

Interactive
Comment

Interactive comment on “Determining water sources in the boundary layer from tall tower profiles of water vapor and surface water isotope ratios after a snowstorm in Colorado” by D. Noone et al.

Anonymous Referee #2

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The authors present an interesting set of data, including stable water isotope measurements, from a tall tower near Boulder. To my knowledge such data are unique, and the measurements used to address a relevant problem. The writing is mostly clear, also there remains room for improvement, as explained in the main points. There are also several other minor points that should be addressed by the authors in order to improve the quality of the manuscript, as detailed below.

Main comments

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1. Vertical resolution

The biggest limitation of the data set is the fairly low vertical resolution of 27m. In particular sharp gradients in stable conditions and in the surface layer are thus probably completely smoothed out. Could the Licor humidity measurements allow for (qualitatively) recreating some of the sharp gradient structure? This limitation of the data set is worth more discussion. How limited is the flux-gradient relation when the profiles have been smoothed so strongly?

In the presentation of the results, it is not always clear where you consider the boundary layer height to be situated, and how it relates to the surface layer. From your dataset, it would be easy to estimate the boundary layer height (e.g. from calculating a Richardson number) and to plot it e.g. in Fig. 3. Also, Fig. 3 could be clarified by using more distinct color shadings, and by not showing the bounding contours of the shading (these are easily confused with the potential temperature contours).

2. Calibration procedure and isotope measurements

As I understand from Appendix A the instrument was not calibrated during the field campaign, which does not allow to correct the data for instrument drift. This seems however recommended, as Aemisegger et al have shown recently for the L1115-i. It is probably a good idea to explain how your calibration strategy differs compared to their study, also since you mention the quality of calibration procedures as an important prerequisite for deuterium excess measurements in the Conclusions.

In the beginning of the manuscript 18O and the additional information from deuterium excess are quickly dropped from the discussion without it being made clear why that is the case. Rather than leaving the reader guessing that the calibration procedure might be the reason, it should be spelled out clearly.

Are the humidity data shown in Fig. 3 from the L1115-i or from the Licor instrument? How well do the two humidity measurements agree?

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There are no data gaps in the profile time series: was there no situation where wind shading from the mast occurred, or were these situations not filtered out?

3. Details on the meteorology

The discussion of the meteorological situation in Sec. 3.1 is very qualitative. This could be considerably improved by providing details e.g. on how cold the "strong surface cooling" was, how cold the "cold nighttime temperatures" were, etc. It is difficult to pick this out from Figs. 3 and 4 alone. The writing from Pg. 16340 L. 20 onwards needs improvement.

4. Clarification of the Rayleigh model

In Sec. 3.1 / Fig. 5, a Rayleigh model is used to match the observations. Can you clarify here what is meant by "precipitation efficiency", and what the implications of that model parameter are for the data? Also, is the match of moisture source temperature and relative humidity unique or could other combinations also yield plausible distillation curves? Also it should be mentioned that mixing during such a long transport distance of water vapor to the measurement site could have altered the isotopic composition. It is not clear how the last paragraph in Sec. 3.1 relates to the previous discussion.

5. Detailed comments

Pg. 16341, L. 26: and ARE indicative Pg. 16341, L. 29: and IS shown Pg. 16342, L. 13-14: I can't see an upward propagation here, as the whole profile shifts to less depleted values than the time before Pg. 16344, L. 26: The writing from here to the end of the paragraph needs clarification/improvement Fig. 9: use solid lines instead of stippling, can't see a brown square. Shading does not show in print.

References

Aemisegger, F., Sturm, P., Graf, P., Sodemann, H., Pfahl, S., Knohl, A., and Wernli, H.: Measuring variations of $\delta^{18}\text{O}$ and $\delta^2\text{H}$ in atmospheric water vapour using two commercial laser-based spectrometers: an instrument characterisation study, Atmos.

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