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Radar backscatter sensitivity of soil moisture in vegetation covered areas

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Radar backscatter is sensitive to the water content of bare soil surface. Vegetation cover masks the soil surface, reducing the sensitivity of the radar backscatter to soil moisture. The water-cloud model is used to account for vegetation effects on the copolarized backscatter coefficient in C and L band.

In this sensitivity study, two different models for opacity are compared to examine their impact on the sensitivity of total backscatter to soil moisture in the presence of vegetation. The retrieval algorithms in practice use average value of vegetation factor (b) to calculate the vegetation optical depth ($\tau = bW_c$) and its transmissivity. This empirical factor depends only on vegetation type. In the second model for opacity, dielectric mixing model, vegetation attenuation properties are calculated based on the dielectric mixing model which accounts for the amounts of free and bound water in the vegetation.

For all vegetation conditions, vegetation transmissivity decreases linearly with water content for $\tau = bW_c$ model. Using the dielectric mixing model, free water present in the vegetation is the dominant factor controlling opacity for high vegetation water conditions and the vegetation transmissivity decreases exponentially with water content.

The predicted sensitivity of the total backscatter to soil moisture is much higher when opacity is calculated using the $\tau = bW_c$model rather than the dielectric mixing model.