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:		Comparison of photogrammetric canopy models from archived and made-to-order aerial imagery in forest inventory
Take-home message:		Archived aerial imagery acquired for ortho-photo production is well suited also for photogrammetric 3D canopy modelling, and adjusting imaging parameters more for 3D stereo-modeling do not bring significant improvements in forest inventory
Presenter name:		Sakari Tuominen
Presenter contact info:		Natural resources institute Finland (LUKE) emal:sakari.tuominen@luke.fi
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
	X	Cutting edge and futuristic inventory techniques and technologies
Preferred presentation form:	X	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.		

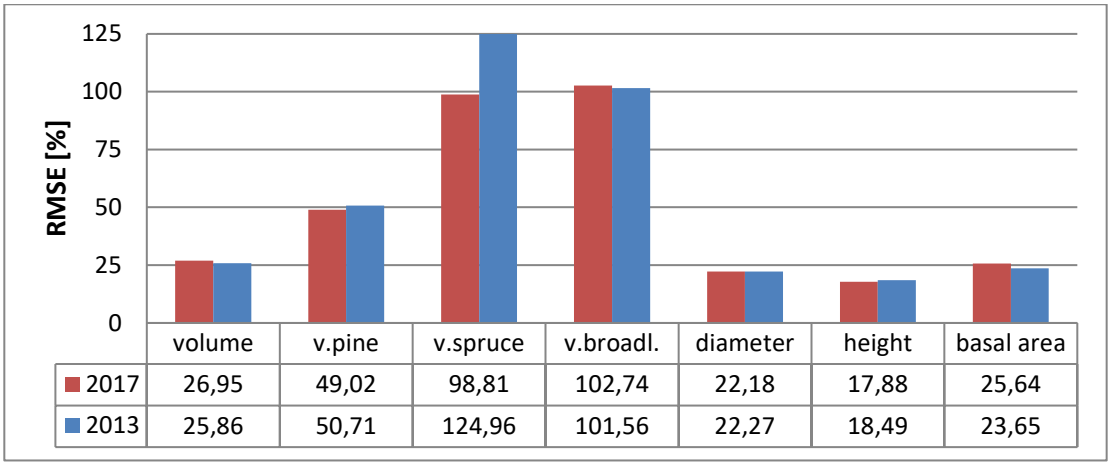
Comparison of photogrammetric canopy models from archived and made-to-order aerial imagery in forest inventory

S. Tuominen, A. Balazs & A. Kangas

Introduction: 3D point cloud data from e.g. airborne laser scanning are well suited for estimating the volume of growing stock and stand height, but tree species recognition often requires optical imagery. Combination of 3D data and optical imagery can be also acquired based on aerial imaging only, by using stereo photogrammetric 3D canopy modeling. The use of aerial imagery is in many cases better suited for large area forest inventories than ALS, due to better area coverage and temporal frequency of data acquisition. Stereo-photogrammetric canopy modeling can also be applied for old imagery acquired for e.g. aerial ortho-mosaic production, assuming that the imagery have sufficient stereo overlap. In this study we compared two stereo-photogrammetric canopy models in forest inventory: one based on old archived imagery acquired primarily for ortho-mosaic production, and another based on aerial imagery whose acquisition parameters were better adjusted for stereo-photogrammetric canopy modeling.

Materials and methods: The field data consisted of 314 field plots arranged systematically in clusters of eight plots with 250 m spacing between plots. Fixed radius (9 m) plots were used, and the plots were measured in 2013 and 2017. Aerial imagery acquired in 2013 and 2017 were tested. 2013 imagery had overlap of 35/80% (line/side), and was ortho-rectified to a resolution of 30 cm. 3D point cloud representing the uppermost canopy layer was derived with a point density of approx. 1.8 points/m2. 2017 imagery was more tailored for stereo-photogrammetric canopy modelling having overlap of 60/80% and spatial resolution of 25 cm. 3D canopy surface model had a point density of 4 points/m2. Field plot characteristics were estimated by k-nearest neighbor (k-nn) method using features extracted from the two aerial image and point cloud data sets. Both aerial data sets were used in combination with the field measurements of respective years. The k-nn estimates were tested by leave-one-out cross-validation, and genetic algorithm was applied in combining the features for finding the best feature combinations (based on the RMSEs of the estimated forest variables).

Results: There was little difference between the aerial data sets in the accuracy of estimated forest variables (Figure 1). Only the volume of spruce showed clear difference in favour of 2017 imagery.



	volume	v.pine	v.spruce	v.broadl.	diameter	height	basal area
2017	26,95	49,02	98,81	102,74	22,18	17,88	25,64
2013	25,86	50,71	124,96	101,56	22,27	18,49	23,65

Figure 1. The accuracy of forest variables (relative RMSE) estimated with alternative aerial data sets.

Conclusion: Higher stereo overlap and density of point cloud do not bring significant improvement in the accuracy of forest estimates with the spatial resolutions tested.

Natural Resources Institute Finland. Latokartanonkaari 9, FI-00790 Helsinki Finland. *sakari.tuominen@luke.fi*