Explore the structural diversity of forest edges using spaceborne lidar

Mengxi Wang[1,2]; Kim Calders[2]; Hans Verbeeck[2]; Frieke Van Coillie[1]; Pieter De Frenne[3]; Camille Meeussen[3]; John Armston[4]; Atticus Stovall[4,5]

[1]Remote Sensing & Spatial Analysis laboratory, Department of Environment, Faculty of Bioscience Engineering, Ghent University, Belgium;

[2]Computational & Applied Vegetation Ecology Laboratory, Department of Environment, Faculty of Bioscience Engineering, Ghent University, Belgium;

[3] Forest & Nature Lab, Department of Environment, Faculty of Bioscience Engineering, Ghent University

[4]Department of Geographical Sciences, University of Maryland, College Park, MD, USA

[5]Biospheric [5]Biospheric Sciences Laboratory, NASA Goddard Space Flight Center, Greenbelt, MD, USA

1. Introduction

Forest edges represent approximately 20% of the global forested area, and the total area of forest edges continues to increase due to forest fragmentation (Haddad et al., 2015). Forest edges have different communities than forest interiors and provide suitable habitats for a variety of animals (Honnay et al., 2002). Forest edges and the forest core are structurally different, yet there is relatively limited description of forest edge structural variation and its drivers, especially at large spatial scales (Meeussen et al., 2020). Quantifying structural variation using traditional inventory techniques, such as measuring the variation of tree height and canopy cover, are laborious, time consuming and hard to scale up to larger areas. Meeussen et al. (2020) used terrestrial laser scanning (TLS) to study structural variation of forest edges across Europe, this was the first study on forest edge structure at the continental scale. Representative sampling of forest edges across forest types and regions using TLS alone remains a challenge, therefore extending the sampling of forest edge types and locations could improve our knowledge on forest edge structure. NASA's Global Ecosystem Dynamics Investigation (GEDI) is designed for the measurement of forest structure and has the potential to address this challenge (e.g., Spracklen, B., 2021). GEDI produces high resolution laser ranging observations of the vertical structure of the Earth tropical and temperate forests, with elevation and height metrics available from the GEDI L2A data product and canopy cover and vertical profile metrics from the GEDI L2B data product (Dubayah et al., 2020).

2. Objectives

In this work, we investigate structural variation of forest edges in different regions of Europe, determining whether this variation is related to different regions and how structure changes from the forest edge to the forest core. We use 60 edge-to-core transects that are distributed across 9 different countries and regions in Europe. They were designed along latitudinal, elevational and management gradients across Europe and TLS data was collected in each transect in 2018. We used a RIEGL VZ-400 instrument (see Figure 1 for a cross-section through two transects). In these 60 transects, 36 of them are covered by GEDI. We calculated GEDI-

Published in: Markus Hollaus, Norbert Pfeifer (Eds.): Proceedings of the SilviLaser Conference 2021, Vienna, Austria, 28–30 September 2021.
Technische Universität Wien, 2021. DOI: 10.34726/wim.1861
This paper was peer-reviewed. DOI of this paper: 10.34726/wim.1939

related structural metrics such as plant area index (PAI), fraction of vegetation cover (FVC) and foliage height diversity (FHD). We will subsequently use our detailed TLS data to validate equivalent metrics derived from GEDI data. Our results will show the potential of exploring the structural variation of forest edges from space, and highlights the potential of monitoring structural diversity gradients at a continental scale.

Figure 1: Cross section through the TLS data of two edge-to-core transects (approx. 100 m) in Belgium. The top transect illustrates a more open forest, the bottom transect represents a rather dense forest.

Acknowledgements

Mengxi Wang was funded by the Chinese Scholarship Council (CSC) personal programme. We thank Tom Verhelst and Barbara D'hont for their help with TLS fieldwork. PDF and CV received funding from the European Research Council (ERC) under the European Union's Horizon 2020 research and innovation programme (ERC Starting Grant FORMICA 757833).

Reference

Dubayah, R. O., Blair, J. B., Goetz, S. J., Fatoyinbo, L., Hansen, M., Healey, S., Hofton, M., Hurtt, G., Kellner, J., Luthcke, S., Armston, J., Tang, H., Duncanson, L., Hancock, S., Jantz, P., Marselis, S., Patterson, P. L., Qi, W., & Silva, C. (2020). The Global Ecosystem Dynamics Investigation: High-resolution laser ranging of the Earth's forests and topography. Egyptian Journal of Remote Sensing and Space Sciences, 1, 100002.

Haddad, N.M. et al. (2015). Habitat fragmentation and its lasting impact on Earth's ecosystems. *Sci. Adv.* 1, e1500052.

Honnay, O. et al. (2002). Permeability of ancient forest edges for weedy plant species invasion. *For. Ecol. Manage.* 161, 109–122

Meeussen, C. et al. (2020) Structural variation of forest edges across Europe. *For. Ecol. Manage.* 462, 117929.
Spracklen, B. (2021) Determination of Structural Characteristics of Old-Growth Forest in Ukraine Using Spaceborne Lidar. *Remote Sens.* 2021, 13(7), 1233