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Evaluating the performance and added value of full physics retrievals of XCO_2 from GOSAT.

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The JAXA Greenhouse gas Observing Satellite (GOSAT), launched in 2009, is the first operating mission dedicated to measuring CO_2 and CH_4 column-averaged dry air mole fractions (XCO_2 and XCH_4) from space. Onboard GOSAT, the TANSO-FTS instrument acquires near-infrared spectra of sunlight backscattered by the Earth's surface and atmosphere. We have developed a full physics algorithm, called RemoTeC, that simultaneously retrieves XCO_2, XCH_4 as well as three effective aerosol parameters representing particle amount, size and height. This method reduces the uncertainty caused by the modification of lightpath by scatterers [Butz et al., 2009].

In this presentation we evaluate the CO_2 retrieval performance of our algorithm. First, we extend the validation study of Butz et al., 2011. From the comparison with 12 ground-based stations of the Total Carbon Column Observing Network (TCCON) on almost two years of data (April 2009 to April 2011), we find a single-sounding precision of our GOSAT retrievals of 2.8 ppm and an interstation bias of 0.25%. If we consider daily means, the precision is 2.3 ppm on average. Furthermore, we investigate the importance of filtering for (thin) cirrus and evaluate correlation of the GOSAT-TCCON differences with geophysical or instrumental parameters. We do not find any significant correlation of errors on XCO_2 with airmass, scattering optical thickness, blended albedo or signal in the O_2 A-band. There is, however, a small dependence between errors and a combination of retrieved aerosol properties.

We also compare RemoTeC retrievals with non-scattering retrievals, both around TCCON and at the global scale. We find that when strict cloud and cirrus filters are applied to the data, the performance of non-scattering retrievals around TCCON stations is surprisingly good, with a precision of 3 to 3.5 ppm for five of the stations and an interstation bias similar to that of full physics retrievals. However, on the global scale, the errors in non-scattering retrievals appear to be larger and they increase with albedo and scattering optical thickness. As a consequence, satellite validation studies might lead to a too optimistic assessment of retrieval performance, if all validation stations are located in regions of similar ground albedo and aerosol load. We conclude that with respect to its validation purpose, the TCCON can be improved if future site locations are chosen to extend the current range of ground albedo.