Dry season leaf flush in a Central Amazon *terra firme* forest via optical method

Marostica, S.F.[1]; Nelson, B.W.[1]; Wu, J.[2] & Saleska, S.R.[2]

[1]*National Institute for Amazon Research (INPA), Manaus, Brazil*
[2]*Ecology & Evolutionary Biology, University of Arizona, Tucson, U.S.A.*

Background

Climate change, climate anomalies, extreme events -- what is the Amazon's future? Green-up detection in Modis images during the 2005 drought (Saleska *et al*., 2007) is confounded by cloud/aerosol contamination (Samanta *et al*., 2010), while dry-season green-up of the Central Amazon in years of normal rainfall (Huete *et al*., 2006) may be an artifact of seasonal BRDF effects (Galvão *et al*., 2011). In-situ studies of canopy leaf phenology may resolve these issues…

Material and Methods

Data Acquisistion System

- 3-band RGB video camera* aimed perpendicular to solar transit, oblique downward view from 54 m above ground on eddy flux tower 60 km north of Manaus;
- Auto-exposure turned on, auto color balance turned off;
- Images captured in 10 second intervals..

Data set

- One frame selected per day (23 Sept, 2010 to 03 Feb, 2011) with ~ fixed scene brightness (~ fixed PAR) under diffuse solar illumination near local noon.

Analysis

1) Visual classification of transition types for all trees that underwent marked full-crown changes;

2) Relative green channel brightness average over the entire frame (Richardson *et al*., 2007);

$$Mean\,Green\,Fraction = \frac{\sum_{1}^{n}\left(Green\,channel\,DN \Big/ \sum RGB\,DN\right)}{n\,pixels\,per\,frame}$$

3) Principal Component Analysis of the entire frame to remove spatial variations in illumination and estimate area of exposed bark.

$$Bare\,Wood\,Fraction = \frac{wood\ \ pixels\ from\,PC2}{n\,pixels\,per\,frame}$$

To avoid artifacts, we also examined the influence of incident PAR on indicators 2 and 3 above.

Results

- Of eleven trees that underwent full-crown transitions in the first month, nine were experiencing some stage of leaf flush (Fig.1);
- Mean Green Fraction graph (Fig.2a) suggests the flush of new leaves was already underway at the beginning of the study and continued at least into October, when leaf maturation caused changes in leaf colors, limiting the usefulness of this indicator. The area of exposed bark decreased steeply during the mid-dry season leaf flush and declined at a slower pace into the rainy season (Fig2b).

*Stardot Netcam XL 3MP RGB bands (1024x768 native resolution) with zoom lens LEN-MV4510CS set to wide angle, following PhenoCam network specifications

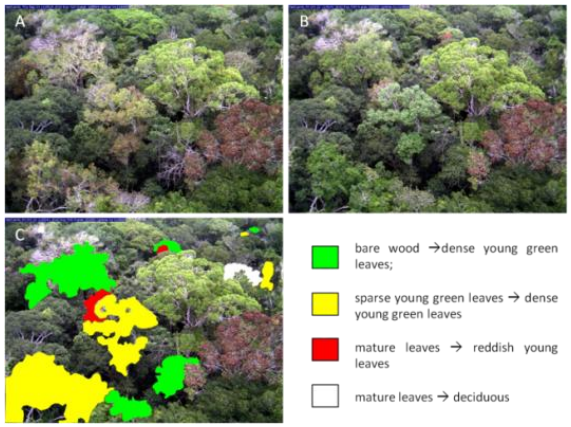

Fig.1: Visual classification of crown transition types over first 30 days (peak of dry season)

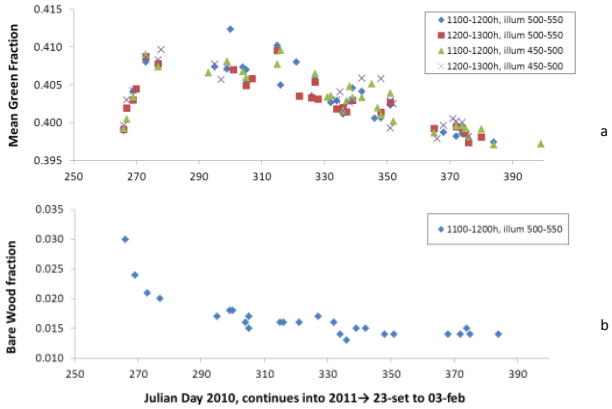

Fig.2: a) Mean Green Fraction over time; b) Bare Wood Fraction over time.

Inferences

As the next step we will attempt to link camera-based vegetation greenness/woodiness with environmental variables, to better understand what controls leaf phenology in the Central Amazon.

References

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Access in real time to images from Amazon Forest in Manaus:

http://lba.inpa.gov.br/lba/?p=camerak34&t=0