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An aerosol correction algorithm to improve the GOSAT TANSO-CAI NDVI product

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The Cloud and Aerosol Imager TANSO-CAI (CAI), onboard the Greenhouse gases Observing SATellite (GOSAT), is equipped with 4 spectral bands of 380, 674, 86,0 and 1600 nanometers (Band 1-4). The main purpose of CAI is to assist the Fourier Transform Spectrometer TANSO-FTS in retrieving accurately the column amount of carbon dioxide and methane by detecting and characterizing clouds and aerosols in FTS footprints. CAI is also designed to monitor the variation of global vegetation indices, and the CAI Normalized Difference Vegetation Index (NDVI) product has already been released.

Since GOSAT is orbiting with a three-day recurrence, CAI observes the same location from the same direction once in every three days. Unlike the MODIS NDVI product, this makes it difficult to correct the effects of Bidirectional Reflection Distribution Function (BRDF) on the CAI NDVI product, but it has a potential capability to detect changes in vegetation with shorter time scale. In the current version, the CAI NDVI is calculated from 30 days composite of the minimum reflectance to minimize contamination of clouds and aerosols, and the effect of aerosols is not explicitly corrected. The goal of this study is to develop an aerosol correction algorithm that can be applied to the CAI NDVI.

Due to the relatively limited number of spectral bands of CAI, we take an approach slightly different from so-called the Kaufmann method or the minimum reflectance method in developing our aerosol correction algorithm. Since the number of observables is four, which are TOA reflectance at bands 1-4, the maximum number of retrieved parameters is also four. We choose optical thickness of fine mode aerosols and coarse mode aerosols, surface reflectance at band 3 and band 4 as retrieved parameters. We assumed that surface reflectance at band 1 and band 2 is expressed as a function of surface reflectance at band 3 and band4. The parameterization of band 1 and band 2 surface reflectance is done by utilizing the CAI minimum reflectance product. We do not expect that this parameterization is rigorously valid in pixel-wise. Therefore, we do not determine aerosol optical thickness for every pixel, but for 10x10 pixels (5x5 km in horizontal scale). Moreover, we do not use all TOA reflectance of 10x10=100 pixels, but select the darkest 10 pixels. Then, the number of observables is 40, and the number of retrieved parameters is 22, which can be determined by least-square fitting.

Left panel of the figure shows optical thickness of fine mode aerosol over souse-east part of Australia on October 20th, 2013. Currently, aerosol optical thickness is not retrieved for pixels with TOA reflectance greater than 0.2 at band 4. Right panel of the figure demonstrates the effect of aerosols on NDVI by comparing NDVI with and without aerosol correction. We can see that the frequency distribution of NDVI is shifted by about 0.1 as a result of aerosol correction, which is consistent with the result of Vermote et al. (2002).

Keywords: vegetation index, retrieval method, GOSAT