Geophysical Research Abstracts
Vol. 21, EGU2019-6475, 2019
EGU General Assembly 2019

Spatiotemporal variation of zero-level offset in GOSAT FTS O_2 A-band and consistency of the derived SIF with OCO-2 SIF

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Satellite remote sensing of solar induced chlorophyll fluorescence (SIF) has been used to improve the estimation accuracy of photosynthesis activity of terrestrial vegetation in recent years. Greenhouse gases Observing SATellite (GOSAT) has ability to observe both SIF and concentration of CO_2 and CH_4 and thus is expected to contribute to understanding of the global carbon budget. Correction of instrumental effects is required to retrieve SIF from satellite measurements (zero-level offset caused by non-linearity in the analog circuit in case of GOSAT). Recently, SIF data have been provided by several satellites; therefore, consistency among satellite data is important to exploit those data. However, zero-level offset of GOSAT has been evaluated with spatiotemporal limitations. Agreement in SIF among satellite data has partly been reported, but difficulty due to difference in the observation pattern remains. Here we investigate the criteria for identifying vegetation-free areas to evaluate the zero-level offset and the offset correction method, while comparing the derived SIF with Orbiting Carbon Observatory-2 (OCO-2) SIF at multiple spatial scale (footprint to global). Criteria were determined as small variation in radiance within GOSAT instantaneous field of view for cloudy ocean and higher albedo in 2.0 μm band than in 1.6 μm band for bare soil, which were slightly different from previously used criteria. GOSAT SIF that was most consistent with OCO-2 SIF was obtained when zero-level offset was evaluated from bare soil over the globe, with bias of about 0.1 mW m^{-2} nm^{-1} sr^{-1}. Our results agree with the previous comparisons and support the consistency among the present satellite SIF data. Implication from temporal variation of the zero-level offset for 9 years is restart of radiometric degradation of the GOSAT spectrometer after switching the optics path selector in January 2015.