Geophysical Research Abstracts
Vol. 18, EGU2016-18224-1, 2016
EGU General Assembly 2016
© Author(s) 2016. CC Attribution 3.0 License.

Leaf aging of Amazonian canopy trees as revealed by spectral and physiochemical measurements

Cecilia Chavana-Bryant (1), Yadvinder Malhi (2), Jin Wu (3), Gregory P. Asner (4), Athanasios Anastasiou (5), Brian J. Enquist (6), Eric G. Cosio Caravasi (7), Christopher E. Doughty (8), Scott R. Saleska (9), Roberta E. Martin (10), and France F. Gerard (11)

(1) Environmental Change Institute, School of Geography and the Environment, University of Oxford, Oxford, United Kingdom, (2) Environmental Change Institute, School of Geography and the Environment, University of Oxford, Oxford, United Kingdom, (3) Department of Ecology and Evolutionary Biology, University of Arizona, Tucson, USA, (4) Department of Global Ecology, Carnegie Institution for Science, Stanford, USA, (5) College of Medicine, Swansea University, Swansea, UK, (6) Department of Ecology and Evolutionary Biology, University of Arizona, Tucson, USA, (7) Sección Química, Pontificia Universidad Católica del Perú (PUCP), Lima, Peru, (8) Environmental Change Institute, School of Geography and the Environment, University of Oxford, Oxford, United Kingdom, (9) Department of Ecology and Evolutionary Biology, University of Arizona, Tucson, USA, (10) Department of Global Ecology, Carnegie Institution for Science, Stanford, USA, (11) Centre for Ecology and Hydrology, Wallingford, UK

Leaf aging is a fundamental driver of changes in leaf traits, thereby, regulating ecosystem processes and remotely-sensed canopy dynamics. We explore leaf reflectance as a tool to monitor leaf age and develop a spectra-based partial least squares regression (PLSR) model to predict age using data from a phenological study of 1,099 leaves from 12 lowland Amazonian canopy trees in southern Peru.

Results demonstrated monotonic decreases in leaf water (LWC) and phosphorous content (Pmass) and increase in leaf mass per area (LMA) with age across trees; leaf nitrogen (Nmass) and carbon content (Cmass) showed monotonic but tree-specific age responses. We observed large age-related variation in leaf spectra across trees. A spectra-based model was more accurate in predicting leaf age (R2= 0.86 and percent root mean square error %RMSE= 33) compared to trait-based models using single (R2=0.07 to 0.73; %RMSE=7 to 38) and multiple predictors (R2=0.76; %RMSE=28). Spectra and trait-based models established a physiochemical basis for the spectral age model. Vegetation indices (VIs) including the normalised difference vegetation index (NDVI), enhanced vegetation index 2 (EVI2), normalised difference water index (NDWI) and photosynthetic reflectance index (PRI) were all age-dependent.

This study highlights the importance of leaf age as a mediator of leaf traits, provides evidence of age-related leaf reflectance changes that have important impacts on VIs used to monitor canopy dynamics and productivity and proposes a new approach to predicting and monitoring leaf age with important implications for remote sensing.