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Comparison of Amazon and Central Africa tropical vegetation dynamics using SEVIRI data from 2009 to 2011

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Tropical forests play a crucial role in determining global exchanges of energy, momentum, water, CO_2 and other greenhouse gases between the land surface and the atmosphere. Quantifying the areal extent, spatial distribution and vegetation status of tropical forests and their dynamics are essential for studies of climate, carbon cycle and biodiversity. Satellite remote sensing has been an indispensable tool to monitor tropical forests. However, frequent and extensive cloud presence makes mapping and monitoring tropical evergreen forests a challenging task. MODIS and AVHRR vegetation products are spatially and temporally discontinuous and inconsistent or very noisy over many pixels in tropical rainforests. The famous debate about the Amazon forest "green-up" during 2005 dry season drought is an excellent example attributed at least partly to the satellite data quality.

Observations from the Spinning Enhanced Visible and Infra-red Imager (SEVIRI), onboard the European Meteosat Second Generation (MSG) satellite, are used in this study to monitor tropical vegetation dynamics. The SEVIRI data used contain observations of land surface at 30-minute time intervals for the year 2009 to 2011. We used top of atmosphere (TOA) reflectance values from the spectral bands of red (0.635um), near-infrared (NIR, 0.81um) and shortwave infrared (SWIR, 1.64 um) and other satellite geometry information to calculate normalized difference vegetation index (NDVI) and land surface water index (LSWI). We generated daily, weekly and monthly NDVI and LSWI based on maximum NDVIs.

We examined the pattern of cloud occurrence, precipitation and the seasonality of green vegetation (evergreen forests and savannas) in Amazon and Central Africa. During wet season, Amazon has much less chance to get clear-sky observations than Central Africa. However, during dry season, Amazon and Central Africa have as many as clear-sky observations as other regions. Among different vegetation types, the seasonal cycle of NDVI is similar to that of LSWI, i.e. high NDVI corresponds to high LSWI, in both regions. In Central Africa, the NDVI and LSWI values differ distinctly from wet season to dry season and follow the seasonality of local precipitation for both evergreen forests and savannas. In Amazon, similar seasonal variations of NDVI/LSWI are seen for savannas but forests exhibit an opposite seasonal cycle against rainfall. In addition, the seasonality of LSWI is significantly smaller than that of NDVI. Interestingly, during the 2010 Amazon dry season drought, both NDVI and LSWI show a large decrease, but with a much larger magnitude in the latter, indicating a stronger sensitivity of LSWI to drought.