Monitoring forest biomass with Tandem-X

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Digital elevation models derived from interferometric X-band SAR may have a potential for forest biomass monitoring. In general, any method based on SAR has the advantage that it sees through clouds, and in addition a DEM contains information about forest height, which is crucial for biomass estimation. The basic idea pursued here is that there are two possible applications of an X-band DEM for forest biomass monitoring. First, if a DTM is available then biomass can be estimated by model inversion, based on InSAR height. Secondly, if a DTM is not available, biomass changes can be estimated from changes in the InSAR DEM. This latter approach, however, requires that the relationship between biomass and InSAR height is linear, i.e. that the dAGB / dIH is a constant. Here dAGB is a change in above ground biomass and dIH is a change in InSAR height. The objective with this study was to describe the relationship between AGB and InSAR height, with a particular focus on whether the relationship was linear or not. Our study area was in a Norway spruce dominated forest in Southeast Norway. This was covered by one ascending and one descending Tandem-X acquisition. The two bi-static Tandem-X image pairs were processed for interferometry resulting in two DEMs. The 2 DEMs were averaged into one final DEM. From this DEM we subtracted a DTM, which had been generated from airborne laser scanning. The result was an InSAR height model, which corresponds to a canopy height model. We established at the same time a set of field plots, being circular and 250 m2 large. On these plots we measured diameter at breast height on all trees, and height on a subsample of trees, and based on allometric models we derived AGB for each plot as a ground truth. We assigned each plot to the nearest 10mx10m pixel in the InSAR height data set, and based on that data set we derived models describing the relationship between AGB and InSAR height. We fitted a model to the data. From an initial full model including an intercept, a slope and an exponential term, we reduced the model step by step by removing non-significant terms. The final model was a no-intercept, linear model, where AGB was proportional to InSAR height. Accordingly, for such a forest, the biomass changes could be monitored without having a DTM available. In addition, strong decreases in the InSAR DEM and coherence are used for clear-cut detection.