Characterizing old-growth forests from multisource remote sensing

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Introduction

- Old-growth forest is the ultimate stand development stage with the most complex structure, which benefits the biodiversity as the different ecological niches are allowed to be assembled.
- Commonly, old-growth forests are characterized by the complexity and diversity of structural attributes generated from field measurement, and functional traits are often missing in old-growth forest characterization.
- Functional traits can be valuable to define the old-growth forests by explaining the changes in the ecosystem function over the time of stand developments.
- Only a few studies have used the integration of structural and functional traits generated from remote sensing to characterize old-growth forests.
- We integrated multisource remote sensing data - mainly LiDAR and hyperspectral- to derive information on the complexity of structure and function of old-growth forests over space and time.

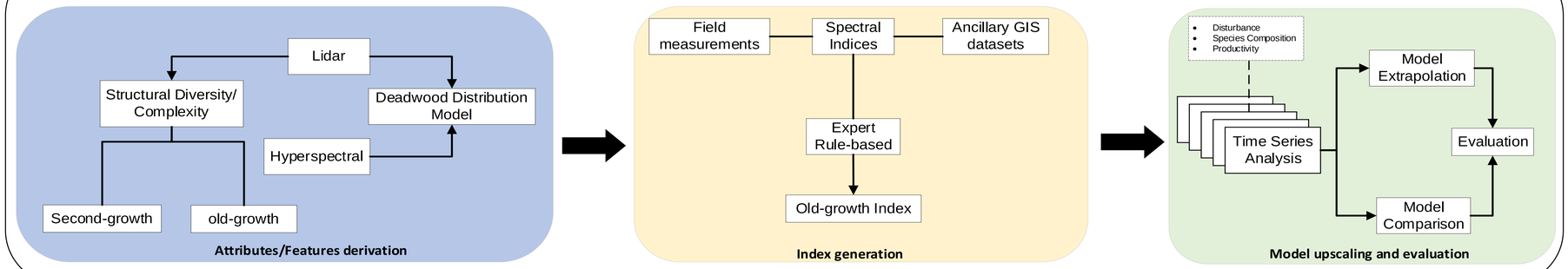
Objectives

- To identify RS-enabled structural and functional traits of old-growth forests.
- To upscale the characterization of old-growth forests to higher spatial extents
- To extrapolate the method to other old-growth forest ecosystems in different biomes and latitudes.

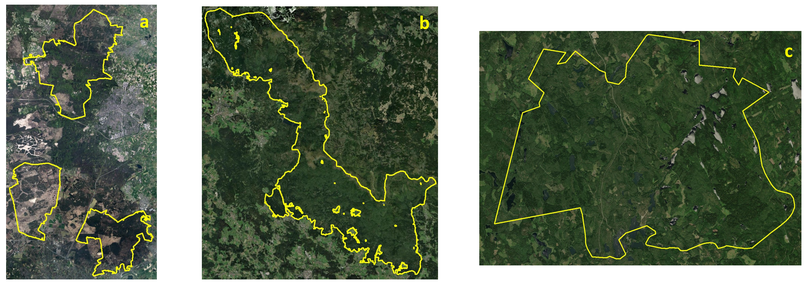
Future Works

- Develop "old-growthness" indices by combining the RS-derived structural and functional attributes using expert rule-based approach.
- Upscale the old-growth forest indices-based model from plot to landscape level.
- Apply model extrapolation and evaluate the method and the used approach.

General Proposed Framework

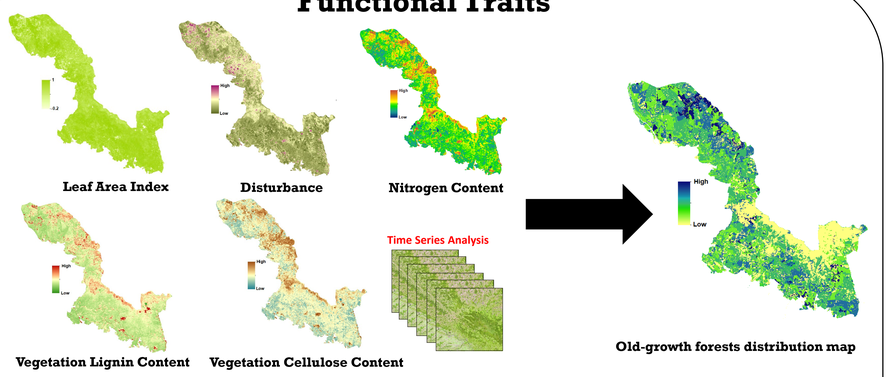


Study Sites



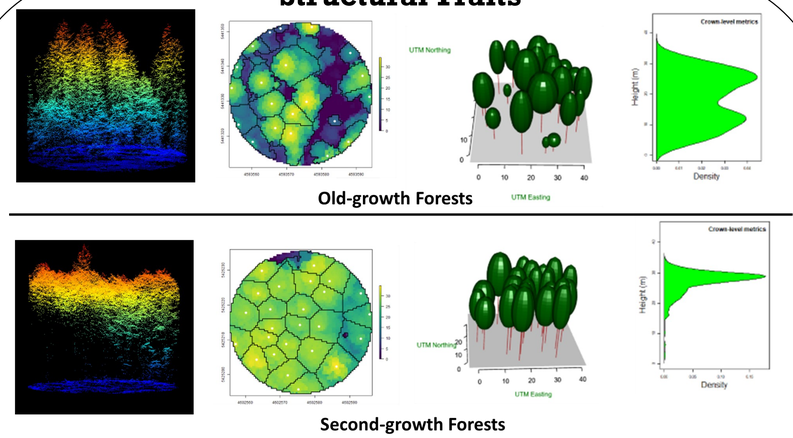
Study Sites of this research: a) Veluwe, The Netherlands, b) Bavarian Forest National Park (BFNP), Germany, c) Evo, Finland. BFNP is the site for benchmarking the procedure, methods, and tests for old-growth forests indices developments.

Functional Traits

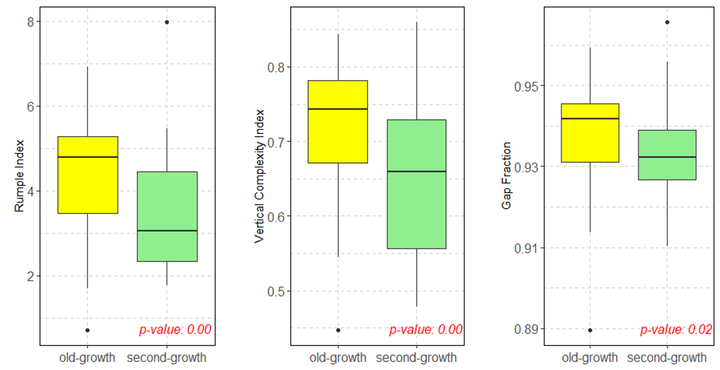


Example of different vegetation indices to observe the dynamics of ecosystem function of old-growth forests. Later will be combined with structural traits and a time-series approach to developing old-growth indices, mapping and upscaling the distribution of the old-growth forest.

Structural Traits



Old-growth forests have more complex and diverse structure than second-growth forests both in horizontal (canopy heterogeneity) and vertical (multilayer canopy) dimensions.



The median of LiDAR structural diversity metrics of old-growth and second-growth forests show a significant difference based on the Wilcoxon test ($p < 0.05$)

References

de Assis Barros, L., & Elkin, C. (2021). An index for tracking old growth value in disturbance-prone forest landscapes. *Ecological Indicators*, 121, 107175. https://doi.org/10.1016/j.ecolind.2020.107175

Falkowski, M. J., Evans, J. S., Martinuzzi, S., Gessler, P. E., & Hudak, A. T. (2009). Characterizing forest succession with lidar data: An evaluation for the Inland Northwest, USA. *Remote Sensing of Environment*, 113, 946–956. https://doi.org/10.1016/j.rse.2009.01.003

Franklin, J. F., & Pelt, R. Van. (2004). Spatial Aspects of Structural Complexity in Old growth Forests. *Journal of Forestry*, 102(3), 22–28. https://doi.org/10.1093/jof/102.3.22

Martin, M., Cerrejón, C., & Valeria, O. (2021). Complementary airborne LiDAR and satellite indices are reliable predictors of disturbance-induced structural diversity in mixed old growth forest landscapes. *Remote Sensing of Environment*, 267, 112746. https://doi.org/10.1016/j.rse.2021.112746

O'Brien, L., Schuck, A., Fraccaroli, C., Pötzelsberger, E., Winkel, G., & Lindner, M. (2021). *Protecting old growth forests in Europe: A review of scientific evidence to inform policy implementation*. https://doi.org/https://doi.org/10.36333/rs1

Spies, T. A. (2004). Ecological Concepts and Diversity of Old growth Forests. *Journal of Forestry*, 102(3), 14–20. https://doi.org/10.2307/2260958

Acknowledgment

The work is part of "BIOSPACE-Monitoring Biodiversity from Space" project with funding from European Research Council (grant 397 agreement ID 834709, H2020-EU.1.1) and the "Data Pool Initiative" for allowing the BFNP datasets to be used.

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