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Lidar Processing for Defining Sinkhole Characteristics under Dense Forest Cover: A Case Study in the Dinaric Mountains

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Abstract. The traditional approach for defining sinkholes characteristics is based on topographic maps and air photographs with derived digital terrain models. This method is sometimes not accurate, requiring costly, time consuming and potentially dangerous fieldwork. Investigations have shown that airborne scanning laser data (lidar) is useful in detection of karst depressions due to the high density of ground points that can be obtained. This is especially important under dense forest canopy, where classical photogrammetric methods do not allow ground points to be measured. The objective of this work was to map and determine geomorphometric characteristics of a large number of sinkholes located in a diverse karst terrain under a dense forest tree-canopy using lidar data.

We tested an algorithm described in previous literature which uses only information from the DTM. It is based on water flow simulations on a surface (DTM) and incorporates four phases: (i) watershed delineation, (ii) confining of sinkholes, (iii) confining of higher rank sinkholes and (iv) extraction of non-karstic sinkholes. Sinkholes were confined by effluent level with cells below the effluent level designated as part of the sinkhole. In the third step sinkholes were ranked according to their location and size – first rank sinkholes are the smallest and are located within a larger sinkhole.

Results are that the sinkhole fraction of 1st, 2nd, 3rd, 4th and 5th rank in the study area was 3.25 %, 4.26 %, 5.68 %, 3.65 % and 3.14 %, respectively. Sinkhole distribution shows a peculiar directionality in their spatial distribution, which seems to be significantly towards a northwest – southeast direction. It was not possible to compare results with ground-truth data due to very low accessibility, nevertheless a statistical and visual assessment of the results shows that lidar is a very effective technique to model sinkholes under dense canopy.

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