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Bias correction of GOSAT SWIR XH_2O using TCCON data

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Water vapor is an extremely important atmospheric constituent to the Earth's climate system which contributes the largest part to the natural greenhouse effect. Its distribution is very high temporally and spatially variable. Accurately measuring and validating water vapor concentration are always in demand.
This study provided a method to reduce systematic biases of column-averaged dry air mole fractions of H_2O (XH_2O) retrieved from the short-wavelength infrared (SWIR) spectra of the Greenhouse gases Observing SATellite (GOSAT), the latest version 02.72 for the period from Jan 2013 to Aug 2017. Data from the Total Carbon Column Observing Network (TCCON, version GGG2014) were used as reference values for the multi-linear regression analysis. Especially bias affected by altitude difference between TCCON sites and GOSAT observation points was adjudged in advance. GOSAT scans acquired in 1 degree x 1 degree rectangular areas centered at each TCCON site were selected. These are compared with the mean values of the TCCON data observed within $\pm$30 minutes of the GOSAT overpass time. There are no coincidences over GOSAT ocean observations. We performed correlation analyses between the GOSAT biases and simultaneously retrieved auxiliary parameters for both land data (land fraction = 100%) and mixture data (a mixture of observations over land and water in the vicinity of coastlines, rivers, and lakes; 60%< land fraction < 100%) separately and then used these correlations to bias correction of the GOSAT data.
The empirically derived bias correction after solving bias affected by altitude difference between TCCON sites and GOSAT observation points showed effective in the GOSAT SWIR XH_2O bias correction. In addition, the XH_2O primarily correlated to the retrieved albedo around 6255 cm-1 and 13200 cm-1 and airmass (a function of the solar zenith angle and the satellite-viewing angle). However, only mixture data correlated to the retrieved AOD around 1.6 μm and temperature while land data correlated highly with surface pressure and altitude of the GOSAT observation point.