Improving leaf area index (LAI) estimation by integrating forest inventory and remote sensing

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A comparison of 'bottom-up' LAI versus 'top-down' LAI

Introduction

- **LAI is the total one-sided leaf surface area per unit ground area (m^2/m^2).**
- **Key variable in ecosystem models and climate research (Running et al., 1986).**
- **Bottom-up: Uses ground-based data (allometric functions).**
- **Top-down: Derived from satellite reflectance data (MODIS, Sentinel).**

Method

- **'Bottom-up' LAI: Based on allometric equations (Gspaltl & Sterba, 2011)**
- **MODIS LAI: Radiative transfer model and NDVI-based backup algorithm (Running et al., 2021)**
- **Sentinel LAI: Neural network trained on top-of-canopy reflectance (TOC) and PROBA-V products (Baret and Weiss, 2018: Swinnen et al., 2023) .**

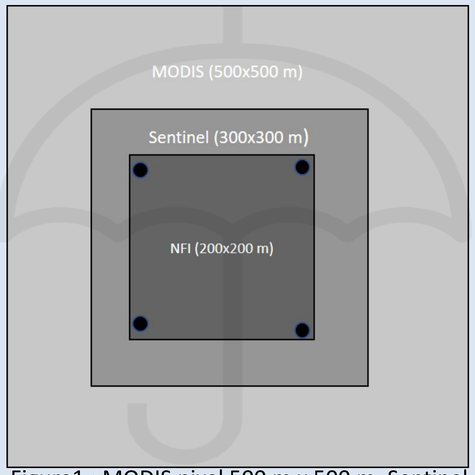

Figure1 : MODIS pixel 500 m x 500 m ,Sentinel pixel 300 m x 300 m and National Forest Inventory (NFI) cluster plot 200 m x 200m

Results

- **Satellite LAI tends to be overestimated in open stands.**
- **Inventory LAI shows higher variability due to local heterogeneity.**

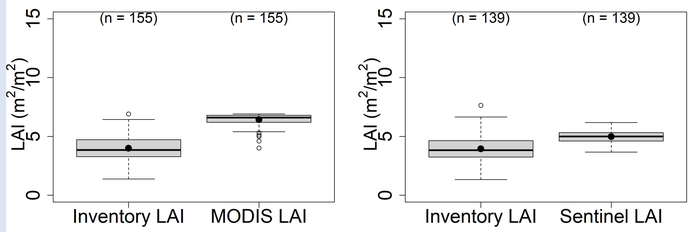

Figure 2 : Mean LAI derived from terrestrial National Forest Inventory data (Inventory LAI, MODIS (MODIS LAI), and Sentinel (Sentinel LAI)

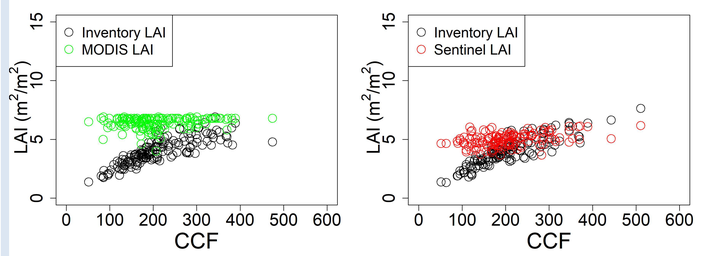

Figure 3 : Scatter plot showing the NFI cluster average LAI versus CCF (crown competition factor), coloured according to different methods (Inventory LAI, MODIS LAI, and Sentinel LAI)

Conclusion

- **Satellite LAI must be corrected for stand density (CCF), especially when CCF < 250.**
- **The developed correction model improves the consistency and accuracy of remote sensing products**

Sharing is encouraged

Publication Link

Abstract

LinkenIn

References