Comparison of five smoothing methods for noise removal in MODIS LAI time series data

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Time series remotely sensed satellite data plays an important role in understanding the dynamics of the climate change. These datasets are not continuous and consistent over space and time. Sensor degradation and atmospheric disturbances often introduce noise in the spectral signature retrieval by such satellites. This noise needs to be corrected to understand the underlying dominant pattern. Moderate resolution imaging spectroradiometer (MODIS) Terra/Aqua Leaf Area Index (LAI) time series data, which tells the underlying photosynthetically active foliage is particularly popular among the researchers considering its high temporal resolution (1 / 2 daily) and fairly good spatial resolution (250m). MOD15A2H LAI/FPAR MODIS product is used in this study to compare five smoothing methods for noise removal: Savitzky Golay (SG), Double Logistic (DL), Local Polynomial Regression (LOESS), Asymmetric Gaussian (AG) and STL (Seasonal Trend Decomposition by Locally weighted regression smoother in TIMESAT). MODIS data is provided with the pixel level retrieval quality information. These methods are evaluated using R and TIMESAT assimilating the pixel level quality information. We use Maharashtra state of India as our study area and compare the results based on land use type such as forests, agriculture, grasslands and savannas. We evaluate the performances of these methods based on Root Mean Squared Error (RMSE) and roughness of the LAI time series. The use of pixel level quality information plays an important role in terms of accuracy of smoothing. Although the result does not confirm any outperforming method for smoothing the time series, filtering with SG with use of quality pixels stands out well among other methods in terms of RMSE and roughness. The SG shows RMSE from 0.002 to 0.6 under different filter settings without using quality information, while the use of quality information gives RMSE of 0.26 and is comparatively smoother. LOESS method in R gives high smoothing but it fails to capture the minute variations in the time series. Our contribution will benefit the researchers in terms of pre-processing of the time series data.

Keywords: Time Series, Noise Removal, MODIS, TIMESAT

