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Atmospheric Measurement Techniques Discussions

Interactive comment on "Ecosystem fluxes of hydrogen: a comparison of flux-gradient methods" *by* L. K. Meredith et al.

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Response to Anonymous Referee #2

The authors thank anonymous referee #2 for the positive evaluation of our manuscript. We are grateful for the thoughtful comments, which we have addressed according to our responses below.

Comment: The work is thorough, maybe overly so (i.e. some material might be better suited for a supplementary section)...

Response: We acknowledge that this is a very valid comment regarding the thoroughness of our manuscript, and this is an issue we grappled with as well. We anticipate

that the main audience for the manuscript will be somewhat detail-oriented, either for replicating parts of the measurement system or considering the advantages of the various methods. Therefore, we felt that keeping all information in the main document was relevant for our audience. We focused on creating clearly defined sections to direct readers to the topics they would be interested in.

Comment: The forced distinction between above canopy and below canopy leads to awkward sentence fragments such as "..the presence of an additional H2 source above the 2 m below canopy flux measurement,. . .". Why not state initially that the 2 m below canopy results will be referred to as 2 m and dispense with the "below canopy" qualifier? There is no above canopy 2 m measurement so the distinction is redundant. Obviously, there are certain aspects to the discussion where the distinction between above and below canopy is relevant, e.g. when discussing the difference in footprint, etc. but otherwise the qualifier is unnecessary.

Response: We thank the reviewer for this valuable comment. We agree that the distinction of region and height together is redundant. We have gone through the manuscript and simplified the language to rid of unnecessary qualifiers. Sometimes it is less awkward to use above/below, than the specific inlet heights and flux heights, but sometimes using the heights is clearer. To help prime readers, we have added a sentence to page 2884 to clarify our nomenclature: "In this manuscript, we refer to measurement heights by their relation to the median forest canopy height (18 m; Fig. 2) when relevant to the topic at hand: above canopy for 24 m and 28 m and below canopy for 0. 5 m and 3.5 m." The nomenclature for below, above, and whole canopy is also presented in Table 2 with the heights defined. We rely on using these labels to describe the methods and results in this paper because they are relevant to the particular challenges and characteristics of those locations.

Comment: Not that it necessarily needs to be addressed in the paper but in the discussion of bias the authors note correctly that use of a single instrument helps to reduce bias. This is true although two instruments being used in an alternating sequence

would also reduce bias and double the sampling frequency which would help to reduce the effects of temporal variability in fluxes or meteorological forcings.

Response: We agree that use of two instruments at a higher measurement frequency would help to reduce sampling errors associated with discrete alternating measurements of each inlet of a gradient pair (Section 2.4.2). We were limited by the speed of H2 chromatography. We reduced the runtime to 4 minutes from the 5.5 min original design by Novelli et al., 1999, but were not able to retain the precision for shorter runtimes. If we had utilized two instruments to reduce the temporal variability, this would have actually increased the likelihood for measurement bias (Section 2.4.3). Not only would there be potential for bias due to leaks or inconsistencies between the gas sampling lines, but also in the detector response and other instrument components that can be very sensitive to slight changes in temperature and pressure and even manufacturing. Often two of the same GC sensors or columns behave differently for apparently no reason (or not easily diagnosed), and we were especially wary of this for making H2 gradient measurements.

Comment: There is at least one other experiment in the literature that utilized comparison of nocturnal H2 and CO2 gradients to estimate H2 flux, i.e. Rahn, et al., GRL, 2002. If for no other reason the reference serves to show how far the current work advances the methods of only a decade or so ago.

Response: We appreciate the reviewer bringing this to our attention; it's a very good suggestion. We have included on page 2895: "In previous work, the trace gas similarity method was used to derive H2 fluxes using CO2 as the reference gas over a weeklong manual collection experiment in an Alaskan boreal forest with promising, but limited results (Rahn et al., 2002)."

Comment: It might be easier for the reader if sections 4.2 and 4.3 were further subsectioned e.g. trace gas similarity, sensible heat similarity and K parameterization.

Response: Thank you for the suggestion. We had considered this kind of subsection-

ing, but felt that the results grouped more naturally by time period (i.e., summer vs winter), instead of by method. We compiled Table 2 so that readers interested in just one method, or the differences between methods, could be considered at a glance.

Interactive comment on Atmos. Meas. Tech. Discuss., 7, 2879, 2014.