Abstract template for the conference "A century of national forest inventories – informing past, present and future decisions"

Dear author. This is a two-page template that in the first page will ask for information on presenter name, topic, and preferred presentation form.

On page two, you are asked to fill in your abstract in the format and font size indicated. Please remember to include authors affiliation information in the footer section of page two. The length of the abstract may not be more than one page including references.

Abstract title:		Time-series models for every single 10x10m-pixel of Austrian forests – Assessing dynamics on different temporal scales
Take-home message:		*ESA's new Sentinel-2 data provide opportunities for NFIs to carry out analyses on different temporal scales and allows improvements on issues ranging from stock estimation to pest control.*
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General topic, see website: (please double click on the check box and activate the relevant one)	☐	Improving future NFIs by learning from the past
	☐	NFIs today and in the future
	☒	Cutting edge and futuristic inventory techniques and technologies
Preferred presentation form:	☒	Oral presentation
	☐	Poster

Abstracts will be reviewed by members of our scientific committee and you will be given information on decisions in due time after the submission deadline has passed.

Time-series models for every single 10x10m-pixel of Austrian forests – Assessing dynamics on different temporal scales

Markus Löw

Introduction: When the European Space Agency (ESA) launched its COPERNICUS-programme in 2016, earth observation reached new levels, providing formerly unknown opportunities for forestry too. In future such freely accessible data from space can continuously turn into a key data source to improve NFIs worldwide. By providing multispectral imagery with up to 10m-resolution and in average 5-days temporal resolution, ESA's Sentinel-2-data offers certainly many application potentials in forest areas. In order to explore so far unidentified possibilities for the Austrian NFI a local Sentinel-2-archive was set up and procedures for pixel-based time series analyses (TSA) were developed. The TSA serve two main aspects: (a) get gradients that describe seasonal vegetation patterns and (b) highlight dynamics that diverge from these presumed patterns.

Materials and methods: The BFW operationally downloads all required multispectral imagery (Level-1C) delivered by Sentinel-2A & 2B. As scripting software we use 'R', benefitting of its diverse corresponding packages. ESA's stand-alone atmospheric correction algorithm (Sen2cor) pre-processes the scenes to surface reflectance values (Level-2A). 10m spatial resolution bands of Level-1C-products were further used for TSA: Red, Green, Blue, and Near-Infrared. Correction masks to exclude cloud-effected pixels are a combination of both product levels. In the first step of TSA, data needs to be tailored adequately and all stacked dates organised efficiently. Next various indices (e.g. NDVI, RGVI, GNDVI, TCB,...) can be analysed. All range from zero to one. The time axis includes two periods: The model period covers data of *n*-preceding years on which a unique and profound model is developed. The projection period covers the current year to the latest available scene. After an additional filtering all data points of the time series are interpolated and smoothed. The single years in the model period combine (optionally weighted) to different percentile courses. Together these gradients give a profound, but also temporally sensitive time series model. In general, the same is done separately for the projection period, though with less strict filter- and smoothing settings that time sensitivity and data density is guaranteed. The kind of divergence between model and projection gradient is further classified to different dynamic/anomaly-categories. All these evaluations are restricted to the forest area based on a detailed forest map.

Results: The TSA result in about 400 million dependable course models that cover all Austrian forests. Every model contains unique information about int*ra*- and int*er*-annual vegetation dynamics, useful for multiple forest applications, as a) for NFI-accountings by themselves and b) for BFW-services for external forestry enterprises. At present, diligent parameterisation serves BFW's final aim to identify e.g. time series patterns of bark beetle infestations in retrospective, or rather by intersection with auxiliary data to delineate vulnerability maps. Sentinel-2-data can contribute to improvements of NFIs as well as to extended services for foresters in practise. At larger temporal scales such a constant monitoring system can even reveal hidden long-term trends concerning impacts of climate change on local forest vitality.

Conclusion: Extracted model-parameters of seasonal courses of biophysical indices (e.g. ever reached maxima or intensity of greening-amplitude) contribute to constantly refine and adjust NFI-computing methods. Currently, model-parameter derived forest type classifications are used at the BFW to improve e.g. biomass estimations by differentiating between tree-specific timber stock models. In addition, inter-annual change detection gives a spatial overview of degradation, utilisation, and management processes.

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