Enhanced forest inventory: A QGIS plugin to incorporate R processing tools in forest management

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Abstract. Forest inventories are important to provide information to forest managers, policy makers and practitioners about the current state of forests and the changes happening in these ecosystems. The traditional forest inventories (samples and field campaigns) used to identify tree species and measure morphological and physiological parameters are financially burdensome and time-demanding. Thus, remote sensing can be an alternative used by public administration to reduce the efforts in the field and improve the quality of forest inventories and land cover mapping at a sustainable price [1, 2]. Nowadays, there is an effort to integrate Lidar point clouds to improve forest inventories because it offers a new perspective on evaluating forest structures. In this context, the goal of this work is to bring the results of higher-level procedures for processing point clouds in the R CRAN using the lidR package to the more commonly used GIS environment in a user-friendly context [3, 4, 5]. To achieve this, we present a QGIS plugin for accessing and processing 3D point clouds to enable decision makers in the forestry sector to have easier and more intuitive access to these data. The examples and results of the processing are given over a specific study area located in the Autonomous Province of Trento, a mountainous region in the northern part of Italy. The proposed plugin launches an R subprocess and communicates directly with it through *stdin* and *stdout* pipes. This makes the procedure smoother and allows to calculate several runs with different parameters to compare which are more likely to be correct in a specific scenario. Intermediate and final outputs are saved in a subfolder of the working directory. Intermediate files of interest for the practitioner are the following: the tiles covered in each LAS lidar tile, digital height models, both the DTM and CHM, tree positions with tree heights, and final per-parcel statistics (Fig. 1). Lidar data provides accurate and detailed information on the vertical structure of canopies and can provide estimated volume and biomass, as well as other parameters that are key in forest management. This plugin differs from other approaches in that it initiates a stream with an active R session and sends commands from QGIS with several solutions that re-use all intermediate steps avoiding recalculating them. This saves time and allows multiple processing threads to run in parallel, and thus test different combinations of input parameters to the workflow. Future developments will see an improved integration with the QGIS interface and a better and more intuitive way to provide allometric models to the workflow. The full paper was submitted to the ISPRS Mid-term Symposium on Remote Sensing "*Beyond the canopy: technologies and applications of remote sensing"* 2024 to be published in the ISPRS Archives.

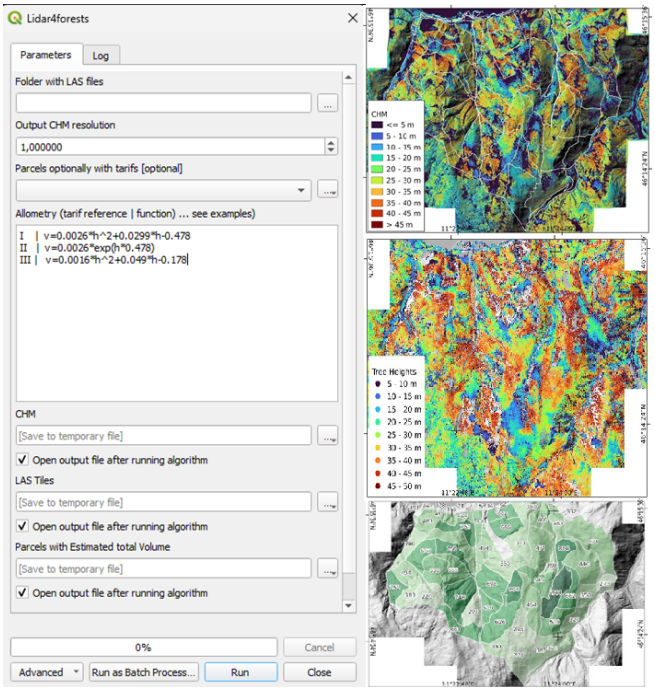

Fig. 1. Plugin interface to insert parameters (on the left). Examples of outputs (on the right from up to bottom): canopy height model, top-tree height distribution of frequencies, and final volume values (m3/ha) for each parcel.

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