EGU21-4584
https://doi.org/10.5194/egusphere-egu21-4584
EGU General Assembly 2021

A workflow to extract vegetated landscape elements from LiDAR point data to study their impact on surface runoff and downstream floods

Ine Rosier, Jan Diels, Ben Somers, and Jos Van Orshoven
KU Leuven, Earth and Environmental Sciences, Leuven, Belgium (ine.rosier@kuleuven.be)

Extensive areas throughout Europe are affected by river flooding. The frequency of these floods has considerably augmented in the past decades, resulting in substantial economic damage. In the strongly urbanized Flanders region of Belgium, insured losses due to floods are estimated at €40-75 million per year. So far little attention has been paid to off-site source areas of which hydrological behaviour influences the flood risk downstream in the catchment. These off-site areas have however the ability to either increase or reduce the exposure of downstream properties and infrastructures to floods. In rural European landscapes, these off-site areas are characterized by a variety of landscape elements (LSEs) such as hedgerows, trees, drainage ditches and terrace slopes. They affect river discharge and the frequency, extent, depth and duration of floods downstream by creating hydrological discontinuities and connections across the landscape but the magnitude of these effects is very much landscape specific.

We propose a hierarchical workflow to extract vegetated LSEs from LiDAR point data consisting of six steps: (1) selection of non-ground LiDAR points from an airborne LiDAR dataset with an average point density of at least 16 points per square meter, (2) extraction of geometry and eigenvalue based features for each point in the LiDAR point clouds, (3) supervised classification of the points into the classes 'vegetated LSE' and 'other non-ground LiDAR points' using a Random Forest classifier, (4) clustering of the classified vegetated LSE points by using the density-based clustering algorithm DBSCAN, (5) segmentation of the clustered points by calculating the concave hull per cluster, and (6) classification of the 2D objects into the vegetated LSE classes 'tree objects' (individual trees, tree groups and tree rows) and 'shrub objects' (bushes, hedgerows and woody edges) by using a Random Forest Classifier and a rule-based approach.

Our workflow was calibrated and tested on two undulating study areas in which the position and geometric characteristics of all vegetated LSEs were recorded in the summer of 2019 using a real-time kinematic GNSS device. The land use in both study areas is dominated by agricultural land. Step 3 of our workflow was validated by using a stratified ten-fold cross-validation method and resulted in a producer's accuracy of 99% in distinguishing between vegetated LSE and other non-ground LiDAR point. Step 6 resulted in producer's accuracies between 42% and 64% when distinguishing tree and shrub objects.

Further fine-tuning of the workflow by incorporating features based on point density distributions within LSE segments is expected to increase the classification accuracy. Our aim is to incorporate the classified 2D objects in spatially explicit hydrological models which will allow estimating their effect on river discharge and the frequency, extent, depth and duration of floods downstream.