Geophysical Research Abstracts
Vol. 13, EGU2011-7859, 2011
EGU General Assembly 2011

Leaf life-cycles and their impact on our interpretation of EO-derived vegetation indices of Amazonian Forests

Cecilia Chavana-Bryant (1), France Gerard (2), and Yadvinder Malhi (3)

(1) University of Oxford / CEH Wallingford, United Kingdom (cecilia.chavana-bryant@ouce.ox.ac.uk), (2) Centre for Ecology & Hydrology (CEH), Wallingford, United Kingdom (ffg@ceh.ac.uk), (3) University of Oxford, Oxford, United Kingdom (yadvinder.malhi@ouce.ox.ac.uk)

The phenological dynamics of terrestrial ecosystems reflect the response of the Earth's biosphere to inter- and intra-annual dynamics of the Earth's climatic and hydrological regimes (Myneni 1997, Nature). Some Dynamic Global Vegetation Models (GDVMs) have recently predicted that by 2050 the Amazon rainforest will begin to dieback (Cox et al. 2000, Nature) or that the ecosystem will become unsustainable (Salazar et al. 2007, Geophysical Research Letters). One of the major components in DGVMs is the simulation of vegetation phenology, however modellers are challenged with the estimation of tropical phenology which is highly complex. Current modeled phenology is based on observations of vegetation in the temperate zones and accurate representation of phenology of the tropical zones is long overdue.

Drought events have been linked to variations in vegetation greenness (Saleska et al. 2007, Science; Samanta et al. 2010, Geophysical Research Letters) and some of these studies have been interpreted as evidence of resilience of tropical rainforests to seasonal and interannual drought. The studies have been entirely satellite-based however, where "greenness" is expressed through vegetation indices (VIs) or Leaf Area Index (LAI) estimates, and thus far there has been little corroboration with on-the-ground observations of the phenology of tropical forests.

We suspect that leaves vary in their spectral reflectance properties as they age, and where their life cycle is strongly synchronised it is likely to be linked to the seasonal variation in climate and/or hydrology. Hence, there is a distinct possibility that the seasonal variation in vegetation indices is driven by the leaf aging as well as by the shedding or appearance of new leaves. Here we present the first field based results of a study investigating the influence that age related variation in the spectral reflectance properties of leaves may have on apparent "greenness" of a tropical forest canopy. These data was acquired during the 3-month-long dry season experienced at a tropical forest site in French Guyana. Around 6,000 reflectance measurements of individual leaves of different ages, sampled vertically (top, mid and low canopy) from 8 different canopy tree species, were collected with an ASD FieldSpec Pro spectroradiometer. These leaf reflectance measurements were complemented by top-of-canopy reflectance measurements obtained using a multispectral radiometer; leaf morphological measurements (leaf wet and dry weight, area and thickness); leaf demography (total number and age distribution) of two 1m branches from each canopy level from which leaves were harvested; forest structural measurements (tree height, DBH, canopy width and extent for a 1 acre plot); and LAI and meteorological data.

Preliminary results show (1) leaf spectral properties related to leaf age and (2) which changes in the leaves observed during their life cycle cause the most significant changes in the leaves' spectrum. Future work will involve expansion of the field work to Peru; leaf chemical analysis; incorporation of the field observations into a light canopy interaction model (North 1996, IEEE Transactions on Geoscience and Remote Sensing) to generate whole canopy vegetation indices, and establish which changes in leaf and canopy properties cause the most significant changes in the VIs; comparison of in situ leaf life cycle and LAI observation with variation in remotely sensed VIs; evaluation of modelled time-series of VIs against the remotely sensed VIs and; re-interpretation of the observed seasonal and spatial variations in VI for the wider Amazon region.