Japan Geoscience Union Meeting 2013
(May 19-24 2013 at Makuhari, Chiba, Japan)

ACG37-P03 Room:Convention Hall Time:May 21 18:15-19:30

Observation of vegetation by GOSAT

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The Japanese Greenhouse gases Observing SATellite IBUKI (GOSAT) is the first satellite that is designed specifically to measure greenhouse gases such as carbon dioxide and methane. After the launch in January 2009, GOSAT is operating succesfully for more than 4 years. The main sensor of GOSAT is the Fourier Transform Spectrometer TANSO-FTS, which has 3 bands in the near-infrared and 1 band in the thermal infrared. Among these bands, TANSO-FTS has an observation window in oxygen A band at 0.76 micron to derive column amount of oxygen (equivalently, column amount of dry air or surface pressure), and to correct effects of clouds and aerosols on the retrievals of column amount of greenhouse gases. Recently, Joiner et al. (2011) and Frenkenberg et al. (2011) have shown that absorption lines in oxygen A band measured by TANSO-FTS can be used to detect chlorophyl fluorescence emitted by plants, and that GOSAT will be useful in wider fields of scientific research.

Chlorophyl fluorescence can be as intense as a few percent of TOA radiance at oxygen A band. Neglecting chlorophyl fluorescence could produce bias errors up to 2 ppm in the retrieved column-averaged mol fraction of carbon dioxide (XCO_2), depending on regions and seasons. Regionally or seasonally dependent bias errors in retrieved XCO_2 degrade the accuracy in inverting the amount of emission and absorption of greenhouse gases, which is the scientific goal of the GOSAT project. We are therefore developing an algorithm which is capable of retrieving XCO_2 and chlorophyl fluorescence simultaneously. Left panel of the figure shows 2.5 degree grid monthly averaged intensity of chlorophyl fluorescence in North America. It can be seen that the distribution of chlorophyl fluorescence is closely related to the normalized vegetation index (NDVI) shown in the right panel of the figure, which was derived from observations of TANSO-CAI (Cloud and Aerosol Imager) onboard GOSAT.

In addition to greenhouse gases, GOSAT is acquiring and processing observation data on vegetation such as chlorophyl fluorescence and NDVI. NDVI data are now provided to public users as a standard product of the GOSAT project. Long term observations of this kind of data are expected to be carried out by the GOSAT successor or similar satellites planed in several countries, and would be useful in studies on vegetation models.

Keywords: chlorophyl fluorescence, vegetation index