FOREST BIOMASS ESTIMATION FROM TANDEM-X INTERFEROMETRY

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This paper presents an overview of the TanDEM-X (TDM) research performed by Chalmers University of Technology and Swedish University of Agricultural Sciences. The objective is to investigate estimation of forest variables using TDM data in Swedish boreal forests.

Large amounts of TDM data of the two test sites Remningstorp and Krycklan in southern and northern Sweden, respectively, have been processed and analysed. Evaluation shows that the quality of TDM data is excellent, and that temporal decorrelation for small azimuth baseline configurations is small due to the near-simultaneous acquisitions.

The research shows that height and biomass can be estimated with RMSE down to about 5% and 15%, respectively, at stand level. These results assume that a high-resolution DTM of the ground surface is available and that the phase is corrected for the ground height. These are excellent results based on spaceborne data, and in parity with estimates from ALS (airborne laser scanning). The best results are obtained during summer conditions where the canopy attenuation is in general higher. Results have been obtained by estimation based on the interferometric phase height using coherence modelling or linear regression, with and without training data. Up-scaling to larger areas has also recently been initiated. The objective is to cover all of Sweden in the end but the first step is to cover parts of the region Västra Götaland.

Two different but related coherence models have been investigated, i.e. the Two-Level Model (TLM) and the Interferometric Water Cloud Model (IWCM). Both models include ground and vegetation scattering components as well as volume height and a measure of the fraction covered by vegetation. The main difference between the models is that TLM is based on using only the complex coherence whereas IWCM also uses the backscattering coefficient. Model inversion is straightforward with TLM since the number of unknowns equals the number of model parameters. IWCM, on the other hand, has more unknowns and therefore a different approach is needed. A least-squares method has been developed to estimate the model parameters based on TDM data extracted over a number of stand polygons. The results show that the models complement each other and that both can be used to develop algorithms for forest biomass estimation.

Promising results have also been obtained for estimating biomass change as well as from using the alternating bistatic mode. These approaches, however, do not rely on the availability of a ground DTM.