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Three very high resolution optical images for land use mapping of a suburban catchment: input to distributed hydrological models

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Urbanization and other modifications of land use affect the hydrological cycle of suburban catchments. In order to quantify these impacts, the AVuPUR project (Assessing the Vulnerability of Peri-Urban Rivers) is currently developing a distributed hydrological model that includes anthropogenic features. The case study is the Yzeron catchment (150 km^2), located close to Lyon city, France. This catchment experiences a growing of urbanization and a modification of traditional land use since the middle of the 20th century, resulting in an increase of flooding, water pollution and river banks erosion.
This contribution discusses the potentials of automated data processing techniques on three different VHR images, in order to produce appropriate and detailed land cover data for the models. Of particular interest is the identification of impermeable surfaces (buildings, roads, and parking places) and permeable surfaces (forest areas, agricultural fields, gardens, trees…) within the catchment, because their infiltration capacity and their impact on runoff generation are different.

Three aerial and spatial images were acquired: (1) BD Ortho IGN aerial images, 0.50 m resolution, visible bands, may 5th 2008; (2) QuickBird satellite image, 2.44 m resolution, visible and near-infrared bands, august 29th 2008; (3) Spot satellite image, 2.50 m resolution, visible and near-infrared bands, September 22nd 2008. From these images, we developed three image processing methods: (1) a pixel-based method associated to a segmentation using Matlab®, (2) a pixel-based method using ENVI®, (3) an object-based classification using Definiens®. We extracted six land cover types from the BD Ortho IGN (visible bands) and height classes from the satellite images (visible and near infrared bands). The three classified images are resampled in the same low resolution of 2.5 m and compared in order to evaluate the accuracy of different image processing methods and to determine for each cover type, the more appropriate image and/or method. This comparison provides hydrologists with a synthetic land cover map.

Four parameters affect the accuracy of land cover mapping: firstly the addition of the NIR band improves vegetation classification such as the distinction between coniferous forest and broad-leaved forest. Moreover the intensity of chlorophyllian activity allows us to characterize the use of agricultural fields. Secondly, the images were taken at three dates in the agricultural calendar. This multi-date data allows the discrimination between permanently vegetalized pastures, and temporarily bare crops, a useful information for hydrologists who study surfaces hydraulic properties. Thirdly, the high resolution of the BD Ortho IGN image emphasizes the heterogeneity inside the spatial entities. Thus, in urbanised areas, high-resolution imagery allows the precise identification of objects > 5 m2 and consequently the quantification of impervious and pervious surfaces. However, the continuity of forest areas is not maintained because of the presence of small entities with sparser tree cover that were classified as herbaceous areas. Finally, image characteristics are more crucial than classification methods for the accuracy of land cover mapping. However, object based approach improves the classification of mixed pixels on the edge between different objects. It's particularly true for buildings and roads.