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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Influence of aerosols and thin cirrus clouds on the GOSAT-observed CO_2: a case study over Tsukuba" *by* O. Uchino et al.

Anonymous Referee #2

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The manuscript of Uchino et al. presents a study of CO2 retrievals from GOSAT over a ground-based validation site in Tsukuba and to study the effect of the aerosol and cirrus treatment of the operational GOSAT algorithm on the accuracy of the retrieved CO2 columns. Specifically, the study uses ground-based CO2 column, vertical profiles of aerosol/cirrus backscatter from a lidar and AERONET observations to show that the current approach of the operational algorithm results in biases of several ppm. Using the measured aerosol and cirrus profiles together with an update of the used solar spectrum reduced the underestimation of the GOSAT retrieval from 2.29% to 0.62%. Finally, it is concluded that a 3-band retrieval approach where the aerosol and cirrus profiles are retrieved should give the best results.

This manuscript deals with an important question on how to accurately retrieve CO2

columns from short-wave infrared measurements in the presence of aerosols and cirrus clouds and approach that is used in this study is interesting.

However, the study is based on a very small dataset and it would also have been beneficial to put the lessons learned into a larger context since it is difficult to draw conclusion on the expected overall improvements on the operational GOSAT retrieval from such a small dataset for a single site. My impression is that the presented study is mostly interesting for retrieval experts and the authors might want to consider if AMT might be a more appropriate journal.

The study concludes that one of the main reasons for the large underestimation in the operational GOSAT retrievals is the use of a 2 band retrieval where only AOT is retrieved and not the profile itself or cirrus clouds. There is a wealth of literature from the OCO team on the 3-band retrieval where the aerosol and cirrus profile is retrieved and the authors might want to consider including at least some of them: Crisp et al., (AMTD, 2011), O'Dell et al., (AMTD, 2011), Boesch et al., (Remote Sensing, 2011), Connor et al., (JGR, 2008), Boesch et al, (JGR, 2006), Crisp et al., (Adv. Space Res., 2004), Kuang et al., (GRL, 2002)

Specific comments:

p. 29885 . . . it is necessary to clarify the global distribution. . . - > to accurate quantify the

p. 29886 . . . by using Toon's solar irradiance database. . . - > include (Toon et al., 1999, personal communication)

p. 29886 To suppress bias error, . . . - > To reduce biases,. . .

p. 29888 Do you have any suggestions why the Tsukuba TCCON FTS has an additional bias. To my knowledge, no such additional factor is needed for any of the other TCCON sites.

p. 29888 Are all GOSAT observations completely spatially collocated with the TCCON

site ?

p. 29889 Is the lidar exactly at the same location as the TCCON instrument?

p. 29889 . . . lidar ratio (extinction to backscatter ratio) to be 50 sr. . . - > which aerosol type is represented by this lidar ratio and would you need to change this according to the type (dust or sulphate)

p. 29894 It might be valuable to have a comparison figure between the Toon and Kurucz solar spectrum

p. 29894 . . . the retrieved aerosol optical thickness was nearly equal to the a priori value. -> the retrieved aerosol optical thickness was similar to the a priori value

p. 29894 The retrieval of aerosol optical depth and surface pressure will critically depend on the accuracy of the forward model. Please discuss if line-mixing and collision induced-absorption included in the calculation of the O2 absorption and if effects from fluorescence or the non-linearity in the interferogramm (Frankenberg et al., 2011) are included which will have an impact on surface pressure and AOD retrievals.

p. 29894 . . . by interpolating in both time and space the Objective Analysis Data of JMA to obtain values for Tsukuba, with the retrieved values. - > what is Objective Analysis Data ?

p. 29894 Section 4.5 (Discussion) includes the final retrieval approach and it might be better to call this section something like 'Improved 3-band retrieval'

p. 29895 These results show that vertical profiles of aerosol species and cirrus clouds must be considered in the retrieval algorithm in order to improve the data quality of the global GOSAT SWIR XCO2when lidar observations are not available. -> How important is the correct type?

p. 29895 The simulated and . . . -> do you mean retrieved ?

p. 29895 We also found that use of Band 3 increased XCO2 by about 2 ppm, but

we have not yet identified the origin of this difference. ->Could this simply be spectroscopy?

p. 29895 The simulated XCO2 results shown in Fig. 10 are satisfactory ->Clarify what you mean by satisfactory. What is the mean difference (or standard deviation) and what is required for meaningful retrievals

p. 29895 . . ., but the aerosol optical thickness thus obtained could be a source of bias in XCO2 for retrievals at sites other than the Tsukuba TCCON site.

->This is a bit confusing and you might want to reformulate this sentence. Of course you only know the performance for one site and you would need to carry out validation for other sites. Using an improved SPRINTARS might further improve the results.

Interactive comment on Atmos. Chem. Phys. Discuss., 11, 29883, 2011.