Early Holocene Indian summer monsoon and its impact on vegetation: Insight from *n*-alkane isotope values of the Central Himalaya relict lake sediments

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Increase in rainfall during the early Holocene has been reported from different regions of Indian sub-continent, although its magnitude shows spatial variability with lower value in regions with high rainfall and vice versa. While the early Holocene rainfall records are available from lowland areas of the Indian sub-continent, it is poorly documented from the high altitude Central Himalayan region which is characterized by orography controlled high rainfall. For the first time, δD_{C29}, $\delta^{13}C_{C29}$ values of alkane and $\delta^{13}C$ values of organic matter from a relict lake of Benital area (located at ca. 2 km altitude) in the Central Himalaya were measured to reconstruct monsoonal rainfall and contemporary vegetation for last 10.5 kyr with an emphasis on the early Holocene. The δD_{C29} values suggest that the early Holocene was characterized by a wet phase with ca. 33% higher rainfall compared to present during ca. 9 ka and the middle-late Holocene was relatively drier. The estimated increase in monsoonal rainfall for the early Holocene is the largest of existing records. The magnitude of early Holocene rainfall suggests in addition to erosion of the bed rocks, increased stream power reworked the older floodplain and resulted in 2.3 times higher sediment discharged into the Ganges-Brahmaputra (GB) delta compared to the present discharge.

Based on the distribution and $\delta^{13}C_{C29}$ values of modern plants, the $\delta^{13}C_{C29}$ values of the lake sediment indicate that during pre and post ca. 7 ka the lake catchment was dominated by woody and non-woody plants, respectively. The poor correlation between δD_{C29} and $\delta^{13}C_{C29}$ values suggests at higher rainfall, the $\delta^{13}C_{C29}$ values of catchment vegetation were less-responsive.