Geophysical Research Abstracts
Vol. 16, EGU2014-15171, 2014
EGU General Assembly 2014

Influence of crisp values on the object-based data extraction procedure from LiDAR data

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Nowadays a plethora of approaches attempt to automate the process of object extraction from LiDAR data. However, the majority of these methods require the fusion of the LiDAR dataset with other information such as photogrammetric imagery. The approach that has been used as the basis for this paper is a novel method which makes use of human knowledge and the CNL modelling language to automatically extract buildings solely from LiDAR point cloud data in a transferable method. A number of rules are implemented to generate an artificial intelligence algorithm which is used for the object extraction.
Although the single dataset method has been found to successfully extract building footprints from the point cloud dataset, at this initial stage it has one restriction that may limit its effectiveness – a number of the rules that are used are based on crisp boundary values. If, for example, the slope of the ground surface is used as a rule for determining objects then the slope value of a pixel would be assessed to determine if it is suitable for a building structure. This check would be performed by identifying whether the slope value is less than or greater than a threshold value. However, in reality such a crisp classification process is likely not to be a true reflection of real world scenarios. For example, using the crisp methods a difference of 1° in slope could result in one region in a dataset being deemed suitable and its neighboring region being seen as not suitable. It is likely however that there is in reality little difference in the actual suitability of these two neighboring regions. A more suitable classification process may be the use of fuzzy set theory whereby each region is seen as having degree of membership to a number of sets (or classifications). In the above example, the two regions would likely be seen as having very similar membership values to the different sets, although this is obviously dependent on factors such as the extent of each region.
The purpose of this study is to identify to what extent the use of explicit boundary values has on the overall building footprint dataset extracted. By performing the analysis multiple times using differing threshold values for rules, it is possible to compare the resultant datasets and thus identify the impact of using such classification procedures. If a significant difference is found between the resultant datasets, this would highlight that the use of such crisp methods in the extraction processes may not be optimal and that a future enhancement to the method would be to consider the use of fuzzy classification methods.