

Interactive comment on “Atmospheric controls on hydrogen and oxygen isotope composition of meteoric and surface waters in Patagonia” by Christoph Mayr et al.

Anonymous Referee #1

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Title: Atmospheric controls on hydrogen and oxygen isotope composition of meteoric and surface waters in Patagonia

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Recommendation: re-submit

Summary

This paper evaluates the isotopic composition of precipitation, lentic water, and lotic waters to understand the isotopic fractionation processes associated with orographic

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rainout, moisture recycling, and moisture sources. The authors found that for sites upwind of the Andes and immediate downwind of Andes, the source of moisture comes from the Pacific Ocean, while for the sites at the Patagonia Atlantic coast regions, the source of moisture comes from the recycled moisture from the continent. The north of Patagonia site obtains moisture from the Atlantic coast. Furthermore, they also relate the rainout effect of water isotopes with the drying ratio and found the decrease of δD in precipitation around 80 permil from the upwind region to downwind region with drying ratio of 0.45.

Assessment

I have an impression in the beginning that this paper would exploit more on the atmospheric controls on the isotopic composition of surface waters in Patagonia such as rain evaporation, convection, mixing, etc (See my general comments for further explanation). Thus in my opinion the title of the paper is misleading. The works itself are interesting and a lot of efforts have been carried out to collect all the samples. While the work and findings are interesting, some improvements need to be carried out thus the readers will get clear and comprehensive overview on the works. I have several general comments below. I would ask the authors to take these comments into consideration as they re-submit the paper for publication in HESS.

General Comments

1. Based on the title, I thought that the authors would use water vapor isotopic composition in their study to better quantify the atmospheric controls of surface water isotopic composition. In this paper, the authors only analyze the isotopic composition of precipitation (and other surface waters) and analyze moisture sources using backward trajectory model. I also expect to see how the water isotopes evolve from the source (e.g., pacific ocean) to the west side of Patagonia (see Berkelhammer et al., 2012 for example). There is no isotope analysis to confirm the moisture source. It is solely based on moisture backward trajectory analysis.

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2. I highly recommend to rewrite the introduction section. I do like short but straight and congested introduction section. However, there are at least two topics needed to be covered in the introduction, thus the readers will have clear insight about the topic. HESS has broad readers and many of them do not have deeply understanding about water isotopes and moisture recycling. I recommend to add at least two paragraphs about: 1. Water isotopes and its fractionation processes, and briefly about Isotopes effects (amount effect, temperature effect, and latitude effect) since it is the main topic in the paper, and 2. Moisture recycling works (e.g., by van der Ent et al., 2010). There are some papers about moisture recycling that are missing in the citation.

3. For the GNIP data, the authors used mean isotope values on a yearly basis if more than 6 months data are available in the particular year. In my opinion it can be tricky since isotope values during summer and winter, and during rainy season and dry season are completely different. If all 6 months isotope data were measured during winter/rainy season, then the δ values will be lower and do not represent δ values for that particular year. Do the authors consider this in their analysis?

4. The use of drying ratio to express rainout process is not clear. Since the beginning the authors do not explain what does the drying ratio tell the readers? What is the purpose of using drying ratio in the analysis? I found out later in the conclusion that drying ratio describes the rainout process. Moreover, the authors also do not explain the relation between drying ratio and rainout process. Low drying ratio means low rainout process or is it vice versa? More detailed explanation about drying ratio is needed. In addition, the locations where the authors taken the upwind samples (Madre de Dios and Los Glaciares)) for drying analysis are not stated in Figure 1.

5. I am also puzzled with the use of Rayleigh-type distillation process in the discussion. How the authors used Rayleigh distillation method is unclear. Rayleigh distillation method can be very useful to describe evaporation, rain evaporation, and condensation process during moisture transport (see Worden et al., 2007; Noone, 2012). This is not covered in the study although the formula and few explanations about Rayleigh

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method are written in the manuscript.

Line by line comments

L refers to line and P refers to Page.

P1L18-20: Authors stated that they evaluated the stable isotopic compositions of precipitation, lentic waters, and lotic waters to understand isotopic fractionation processes associated with orographic rainout, moisture recycling, and moisture sources. I cannot find in the text how the authors used these water isotopes to understand the processes associated with moisture recycling and moisture sources. They only used backward trajectory to find the moisture sources (see my general comments).

P1L31-32: Rewrite the sentence. Grammatically incorrect.

P3L3: The authors mentioned that they collected 4 groundwater samples. However, I do not see any results on groundwater. So maybe delete this statement?

P3L6: Delete are. Grammatically incorrect.

P3: For calculation of drying ratio, I suggest to write a reason why you use formula number 4 instead number 2 and 3. The reason may be that you do not have water vapor isotopes measurements.

P4L5-7: Rewrite the sentence.

P4L7: You may write:using the technique introduced by Sodemann et al. (2008).

P4L27: Maybe remove sentence for two other Patagonian sites that are not considered in the study.

P4L30: Delete respectively.

P5L14-16: For these two sentences, can you elaborate more on the results? For example mention about precipitation amount and temperature (related to altitude). Precipitation amount and temperature strongly influence the isotopic composition of pre-

precipitation.

P5L24-25: I am wondering if big difference between δ precipitation in Puerto Montt (PMO) and Bariloche (BAR) is due to upwind and downwind locations alone. I suggest the authors also relate δ values with precipitation amount and temperature at that particular year (1999).

P6L18-29: It will help the reader if you write the colors for all the locations. For example: Andean lakes close to Bariloche (Green) show. . . .

P6L29: Here you mention again about Bariloche plot (green). Is it the same with previous sentence (Andean lake)?

P7L8: Rewrite the sentence. Grammatically incorrect.

P7L14-15: Here you mention the δ difference between Bahia Blanca (BBL) and Bariloche (BAR). But in the next sentence, you mention about temperature difference of 0.5 degree celcius and Figure 2g and 2h. When I look to your Figure 2, then I found BBL is Figure 2g (correct) and BAR is Figure 2e (not correct). The temperature difference is also not correct.

P7L15-17: I will say the discrepancy in δ is due to temperature different or altitude different, which leads to orographic isotope effect.

P7L21-27: For Rayleigh distillation method, please see my general comments.

P8L4-5: Missing location for Madre de Dios and Los Glaciares. Please see my general comments.

P8L10: Rewrite the sentence. Grammatically incorrect.

P8L19: You may re-write the sentence into: . . . , respectively, using the liquid-ice fractionation values taken from Majoube. . . .

P9L17: Delete word: of downwind.

P9L19: Replace “almost plots on the GMWL” with “ are plotted close to GMWL”.

P14L2: missing the: the selected GNIP stations.

P14L6: You stated GNIP period from 1984-2014. However, Figure 2 d-f say 1970-2000. Which one is the correct one? Can you also please improve the Figure 2? I can hardly read the wind vectors.

P17L4: The sentence: for 1984 and 1999, respectively is not correct.

P18L4: missing “and”. Stars represent Patagonian sites and circles represent Pampas.....

P19L2: ...values of lentic waters for selected regions. . .

P22L2: Change PUW with PDW and change stippled line into dash lines.

References

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