Synergistic observations using a wide spectral-coverage FTS and an agile pointing mechanism onboard GOSAT

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Since February 2009, Thermal And Near infrared Sensor for carbon Observation Fourier-Transform Spectrometer (TANSO-FTS) onboard the Greenhouse gases Observing SATellite (GOSAT) has been providing long-term high-resolution radiance spectra of and uniform quality. Among the satellite-borne spectrometers for greenhouse gases (GHG) observations, only GOSAT uses FTS technology to acquire high-resolution spectra. With the FTS multiplex advantage, the single spectrometer with a common field of view can simultaneously cover both two linear polarization of the solar scattered light and thermal emission from the earth's surface and atmosphere. After seven years of operation, most of the level 2 products have still been retrieved only from the scalar solar scattered light spectra. However, there is a strong need to acquire information for at least two vertical-layers (upper and lower atmosphere) to understand GHG dynamics. Theoretically, vertical profiles can be retrieved from thermal infrared spectra using the Levenberg-Marquardt method. The algorithm assumes that the measurements and a priori errors are random; however, actually measured radiance spectra and the forward model show calibration errors and systematic biases, respectively. In addition, in the existing retrievals, many parameter need to be retrieved simultaneously. These errors make retrievals unstable. Therefore, the parameters to be assumed and retrieved need to be reconsidered.
The modification of the light path by the scattering induced by thin clouds and aerosol scatterings, which are highly polarized, is still the largest source of errors and information on their vertical location can minimize the errors in GHG retrievals. The measured light is a combination of surface reflection and scattering by clouds and aerosols, which have different phase functions. Polarization measurement of O_2 A band spectra has potential height information The TANSO-FTS instrument has a ZnSe non-coated beam with an incident angle of 45deg and a large polarization sensitivity. The analysis using vector radiative transfer calculation and an instrument Muller matrix becomes complicated. The polarization of the spectra shows strong dependency on the geometry of the sun, the target object and the satellite. A unique function of TANSO-FTS is agile targeting; the two axes mechanism helps target and view a point source from different geometries by uploading the pointing angle and location tables on a daily basis.
In this study, a simpler but robust algorithm is proposed by minimizing the number of parameters to be retrieved, and optimizing sampling pattern and viewing geometry to minimize the highly geometry-dependent polarization related errors.

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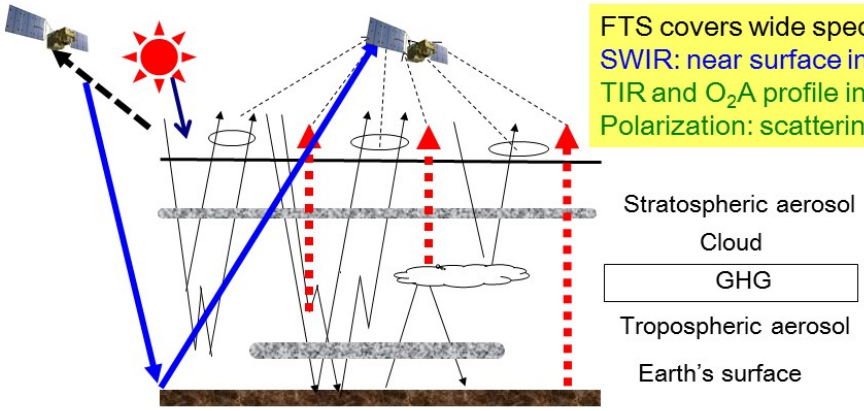

High spectral resolution data of (1) Solar lines (Fraunhofer lines, Fluorescence)
(2) Earth albedo (reflectance and scattering)
(3) Thermal radiation
(4) Two linear polarizations

