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Interactive comment on "The overwhelming role of soils in the global atmospheric hydrogen cycle" *by* T. S. Rhee et al.

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We thank the reviewer for the careful reading and the comments on our paper. The reviewer questioned 3 points, all of which are related to the determination of uncertainty in soil uptake rate. The first question is the influence of seasonal variations of source emissions on the isotopic fractionation factor, the second concerns the influence of the inter-hemispheric exchange, and the third seems to be related to the limited air sampling frequency. We reply to these questions below:

1. As stated in the text, we assumed a system that maintains isotopic equilibrium for a given period. In this study this period is to be one year as implicitly mentioned in the text and figures. Under this condition, the variation of source strengths for

the given period (e.g., seasonal variation of source strengths) does not influence the determination of isotopic fractionation factor. To make it clear, we now add this description in the text and the appendix.

2. The SH influence to the determination of soil sink is examined using a two-box model and the details about the model are added in section 4.3. The results show insignificant change in isotopic fractionation factor with and without taking the inter-hemisphere exchange of air mass into account. Therefore, our calculation of soil sink strength using the observations of H_2 mixing ratios of the δD values in the NH appears to be insensitive to the SH influence.

3. Regarding the limited time resolution of measurements, we mentioned this in the section of results and conclusion. Since there have been no reports of measurements of isotopic ratios of free tropospheric H_2, we can't help but using our limited data to estimate soil uptake rate. Gerst and Quay (2000) reported hydrogen isotope analysis for air sampled in remote areas on surface, but the data (their pioneering data were based on an extremely difficult analytical process) are too scattered to be compared with our measurement. As stated in the conclusion, it is highly desirable to obtain qualified data in different time and space in the future. Few publications are "the last word".

Minor comments:

1. In figure 2, the month (and not the “fraction of year”) should be indicated on the horizontal axis.

Agreed and corrected.

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2. Section 4.6 is somewhat hard to follow. The effect of climate change on the soil sink should be mentioned earlier than in the conclusions.

This part is moved to the section of discussion.

Reference

Gerst, S., and Quay, P.: The deuterium content of atmospheric molecular hydrogen: Method and initial measurements, J. Geophys. Res., 105 (D21), 26433-26445, 2000.

Interactive comment on Atmos. Chem. Phys. Discuss., 5, 11215, 2005.