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Airborne laser scanning derived terrain models for modelling overland flow

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The technique of airborne laser scanning (ALS), also often referred to airborne lidar, sets new standards in digital terrain modelling. This is because ALS combines high point densities (typically 1-10 points per square meters) and high ranging accuracy (typically $<$ 5 cm) with an ability to see through small openings in the vegetation cover. Thus it becomes possible to reconstruct the bald earth surface with high accuracy. In many European countries ALS derived digital terrain models (DTMs) have found widespread use in operational hydrology in recent years. They have become a prime data source for hydraulic models and for modelling overland respectively overbank flow. The quality of these simulations depends crucially on how well vegetation and other non-terrain objects have been removed in the generation of the DTMs. The process of removing non-terrain points from the ALS measurements is commonly referred to as filtering. In the past, ALS systems only measured the range to detected objects. Thus the filtering process had to rely on just using geometric criteria for filtering the ALS point cloud. More recently, so called full-waveform ALS systems have become available. These systems measure, in addition to the range, physical observables which can be used for improved removal of non-terrain points. It is shown how full-waveform ALS improves in particular the removal of short vegetation and other short objects (dead trees, stones, etc.). Therefore small-scale runoff patterns can be simulated more realistically than ever before. This is demonstrated through irrigation experiments. The improvement compared to ranging ALS systems is demonstrated by comparing surface runoff simulations for an urban area in Vienna and a forested area in the eastern part of Austria. With the increasing availability of full-waveform ALS systems this technique will find widespread operational use in hydrology.