Relating Radar Backscatter to Boreal Forest Canopy Parameters

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In the past few years, many studies have focused on the use of radar data for monitoring and mapping the aboveground vegetation biomass over various ecologically significant regions of the Earth's surface. Although there is a common agreement that the radar data at low frequencies show a strong correlation with the biomass distribution, vegetation type and architecture, the development of algorithms for inferring canopy parameters are yet to be achieved. During, the first intensive field campaign for the Boreal Ecosystem Atmospheric Study (BOREAS) in August of 1993, AIRSAR data were acquired over the entire BOREAS study area. One of the objectives of the AIRSAR deployment was to examine the sensitivity of the radar signal to vegetation type and biomass distribution in the boreal forest and to develop algorithms for inferring vegetation parameters. During the experiment a set of ground measurements were also made to support the AIRSAR data analysis. The dominant stands in the study area consist of black spruce, young jack pine, old jack pine, and aspen. These stands represent a wide range of biomass and canopy architectural variations which can be distinguished in SAR images. In this paper, we will discuss the feasibility of mapping the boreal forest canopy parameters by making use of the polarimetric SAR data, The mapping procedure is based on using a backscatter model to understand the sensitivity of the radar signal to the parameter of interest and developing a semi-empirical model for estimation and mapping application on SAR imagery. In this paper, we use a multilayer polarimetric radar backscatter model to examine the sensitivity of the radar signal to canopy water content, foliage biomass and leaf area index (LAI). It is shown that the sensitivity of the radar signal to these parameters is also a function of the canopy geometry and structure. Finally, a semi-empirical model for the canopy water content is developed by estimating structural parameters from field measurements and training areas in SAR images. The model is employed to estimate the crown and total canopy water content which are then used to produce a biomass map of the BOREAS study area. The estimation result shows an agreement with the biomass values obtained from field experiments and allometric equations.

This work is performed at the Jet Propulsion Laboratory, California Institute of Technology, under contract from the National Aeronautic and Space Administration.