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Seasonal variation in oxygen isotope ratio of selected Indian rivers- signature of source waters

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River basins constitute major captures of the regional precipitation and the flow through a major river transfers this water collection to the ocean completing an important sector in the global hydrological cycle. Consequently, time variation of isotopic ratios in river waters may be useful in tracing the magnitude of recent climate change induced by increase in greenhouse effect. In addition, study of river samples from strategic regions may reveal hydrological modifications introduced into the basin by human activities.

India is located in the tropical belt under the influence of Asian Monsoon and receives intense seasonal precipitation in the form of rain in the plains and snow in the Himalayan region. This precipitation is finally collected through complex processes by a large number of rivers, which flow through the Indian subcontinent and discharge finally into the Arabian Sea and the Bay of Bengal. These rivers supply a major part of the required water for agriculture and household needs. Therefore, it is important to characterize the climatic and anthropogenic influences impacting on their water supply. In this context, we have carried out studies of oxygen isotopic variations on a set of Indian rivers during the last two years.

The selected rivers along with the sampling locations are: Ganga (main canal at Dhanauri), Yamuna (main canal at Saharanpur), Beas and its tributary Parbati (near Bhuntar, Kullu), Tista (at Jalpaiguri), Hooghly (near Burdwan) and Narmada (near Garudeshwar, Gujarat). The first six are Himalayan rivers and the last one is a central Indian river rising from Vindhyan Hills.

Oxygen isotope ratios were measured in collected samples (weekly or bimonthly) from early 2002 and the final data are now available for about 100 samples in each case. The time variation plots show many interesting features displaying effects of snow melt contribution to integrated rain water capture and evaporation during transport. The average $\delta^{18}O$ values with s.d. (number of samples) are: Ganga –9.3 ± 0.8 (83); Yamuna –7.9 ± 0.8 (84); Beas –9.1 ± 0.6 (70); Parbati –10.2 ± 0.9 (71); Tista –7.7 ± 1.4 (98); Hooghly –6.9 ± 0.9; Narmada –3.9 ± 1.2 (100). It is seen that all the six Himalayan rivers have lower mean $\delta^{18}O$ (–8 to –10 ‰) compared to the peninsular river (Narmada). The Himalayan rivers have substantial contribution from rain systems at the end of the Monsoon track resulting in depleted ^{18}O. Also, in some cases (like Bhagirathi or Alaknanda for Ganga) high altitude glaciers contribute melt waters, which are highly depleted. The variation of ~ 2 ‰ among them also can be explained by melt-water contribution. It is seen that the lowest $\delta^{18}O$ values for these rivers are obtained during the months of August and September i.e. the post monsoon period. This is probably caused by high intensity rains coupled with snow-melt contribution.