

Interactive comment on “The patterns and implications of diurnal variations in d-excess of plant water, shallow soil water and air moisture” by L. Zhao et al.

Anonymous Referee #2

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The manuscript of Zhao et al presents a detailed set of investigations into the deuterium excess (dex) of waters in of plants, soils, and the surface atmosphere across a basin in central China. At five sites over a period of 1-3 days these quantities were measured at 1-2 hour frequencies, and thus present an interesting dataset with which to explore the role of vegetation in controlling the diurnal cycle. While I find the objective of this paper an interesting topic, I feel that more could be done to demonstrate the how plants, soils and meteorological conditions influence isotopic cycling in these environments.

Many of the results of this study are consistent with previously understood dynamics in the soil-plant-atmosphere continuum. The isotopic enrichment of waters as it moves

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from soils into xylem, from xylem to leaves, and from leaves to the atmosphere has been actively studied by Farquhar, Cernusak, Ehleringer, Dawson, and many others. The authors demonstrate a diurnal cycle in leaf dex values, but no attempt is made to reconcile these observations with well-understood dynamics of leaf enrichment. In order to justify the authors conclusions about the role of plants in mediating the dex content of surface vapor, these models should be tested to see what the diurnal cycle of leaf transpiration dex would be based on theory.

The trend in dex of soil moisture observed at S3 is very puzzling. The limited explanation that the authors give is not sufficient nor justified by any mechanistic process know to occur in soils. Much more detailed assessment of these data are needed or this section should be removed as it is not adequately addressed. Overall, I find the analysis of the collected data in this manuscript weak. The figures (with the exception of F1 and F3) all plot observed data with respect to time, yet many claims are made about the relationship between dex and meteorological conditions are made.

P4434 L9: Add in note about the ecosystem types assessed for those not familiar with the Heihe Basin L10: This wording implies that measurements were made over multiple days (please clarify) L11: Change ‘plots’ to ‘values’ L12: The conclusion that dex values vary between different pools, or that there is a diurnal cycle in the atmosphere is not a novel finding. L17-22: Many of these relationships are expected from classic models such as Craig-Gordon, why is this novel?

P4435 L17: Explain this with respect to the physical processes that affect dex first, then note the graphical relationship afterward.

P4436 L5: dex ‘in surface atmospheric vapor’ L20: The theory of Merlivat and Jouzel was developed for open water evaporation where $\delta_{ET} = \delta_A$, why is this theory relevant here? L25: This is an interesting point. What do model like those of Farquhar and Cernusak predict?

P4437 L10: I feel that (2) is not addressed sufficiently.

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P4439 L14: How many locations, where were they located relative to the vegetation?

P4440 L5-12: A better description of the weather stations would be helpful. What instruments were used, at what height above ground were the measurements made?

P4444 L6: Much of this section is just stating what's in tables 5 and 6. L17: Again, what at what heights were measurements made? This clearly affects your results.

P4446 L21: What is the justification for this statement? L24: Leaf water enrichment during transpiration has been understood for a long time, as is the influence of T and RH on this process

P4448 L23: What does the Farquhar and Cernusak model (or something similar) predict for the effects of transpiration on dex in leaves. What role does RH and T play in this as well? L26: Is this always true? What if the original oceanic source of some of the vapor had a low RH and the dex of entrained atmospheric moisture is quite high?

P4449 L11-21: This 'trend' in dex of soil moisture I find very confusing? You state multiple times, and is often reported in the literature, that root uptake doesn't fractionate. Then the only other mechanism to alter the soil dex is evaporation. But evaporation will result in enriched soils and result in a lower dex. How do you possibly explain the increases in dex at the end of the day? Why does only this sample show this trend? This finding is very puzzling and not explained adequately!

F1: This map is difficult to read, and may print poorly in black and white. Perhaps swap the locations of the North arrow and the legend (after removing Yagan) and use a color for the rivers not found in the terrain gradient.

F2: The legends for this and other plots are very unclear. Please state which panel corresponds to which site. Please use the same tick spacing on x-axis (12hrs) on each plot so that the observational windows can be compared more easily. Also remove the minutes (here and elsewhere) since they are all zero.

F4: Combine this and figure 7 and plot as in F2. This would allow us to see the
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difference between sunny and shady days more clearly.

F5: Combine this and figure 8 as above. What does the shaded area and the grey arrow signify.

Plot the relationship between dex in the various pools with PAR, T, and RH. Where are there strong relationships? What does the relationship between dex of leaf water and dex of the atmosphere look like?

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