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Atmospheric Measurement Techniques Discussions

Interactive comment on "A framework for accurate, long-term, global and high resolution observations of tropospheric H_2O-δD pairs – a MUSICA review" *by* M. Schneider et al.

Anonymous Referee #2

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The paper "A framework for accurate, long-term, global and high resolution observations of tropospheric H2O-δD pairs - a MUSICA review" presents the results of the MUSICA project which aims at providing coherent δD-H2O observations from different platforms. While no new scientific progress is reported, the publication of this paper as a review paper makes sense for potential users of δD because of the complex nature of such remote sensed products. Moreover a summary paper on the different available products would nicely help the potential users. I would however strongly recommend to the authors to make changes and cuts in order to make it more like a review paper. Some sections provide redundant information which was already provided in your previous papers. It would be nice to illustrate the long term aspect of your FTIR data by

showing long term time series. It would also be useful for potential users to document the capabilities of all the FTIR stations in term of vertical sensitivity (averaging kernels and DOFS, I did not find this information in your previous papers).

General comments:

Section 2 - Retrieval description:

You spend some time describing the retrieval setup, it would be also useful to report the noise levels you used for the FTIR and IASI retrievals. Also you state that you fit the temperature from IASI spectra (section 2.3.2), is it the same procedure than in Wiegele et al., 2014 (a priori is the EUMETSAT L2 with a strong constraint)? In that case it would be interesting to report it as well because it means you are sensitive to EUMETSAT temperature errors.

Section 3: Accurate remote sensing products

- The use of accurate here suggests that there is no error in the retrievals, the authors however nicely describe a systematic bias between certain ranges. The description of a most likely range of bias is very useful for the users but it also indicates that the retrievals are not exact like the title suggests. I recommend to modify the title to a less overselling one, such as "absolute characterization of remote sensing products".

- Could you provide the numbers in the description of the correlation (correlation coefficient and associated p-values). Section 3.1 L18 and Section 3.2 L6

- The comparison of retrieval products with non-smoothed in situ data is also of interest for the users as it allows to realize how much the smoothing affects the data. Could you

add a comparison between non-smoothed data (like you do in Figure 5) and retrieved ones or say a word about how the smoothing affects the in situ data.

Section 4: Validation of H2O-deltaD pairs

It is true validating the added value of deltaD retrieval is very important but it has already been made in Schneider et al., 2015 and Wiegele et al., 2014. What is the interest to present here the moisture pathways and the extreme approaches again? The novelty compared to these previous papers is not clear. Moreover the message of these two approaches is the same. I recommend presenting only one or the other.

Is there a reason why you would expect differences between IASI-A and IASI-B? Are the radiances measurements not calibrated and compared? Could you develop why you need to verify.

Section 5: Consistent long-term observation with NDACC/FTIR

- It would be useful in the perspective of a review paper on the capabilities of the MUSICA network to present the vertical sensitivities of the different FTIR sites. What vertical sensitivity can we expect from the new FTIR? Maybe within the Table 5, you could add a column with the altitude range of sensitivity and the dofs. - An example (or several) of long term times series would nicely illustrate the title of the section. Is there any inter annual variability, do you observe trends? Such questions would greatly help to assess the added value of such long term timeseries. - The lower panel of Figure 7 shouldn't appear in this section, it is more related to section 4 but the message was already clear from section 4.1.

Section 6: Quasi global and high resolution observations with IASI

- The processing of all IASI data is very challenging and requires the development of dedicated solution, are you able to process the IASI data in near real time? It is also an information that data users are interested in and that would fit within this section. - Figure 8 and 9 are redundant, one is enough to illustrate your point. - The type 1 versus type 2 discussion would better fit in section 4.

Appendix D

This appendix could be summarized in the article in one sentence without associated figure. I understand that the coverage is slightly better for type I product but I believe one number would be enough to illustrate that.

Minor comments

- "Exemplary": often used throughout the manuscript, if possible, alternate
- P2, L14: deltaD x 1000
- P2 L31: "for investigating the dynamics of the MJO (..)", add Tuinenburg et al., 2015 as a reference concerning the study of MJO with IASI.
- P2, L33: "However, there is only one study so far where attempts have been made for empirically validating these H2O-δD pairs (Schneider et al.,2015)" – Herman et al., 2014 and Worden et al., 2011 are previous attempts to validate TES deltaD retrievals, please consider them in this sentence.

- P2, L35: “Further and more detailed validation efforts for the H2O-δD pairs are urgently needed”- Urgently sounds a bit over dramatic regarding the numerous publications that have been made since the TES data (2006) for example.
- P5, L24: “The Type 2 product offers consistent H2O-δD pairs, which are sensitive to the lower and the middle troposphere, whereby it is possible to reasonably separate both altitude regions (degree of freedom for signal, DOFS, is typically about 1.8).” – Is it the case for all FTIR sites? What are the dofs for the different sites? This information would be useful in the table 5.
- P7, L2: “We would like to remind that there is no similar study where the accuracy of simultaneous tropospheric H2O and δD remote sensing observations is documented by such direct comparison to coincident reference profiles”. – What about Herman et al., 2014?
- P7, L18: Please specify the coefficient correlation values
- P8, L2: The figure mentioned here shows spatial colocation of the different measurements and does not give any information on the bias. The figure is not needed in this context, referencing to Schneider et al (2015) is sufficient.
- P12,L18-22: “the MUSICA NDACC/FTIR isotopologue data are representative for different altitudes and for larger scale processes (the data represent vertical layers averaged over 2-5 km (see typical averaging kernels in Fig. 3 of Schneider et al., 2015) ”- Again, are these “typical” averaging kernels representative of all the FTIR stations? A large scale process better defines a process that occurs at a wide horizontal scale than a vertical one. I suggest using “deeper layers”.
- P13, L4:10: “ After the rain season (OND, blue) the vapour is most depleted in HDO. Then evaporation of precipitated surface water might be more important as free tropospheric moisture source than during the other seasons. Between January and March (JAM, green) the vapour concentrations remain similar as during

the previous months, but the air becomes more enriched in HDO, which might indicate increased importance of mixing with humid boundary layer air and reduced importance of condensation processes. For April to June (AMJ, purple) air gets more humid, but δD remains almost constant, indicating to further moistening due to even stronger mixing with humid boundary layer air.” - The interpretation of δD is not straitghtforward and several combinations of different processes can explain a same H2O- δD composition. I would keep this part very brief to avoid erroneous interpretations. For example you suggest that the surface evaporation in OND will give water vapor a more depleted signature. However, evaporation from surface tends to enrich water vapor as there is no fractionation during evapotranspiration. Or in MAM, different airmass trajectories from different sources with same mixing historic could explain the observed signatures.

- P13, L15: “The IASI ground pixel at nadir has a diameter of only 12 km” – 12 km is not that small, GOSAT as TES ground pixels are smaller, moreover there is less nadir measurement than not nadir measurement because of the large IASI swath, remove only.
- P13,L23: “Please recall that one data point represents a ground pixel of 12 km diameter (at nadir)” – This sentence is not necessary as it was said a few lines before.
- P17,L2: IASI and TES retrievals have been cross-validated in Lacour et al., 2015 you should add this reference here. Also add the reference in the Table 6.

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