Hydrol. Earth Syst. Sci. Discuss., 11, C3121–C3128, 2014
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Hydrology and Earth System Sciences
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Discussions

Interactive comment on "Estimating glacier and snowmelt contributions to stream flow in a Central Andes catchment in Chile using natural tracers" *by* M. Rodriguez et al.

Anonymous Referee #1

Received and published: 17 August 2014

Rodriguez and co-authors present a statistical exercise in hydrograph separation in a partly glacierized catchment in the Central Andes. This is a welcome contribution to the existing literature on glacier hydrology, as it applies three different models to determine the proportions of glacier and snowmelt in river headwaters. However, the manuscript seems to focus on the statistical models rather than the results and their implications. For instance, there is only a short and superfluous discussion of the results (section 5.1), whereas the discussion of models is long and partly repetitive. Also, the presentation of the input data needs to be improved and the uncertainties of the results have not been quantified.

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Discussion Paper

Comments: 8950,9: Insert ”the” in front of ”variability”

8950,13: Typo in ”glacierized”

8950,16: Change ”,” to ”.”

8951,26: Change”by” to ”to”

8952,1: ”... better describe ...”

8953,13-8954,15: Clearly state the objective of the study! Currently the objective is presented in the Discussion section (8969,14-8969,17). Also, shorten these paragraphs as they contain a lot of superfluous information that is repeated again in the Methodology section

8953,19-21: Difficult to understand this sentence. Rephrase

8953,22: Change ”in” to ”on”

8953,25: Insert ”it” after ”because”

8954,17: Readers need more information on the study area. How much of the catchment is glacierized? How many glaciers are there? Are they debris-covered? Do you have any information on glacier mass balance? What is the altitudinal range of the catchment? Is there any vegetation? What do you know about soil development and the thickness of the soil layer?

8954,17: Later in the manuscript various parts of the catchment are used in the hydrograph separation. Inform of any differences in vegetation, geology and topography is therefore relevant.

8954,18: Consensus in the name of the catchment. Here, the catchment is called Juncal at Juncal River basin, whereas in Figure 1 it is called Juncal basin and Juncal River basin

8954,19: Make a reference to Figure 1 at the end of the sentence

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8955,9: Mention the specific annual discharge

8955,17: Mention the number of samples of each series

8955,21: Change ”Between” to ”In”

8955,21: Mention the dates of first and last sampling

8955,25: What about daily fluctuations in ions and isotopes? What are the potential biases caused by the time of sampling during the day? Mention when the samples were collected during the day

8956,16: Mention the number of ”all water samples”

8956,16: Are you referring only to UChile samples or all samples? Were the DGA samples filtered immediately after collection and analyzed using the same protocols as the UChile samples?

8956,16-18: I am sceptical about this late-filtration procedure, since it is a very reactive geology (limestone). If it was a granitic-gneissic geology or if it was a non-glacial river with low suspended sediment concentrations, it would most likely have a negligible influence on the hydrograph separation modelling, but in this case this assumption needs to be tested and any biases addressed. Do you have any data about the suspended sediment load?

8957,3-5: Have you quantified the post-sampling dissolution by comparing immediately-filtered samples with late-filtered samples collected at the same time? This needs to explained in detail. What was the result of this comparison and what are the implications?

8957,5-7: How did you calculate charge balances without measuring bicarbonate and nitrate (8955,26-8956,1)?

8957,9-21: Shorten this paragraph and avoid repetition

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8958,4: Mention what the first R stands for

8959,15: The assumption that dD and dO-18 provide non-redundant information needs to be addressed at an early stage. The best place is probably in section 2.3

8961,1: Equations 10 and 11 should come right after the end of this sentence

8961,1-10: Move all the discussion about fractionation to section 2.3. Fractionation processes are relevant to all models

8962,1: This is my main corcern about this manuscript. The data is poorly presented. Section 4.1 should be rewritten. It would be natural to start by providing the reader with an overview of all the data and time series. Summarize the ionic and isotopic statistics (number of samples, mean or median, max, min values) in a table. Then present the DGA time-series followed by the UChile time-series (and show the similarity between immediately-filtered and late-filtered samples in a figure)

8962,4-5: Use actual concentrations rather than centered and scaled value. I disagree that Figure 3 provides a better visualization of the temporal variations than ordinary time-series using actual concentrations. The scaling causes the ion variations to be on top of each other, making it difficult for readers to see the variations of a specific ion. This can be avoided if you use actual values. Also, it is not mentioned how the data was centered and scaled. Were the ions discharge-weighted? If not, how did avoid that scaling was not affected by the time and frequency of sampling?

8962,7-8: Mention the specific dates when the periods are assumed to start and end, so that the text is in accordance with Figure 3

8962,14-15: Discuss whether the apparent isotopic variability is a consequence of the frequency of sampling

8962,19-24: Figure 4 does not show this to the readers. The individual data points in the figure are too difficult to differentiate from each other. Try to present the data in a way that makes it easy for readers to see what the data shows

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8963,5: Do you have information on the isotopic composition of assumed end-members or sources (including spatial variations in river water within the catchment)?

8963,8: There is a bracket missing

8963,13: Why not present a dD-excess D plot and discuss the role of fractionation processes?

8963,19-20: It is difficult to understand what you mean. Consider rephrasing this sentence

8963,21: Change ”sample” to ”samples”

8963,25: ”... which one was most suitable ...”

8964,11: Now I am confused. In line 8963,26 you state that only chemical data was included, but here you state that dD and dO-18 were included

8964,19: In Figure 6 calcium and magnesium are included, but the text just said that they were neglected (8964,10-11)

8964,20: Which saturation index analysis are you referring to? There has not been any previous mentioning of a saturation index analysis, so readers have no idea of how this analysis was conducted, what the results of the analysis were, and what uncertainties it contained

8964,23: Change ”minimal” to ”decreasing”

8965,8: What is a ”light trend”?

8965,9: Use lower case in ”residual”

8966,3: Insert ”The” in front of ”snow”

8966,3: How do you know this? Make a reference to the documentation. Is this statement based on satellite imagery?

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8966,4: What about the contribution of snowmelt from snow located on the surface of glaciers?

8966,5-19: It is difficult to follow your argumentation here. Consider rewriting this paragraph to better communicate your arguments

8966,9-11: Where exactly does this water flow occur? If the water flow in the limestone rocks is an important route of meltwater, then explain its role

8966,11-13: Make a table that presents the chemical data from the western part of the catchment and chemical data from other parts of the catchment. The readers need to see for themselves how the various ions and isotopes deviate from each other in the different parts of the catchment, and how your statement is supported by the data

8966,17-19: Show on a map what you mean

8966,22: Change ”study” to ”studies”

8966,23-24: Use past tense

8967,8: Mention what the ratio from Ragettli and Pellicciotti (2012) is

8967,9: Mention what your ”prior information” is

8967,18: Explain to the reader why the samples move below the first eigenvector

8967,22: Delete ”for us”

8967,24-27: Mention the actual values that you discuss

8968,9-18: Include the uncertainties of the separated contributions

8968,10-14: Are these results discharge-weighted or integrated over some time-domain or just mean values of the samples? If so, mention how this was done, what time-domain was used and what effect the uncertainty of the discharge measurements has on the final results

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8968,10-14: Are you referring to seasons in general or a specifi season in 2011 or 2012?

8969, 14-17: As mentioned earlier, this is very late to inform the readers about the objective of the study

8970,9: Insert ”By” in front of ”understanding”

8970,19: What is the bracket referring to? This should be moved or deleted

8971,12: Here and elsewhere, do not use the short form of not in a scientific text

8972,7-20: This is a repetition of page 8963. Either delete or rewrite this paragraph

8973,13-14: As the aim of the study is to estimate ”the hydrological role of glaciers ...”, then this must be the focus of the Discussion section. In the Discussion section most attention must be given to the temporal and spatial variations in the contribution from glaciers, and the models should receive much less attention except for a discussion of the differences in the results of the various models

8973,23-26: Why was this ”not evaluated here”?

8975,2: Change ”were” to ”we”

8975,2-9: This should be moved to previous sections. I do not like the somewhat misleading term ”glacierized” . Consider changing this term to ”bulk glacier meltwater”

8975,3: Change ”glaciarized” to ”glacierized” (if you choose to keep this term)

Table 2: Explain in the caption what the terms (Glacier, Directly snow, Soil, ...) are defined

Figure 3: Mention in the caption what the vertical lines present and the exact dates they occur. According to the text there should be an additional line on 1st April 2012. Separate immediately-filtered samples from late-filtered samples. Change the time spacing to start at the first of each month

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Figure 4: This figure is completely messy. It is impossible to differentiate the data points. Consider presenting the data in another way – perhaps by using an ion ratio-versus-ratio plot. Why is potassium neglected in the Piper diagram? Normal potassium is combined with sodium

Figure 5: In the caption change ”Deuterium” to ”dD” and change ”oxygen 18” to ”d18O”. Rewrite the secoend sentence in the caption

Figure 6: In the legend in the upper figure A, sulphate should have a charge of 2-

Figure 8: It is difficult to differentiate the data points in the U1-U3 plot. Make the figure larger

Figure 9: Mention in the caption that only spring samples are used. Rewrite the second sentence of the caption to better explain what the bar or bars represent

Figure 10: Why are the figures split in two on the 15th of December 2011? What happened on that date? Change the time spacing to start at the first of each month. The four lower figures are very important to the objective of the manuscript. They should be shown in a separate figure and at a much larger scale

Figure 11: Change the time spacing to start at the first of each month

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Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 11, 8949, 2014.