Geophysical Research Abstracts
Vol. 19, EGU2017-10162, 2017
EGU General Assembly 2017

Use of Green-Red Normalized Difference (GRND) index to evaluate large-scale canopy phenology in tropical forests

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Canopy phenology is a vital indicator of environmental controls on species and ecosystems. However, tropical phenology remains one of the most challenging components to parameterize in ecosystem models. Recent studies have shown that certain components of phenology (e.g. leaf flushing or leaf abscission) respond in different regions of the spectra, allowing us to observe phenology using remote sensing (RS) data. As RS is one the most used data to describe environmental conditions in ecosystem models, a comprehensive understanding of the spectral intervals responsible for the signal to describe phenological patterns in the tropics is needed. Here, we explore the potential use of Green-Red Normalized Difference (GRND = 563 nm – 661 nm / 563 nm + 661 nm) index to describe spatial variability of canopy phenology across the Amazon forest. We used time-series observations from Moderate Resolution Imaging Spectroradiometer (MODIS) atmospherically corrected using the Multi-Angle Implementation of Atmospheric Correction Algorithm (MAIAC) to derive GRND. Two others vegetation index were determined for comparison: Enhanced Vegetation Index (EVI) and Normalized Difference Vegetation Index (NDVI). We used time-series observations (2003-2013) and plotted biweekly long-term mean of MODIS GRND, EVI and NDVI. The results showed that the GRND and EVI were more sensitive to phenology components of leaves than the NDVI because of the respective changes in green and NIR reflectance. Changes of visible radiation are largely driven by leaf pigment concentrations, which, in turn, are closely linked to leaf age. Consequently, leaf demography is an important driver of photosynthetic potential. We suggest that the patterns observed of GRND was related with leaf flushing spectral response, while EVI was more related to changes in leaf area index (LAI). These variations may be missed when only observing reflectance sensitivity to changes in LAI. New remote sensing approaches will further enable us to access spectral response of phenology components, and contribute for a better understand of phenological patterns in tropical forests.