Simulating Spectral Heterogeneity In Tropical Forest Canopy Reflectance With 3d Radiative Transfer Modeling
Dav Ebengo Mwampongo, Florian de Boissieu, Claudia Lavalley, Grégoire Vincent, Chrisitane Weber, Jean-Baptiste Feret

To cite this version:

HAL Id: hal-02445433
https://hal.umontpellier.fr/hal-02445433
Submitted on 20 Jan 2020

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers. L’archive ouverte pluridisciplinaire HAL, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d’enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.
Simulating spectral heterogeneity in tropical forest canopy reflectance with 3D radiative transfer modeling

Dav M. Ebengo (1), Florian de Boissieu (1), Claudia Lavalley (1), Grégoire Vincent (2), Christiane Weber (1) and Jean-Baptiste Féret (1)

(1) TETIS, Irstea, AgroParisTech, CIRAD, CNRS, Université de Montpellier, Montpellier, France; dav.ebengo@teledetection.fr
(2) AMAP, IRD, CIRAD, INRA, CNRS, Université Montpellier, Montpellier, France

Introduction

- Biodiversity monitoring needed to mitigate the erosion of biodiversity → Remote sensing can provide information for such task
- Spectral Variation Hypothesis (Palmer et al. 2002): potential for biodiversity mapping in tropical forests using spectral info (Féret & Asner 2014)
- Operational applications need validation of experimental results and identification of potential and limitations of existing and future satellite missions
- Physical modeling allows better understanding of how to link remote sensing data with vegetation properties

How to represent complex concept such as biodiversity with 3D physical modeling?

Objective

- Test two representations aiming at simulating spectral heterogeneity by taking into account horizontal variability in leaf optical properties (LOPs):  
  - ITC approach: LOPs identical for all pixels within an Individual Tree Crown (ITC)
  - Pixel approach: LOPs vary among pixels within ITC, based on estimates of pigments

Study area & Experimental data

- Experimental site (200 x 200 m) located in the North of French Guiana (Paracou)
- Airborne imaging spectroscopy: measured spectral heterogeneity
- LiDAR data (TLS and ALS): accurate definition of 3D structure, including wood and leaves
- ITCs delineation, species inventories and LOPs measured from field spectrometer

Methods

- Reconstruction of 3D forest structure from ALS and TLS using AMAPVox
- ITC approach: LOPs measured from an identified ITC with field spectroscopy applied to all pixels of this ITC
- Pixel approach: Estimation of leaf pigments (Chlorophylls – Cab, Carotenoids – Cxc, Anthocyanins) using spectral indices (Gitelson et al. 2006)
  - Adjustment of a statistical model between spectral indices and leaf pigment content using DART simulation
  - Application of the statistical model on each pixel of experimental airborne imaging spectroscopy
- Compare spectral dissimilarity among and within a selection of species for each approach, using spectral angle

Assessment of spectral dissimilarity

- Relation of spectral dissimilarity between measured data and ITC approach
- Spectral dissimilarity within: E. sagotiana: blue, V. Americana: orange and among E. sagotiana and V. Americana: green
- Relation of spectral dissimilarity between measured data and pixel approach

Conclusion & perspectives

- Two ways of integrating variability in LOPs in 3D RTM have been tested for the simulation of spectral heterogeneity
- Pixel approach outperforms ITC approach: need of many samples (ITCs delineation) for validation
- Need to test other metrics for spectral dissimilarity

References