Chapter 47
Using OpenStreetMap to Create Land Use and Land Cover Maps:
Development of an Application

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ABSTRACT

OpenStreetMap (OSM) is a bottom up community-driven initiative to create a global map of the world. Yet the application of OSM to land use and land cover (LULC) mapping is still largely unexploited due to problems with inconsistencies in the data and harmonization of LULC nomenclatures with OSM. This chapter outlines an automated methodology for creating LULC maps using the nomenclature of two European LULC products: the Urban Atlas (UA) and CORINE Land Cover (CLC). The method is applied to two regions in London and Paris. The results show that LULC maps with a level of detail similar to UA can be obtained for the urban regions, but that OSM has limitations for conversion into the more detailed non-urban classes of the CLC nomenclature. Future work will concentrate on developing additional rules to improve the accuracy of the transformation and building an online system for processing the data.

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INTRODUCTION AND BACKGROUND

OpenStreetMap (OSM) is a well-known collaborative mapping project that involves volunteers from all over the world in the creation of a free, global geospatial database. With more than 2.8M registered contributors at the time of writing (July 2016) (http://wiki.openstreetmap.org/wiki/Stats), OSM is one of the most popular projects exemplifying the concept of Volunteered Geographic Information or VGI (See et al., 2016). The availability of the OSM database under a fully open license, which allows anyone to use the data freely and produce derived products, has attracted the interest of a multitude of end users such as industry, professionals, governments and humanitarian organizations (Haklay, Antoniou, Basiouka, Soden, & Mooney, 2014; Soden & Palen, 2014; Olteanu-Raimond et al., 2015; Mooney & Minghini, in press). The success of the project has also attracted the attention of the academic community (Jokar Arsanjani, Zipf, Mooney, & Helbich, 2015), and OSM is now considered to be a research topic on its own.

There are a number of factors that can account for the popularity and massive exploitation of OSM data. The large number of contributors over time has ensured that OSM data have reached a high degree of quality. Many studies exist that have compared OSM data with authoritative datasets and showed that they are of a comparable quality, at least in urban areas where more contributors are active (see e.g. Girres & Touya, 2010; Haklay, 2010; Ciepłuch, Jacob, Mooney, & Winstanley, 2010; Ludwig, Voss, & Krause-Traudes, 2011; Fan, Zipf, Fu, & Neis, 2014; Zheng & Zheng, 2014; Brovelli, Minghini, Molinari, & Zamboni, 2016). The OSM database is also extremely rich, as it includes a variety of thematic layers (with attribute information) that are not traditionally available in other official or authoritative datasets. Lastly, the OSM database is constantly updated and enriched by contributors, and each new version is immediately available for use. In contrast, there are a number of problems related to OSM including an inconsistent spatial coverage (see e.g. Haklay, 2010; Zielstra & Zipf, 2010; Hecht, Kunze, & Hahmann, 2013; Fram, Chistopoulou, & Ellul, 2015; Ribeiro & Fonte, 2015; Brovelli, Minghini, & Molinari, 2016) and positional and thematic inconsistencies, where the latter is due to the relative freedom provided to the contributors in defining object attributes (Ballatore & Mooney, 2015).

Despite these known issues with OSM, the thematic richness of this dataset means that it has great potential for land use and land cover (LULC) mapping. LULC maps are fundamental inputs to many applications ranging from habitat monitoring to ecosystem accounting, among others. These maps are usually generated through the classification of satellite imagery. However, their creation is time consuming and therefore their release, even when at greatly detailed level, is only every few years. For example, CORINE Land Cover (CLC) has been produced for 2000, 2006 and 2012, where the 2012 product is still being validated in some countries. The Urban Atlas (UA) is another example of a detailed LULC map but is only available for cities in the European Union. There are also a number of global land cover products available, e.g. GLC-2000 (Mayaux et al., 2006), MODIS (Friedl et al., 2010) and the recently produced GlobeLand30 (Chen et al., 2015), where the latter product has been compared with other authoritative land cover products in Italy and Germany, and good overall agreement was found (Brovelli et al., 2015; Jokar Arsanjani et al., 2015). Other studies have shown that when these products are compared with one another, there are large spatial disagreements between them (Fritz et al., 2011). The Geo-Wiki crowdsourcing tool has been developed as one way of involving citizens in collecting data on land cover using Google Earth imagery to improve global land cover maps (See et al., 2015). OSM provides an alternative, relatively unexploited source of LULC information that could also be used to generate, verify and validate LULC maps.