

Interactive comment on “High-resolution stable isotope signature of a land-falling Atmospheric River in southern Norway” by Yongbiao Weng et al.

Anonymous Referee #1

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Review of Weng et al.

This paper describes a detailed case study of an AR event that occurred in Norway. They investigated the causes of the observed W-shaped isotope evolution using various methods focusing on below cloud evaporation, advection/mixing of air masses due to frontal dynamics, and moisture source. They also explained the interpretations of isotope dynamics by past studies during the AR event in California. I think the content of the paper is beneficial to understand isotopic behavior in ARs, and it is worth publishing. However, the paper is overall very reader unfriendly. There are so many methods involved in this study with many acronyms and many redundant discussions.

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I think we can condense the paper considerably and still be able to tell the key findings of this paper.

1. In the Introduction, first describe the background of the study and then list key research questions you would like to answer. The authors described precipitation -> isotope -> AR, and raised the first question of uncertain moisture source of AR in p2, line 18-19. Then, they went back to describe precipitation isotopes. The flow of the Introduction needs to be improved.
2. p3, line 10 – p4 line 11: This part is redundant and does not belong to the Introduction. It is mentioned later in my comment, but I think some of these citations need to appear in the Results section when you describe certain processes. Either list the key components in 1 or 2 lines, or remove this part.
3. Remove p4 line13-22. Describe here what are your research questions and briefly explain how you are going to approach them.
4. Remove p4 line 24-25. Not necessary.
5. p4 line28: what is sharki.oslo.dnmi.no?
6. p7-8: why so many datasets are used? Could it be analyzed just by ERA5? I do not get the rationale for using this many data.
7. Figure 1: just show either one. The aim of this study is not a verification of the satellite dataset. ARs can be simulated well enough in reanalysis for this study purpose.
8. Figure 2: Why do you use forecast data? Can it be from ERA5? Please consider reducing datasets for simplicity.
9. Section 3.1 and Section 4: These parts are very redundant and painful to read. Some of the explanations appear many times when explaining different variables. The important thing in this part is to list key behaviors that you are going to investigate in Section 5. You do not need to list all behaviors shown in Figure 3. Therefore, I suggest

rewriting it in the following format. First, describe how you separate the event into 4 stages based on frontal conditions. Then, describe key behaviors in each stage (I -> IV). The content in sections 3.1 and 4 can be combined.

10. p14 line14: Are there any common features in the past W-shape event? Such as frontal dynamics?

11. Section 5: In this section, I think it would be more accessible to add some more citations when interpreting results.

12. p15 line28-29: “does not yet...” I do not get it. Please make it more accessible. Also, I understand that positive $\Delta\delta$ indicates strong re-evaporation, but what does “evaporation is incomplete” mean when it’s negative?

13. Figure 5a: Could you change the shape of the markers according to each stage? It isn’t easy to memorize when each stage starts so I think it’s helpful for readers.

14. Figure 5b-d: I think it is helpful to use discrete colormap levels rather than continue colormap since you refer to some exact numbers in the text.

15: Figure 5: I do not understand how each line is calculated. For example, in Figure 5b, which parameter is modified? RH?

16: Figure 5: It seems to me that overall RH, precipitation, droplet diameter only explain Δd but not $\Delta\delta$. Droplet size seems to explain $\Delta\delta$ variability to some extent but not so clear. What could be the reasons?

17: p17, line13-14: “coordinate system of drop-size dependent effects of RH on rain-drops”? Please explain.

18: p18 line 2-3: more HDO is transferred to the liquid phase?

19: p19 line1: “This indicates the influence of the below-cloud exchange.” Is this true? I thought Δd indicate the amounts of below-cloud evaporation. Some citations might help.

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20: p20 line18-19: Could you make it more accessible?

21: p20 line22 and throughout: Is there any difference in meaning between “less depleted” and “enriched”? Can we just use “enriched”?

22: p20 Line25: cite some papers on heating profiles and isotopes

23: p20 line29 – p22 line3: I think we can remove this part or move it to supplement. I do not see any key messages in this part. Aside, Table 1 should be a figure to compare simulation and observations.

24: p22 line10 – p24 line6: This part overlaps with section 3 so make it short and combine with section 3. The key message here is that the moisture uptake region coincides with AR tracks. The right side of figure 7 is not necessary and distracting.

25: Figure 8: the colors of the first two dashed lines are a bit difficult to distinguish. Could you change one of the colors?

26: Figure 8: Could you also make figures of mean or medians of these pdfs since that is mainly discussed in the text?

27: p28, line 34: If I understand correctly, Y10 uses isoRSM. Based on your discussion, can we consider the claims of Y10 are more reliable?

28: Abstract line16-18: Make it more accessible to readers who only read the abstract.

29: Abstract line 20: “AR events in California”

30: Abstract line 20-25: This part may not be suitable for the abstract. The conclusions are too ambiguous.

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