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Corrigendum to “An intercomparison of total column-averaged nitrous oxide between ground-based FTIR TCCON and NDACC measurements at seven sites and comparisons with the GEOS-Chem model” published in Atmos. Meas. Tech., 12, 1393–1408, 2019

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In the manuscript “An intercomparison of total column-averaged nitrous oxide between ground-based FTIR TCCON and NDACC measurements at seven sites and comparisons with the GEOS-Chem model” by Zhou et al. (2019), three statements must be corrected.

First, the interpretation of the underestimation of X_{N_2O} trends from TCCON measurements is wrong. Therefore the statement in the abstract “The X_{N_2O} trend from the TCCON measurements is slightly lower due to an underestimation of the trend in TCCON a priori simulation.” is not correct. Using a different trend in the TCCON N_2O a priori profiles does not affect the TCCON retrievals, as TCCON performs a profile scaling retrieval. In Sect. 5.3, the authors came to this wrong conclusion because they introduced a change in the profile shape when updating the TCCON retrieval.

Second, in Sect. 5.3, we compared the N_2O trend at the surface derived from the flask measurements to the column-averaged N_2O trend from the FTIR measurements. However, we did not take the N_2O mole fraction difference between the surface and column-averaged concentrations into account when comparing their trends in units of ppb yr^{-1}.

Third, in Sect. 2, the full name of SBF in Eq. (1) is symmetrical basis function instead of source brightness fluctuation.

Therefore, the corresponding sentences in the paper must be corrected as follows.

– Abstract

The sentence “The X_{N_2O} trend from the TCCON measurements is slightly lower (0.81 ± 0.04 ppb yr^{-1}) due to the underestimation of the trend in TCCON a priori simulation.” is corrected as follows: “The X_{N_2O} trend derived from the TCCON measurements is 0.81 ± 0.04 ppb yr^{-1}, which is slightly lower than that from NDACC measurements.”

- Section 2 TCCON and NDACC measurements

  with Eq. (1): "a source brightness fluctuation (SBF) correction correction is applied" must read "a symmetrical basis function (SBF) correction is applied".

- Section 5.3 N_2O trends

  The third paragraph in this section is corrected as follows.

  > The X_{N_2O} trend derived from TCCON measurements (apart from Sodankylä and Ny-Ålesund) is 0.81 ± 0.04 (1σ) ppb yr^{-1}, which is slightly smaller compared to the result from NDACC (0.93 ± 0.04 ppb yr^{-1}). The trend of N_2O at the surface from the flask sample measurements is 0.93 ± 0.02 ppb yr^{-1}. To compare the surface trend to the column-averaged trend, the trend derived from the flask measurements must be multiplied by the ratio of X_{N_2O} to the N_2O concentration near the surface at each site. As a result, the column-averaged trend derived from the flask sample measurements is 0.89 ± 0.02 ppb yr^{-1}, which is generally in good agreement with the trend derived from the NDACC measurements but slightly larger than that derived from the TCCON measurements.

- The second and third paragraphs in Sect. 6 Conclusion are rewritten as follows.

  Trends and seasonal cycles of X_{N_2O} derived from TCCON and NDACC measurements and nearby surface flask sample measurements are compared to the GEOS-Chem model a priori and a posteriori simulation. The a posteriori N_2O fluxes are optimized based on surface N_2O measurements within a 4D-Var inversion framework. The X_{N_2O} trends from the GEOS-Chem a posteriori simulation (0.97 ± 0.02 ppb yr^{-1}) are close to those seen in the NDACC (0.93 ± 0.04 ppb yr^{-1}). The X_{N_2O} trend derived from the TCCON measurements of 0.81 ± 0.04 ppb yr^{-1} is slightly lower compared to the trends derived from the NDACC measurements and the flask sample measurements (0.89 ± 0.02 ppb yr^{-1}) after taking the difference between the surface and column-averaged N_2O concentrations into account. The seasonal variations in X_{N_2O} from the GEOS-Chem model simulations are consistent with those from TCCON and NDACC measurements in the Northern Hemisphere but not in the Southern Hemisphere. A discrepancy exists between the surface samplings and the model a posteriori simulation in the Southern Hemisphere, and it is inferred that lack of observations limits the improvement in the N_2O a posteriori fluxes. As NDACC measurements provide N_2O profiles with about three distinct partial columns, the model simulations are compared with NDACC measurements in three vertical ranges (surface–8, 8–17, and 17–50 km). It is found that the discrepancy in the X_{N_2O} seasonal cycle between model simulations and FTIR measurements in the Southern Hemisphere is mainly due to stratospheric effects.

  In summary, the TCCON and NDACC X_{N_2O} measurements are in good agreement, and their differences are within the combined uncertainty. However, due to the averaging kernels, TCCON X_{N_2O} retrievals are strongly affected by a priori profiles, especially with a polar vortex, while NDACC X_{N_2O} retrievals can capture the tropospheric and stratospheric variations in N_2O very well using a fixed a priori profile. Fortunately, the issues of TCCON X_{N_2O} measurements could be solved with an improved a priori profile shape.

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