

TREE SPECIES MAPPING WITH MULTITEMPORAL SENTINEL-2 DATA

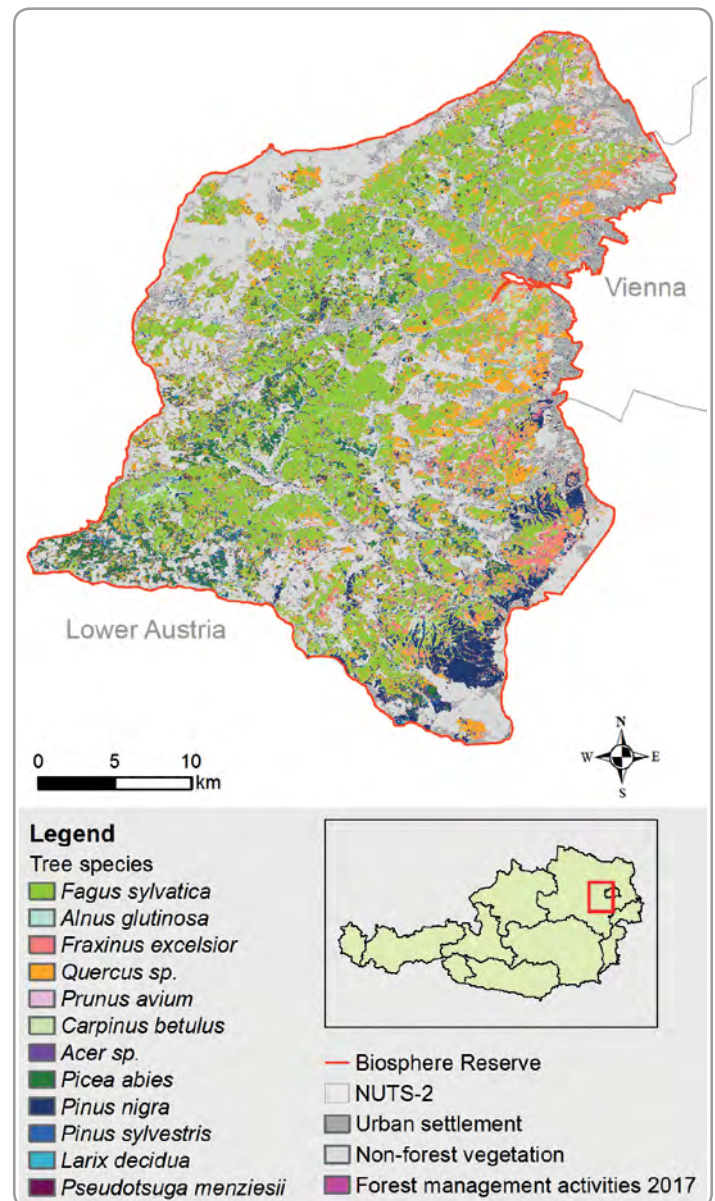
Derivation of main land cover classes and a detailed tree species distribution map from Copernicus datasets in UNESCO's Biosphere Reserve Wienerwald.

The challenge

UNESCO's biosphere reserves are model regions for promoting and developing sustainability. Ecological balance, economic security and social equity are the three pillars. In biosphere reserves, stakeholders aim to develop, implement and evaluate models of sustainable use. This requires detailed and up-to-date information about the biosphere including its natural assets. The biosphere reserve Wienerwald (BPWW), founded by the federal States of Lower Austria and Vienna, covers an area of 105,645 hectares (of which 60% is forest) and extends across 51 communities in Lower Austria and seven municipal districts of Vienna. Some 815,000 people live in the region of BPWW which incorporates 15 nature preserves. Unfortunately, the current information about the forest ecosystem is based on a patchwork of different data sources and is not up-to-date.

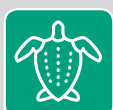
The space based solution

We demonstrate how Sentinel-2 (S2) satellite data can be used to support land administrations such as biosphere reserves to achieve their goals by providing detailed land cover and tree species related information. With its high spatial, spectral and temporal resolution, the twin constellation of S2 satellites delivers earth observation data of unprecedented quality. The sensors on board of S2 capture 13 spectral bands at 10, 20 and 60 m spatial resolution and pass every point on Earth at least every five days (even more frequently in areas of overlapping orbits). Using advanced image processing tools and machine learning techniques, it is possible to produce highly accurate and up-to-date tree species maps from time series of S2 images. In our case study, we used 18 cloud-free S2 scenes acquired between August 2015 and October 2017 for the classification of 12 tree species (seven broad-leaved and five coniferous species) and four non-forest classes (grassland,



Cumulated tree species and land cover product from the Biosphere Reserve Wienerwald derived from Copernicus S2-data.

Thematic Area



BIODIVERSITY AND ENVIRONMENTAL PROTECTION

Region of Application



NORTHERN AUSTRIA VIENNA

Sentinel mission used



S2

Copernicus Service used



-

Usage Maturity Level



4

agriculture, built-up and water). The developed semi-automated workflow includes feature selection and model optimization. In addition, we implemented a change-detection application to monitor forest management activities. Copernicus data enables us to achieve consistent and spatially accurate mapping of tree species.

Benefits to Citizens

The derived product represents the first tree species distribution map of the BPWW and now constitutes an important basis for the sustainable development of the reserve. The established workflow serves as an efficient tool to detect the high variety of tree species which is crucial for the maintenance of current ecosystem services in one of Europe's largest contiguous broad-leaved forests. Furthermore, the product can be used to derive parameters which are directly related to the recent utilization of forest resources in the biosphere reserve. Forest enterprises, forest authorities and administrations, as well as site managers, benefit from such detailed tree species and timely forest change mapping. The tool and methodology can be applied globally for similar classification tasks. Additionally, the proposed space based solution contributes to several projects initiated by the University of Natural Resources and Life Sciences Vienna (BOKU) and the BPWW Management. Furthermore, students of various master programmes at BOKU can directly benefit from the gathered knowledge on effective exploitation of S2 data for tree species mapping.

Outlook to the future

The potential value of other Copernicus missions is well recognized. We work on approaches to combine S2 imagery with remotely sensed data from other sensors (e.g. of the Sentinels constellation) to further increase classification accuracy, class depth and the spatial resolution of our product. Application of our method in other forested areas and/or other biosphere reserves would be highly appreciated.

“Land cover and tree distribution are main interests of the biosphere reserve management. With the aid of these two products we have a solid database for monitoring and know where to focus, for instance, when it comes to the topic of green corridors.”

*Dr. Herbert Greisberger,
Director, Biosphere Reserve Wienerwald*

Acknowledgements

We thank our project partners Austrian Federal Forests (ÖBf), Forestry Office and Urban Agriculture of Vienna (MA 49) and forest enterprise of Heiligenkreuz Abbey for providing reference information. The research was partly supported by the Austrian Research Promotion Agency through the ASAP project 854027 E04Forest.

Markus Immitzer¹, Martin Neuwirth¹, Sebastian Böck¹, Francesco Vuolo¹, Clement Atzberger¹, Harald Brenner² and Herbert Greisberger²

1. University of Natural Resources and Life Sciences, Austria
2. Biosphärenpark Wienerwald Management GmbH, Austria
Email: markus.immitzer@boku.ac.at

ABOUT COPERNICUS4REGIONS

This Copernicus User Story is extracted from the publication “**The Ever Growing use of Copernicus across Europe's Regions: a selection of 99 user stories by local and regional authorities**”, 2018, Edited by NEREUS, the European Space Agency and the European Commission.

The model cases focus on local and regional authorities who successfully applied Copernicus data in 8 major public policy domains. The views expressed in the Copernicus User Stories are those of the Authors and can in no way be taken to reflect the official opinion of the European Space Agency or of the European Commission.

Funded by the European Union, in collaboration with NEREUS. Paging, printing and distribution funded by the European Space Agency. IPR Provisions apply. Copernicus4Regions material may be used exclusively for non commercial purposes and provided that suitable acknowledgment is given.