Predicting of forest attributes with multispectral LiDAR data

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INTRODUCTION

- LiDAR data provide detailed information on tree heights, while the information related to the spectral signatures of trees is limited, as only one spectral band is available (the most common is 1064 nm).
- Recently quite a lot of effort has been devoted to developing so called multi/hyperspectral LiDAR sensors; these sensors can acquire LiDAR data using different wavelengths allowing to have intensity information in different bands.
- At the moment the only multispectral LiDAR sensor commercially available is the Optech Titan that employs three laser scanners working at 532 nm, 1064 nm, and 1550 nm.
- This system allows us to have spectral information in three bands and to have a larger point density as the elevation information is aggregated over returns from all the three scanners.

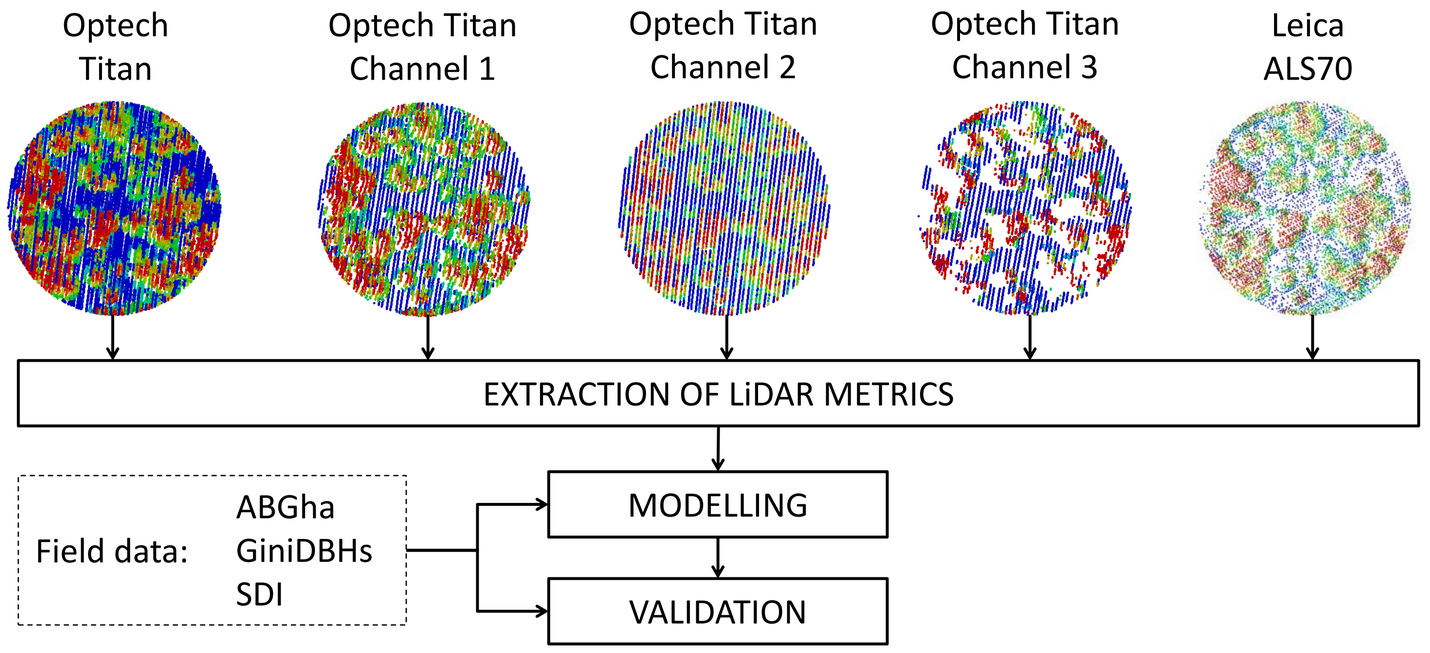
OBJECTIVE

To explore the potential of the Optech Titan multispectral LiDAR data to model and predict forest attributes (aboveground biomass per hectare (*AGBha*), Gini coefficient of the diameter at breast height (*GiniDBHs*), Shannon diversity index of the tree species (*SDI*)) at plot level.

DATA SETs

- The study area is located in the Hadeland municipality in Southern Norway.
- The field data were collected on seven circular sample plots of size 1000 m^2 and two circular sample plots of size 500 m^2.
- In order to have a larger number of plots for the analysis the plots were split in 32 subplots of 250 m^2.
- Within each sample plot, tree species, diameter at breast height (DBH), and tree coordinates were recorded for all trees with DBH>3 cm.
- A total of 1075 trees were recorded of which 22.1% were broadleaves, 71.1% Norway spruce, and 6.8% Scots pine.

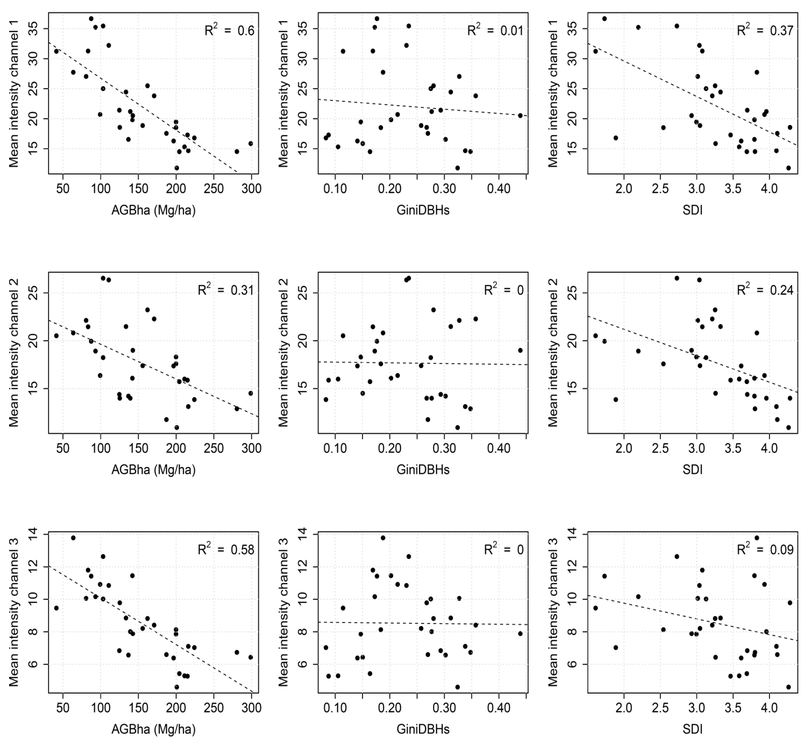
METHODS

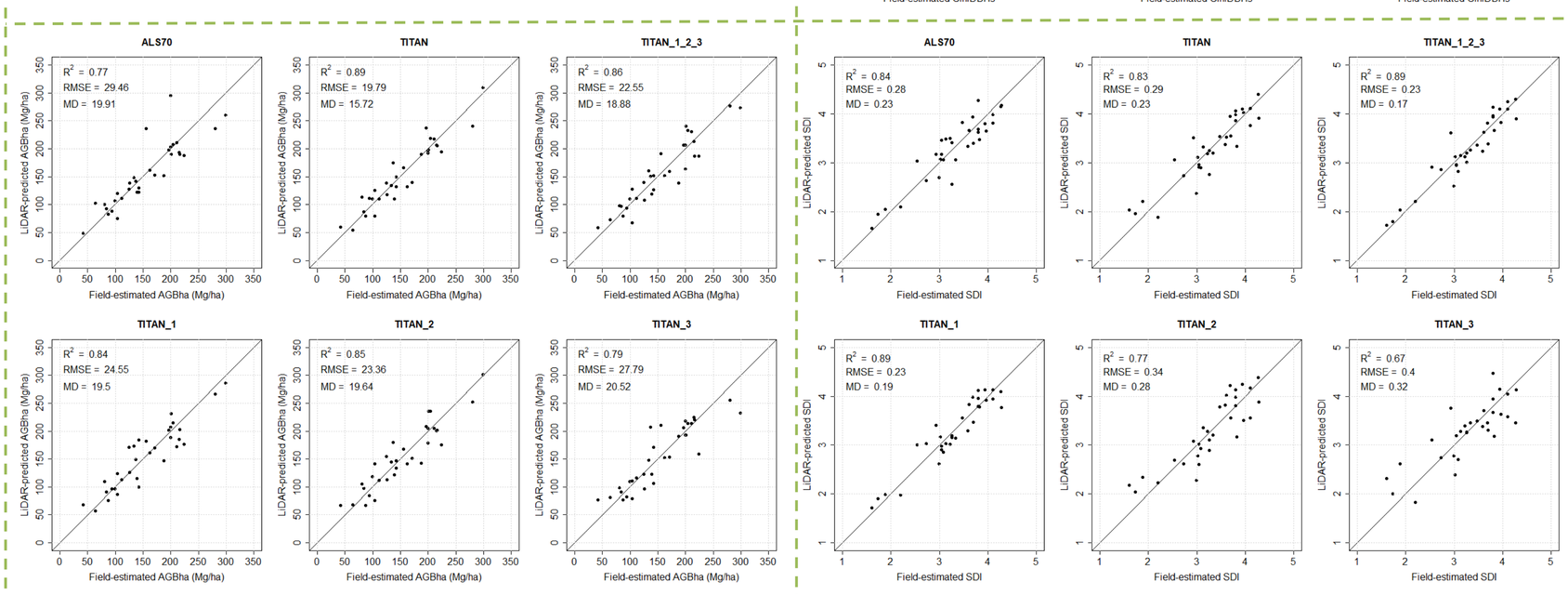


RESULTS

- Multispectral LiDAR data provided better model prediction results compared to LiDAR data acquired with a conventional LiDAR working at 1064 nm.
- Optech channel 1 (1550 nm) seemed the most useful as it showed a good correlation with almost all the considered response variables.
- Channel 3 (532 nm) seemed to provide less informative data.

Response variable	Model name	Metrics selected				
AGBha	ALS70	zpcum2	ikurt	p4th		
	TITAN	zmean	zentropy	itot	p2th	
	TITAN_1_2_3	zq50_1	p1th_1	zpcum8_2	zpcum9_2	p1th_3
	TITAN_1	zq50	zpcum9	imax	p2th	
	TITAN_2	zq40	zpcum8	zpcum9	p1th	
	TITAN_3	zmax	imean			
GiniDBHs	ALS70	zentropy	zq40	zq55	zpcum9	
	TITAN	zmax	zentropy	zq60	zpcum9	
	TITAN_1_2_3	zentropy_1	zq55_1	zpcum9_1	p4th_1	zq85_2
	TITAN_1	zmax	zentropy	zq55	zpcum9	
	TITAN_2	zmean	zentropy	zq45	zpcum9	
	TITAN_3	zkurt				
SDI	ALS70	zq90	zpcum1	zpcum9	ikurt	
	TITAN	zmax	zsd	itot	p2th	
	TITAN_1_2_3	itot_1	imax_1	zmax_2	zsd_2	p2th_2
	TITAN_1	zmean	zq45	itot	iskew	
	TITAN_2	zmax	zsd	itot	p2th	
	TITAN_3	zmax	zentropy	itot		





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REFERENCES

- M. Dalponte, L. T. Ene, T. Gobakken, E. Næsset, D. Gianelle, "Predicting Selected Forest Stand Characteristics with Multispectral ALS Data," *Remote Sensing*, 10, 4, 2018