Atmospheric Measurement Techniques Discussions

Atmos. Meas. Tech. Discuss., referee comment RC2
https://doi.org/10.5194/amt-2021-141-RC2, 2021
© Author(s) 2021. This work is distributed under
the Creative Commons Attribution 4.0 License.

Comment on amt-2021-141

Anonymous Referee #3

Referee comment on "Retrieving H_2O/HDO columns over cloudy and clear-sky scenes from the Tropospheric Monitoring Instrument (TROPOMI)" by Andreas Schneider et al., Atmos. Meas. Tech. Discuss., https://doi.org/10.5194/amt-2021-141-RC2, 2021

The manuscript by Schneider et al is a valuable contribution towards the application of global HDO/H2O data for scientific interpretation. While the paper in in general well written, I have a few points/concerns that require consideration.

Major points:

Retrieval:
1) In table 1, you list a reduced chi2 filter of <150. Is this really the reduced chi2? If yes, 150 as a cutoff appears extremely high, i.e. you are not fitting the spectra properly. Given your regularizations, I would really like to see typical residuals of your spectral fits.
2) Surface albedo prior: I am somewhat concerned about your choice of a surface albedo prior, using an annual average. This could create seasonal biases in your retrieval, depending on how strongly you regularize the retrieval. Some more details would be good to show that this is NOT the case. Also, what do you assume as the spectral dependence of your surface albedo in the fitting window? Varying snow cover and vegetation growth can cause large seasonal cycles in albedo, so using an annual average as prior seems to be not a great choice (MODIS provides more than enough data to get monthly priors).
3) Averaging kernels and profile scaling: It seems you are using a profile scaling approach, which might explain the somewhat counter-intuitive averaging kernels shown in Figure 10. As you only scale the profile: How do you compute (and provide) the column averaging kernels with your retrievals? It seems the data would be rather unusable without the kernels. Also, why did you choose not to fit the profile? While your DOF might not be >>1, it would help not getting extreme values in your column kernel. In Figure 10, I would also suggest to plot the kernels with pressure as y axis. Given the scale height of H2O is low, the higher altitudes are rather unimportant for SWIR HDO/H2O retrievals.

Science: In your example cases, it would be good to really point out what could be learned from delta-D rather than just H2O alone. At the moment, this is unclear. More Rayleigh plots (e.g. a density plot of your global dataset) would be very helpful.

Small issues:

Line 40: is notified?? I think I know what you mean but it won't be clear

Line 61: Absorption cross section (not scattering)

Line 80: Interferences and biases: Would be good to show spectral fits to maybe provide some more evidence to the gut feelings expressed here

Line 134: just saying "unit vector" is fine

Figure 18: In the left panel, there seems to be a high density region with very low H2O crossing over all possible delta-D values. This seems somewhat unphysical, do you have an explanation for that? Could you plot the locations of this weird "vertical stripe" of data in the density plot?

Last but not least, my apologies for the delayed review.