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Robust retrieval of surface soil moisture across wide-ranging incidence angles over short crops: for application to NI-SAR

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We present our ongoing efforts to deliver surface soil moisture information at agricultural field scales using airborne or satellite synthetic aperture radar (SAR) data through the development and inversion of physical models for forward radar scattering from vegetation surfaces. While the past successful results were validated at 40-deg incidence angle for the Soil Moisture Active passive mission, the current work extends the incidence angle range from 30 to 50 degs so that the algorithm may apply to the future L-band NASA-ISRO SAR (NI-SAR) mission. NI-SAR aims at providing global soil moisture data at 200m resolution every 6 days.

The soil moisture retrievals were validated over agriculture sites in Canadian Prairies using L-band airborne SAR data, where the fields experienced entire crop growth stages and two cycles of wetting and drydowns. The forward models were developed over NI-SAR's incidence angle range of 30 to 50 degs for individual crops.

The estimates are accurate to unbiased rmse of 0.053, 0.058 and 0.047 m³/m³ in volumetric water content for soybean, wheat, and pasture fields respectively over diverse conditions of vegetation growth and soil wetness. Surface roughness and vegetation amount were retrieved simultaneous to the soil moisture solutions. The roughness estimates are realistic.

There was no significant effect of the local incidence angle on the retrieval performance, most likely because the path length of the radar wave through the vegetation (and therefore extinction of the soil moisture signal) did not vary much with incidence angle. The results are encouraging for successful soil moisture mapping for the NI-SAR mission.