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3D SAR for the monitoring of forest biomass

Svein Solberg and Holger Lange
Norwegian Forest and Landscape Institute, Ås, Norway (svein.solberg@skogoglandskap.no)

The idea with this research is to develop a new, operational monitoring tool for forest biomass, or volume. We use satellite based 3D SAR (synthetic aperture RADAR) data to derive canopy height, and correlate this to biomass and volume. We are currently working on two methods of 3D SAR: radargrammetry and interferometry (InSAR), based on repeat-pass acquisitions (TerraSAR-X), and bi-static acquisitions (Tandem-X), respectively. From the SAR processing we get Digital Surface Models (DSM), from which we subtract a Digital terrain Model (DTM), resulting in a Canopy height Model (CHM). This CHM is then related to the ground truth, or ground reference data. This is field inventory data which is recalculated to volume and above-ground biomass based on allometric models. The results show linear relationship without saturation over the entire range of volume and biomass. The accuracy is moderate or fairly high as compared to other remote sensing methods, with RMSE values around 18% for forest stands, and about 4 % for 250 m2 plots. The linear relationship may enable monitoring of temporal changes in biomass and volume, without having a DTM as input, and the method would in this way be a possible method for tropical forest monitoring, where DTMs are rarely available. Some correction factors will be required. The retrieval of volume and biomass is influenced by topography (slope, aspect) and acquisition geometry, in particular incidence angle and flight direction (ascending vs. descending orbits). The differences are most pronounced in steep terrain. We present a correction algorithm for this using pairs of acquisitions, one ascending and one descending, using the local incidence angle as explanatory variable.