Development of a novel data fusion model to generate high spatiotemporal resolution NDVI time series

*Wei Yang[1], Jin Chen[2]

1. Chiba University, 2. Beijing Normal University

Normalized Difference Vegetation Index (NDVI) is one of the most commonly used vegetation indices for monitoring ecosystem dynamics and modeling biosphere processes. However, global NDVI products are usually provided with relatively coarse spatial resolutions that lack important spatial details. Producing NDVI time-series data with high spatiotemporal resolution is indispensable for monitoring land surfaces and ecosystem changes, especially in spatiotemporally heterogeneous areas. We therefore proposed an Improved Flexible Spatiotemporal DAta Fusion (IFSDAF) method to fill this need. In accord with the distinctive characteristics of NDVIs with large data variance and high spatial autocorrelation compared with raw reflectance bands, the IFSDAF method first produces a time-dependent increment with linear unmixing and a space-dependent increment via thin plate spline interpolation. It then makes a final prediction by optimal integration of these two increments with the constrained least squares method. Moreover, the IFSDAF was developed with the capacity to use all available finer-scaled images, including those partly contaminated by clouds. NDVI images with coarse spatial resolution (MODIS) and fine spatial resolution (Landsat and Sentinel) in areas with great spatial heterogeneity and significant land cover changes were used to test the performance of the IFSDAF method. The root mean square error and relative root mean square error of predicted relative to observed results were 0.0884 and 22.12%, respectively, in 3 heterogeneous areas, and 0.0546 and 25.77%, respectively, in areas of land-cover change. These promising results demonstrated the strength and robustness of the IFSDAF method in providing reliable NDVI datasets with high spatial and temporal resolution to support research on land surface processes. The efficiency of the proposed IFSDAF method can be greatly improved by using only the space-dependent increment. This simplification will make IFSDAF a feasible method for monitoring global vegetation.

Keywords: Spatiotemporal data fusion, High spatial and temporal resolution, Weighted integration