Evaluation of feasibility of continental vegetation monitoring using Himawari-8.

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A new generation geostationary meteorological satellite, Himawari-8, began operation in July 2015. Due to newly attached multiple bands in the visible and near infrared wavelength ranges and improved observation frequency of onboard sensor, AHI (Advanced Himawari Imager), application to terrestrial monitoring is expected.
Himawari-8/AHI data are provided as the radiance or the reflectance at the top of atmosphere (TOA) level. In order to monitor terrestrial vegetation, conversion to surface reflectance (TOC: Top of canopy reflectance) is necessary. However, the methods to estimate and verify TOC reflectance of Himawari-8/AHI data has not yet been established. Furthermore, the TOC reflectance data of Himawari-8/AHI requires careful interpretation due to observational geometric conditions unique to geostationary orbit.
In order to understand the feature of the TOC reflectance and the normalized index by Himawari-8/AHI data and to evaluate the usefulness for terrestrial vegetation monitoring, first, we estimated the TOC reflectance from Himawari-8/AHI data with 6SV. The estimated TOC reflectance from Himawari-8/AHI was further evaluated using independent observations such as Terra, Aqua MODIS data and ground observations (HemiSpherical Spectro-Radiometer (HSSR) at Phenological Eyes Network (PEN) sites).
We compared the Himawari-8 TOA/TOC reflectances with the MODIS TOA/TOC reflectances from Terra and Aqua. In particular, in the shorter wavelengths such as blue and green, the R^2 was greatly improved by atmospheric correction. Furthermore, if we selected data only with similar illumination and geometric condition of AHI and MODIS, both TOC reflectances were very close to each other in all wavelength bands. Then, we checked the monthly variation in the TOC reflectances of AHI, MODIS, and HSSR. We found that the three TOC reflectances are similar in the first half of the year (spring and summer). However, after summer, the TOC reflectances of AHI were higher than those of MODIS and HSSR. It can be explained by the dominant backward scattering component in AHI in Japan. In particular, the difference in intensity between the backward scattering and the forward scattering increases toward winter seasons. Meanwhile normalized index such as NDVI could effectively reduce the anisotropic effect on the TOC reflectance and it can capture vegetation phenology similar to MODIS. As a result of cross-validation, Himawri-8 TOC reflectance estimated in this study was generally consistent with other data. However it is necessary to consider the observation conditions of the Himawari-8 TOC reflectance. In the next step, we will demonstrate how the high temporal resolution of Himawari-8 improve our understandings of terrestrial vegetation dynamics.

Keywords: Himawari-8, atmospheric correction, PEN, MODIS, vegetation monitoring, 6SV

