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# Estimation of vegetation parameters such as Leaf Area Index from polarimetric SAR data

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This work presents the analysis of the capability to use the radar backscatter coefficient in semi-arid zones to estimate the vegetation crown in terms of Leaf Area Index (LAI). The research area is characterized by the presence of a pine forest with shrubs as an underlying vegetation layer (understory), olive trees, natural grove areas and eucalyptus trees. The research area was imaged by an airborne RADAR system in L-band during February 2009. The imagery includes multi-look radar images. All the images were fully polarized i.e., HH, VV, HV polarizations. For this research we used the central azimuth angle (113°). We measured LAI using the ΔT Sun Scan Canopy Analysis System. Verification was done by analytic calculations and digital methods for the leaf's and needle's surface area. In addition, we estimated the radar extinction coefficient of the vegetation volume by comparing point calibration targets (trihedral corner reflectors with 150cm side length) within and without the canopy. The radar extinction in co- polarized images was ∼26dB and ∼24dB for pines and olives respectively, compared to the same calibration target outside the vegetation.

We used smaller trihedral corner reflectors (41cm side length) and covered them with vegetation to measure the correlation between vegetation density, LAI and radar backscatter coefficient for pines and olives under known conditions.

An inverse correlation between the radar backscatter coefficient of the trihedral corner reflectors covered by olive branches and the LAI of those branches was observed. The correlation between LAI and the optical transmittance was derived using the Beer-Lambert law. In addition, comparing this law's principle to the principle of the radar backscatter coefficient production, we derived the equation that connects between the radar backscatter coefficient and LAI.

After extracting the radar backscatter coefficient of forested areas, all the vegetation parameters were used as inputs for the MIMICS model that simulates the radar backscatter coefficient of pines. The model results show a backscatter of -18dB in HV polarization which is 13dB higher than the mean pines backscatter in the radar images, whereas the co-polarized images revealed a backscatter of -10dB which is 23dB higher than the actual backscatter value deriver from the radar images. Therefore, next step in the research will incorporate other vegetation parameters and attempt to understand the discrepancies between the simulation and the actual data.