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Atmospheric Measurement Techniques Discussions

Interactive comment on "Intercomparison of Arctic ground-based XH_2O observations from COCCON, TCCON and NDACC, and application of COCCON XH_2O for IASI and TROPOMI validation" *by* Qiansi Tu et al.

Anonymous Referee #2

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The work of Tu et al. intercompares the column-averaged dry-air mole fraction of water vapor retrieved from ground based NIR infrared solar absorption low resolution measurements using two EM27/SUN FTIR Spectrometers which are forming the COCCON network, both are collocated with two high resolution instruments at two locations (Sodankylä, Finnland and Kiruna, Sweden), which form part of the TCCON and NDACC networks. Finally the XH2O-COCCON product is used for a comparison of the two different satellite products of water vapour, IASI-MUSICA and TROPOMI.

It is a very good concept to use two identically spectrometer at two established sites in

similar climatological conditions which both are part of a Network and therefore appropriate to be validated and/or calibrate COCCON - XH2O as a new validated product of the COCCON Network.

H2O vertical columns are very variable and the use of the ground based instruments of the COCCON- network for Validation of space born products for validation is very useful and promising especially the recording of a longer time series which covers more season helped to obtain significant results. The bias between COCCON with respect to MUSICA-NDACC (MAP) [(Musica NDACC (WACCOM)] and coccon is just -1 % [-3%] and with respect to TCCON -3 %. The authors suggest that the bias is in the range of the calibration factors applied in the COCCON retrieval. The Satellite product IASI MUSICA (Map) has an bias of 6% with respect to COCCON, while the original IASI MUSICA (WACCOM) has a little less bias 4.5% which indicate that their are different reason for the bias and the bias is not explained by the a priori.

The paper is well written , structured and has very clear, results and I recommend to accept the paper and recommend to publish the paper as is, addressing the minor corrections. from the other reviewer and only optional addressing specific comments below.:

Some readers are maybe interested in a bit more details about the COCCON-XH2O retrieval itself, maybe this could be added very easy in section 2.2 . What are the used microwindows, and linelist and if the XH2O is calibrated against TCCON or Musica in Karlsruhe, how large are these calibration factors, and how are they calculated.

As it is possible that there will be further developments in one of these network products and satellite products it could be helpful, to summarize for all 3 ground based products and maybe also for the space born instruments IASI (MAP, NCEP) , and TROPOMI products, some key retrieval settings, specially as there are significant bias found, it would be nice to have on one glance , spectroscopic information, Microwindows„ linelist and lineshape model, H2O-continuum and atmospheric self emission and calibration

factors. Maybe also key feachers of the inversion as the aprioris , especially . as a study regarding this is shown for IASI-Musica in the work as well, maybe also the number of DOF might be interesting for Musica Products and TROPOMI.

The bias calculated in the study evaluates very clear the accuracy given by the different products, but could you give a rough statement on the precision of a single xH2O COCCON measurement and its duration and how these two numbers compare to the TCCON and NDACC-Musica. measurements.

The authors show very clear for the Musica /COCCON comparison that there are differences in the two different versions for ground based (NDACC) Musica and that matching the aprioris does decrease the bias from 3 to 1 % , while for the space-IASI Musica the matching of the aprioris does not improve the comparison between IASI y COCCON, but the opposite is observed, it increases the bias, so that the a priori related bias actually probably has got a different sign as another bias related to the forward model or calibration factor.

Just for interest : Figures 11a,b. R is so good, that a linear dependence on the difference of the apriori is indicated and might be explained using the averaging kernels. If AK is available for IASI-MUSICA. retrievals, could you calculate the impact of the different aprioris theoretically and explain the 1%, difference. Musica IASI (Map)-Musica IASI (waccom) approx.. gˆT(AK _Musica)(x_apr_MAP- x_apr_Musica) o similar. Then, if the aposteriori correction seems to work for IASI, it could maybe be applied to TROPOMI to evaluate, how much of the Bias of the 9% might be explained due to the difference in the apriori. A plot of the average apriori of COCCON y TROPOMI might also help to evaluate this. And I would actually ask the authors to include a typical averaging kernel of the two satellite products, maybe there is still space in Figure 5.

If a apriori correction (aposterior applied) explains the differences between the two IASI –Musica versions, could you apply this to correct for the unmatched a prioris in the case

of TROPOMI. This means could you generate posterior a TROPOMI(MAP) product? O Just evaluate how much would the bias change?

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