Stratification of Democratic Republic of the Congo's forests using RapidEye satellite images processing: case study in the context of EO4REDD project.

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The Earth Observation for Reducing Emissions from Deforestation and forest Degradation (EO4REDD) project aims at developing an operational and cost-effective service for carbon stock changes monitoring in the REDD+ context of Maï Ndombe region, Democratic Republic of the Congo. The service combines in an innovative way the use of satellite, aerial and ground measurements data and is divided in three steps:

I. Mapping and quantifying forest cover changes using VHR satellite imagery (RapidEye - RE) ;
II. Measuring Above Ground Biomass (AGB) through dendrometric parameters extraction from airborne stereoscopic image pairs and allometric equations calibrated using ground measurements ;
III. Relating these two products to assess carbon stocks changes at regional scales.

This paper focus on the semi-automated object-based stratification of forests occurring in step I. This critical step allows to map large-scale forest typology and to detect areas of interest where field data and aerial images have to be acquired (in step II). As a result, a better accuracy of biomass changes estimates can be obtained. The overall strategy is to use a forest mask as starting point of a hierarchical process (*multi-threshold object-based segmentation techniques using the RE five bands spectral values and minimum object size as parameters*) that step-wise subdivides the large forest area into smaller but more homogeneous forest types. A stratification in five classes was developed on a 2000 km² area using RE data from 2012 and 2013: Dense Primary Forest, Secondary Forest Complex, Open Forest, Palm-dominated Forest and Fallow Forest. As the final objective is to estimate forest carbon stock changes on a given time-period, an analysis of forest cover losses due to deforestation and forest degradation was performed. Main forest cover losses occurred inside of Dense Primary (±50%) and Secondary forest classes (±40%). The carbon losses due to these forest cover changes were estimated using ground measurements and a literature review. Not using the stratification conducted to an overestimation of about 50% of these losses, illustrating the necessity of this process in order to calculate accurate carbon stock losses.

The approach developed will be improved in several ways during a second phase of the project. First, the classification in forest types was rather limited and could be expanded to cover a wider variety of classes. Ancillary data, such as DEM and theoretical watersheds, could be used to create buffer zones in which edaphic forest is likely dominant. Additional spectral information from other satellite data (SAR, Sentinel …) could be used, for example to develop a non-dependent method to cloud and haze covers. Finally, AGB estimates could be strengthened by using a larger sample of ground measurements.