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Hydrology and Earth System Sciences
Discussions

Interactive comment on "Variation of deuterium excess in surface waters across a 5000-m elevation gradient in the east-central Himalaya" *by* K. A. Voss et al.

Anonymous Referee #1

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The authors present the results of oxygen and hydrogen stable isotope measurements in river, ground, snow, glacier and lake waters in two river basins in the Himalaya Mountains and based on the discussion of the data, they conclude "Himalayan surface water stable isotope lapse rates strengthen in high-elevation regions". Further, several inferences are made on the importance on the contribution of different water types (snow, lake, glacier) and weather types to river discharge. The topic of water sources in Central Asia is an important one and such studies are most needed and welcomed; however the present manuscript does not fall in these categories – there are several methodological shortcomings that render the results and their interpretation, to say the least, problematic. These are detailed below. Some can be addressed, but some not

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Discussion paper

– the data set is all the authors had and the study must do with it. Main issues 1) Sampling – while I understand the difficulty of sampling in the mid- and high-altitude Himalayas, a well-planned field campaign could have resulted in better data. For instances, if groundwater samples were collected in SK watershed, I don't understand why river samples were not. Two maps of stable isotope distribution in groundwater and surface water would have yielded a better picture of the processes in the region. Anyway, what we have is what we have; this is merely a suggestion for future studies. 2) Amalgamation of different water types. This is my main concern – why (fig. 2) were all water types mixed in the analyses of lapse rates (at least, this is my understanding of the plots in fig. 2). Groundwater is very conservative in terms of O and H stable isotopes, while river water reflects minute changes (e.g., fig. 4 in the manuscript by Voss et al.) – as such, calculating lapse rates based on mixing all water types is wrong (were indeed glacier data included in the charts in fig. 2? The ice could be thousands of years old. . .). I suggest calculating the lapse rates separately for river and snow data. Further, I it seems that the lack of correlation in the pre-monsoon values (fig. 2) in the SK basin is an indicator of the bias towards groundwater samples, which are more conservative. In the BK basin, where mostly river samples are used, the lapse rates seem more consistent (both between them and with previously published data). 3) I am not sure I understand how the presentation of data in fig. 3 is used to understand the "elucidate the relationship between precipitation moisture source and d-excess". In the absence of moisture source determination using precipitation data (e.g., by using the HYSPLIT model) the above inference seems difficult to make. Fig. 3 seem to indicate that the stable isotope values in snowmelt change more between the pre and post monsoon period, than in glaciers (which is normal, melting of snow – X axis does not influence much the stable isotope composition of glacier-dominated rivers – as expected). 4) No information is given on discharge – this is mandatory if water resources are to be discussed. The discussion in chapter 5.2 is the most important section of the text, although it is difficult to assess its accuracy, given the mixing of data described above. Further, the conclusions seem to be a collection of generalist infor-

mation, rather than the outcomes of the study. I suggest the authors 1) to separate the analysis of data based on water types, and 2) re-focus the discussion on the variability of the stable isotope values in rivers and next how are these changed by snowmelt. The discussion of seasonality seems difficult, due to the lack of data (stable isotope values in snow measured several months after snowfall (indeed, how were these samples collected – surface snow, vertical profile through the entire snowpack?) are a poor proxy for the initial value of precipitation. There are several short comments, but these could be left out now.

A word on terminology: while common in oral communication, several phrases are not accepted in written text: water isotopes do not exists, only O and H isotopes in water, "isotopically depleted snow" should be "isotopically heavy snow", "Isotopic lapse rates" do not exists and so on. Please read carefully throughout the text an correct all these errors. A good starting point for nomenclature and terminology could be Z. Sharp's "Principles. . ."

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