Analysis of the effect of crown structure changes on backscattering coefficient using modeling and SAR data

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Abstract

Stand level forest canopy structure such as the size, density, and distribution of the branches and leaves may have a strong effect on radar backscatter. In this study, several broad-leaf (birch) stands and needle stands (larch) with different growing stages and different canopy structures are established using parametric and stochastic L-system. Birch and larch are the dominant species in northeast China boreal forest. Stands with 10, 30, 50 years and with 10, 40, 100 years, which correspond to young, mid-age and mature birch and larch stands respectively, are simulated according to field measurements. To stands with the same age, the above ground biomass is almost the same. Then different 3-D birch and larch crown architectures faithful to the real stand are generated using L-system, which provide realistic and detailed canopy biometric data for radar model. The radar model used here is a 3-D forest radar backscatter model based on the Radiative Transfer Theory, which considers the tree crown distribution during backscattering calculation and is used to simulate the backscatter coefficients of these stands.

In this paper, total 60 stands with 30*30m area, namely three stand ages, ten canopy structures and two species, are simulated and analyzed at C-, L-band with different polarizations. Simulation results show that the backscatter coefficient is sensitive to the canopy structure, particularly at C-band and L-band HV polarization. The discrepancy between birch and larch stands with the same tree age is distinct. Especially to the birch stands, the effect of crown structure changes on backscattering can reach to 12dB at C-HV and 7.9dB at L-HV respectively. To larch stands, the discrepancy could be 5.9dB at C-band. And the crown structure effect to the C-band is more obvious than L-band because of its short wavelength. Then the simulation results of L-HH, C-HH and C-HV polarizations are compared with JERS-1, ASAR data of Changqing forest farms located at DaXinAnLing, northeast of China, which shows good correspondence.

Reference

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