Analysis of the spatial variations in the phenology of deciduous broadleaf forests in Japan with Himawari-8 NDVI hyper-temporal signatures

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A new generation of geostationary satellite sensors, including Himawari-8 Advanced Himawari Imager (AHI), have been launched during the last decade. These sensors are equipped with a red and near-infrared bands and can image an Earth’ s hemisphere at 10 min intervals, providing the potential to generate high-temporal resolution vegetation index (VI) time series data even in cloud-prone areas and seasons. In this study, we assessed how AHI NDVI “hyper-temporal” signatures varied for deciduous broadleaf forests (DBFs) along a temperature, elevation, and latitudinal gradients in Japan. AHI 10-min data of Japan were obtained for a three-year period of 2016-2018 and reduced into daily NDVI time series. The warmth index (WI) and coldness index (CI), temperature-driven indices, were also obtained from mean monthly temperature. A land cover map derived from ALOS data was used to identify DBF areas along the transects. AHI NDVI hyper-temporal signatures, consisting of a large number of observations, had one growth cycle/season per year, but were different along temperature, elevation, and latitudinal gradients. The start of growth season (SGS) metric derived from AHI NDVI was positively, but weakly correlated with the latitude (r = .47) and elevation (r = .47). In contrast, the AHI NDVI-derived end of growth season (EGS) metric significantly correlated to the latitude (r = .73), but not to the elevation (r = .07). The highest correlations were obtained with the temperature-derived WI and CI for these metrices (r = .86 between the SGS and WI, and r = .75 between the EGS and CI). These results indicate that Himawari-8 hyper-temporal data were useful for regional-scale analysis of vegetation growing season.

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