Atmos. Meas. Tech. Discuss.,
doi:10.5194/amt-2019-240-AC3, 2019

Atmospheric Measurement Techniques Discussions

Interactive comment on "First data set of H_2O/HDO columns from TROPOMI" *by* Andreas Schneider et al.

Andreas Schneider et al.

a.schneider@sron.nl

Received and published: 24 October 2019

The manuscript "First data set of H2O/HDO columns from TROPOMI" by Schneider et al. introduces a new product of HDO/H2O δD global distributions measured by the TROPOMI instrument. The manuscript makes an important contribution to the science community and is very well written. It qualifies to be published as is by AMT.

We thank the referee for the positive review. In the following, all individual comments are quoted in italics and our response is given below.

However, I do feel that it will improve the paper significantly if there are more discussions on the information contents and sensitivities of the measurements. This can be shown in the form of jacobian or averaging kernels for vertical sensitivities.

We have added a plot of a TROPOMI spectrum with spectral fit and a plot of the corresponding residual. We have also added a panel with χ^2 to all time series and statistics plots. Examples of averaging kernels are plotted in Figure 2 (Figure 1 in the discussion paper).

I am also concerned about the global δD latitudinal variations being a factor of temperature distributions (see Figure 7). The cause for this was described as "The general latitudinal gradient due to the temperature-dependence of the fractionation effects and progressive rain out of heavy isotopologues, the so-called latitudinal effect, is plain." In general, thermal signals are sensitive to the surface thermal contrasts, which reflects measurement sensitivity. This often shows up as latitudinal variations in retrieved products or over higher ground (e. g., the Andes and the Himalayas). I don't know if the authors have studied these effects in the spectral region used. If yes, how would you attribute the latitudinal variations caused by temperature effects of the HDO/H2O physics vs the thermal contrast effects of remote sensing?

Sensed radiation of wavelengths up to 3 µm is predominately reflected solar energy (e. g. Tempfli et al., 2009). Our spectral region at 2.3 µm is in this range. In retrievals in the short-wave infrared thermal radiation is usually neglected, for instance for the SCIAMACHY, GOSAT and TROPOMI data products obtained in this spectral range (e. g. Frankenberg et al., 2009, 2013; Scheepmaker et al., 2015; Schneider et al., 2018; Borsdorff et al., 2018; Hu et al., 2018). Furthermore, the latitudinal and altitude variation of δD corresponds to our expectations; we don't have indications that it may be wrong.

Also, since TROPOMI and VIIRS are on different platforms, how were the footprints matched? What was the error estimate in this step?

We use the official TROPOMI VIIRS data product (Siddans, 2016). S5P and S-NPP fly in formation. The latitude and longitude of the VIIRS pixels are transformed into a Cartesian coordinate system y (across-track), z (along-track), with origin at the centre of the S5P pixel and scaled such that the corners of the nominal FOV have values of $y = \pm 1$ and $z = \pm 1$. This is the basis for identifying which VIIRS pixels fall into a S5P FOV. An average weighted with a spatial response function is computed. A detailed algorithm description can be found in the ATBD (Siddans, 2016). The data product does not give an error estimation.

A very minor point: the Suomi National Polar-orbiting Partnership, should be S-NPP or SNPP, not just NPP.

This has been corrected in the manuscript.

References

T. Borsdorff, J. aan de Brugh, H. Hu, O. Hasekamp, R. Sussmann, M. Rettinger, F. Hase, J. Gross, M. Schneider, O. Garcia, W. Stremme, M. Grutter, D. G. Feist, S. G. Arnold, M. De Mazière, M. Kumar Sha, D. F. Pollard, M. Kiel, C. Roehl, P. O. Wennberg, G. C. Toon, and J. Landgraf. Mapping carbon monoxide pollution from space down to city scales with daily global coverage. *Atmos. Meas. Tech.*, 11(10):5507–5518, 2018. doi: 10.5194/amt-11-5507-2018.

C. Frankenberg, K. Yoshimura, T. Warneke, I. Aben, A. Butz, N. Deutscher, D. Griffith, F. Hase, J. Notholt, M. Schneider, H. Schrijver, and T. Röckmann. Dynamic processes governing lower-tropospheric HDO/H_2O ratios as observed from space and ground. *Science*, 325 (5946):1374–1377, 2009. doi: 10.1126/science.1173791.

C. Frankenberg, D. Wunch, G. C. Toon, C. Risi, R.A. Scheepmaker, J.-E. Lee, P. O. Wennberg, and J. Worden. Water vapor isotopologue retrievals from high-resolution GOSAT shortwave infrared spectra. *Atmos. Meas. Tech.*, 6(2):263–274, 2013. doi: 10.5194/amt-6-263-2013.

H. Hu, J. Landgraf, R. Detmers, T. Borsdorff, J. aan de Brugh, I. Aben, A. Butz, and O. Hasekamp. Toward global mapping of methane with TROPOMI: First results and intersatellite comparison to GOSAT. *Geophys. Res. Lett.*, 45(8):3682–3689, 2018. doi: 10.1002/2018GL077259.

R. A. Scheepmaker, C. Frankenberg, N. M. Deutscher, M. Schneider, S. Barthlott, T. Blumenstock, O. E. Garcia, F. Hase, N. Jones, E. Mahieu, J. Notholt, V. Velazco, J. Land-

graf, and I. Aben. Validation of SCIAMACHY HDO/H_2O measurements using the TCCON and NDACC-MUSICA networks. *Atmos. Meas. Tech.*, 8(4):1799–1818, 2015. doi: 10.5194/amt-8-1799-2015.

A. Schneider, T. Borsdorff, J. aan de Brugh, H. Hu, and J. Landgraf. A full-mission data set of H_2O and HDO columns from SCIAMACHY 2.3 µm reflectance measurements. *Atmos. Meas. Tech.*, 11(6):3339–3350, 2018. doi: 10.5194/amt-11-3339-2018.

R. Siddans. S5P-NPP cloud processor ATBD. Technical report, Rutherford Appleton Laboratory, 2016. URL http://www.tropomi.eu/sites/default/files/files/S5P-NPPC-RAL-ATBD-0001_NPP-Clouds_v1p0p0_20160212.pdf.

K. Tempfli, N. Kerle, G. C. Huurneman, and L. L. F. Janssen, editors. *Principles of Remote Sensing*. The International Institute for Geo-Information Science and Earth Observation, 2009. ISBN 978-90-6164-270-1. URL https://webapps.itc.utwente.nl/librarywww/papers_2009/general/principlesremotesensing.pdf.

Interactive comment on Atmos. Meas. Tech. Discuss., doi:10.5194/amt-2019-240, 2019.