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

Abstract title:		How much can airborne laser scanning based forest inventory by tree species benefit from auxiliary optical data?
Take-home message:		*Sentinel-2 can support airborne laser scanning in species-specific forest inventory nearly as well as aerial images. Fusion of Sentinel-2, ALS data, and aerial images improved the separation Scots pine and Norway spruce.*
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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.		

How much can airborne laser scanning based forest inventory by tree species benefit from auxiliary optical data?

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Introduction: The recently launched Sentinel-2 satellite's MSI (Multi-Spectral Instrument) sensor contains three new vegetation red edge (RE) bands that are not available in Landsat or aerial images. Thus, Sentinel-2 images have potential to improve the estimation of boreal forest tree species composition. The objective of this study was to investigate the benefit of three different optical data sources (Sentinel-2, Landsat 8 and aerial images) to support airborne laser scanning (ALS) data in species-specific forest inventory.

Materials and methods: Our data covered 633 sample plots in eastern Finland. We used nearest neighbor imputation for simultaneous prediction of Scots pine, Norway spruce and broadleaved species' volume by species group. The variable selection was performed by means of simulated annealing of different data combinations.

Results: All optical data sources improved the species-specific plot volume predictions compared to using just ALS. The improvement was always greatest for broadleaved species group. The species-specific root mean square errors were 64.3%, 61.5%, 58.1% and 57.9% for ALS, ALS+Landsat 8, ALS+Sentinel-2 and ALS+aerial image data combinations, respectively, and 54.2% for ALS with the channels of both aerial images and Sentinel-2.

Conclusion: Optical data fused with ALS clearly improve the overall performance of species-specific forest volume prediction. Sentinel-2 outperformed Landsat 8 and was almost as good an option as aerial images. Compared to using just ALS and aerial images, adding the Sentinel's second red edge and narrow near-infrared bands improved the separation of pine and spruce. The results suggest that all optical data, from airborne or spaceborne sources, are useful when combined with ALS data in species-specific forest inventory.

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