What controls precipitation $\delta^{18}O$ in the southern Tibetan Plateau at seasonal and intra-seasonal scales?

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Understanding the spatial and temporal controls of tropical precipitation $\delta^{18}O$ is necessary for paleoclimate reconstructions from the wealth of regional archives (ice cores, lake sediments, tree ring cellulose, and speleothems). While classical interpretations of such records were conducted in terms of local precipitation, simulations conducted with atmospheric general circulation models enabled with water stable isotopes have suggested that past changes in south Asia precipitation $\delta^{18}O$ may be driven by remote processes linked to moisture transport. Only studies conducted at the event scale can provide firm constraints to assess the drivers of precipitation $\delta^{18}O$ and the validity of simulated mechanisms. Here, we take advantage of new daily precipitation $\delta^{18}O$ monitored from January 2005 to December 2007 at two southern Tibetan Plateau stations (Lhasa and Nyalam). The drivers of daily to seasonal variations are investigated using statistical relationships with local and regional temperature, precipitation amount and convective activity using in situ data and satellite products. The strongest control on precipitation $\delta^{18}O$ on the southern Tibetan Plateau at event and seasonal scales is provided by the integrated regional convective activity upstream air mass trajectories, cumulated over several days. The daily data presented here provides a benchmark to evaluate the capacity of isotopically enabled atmospheric general circulation models (iGCMs) to simulate the response of precipitation $\delta^{18}O$ to convection. This is illustrated using a nudged and zoomed simulation with the LMDZiso model. While this model successfully produces some seasonal and daily characteristics of precipitation $\delta^{18}O$, it fails to simulate the correlation between $\delta^{18}O$ and upstream precipitation. This calls for caution when using iGCMs to interpret precipitation $\delta^{18}O$ archives in terms of past monsoon variability.

Key words: precipitation, $\delta^{18}O$, southern Tibetan Plateau, regional convective activity, isotopic GCMs