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Enhanced detection of water and ground surface in airborne laser bathymetry data using waveform stacking

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The past years have seen an increasing scientific interest in high-resolution topographic data of fluvial geomorphology. Moreover, from an administrative perspective, the European Union's water framework directive and the flood directive formulate further requirements on monitoring fluvial landscapes.

For capturing the geomorphology of shallow water bodies, e.g. creeks and rivers, airborne laser bathymetry (ALB) has become a method of choice. These instruments operate in the green wavelength domain, enabling for the laser to penetrate the water column.

As the water surface is the boundary between two media, i.e. between air and water, and from a physical perspective represents the locus where the laser beam is bent and decelerated. Therefore, the detection of this boundary is crucial for retrieving the channel morphology correctly. However, in case of low signal-to-noise ratio (SNR) these detection may fail for single laser shots.

This gives the motivation for increasing the SNR by simulating a bigger laser footprint by means of stacking adjacent laser waveforms in a spatial neighbourhood, e.g. a slanted cylinder. On the one hand, this implies a reduction in spatial resolution; on the other hand though, it means an increase in reliability of the results, both in the detection of the water surface and enabling for assessing the turbidity of water column.

The presented approach is evaluated by means of a multi-temporal airbone laser bathymetry dataset captured over the river Pielach and neigbhouring standing water bodies in Loosdorf, Lower Austria.