; Convective activity; Local and regional control; Yamdruk-tso basin; Southern Tibetan Plateau