Greenhouse gas concentrations retrieved from a combined use of SWIR and TIR observations by the GOSAT series satellites

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The Fourier Transform Spectrometers onboard the GOSAT series satellites have spectral windows in both shortwave infrared (SWIR) and thermal infrared (TIR), which enable us to simultaneously observe the Earth' s surface reflected sunlight and the thermal emission at the exactly same footprint. SWIR spectra have information on the total column amount of carbon dioxide and methane, while TIR spectra are sensitive to these gases mainly in the upper troposphere. Combining these two windows, GOSAT and GOSAT-2 are capable of retrieving concentrations of carbon dioxide and methane in the lower troposphere, which helps the surface flux estimate of these greenhouse gases.

Another unique feature of GOSAT and GOSAT-2 is polarization measurement in the SWIR windows, which can be used to correct undesirable effects of aerosols on the accurate retrieval of the greenhouse gas concentrations. It seems clear that retrievals of greenhouse gas concentrations from the GOSAT series satellites are best performed by the algorithm that uses all the measurements from the FTS sensors.

We have developed an experimental algorithm which can be applied to both GOSAT and GOSAT-2 observations. Our approach is a so-called full physics algorithm, which uses TIR and polarimetric SWIR spectra simultaneously as measurement. Gas concentrations were retrieved as a maximum a posteriori solution. We adopted total 5 layers to represent vertical profiles of carbon dioxide and methane, with 2 layers in the troposphere. Column-averaged concentrations of carbon monoxide were derived from GOSAT-2 observations.

We compared our retrievals with ground truth data as well as other satellite retrievals including OCO-2 and TROPOMI. Preliminary result shows that our GOSAT and GOSAT-2 retrievals are both promising. In this paper we will present some of our recent progress including greenhouse gas concentrations in the north hemisphere permafrost regions and Austrian wildfire regions.

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