

## ***Interactive comment on “Aircraft validation of Aura Tropospheric Emission Spectrometer retrievals of HDO and H<sub>2</sub>O” by R. L. Herman et al.***

**Anonymous Referee #1**

Received and published: 30 May 2014

Review of “Aircraft validation of TES HDO and H<sub>2</sub>O”, by Herman, et al.

This paper describes the use of in situ observations of the HDO/H<sub>2</sub>O ratio in water vapor to validate those made by TES. The approach of the analysis uses the fact that the in situ observations are precise and accurate enough to be considered the true values for atmospheric dD. The comparison of the in situ observations and the TES retrievals yields values for a bias error and an empirical error. Overall the paper is clear and well presented, with only a few exceptions listed below. The measurements are interesting and the paper will be a useful for those using TES data. There are a few comments and questions that I would like the authors to address.

Why isn't the bias uncertainty included in the error budget? It is treated independently,

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but there is no reason given in the text for this treatment. Do you expect this bias to be the same everywhere for TES? How do you justify the 20 per mil uncertainty on the bias? The V004 bias was 63 per mil based on Mauna Loa data. Is this difference due to location? Retrieval? Changes in spectroscopy? Please explain and justify your approach.

As the paper is currently written you imply that after correcting for the 98 per mil bias, TES has a measurement error of  $\pm 26$  per mil in the BL. Unless you have a good reason, it seems to me that the uncertainty in the offset bias needs to be included in this number.

Title: The paper does not really discuss the validation of HDO and H<sub>2</sub>O independently, only the ratio. I suggest a title using dD or the ratio HDO/H<sub>2</sub>O in the title.

Abstract: Use the per mil units for the bias errors. Also a few places in the text need to be changed. (pg 13, 16)

pg 11, line 14. Why are the 1000 hPa levels excluded?

Page 11, Eq. 1, and Figure 3b: I am curious how this TES operator works with in situ data. I went to the Worden 2006 JGR reference and did not find a good explanation (none at all, really). Can you provide a better reference or explain in the text? This had a large effect on dD in the BL (+50 per mil), so it is important for the reader to understand.

Page 12: and Figure 4. This is really the TES measurement corrected for the bias. The thin black lines are TES<sub>corrected\_for\_bias</sub> – insitu. The thick black line is then the residual bias after the bias correction? It would be helpful for you to explicitly identify all TES measurements in the figures as having been corrected for the bias somehow. Here you could explain much more about the bias and what you think the source is. Is it spectroscopic? Do you expect it to be constant for all retrievals everywhere?

page 13 lines 15 – 20 are confusing. Do you subtract a constant or multiply by a

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constant?

Page 16 line 20. You should state that these empirical errors are after applying the correction for the bias of 98 and 37 per mil.

All figures please use a) b) etc instead of left and right. Several labels are hard to read, especially Fig 3 labels. Also, thick lines could be thicker. They are hard to read in reduced sizes.

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Interactive comment on Atmos. Meas. Tech. Discuss., 7, 3801, 2014.