

## ***Interactive comment on “Comparison of Optimal Estimation HDO/H<sub>2</sub>O Retrievals from AIRS with ORACLES measurements” by R. L. Herman et al.***

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Author Comment to Anonymous Referee #3 of amt-2019-195:

We thank the referee #3 for constructive comments on the manuscript amt-2019-195, “Comparison of Optimal Estimation HDO/H<sub>2</sub>O Retrievals from AIRS with ORACLES measurements.” Below are our author comments (\*) in response to the referee’s comments. Changes will be made to the manuscript pending the other reviewers’ comments.

Specific comments

148-57: Another instrument that provided HDO measurements was Envisat MIPAS. For instance: Lossow, S., Steinwagner, J., Urban, J., Dupuy, E., Boone, C. D., Kellmann, S.,

Linden, A., Kiefer, M., Grabowski, U., Glatthor, N., Höpfner, M., Röckmann, T., Murtagh, D. P., Walker, K. A., Bernath, P. F., von Clarmann, T., and Stiller, G. P.: Comparison of HDO measurements from Envisat/MIPAS with observations by Odin/SMR and SCISAT/ACE-FTS, *Atmos. Meas. Tech.*, 4, 1855–1874, <https://doi.org/10.5194/amt-4-1855-2011>, 2011.

\*We agree and will add a citation to Envisat/MIPAS.

I130-131: Are these mean winds and surface pressure during the aircraft campaign (September 2016) or do they refer to a specific date and time?

\*These are mean winds and surface pressure from MERRA2. We will add a sentence to the Figure 1 caption.

I243-256: If it is not too much extra work, I would suggest to combine Figs. 2 and 3 in a single figure, e.g., by using different colors for the different matching criteria.

\*We will do this.

I291-292: Adjust y axis range to -200 ... +6200 m (or similar)?

\*We will do this.

I299-300: The caption says "RMS (standard deviation)", but  $\text{RMS}^2 = \text{BIAS}^2 + \text{STD-DEV}^2$ , I think? Are these numbers standard deviations or RMS errors?

\*This column is only st. dev., and will be relabeled accordingly.

I315: It may help the reader to say that  $G_R$  refers to the gain matrix of the HDO/H<sub>2</sub>O retrieval.

\*We will do this.

I316: Which systematic errors and interference errors have been considered here?

\*The random error is due to noise. Radiative interference errors are due to CH<sub>4</sub>, N<sub>2</sub>O, Surface Emmissivity, effects of temperature, and clouds.

I316-318: Looking at the averaging kernels, there are likely quite significant correlations being found in retrieval covariance S?

\*Yes, that is correct. All of our retrieval products have significant covariation between levels and species but these are taken into account for process studies by appropriate use of the supplied uncertainties and in assimilation studies through use of the averaging kernel and observation error covariances in the assimilation cost function.

I333-334: Maybe say again that the estimated error is obtained from optimal estimation retrieval theory and the empirical error is obtained from the satellite-aircraft comparison, to help the reader?

\*We will do this.

I344-348: Based on these error estimates, can the AIRS HDO/H<sub>2</sub>O ratio retrievals be considered useful for further scientific analysis?

\*Yes, we will clearly state in the Conclusions that AIRS HDO/H<sub>2</sub>O ratio retrievals are useful for scientific analysis.

I357-359: Not sure the team list is actually needed?

\*The AMT publication guide specifies to use this format.

Technical corrections -

\*We will make all technical corrections listed below: I24 and I44: ... HDO/H<sub>2</sub>O \_ratio\_ I81: D/H -> HDO/H<sub>2</sub>O I85, I226 and other places: use lower case section headings I151: \_the\_ forward model I169: DeSouza-Machado I176: of \_the\_ satellite retrievals I213: completed \_by\_ applying (?) I258-259: Labels (a) and (b) are missing. I332: shows \_that\_ the empirical error (?) I340-341: acronym for WISPER does not need to be repeated I467: paper title is formatted as a hyperlink Interactive comment on Atmos. Meas. Tech. Discuss., doi:10.5194/amt-2019-195, 2019.

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