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Lessons learned on forest biomass estimation in the six GLOBBIOMASS regional case studies

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The ESA GlobBiomass project aims to reduce uncertainties in current estimates of above-ground biomass (AGB) of forests by developing an innovative synergistic mapping approach at five regional sites for the epochs 2005, 2010 and 2015 and for one global map for the year 2010.

Biomass stock and change maps with spatial resolution of 50 – 150 m and with a multi-temporal approach comprising three epochs: 2000 or 2005, 2010 (reference year), and 2015 will be developed for these regions. The regional maps will aim for an overall accuracy of 80% (20% error) or better.

The five regions cover the most important forest biomes:

• Poland: Temperate forest

• Sweden: Boreal forest

• Indonesia: Tropical forest

• Mexico: Tropical forest-woodland transition

• South Africa: Forest-savanna mosaic

We report on progress in the GlobBiomass Task 5 (Regional Biomass Estimation) and describe the regional methods for generating the regional biomass maps and associated uncertainties.

The method to be used for regional biomass estimation in Poland will be based on Random Forest (Breiman, 2001). This machine-learning algorithm combines decision tree predictors such that each tree depends on the values of a random vector sampled independently and with the same distribution for all regression trees in the model.

In Sweden, two main approaches are foreseen: the k Nearest Neighbour (kNN) and the Water Cloud Model (WCM). The kNN algorithm is a non-parametric method used for regression, while the WCM algorithm describes the relationship between forest backscatter and forest variables.

For the Indonesian forest region, regional AGB maps will be derived based on regression modelling. The reference data are extrapolated by relating field observation to airborne LiDAR and the extrapolated maps will be used in the regional biomass mapping from space.

In the Mexican study region, a Maximum Entropy algorithm (MaxEnt) will be used to map AGB. The algorithm is widely used for estimation of species presence, and has recently been used for classification of remote sensing data.

In South Africa, CESBIO's methodology to map AGB using L-band SAR data and the MIPERS (Multistatic Interferometric Polarimetric ElectroMagnetic) model will be applied. The model simulations are used to study the relationships between the L-band radar backscatter and the forest AGB. The retrieval method has been developed at country scale for Cameroon's savanna and is being extended to the whole African savannas.

An analysis of accuracy and uncertainty is an inherent part of the work in all study regions. Despite the methodological diversity for the different AGB retrievals our analysis emphasizes the relevance of a spatially discrete description of uncertainty, identifies advantages and delineates cautionary notes on its use.