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Classification and mapping of urban areas based on point clouds from ALS, aerial and satellite images

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Viewed as one of the causes of the global environmental change, the anthropogenic land use and land cover change accelerated in the last decades, reason why this fast-evolving and complex process deepen its environmental impact and increased the population demands. Quantifying the properties of land and overcoming the limitations of mapping the intricacies of land uses and cover, complementary remote sensing data can be used for obtaining detailed structural information.
The major aim of the research is focused on classifying the urban area from the perspective of land use and land cover. This implies several different types of datasets and methodologies which through their fusion an improved accuracy is obtained. Secondly, for the purpose of comparing the performance of multi-source remote sensing data and the sensor's potential for urban land use and land cover classification, the database consists of lidar point cloud data, very high-resolution RGB imagery, multispectral data, ancillary data. Regarding the spatial segmentation, one of the major characteristics of LiDAR (ALS) data is the height information together with other contextual parameters as entropy, homogeneity, planarity. Several machine learning techniques have been tested and after the results analysis, the random forest model reveals the most accurate results being able to retrieve a fitted probability for all classes. The final results of the classification and data fusion integration are assessed by taking into consideration the accuracy parameters and confusion matrix. Essential for an accurate semantic classification are both 3D geometry data and the image-derived features, the last one having greater importance. Using data fusion at urban scale led to the improvement of the delineation of both the man-made regular structured objects and medium-high vegetation (shrubs and trees). The methodology tested in the present study can be successfully extended to other topics from change detection to mapping natural ecosystem resources as water bodies, vegetation.
The study importance resides in the fact that the city can be seen as a living organism which has to take part to a continuous process of monitoring, its morphological characteristics and their changes being mandatory for implementing and maintaining a sustainable land management.