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Change detection in and around UNESCO World Heritage sites including tropical forests

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UNESCO World Heritage sites including tropical forests require operational monitoring tools in and around their protected areas, as a support for REDD+ and biodiversity conservation actions. Considering the limited accessibility of these sites, remote sensing should become a key component of such monitoring tools. This study is part of a project that aims at designing an operational protocol for the processing of high resolution time series for the monitoring of protected UNESCO WH sites including tropical forests. Worldwide, 12 of those 76 sites have been selected to test the new method, and a 20 km buffer region has been added to the official boundaries in order to account for potential external threats and leakages. In total, the study area was approximately 170 000 sq km, covered by SPOT and Landsat images around three epochs.

The main focus of this study is on the forest change analysis in the South East Atlantic Forest WH site (12 000 sq km), which was accepted by UNESCO in 1999. The objective was to assess forest changes between 1990, 2000 and 2010 to see if the protected area status had an impact on the land cover dynamic in and around the site. A semi-automated change detection method was therefore designed. After state-of-the-art pre-processing of the SPOT and Landsat scenes, a Geographic Object-Based Image Analysis was designed for the change detection. This analysis includes three steps : i) to build spatio-temporal image regions, ii) to detect statistical outliers and iii) to classify the outliers in no change, deforestation, afforestation or forest degradation.

The first step consisted in the comparison between a multi-temporal image segmentation and a set of three linked single-date segmentations. The main challenge in this case was to build consistent analysis units through time, which could accommodate for small mis-registration errors. The second step compares two methods of automated detection of outliers in the map. These two methods are based on the iterative exclusion of the potential outliers using two different models for the representative or unchanged image regions. The last step includes a set of rules that classify outliers by crossing the temporal outlier detection with the spatial outlier detection. The generic design of the whole processing line aims at being ready for upcoming operational sensors.