EGU2020-20468, updated on 27 Nov 2020
https://doi.org/10.5194/egusphere-egu2020-20468
EGU General Assembly 2020

Quantifying the influence of low vegetation on vertical uncertainties of 3D point clouds derived from UAV-based ground surface measurements

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The use of unmanned aerial vehicles (UAV) for ground surface measurements in natural hazard studies has strongly increased in recent years. Multi-temporal 3D point clouds derived from light detection and ranging (LiDAR) sensors and photogrammetric techniques including structure-from-motion (SfM) and dense image matching (DIM) have become important tools for monitoring the activity of geomorphic processes. However, due to georeferencing errors and measurement inaccuracies, change detection with centimeter precision remains challenging, especially in study areas covered by vegetation. This study aims at quantifying the influence of low vegetation on the vertical uncertainties of 3D point clouds in a study area mostly covered by meadows and pastures with different grass heights. 3D point clouds derived from UAV-SfM and UAV-LiDAR are compared to terrestrial ground surface measurements of a differential global navigation satellite system (dGNSS) receiver in order to quantify the vertical uncertainties and to detect advantages/disadvantages of the different sensors. The results indicate that neither method is able to detect the ground surface under dense low vegetation with centimeter precision, and that surface displacement rates derived from multi temporal analyses can be highly influenced by changes in vegetation height between surveys.