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REAL AND SIMULATED WAVEFORM RECORDING LIDAR DATA IN BOREAL JUVENILE FOREST VEGETATION

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Abstract. Airborne small-footprint LiDAR is replacing field measurements in regional-level forest inventories, but auxiliary field work is still required for the optimal management of young stands. Waveform (WF) recording sensors can provide a more detailed description of the vegetation compared to discrete return (DR) systems. Furthermore, knowing the shape of the signal facilitates comparisons between real data and those obtained with simulation tools. We performed a quantitative validation of a Monte Carlo ray tracing (MCRT) -based LiDAR simulator against real data and used simulations and empirical data to study the WF recording LiDAR for the classification of boreal juvenile forest vegetation. Geometric-optical models of three common species were used as input for the MCRT model. Simulated radiometric and geometric WF features were in good agreement with the real data, and interspecies differences were preserved. We used the simulator to study the effects of sensor parameters on species classification performance. An increase in footprint size improved the classification accuracy up to a certain footprint size, while the emitted pulse width and the WF sampling rate had minor effects. Analyses on empirical data showed small improvement in performance compared to existing studies, when classifying seedling stand vegetation to four operational classes. The results on simulator validation serve as a basis for the future use of simulation models e.g. in LiDAR survey planning or in the simulation of synthetic training data, while the empirical findings clarify the potential of WF LiDAR data in the inventory chain for the operational forest management planning in Finland.

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