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Hydrology and Earth System Sciences
Discussions

Interactive comment on "Spatiotemporal variability of oxygen isotope compositions in three contrasting glacier river catchments in Greenland" *by* J. C. Yde et al.

Anonymous Referee #3

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The manuscript presents a diverse water isotope (δ18O) data set from three different glacierized catchments in Greenland. Streamwater isotopic composition from samples collected between 2000 and 2009 are analyzed using isotopic hydrograph separation and isotope data collected from snow and ice samples. The paper is overall well written (although a few minor typos still need to be corrected). The study provides a nice compilation of different isotope data sets and the combined results section provide an interesting discussion of potential mechanisms responsible for the observed diurnal or spatiotemporal differences in the isotopic signals. The authors provided an excellent literature review and did a very good job supporting data interpretations and discus-

sion of results with previous studies. My main recommendation to the authors that the manuscript needs a clearer structure and a more information in the methods section that make it easier for the reader to understand what calculations were done to estimate the different hydrograph components and how uncertain these estimates are. It is understandable that due to the challenging research environment many samples have been collected in an opportunistic way (e.g., one time stream sample). Nevertheless the work that is presented would gain value if sources of uncertainty were discussed and presented in the methods and result section. In the results section the actual results of the hydrograph separation get a little lost because there is no clear distinction between the description of the site characteristics, the end-members (e.g. snow or ice isotopic composition) and the interpretation of results. Perhaps instead of grouping the results section into the three watersheds the authors should rather consider structuring the results section into first a presentation of the input data (e.g. end-member composition across sites), the hydrograph separation results, discussion of uncertainties, comparison of hypothesized processes across sites and a separate discussion that is focusing on the comparison of findings with previous investigations as defined in the objectives.

Specific comments

Abstract Line 10: "specific water component" is not very specific. Could this be narrowed down to a list of the actual water sources that were discussed in the results section?

Page 5849, last paragraph: Melting snow samples at room temperature causes a much stronger fractionation and concentration of lighter isotopes in the headspace than melting the snow slowly in a fridge. In addition, depending on the ratio of snow sample to bottle volume the resulting headspace in the melting process can be of variable volume for each sample again causing variable fractionation between melted snow samples. This effect needs to be determined (e.g. comparison of the isotopic value of two snow samples collected from the same location/layer, one melted at room temperature, the

other melted in the fridge) and the uncertainty associated with this effect considered in the isotopic hydrograph separation.

Page 5850, line 1: Correct “wter isotope”.

Page 5851, line 3: I find it strange to use the German word for glacier in as glacier name (e.g. Mittivakkat Gletscher).

Page 5851, line 11: Here it would make sense to restate the elevation range of the catchment or glacier in parentheses.

Page 5852, line 10: Replace “where” in “30 May 2008 where a rainfall event” with “when”.

Page 5852, line 28: Awkward phrasing. “. . .the runoff suddenly remained constant, coinciding with an air temperature increase and a change in 18O from decreasing to. . .”.

Page 5853, line 12 ff.: I would find it interesting if the snowmelt/ice melt dynamics would be explored more in depth using the diurnal variation of the isotope signal. Could it be that as snowmelt is increasing over the day, subsequently the snowmelt volume passing through the glacier is increasing as well causing melting of the englacial conduits due to the heat of fusion introduced with the snowmelt. It would be interesting to see of rates of conduit enlargement could be correlated to observed increases in ice meltwater contributions.

Page 5857, line 25: You mention the interannual mean δ18O was -24.17$\pm$0.20‰ while at the same time you provide information that this value was only calculated over the July-Aug. period. I would say “interannual” is the wrong term here since clearly you didn’t take samples every month over one year. This needs to be corrected. In addition, I would suggest adding information throughout the manuscript on how many samples these mean values are based (e.g. n=7).

Page 5858, line 19: Insert “was” before “. . .derived from mixed proglacial snowmelt

and ice-marginal ice melt.”.

Page 5861, line 24: “An alternative explanation may be that snowmelt only constituted so small a proportion of the meltwater in the late melt season that backscattering rendered water source discrimination impossible.” This sentence is not clear.

Page 5862, line 12: Plural! “. . .phenomenon on large glacier with lateral tributary. . .”.

Figure 2: This figure is hard to read. I would suggest using a topographic depiction instead of a Lands

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Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 12, 5841, 2015.