



## Multi-temporal and multi-angular bistatic specular scattering measurement of corn crop field using scatterometer at multi-frequency (L, C, and X bands) and co-polarizations (HH and VV)

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### Abstract

Multi-temporal and multi-angular bistatic scatterometer measurements were conducted on the specially prepared corn crop-bed of an area  $10 \times 10 \text{ m}^2$  at multi-frequencies (X, C, and L bands) and co-polarizations (HH- and VV-polarisation) for the angular incidence angle ranging from  $20^\circ$  -  $60^\circ$  at eight growth stages of the crop in the specular direction ( $\phi=0$ ). The purpose of this measurements was to find out whether the bistatic radar systems can provide a performance, in terms of sensitivity to vegetation parameters, equal to or greater than the performance of monostatic radar systems. Therefore, the computed specular scattering coefficients ( $\sigma^\circ$ ) at multi-frequencies (X, C, and L bands) for co-polarizations (HH- and VV-polarisation) of corn crop field were analysed with measured corn crop growth variables for the angular incidence angle ranging from  $20^\circ$  -  $60^\circ$  at eight growth stages of the crop. The crop growth variables such as fresh biomass (FBm), leaf area index (LAI), plant height (PH), and vegetation water content (VWC) were considered for the corn crop. The corn crop growth variables were measured on each day of the bistatic specular scattering measurements. The temporal changes in the bistatic specular scattering coefficients ( $\sigma^\circ$ ) for all the three bands followed the patterns with the measured corn growth variables. The correlation analysis was carried out between  $\sigma^\circ$  and measured corn growth variables to select the optimum frequency, polarization and angle of incidence of the bistatic specular scatterometer system for the measurement of corn crop field. The results of the correlation analyses showed that X-band for VV-polarization at  $40^\circ$  angle of incidence had the highest correlation coefficient with the crop growth variable LAI ( $R = -0.989$ ) and PH ( $R = -0.988$ ). Whereas, FBm ( $R = -0.978$ ) and VWC ( $R = -0.974$ ) were found highest at L-band for HH-polarization at  $50^\circ$  angle of incidence. These experimental results may provide the useful information for the design of future bistatic radar system for sensing the corn crop as well as other agricultural applications.

**Keywords:** Bistatic scatterometer system; Corn crop; FBm; LAI; VWC

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