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Predicting OpenStreetMap Coverage by Means of Remote Sensing: The Case of Haiti

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Abstract : Accurate, complete, and up-to-date geospatial information is the foundation of successful disaster management. When the 2010 Haiti Earthquake struck, accurate and timely information on the distribution of critical infrastructure was essential for the disaster response community for effective search and rescue operations. Existing geospatial datasets such as Google Maps did not have comprehensive coverage of these features. In the days following the earthquake, many organizations released high-resolution satellite imagery, catalyzing a worldwide effort to map Haiti and support the recovery operations. Of these organizations, OpenStreetMap (OSM), a collaborative project to create a free editable map of the world, used the imagery to support volunteers to digitize roads, buildings, and other features, creating the most detailed map of Haiti in existence in just a few weeks. However, large portions of the island are still not fully covered by OSM. There is an increasing need for a tool to automatically identify which areas in Haiti, as well as in other countries vulnerable to disasters, that are not fully mapped. The objective of this project is to leverage different types of remote sensing measurements, together with machine learning approaches, in order to identify geographical areas where OSM coverage of building footprints is incomplete. Several remote sensing measures and derived products were assessed as potential predictors of OSM building footprints coverage, including: intensity of light emitted at night (based on VIIRS measurements), spectral indices derived from Sentinel-2 satellite (normalized difference vegetation index (NDVI), normalized difference built-up index (NDBI), soil-adjusted vegetation index (SAVI), urban index (UI)), surface texture (based on Sentinel-1 SAR measurements)), elevation and slope. Additional remote sensing derived products, such as Hansen Global Forest Change, DLR`s Global Urban Footprint (GUF), and World Settlement Footprint (WSF), were also evaluated as predictors, as well as OSM street and road network (including junctions). Using a supervised classification with a random forest classifier resulted in the prediction of 89% of the variation of OSM building footprint area in a given cell. These predictions allowed for the identification of cells that are predicted to be covered but are actually not mapped yet. With these results, this methodology could be adapted to any location to assist with preparing for future disastrous events and assure that essential geospatial information is available to support the response and recovery efforts during and following major disasters.

Keywords : disaster management, Haiti, machine learning, OpenStreetMap, remote sensing
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