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Dissolved carbon system in the Bhagirathi basin, Uttarakhand, India: implications on CO_2 degassing

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The study of the source and dynamics of dissolved carbon in the mountain rivers and its interaction with the atmosphere is one of the key knowledge areas in understanding the present scenario of biogeochemical carbon cycling. Mountain streams receive, metabolize and transport both organic and inorganic carbon from various sources into their catchment and also degas some part of it into the atmosphere. The degassing of CO_2 from these rivers are known to be driven by their high turbulence and gas transfer velocity rather than the amount of carbon supplied into them. Previously, work has been done to estimate CO_2 flux from large inland water bodies, but studies with particular focus on quantifying the carbon flux from high-altitude streams are limited. Here, we present our data from Bhagirathi headwater catchment in the Garhwal Himalaya, India which is the source of recharge of River Ganga - the longest river of India. The upper part of the Bhagirathi basin is sampled for river, geothermal spring, groundwater, and reservoir water during the post-monsoon season (October 2019). From the major ion abundance pattern, it is found that, Ca^{2+} and Mg^{2+} are the dominant cations and HCO_3^- and SO_4^{2-} are the dominant anions in the river and groundwater which suggests, coupled reaction of Sulphide Oxidation – Carbonate Dissolution (SO – CD) is prevalent in the study area. The Dissolved Inorganic Carbon (DIC) which is mostly HCO_3^- (mean = 705.7 µeq/L) varies according to the weathering pattern in the basin, higher in the areas where the river flows on the carbonate rocks and lower where it meets granitic intrusives. The $\delta^{13}C$ value (mean = – 7.6 ‰) increases with altitude as higher elevation doesn't allow vegetation to form and soil to grow there which adds depleted carbon to water. The mean pCO_2 of river water is estimated as 1274.6 µatm which is ~3 times more than atmospheric pCO_2 (412 µatm), which indicates Bhagirathi River Basin is an active area of CO_2 degassing.