H149 Water contamination and water quality improvement in river

A Scalable Strategy for Riparian Vegetation Assessment Using LiDAR

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Riparian vegetation is fundamental to the health of fluvial systems; it filters sediment and nutrients from runoff, stabilizes stream banks, controls sediment erosion, shades and cools water, and provides habitat for a diverse array of terrestrial organisms. Because of the outsized impact that riparian buffers have on water and ecosystem quality, quantifying its extent is of great interest to hydrologists, watershed planners, stream restorationists and many other parties. We propose a computationally efficient scheme that uses only LiDAR point cloud data allowing a rapid and scalable quantification of riparian vegetative cover. While manually identifying riparian vegetation using orthoimagery is feasible for small study areas, automated techniques become necessary as the size of the study area increases. Furthermore, many automated approaches to quantifying riparian coverage work well but may require the acquisition of specialized imagery or rely on obfuscated workflows. Our strategy uses only LiDAR data to generate intermediate rasters that are combined to produce a final raster of vegetative coverage. Our pilot study area includes the North Fork Forked Deer watershed in west Tennessee. LiDAR covering the study area was collected by Laser Mapping Specialist, Inc for the US Army Corps of Engineers with a horizontal accuracy of 1.0m and vertical accuracy of 0.37m. Landcover predictions were made by applying various filters to raster datasets derived from LiDAR, and filter parameter ranges were established by optimizing the filtering algorithm with a differential evolution algorithm. Nine derived raster datasets in total were evaluated, but the bulk of the model accuracy was achieved using only canopy height and LiDAR return number rasters. We validated the model against a hand-delineated land use dataset covering the watershed leading to a preliminary accuracy of 87% in the riparian corridor. The projected model could be applied to any watershed where LiDAR data is available allowing for efficient management of water and sediment resources.