Observing vegetation seasonal dynamics in Japan with Himawari-8 hypertemporal data

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Spectral vegetation index (VI) time series data derived from moderate resolution, polar-orbiting satellite sensors, have been used to monitor and characterize the Earth’ s vegetative cover and its dynamics in regional to global scales. Unities of these VI time series data are, however, constrained by frequent cloud covers. That is, the derived VI products from these sensor data are at a weekly or bi-weekly temporal resolution due to the availability of cloud-free observations, resulting in relatively high uncertainties in their seasonal dynamics characterization. A new generation of geostationary satellite sensors equipped with spectral bands suitable for VIs, such as Himawari-8/9, have been launched during the last decade. As they are on geostationary orbit, they can image an Earth’ s hemisphere at 10-15 min intervals, potentially serving as another significant data source for the studies of vegetation dynamics.

In this study, we assessed the utilities of Himawari-8 “hypertemporal” NDVI data for characterizing seasonal dynamics of vegetation and land cover conditions. We compared Himawari NDVI temporal signatures to those derived from a new generation polar-orbiting satellite sensor, Visible Infrared Imaging Radiometer Suite (VIIRS), at select sites in Japan. Our analysis showed that cloud-free observations were available for ~24 days during the 45-day green-up period with Himawari, but ~12 days with VIIRS. In other words, the number of days with cloud-free observations could double with Himawari data compared to VIIRS data. These results indicate the potential of Himawari data for providing higher temporal resolution NDVI time series data and, thus, improved monitoring and characterization of vegetation dynamics in Japan compared to the current polar-orbiting satellite data. One potential drawback would be the fixed view zenith and azimuth angles which might become problematic when one is interested in analyzing vegetation dynamics across space. Validation of Himawari-observed NDVI temporal profiles with ground observational NDVI and carbon flux data will be one required step.

Keywords: Himawari, geostationary satellite, vegetation phenology, land surface phenology, NDVI

