

## ***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.***

### **Anonymous Referee #3**

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Review of "Comparison of Optimal Estimation HDO/H<sub>2</sub>O Retrievals from AIRS with ORACLES measurements" by R. Herman et al.

#### General comments

In this new study, Herman et al. present comparisons of HDO/H<sub>2</sub>O retrievals from AIRS/Aqua satellite measurements with aircraft data obtained by the WISPER instrument during the ORACLES field campaign in September 2016. Bias and RMS errors have been quantified for the lower troposphere (1000-800 hPa) and the mid troposphere (800 to 500 hPa). The bias and RMS errors from the comparison of the AIRS and aircraft data are found to be consistent with error estimates from optimal estimation retrieval theory.

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Overall, I found this to be an interesting study and consider the results to be robust. The manuscript is well written and concise. I would like to recommend the paper for publication in AMT, subject to a few minor comments and technical corrections listed below.

### Specific comments

I48-57: 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.

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?

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.

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

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?

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.

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

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

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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?

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?

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

Technical corrections

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

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