MODELING AND ANALYSIS OF COHERENT BISTATIC SCATTERING FROM CROPLANDS AND FORESTS

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Soil moisture is one of the most important parameters in studying the global ecosystems, exerting first-order control on land-atmosphere interactions. Soil moisture measurements on global and local scales also play an indispensable role in weather forecasting, flood prediction, understanding of energy, carbon, and water cycling in the ecosystem.

Extending typical radar scattering models to beyond the monostatic backscatter direction allows the opportunity to investigate novel and potentially more effective soil moisture estimation techniques, which take advantage of bistatic observation strategies. These include L-band GPS/GNSS reflected signals and the UHF MilComSat reflected signals. The information content of such bistatic multi-angle measurements is potentially richer than just the backscattering scenario. Furthermore, it is possible to achieve the measurements through passive receiver systems, which are simpler and less expensive than the conventional fixed incidence angle monostatic radar observatories.

This paper will present a coherent bistatic forward scattering model at L-Band and P-band for different terrain types and various land covers. This proposed coherent bistatic scattering model has the same three major categories of contributions as the monostatic case: (a) direct ground scattering (b) vegetation volume scattering and (c) scattering due to interactions between ground and the overlaying vegetation. However, each mechanism has to be generalized and adapted to all scattering angles instead of just the backscatter case. Each contribution is determined and calculated from analytical scattering definitions of contributing constituents, however unlike conventional radar scattering models, above ground ($0 \leq \phi \leq 360; 0 \leq \theta \leq 90$) bistatic wave scattering and radar backscatter cross-sections are determined.

The applicability of this bistatic scattering model for soil moisture estimation will be demonstrated via numerical simulations and sensitivity analysis for geometries mimicking bistatic measurement scenarios. Future work includes examining model performance with data available from bistatic platforms such as GPS/GNSS reflectometry to assess model validity.