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Pattern in isotopic ratio of Indian Summer Monsoon Rainfall (ISMR) 2010 capturing the origin of moisture source; a case study from Southern India

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Stable isotopes of rainfall (δ18O and δD) can be used for understanding moisture source of air parcels (Sengupta and Sarkar, 2006). Majority of rainwater isotopic studies reported are done based on rainwater collected over long time duration reflecting large time integration ranging from days to week. Most recent studies have shown anomalous behavior of isotopic composition in the water samples confined to event bound sampling of rain at small time interval (Peng et al., 2007). Such observation allows capturing the isotopic signatures of rain water originating from an evolving cloud system.
Here we present simultaneous observations of rainfall intensity and isotopic ratios in rain water sampled at high frequency within individual events. We restrict our present work to southwest monsoonal precipitation. The convective systems studied were confined to rain giving cloud systems of Indian Summer Monsoon Rainfall (ISMR) of 2010. Rainwater samples collected at 1-2 minutes interval from 11 rain events which occurred between the months of June till September were studied from isotopic composition. Rainfall intensities during the events were simultaneously monitored. The water samples were analyzed for isotopic ratios using Gas Bench II peripheral of IRMS MAT 253. A laser precipitation monitor by Thies Clima was used for high precision rainfall intensity measurement. The high precision analysis of isotopic composition enables a clear identification of the variations in isotopic ratios over time and during an event (lasting for several hours). This variability is largely defined by the amount of precipitation received during the period of samples. The linear relationship between rain amount and observed δ18O values gives an end member moisture composition from intercept values during specific events. The intercept values for the events observed for the month of June through September were found varying between -0.2 ‰ to -2.7 ‰ in δ18O ratios. The backward trajectory computation of air masses suggests a source region of moisture parcel. The source region lying along the coast of East African mark a boundary for the origin of enriched water vapor for the rainfall happening during June 2010 and the temporal changes in the source region and contribution from continental source during the month of July and August months are captured in the progressive depletion in isotopic signature in the rainwater. The study will provide a new scope of finding the quantitative contribution of continental moisture and oceanic moisture during onset and advancement of southwest monsoon.