APPLICATION OF THE TOR VERGATA SCATTERING MODEL TO L BAND BACKSCATTER DURING THE CORN GROWTH CYCLE

A. T. Joseph[1], R. van der Velde[2], P.E. O'Neill[1], R. Lang[3], and T. Gish[4]

[1]Hydrological Sciences Branch/614.3, Hydrospheric and Biospheric Sciences Laboratory, NASA/Goddard Space Flight Center (GSFC), Greenbelt, MD 20771 USA, Tel: 301-614-5804, Fax: 301 -614-5808, e-mail: Alicia.T.Joseph@nasa.gov, Peggy.E.ONeill@nasa.gov

[2] Faculty of Geo-Information Science and Earth Observation (ITC), University of Twente, Enschede, Hengelosestraat 99, P.O. Box 6, 7500 AA Enschede, The Netherlands, e-mail: velde@itc.nl

[3]Dept. of Electrical and Computer Engineering, George Washington University, Washington, DC 20052 USA, Tel: 202-994-6199, Fax: 202-994-0227, e-mail: lang@gwu.edu

[4]Hydrology & Remote Sensing Lab, USDA-ARS, Beltsville, MD 20705 USA, Tel: 301-504-8378, Fax: 301-504-8931, e-mail: timothy.gish@ars.usda.gov

At the USDA's Optimizing Production Inputs for Economic and Environmental Enhancement (OPE^3) experimental site in Beltsville (Maryland, USA) a field campaign took place throughout the 2002 corn growth cycle from May 10th (emergence of corn crops) to October 2nd (harvest). One of the microwave instruments deployed was the multi-frequency (X-, C- and L-band) quad-polarized (HH, HV, VV, VH) NASA GSFC / George Washington University (GWU) truck mounted radar. During the field campaign, this radar system provided once a week fully polarized C- and L-band (4.75 and 1.6 GHz) backscatter measurements from incidence angle of 15, 35, and 55 degrees. In support of these microwave observations, an extensive ground characterization took place, which included measurements of surface roughness, soil moisture, vegetation biomass and morphology. The field conditions during the campaign are characterized by several dry downs with a period of drought in the month of August. Peak biomass of the corn canopies was reached at July 24th with a total biomass of approximately 6.5 kg m^{-2}. This dynamic range in both soil moisture and vegetation conditions within the data set is ideal for the validation of discrete medium vegetation scattering models.

In this study, we compare the L band backscatter measurements with simulations by the Tor Vergata model (Ferrazzoli and Guerriero 1996). The measured soil moisture, vegetation biomass and most reliably measured vegetation morphological parameters (e.g. number of leaves, number of stems and stem height) were used as input for the Tor Vergata model. The more uncertain model parameters (e.g. surface roughness, leaf thickness) and the stem diameter were optimized using a parameter estimation routine based on the Levenberg-Marquardt algorithm. As cost function for this optimization, the HH and VV polarized backscatter measured and simulated by the Tor Vergata model for incidence angle of 15, 35 and 55 degrees were used (6 measurements in total). The calibrated Tor Vergata model simulations are in excellent agreement with the measurements of Root Mean Squared Differences (RMSD's) of 0.8, 0.9 and 1.4 dB for incidences of 15, 35 and 55 degrees, respectively. The results from this study show that a physically based scattering model with the appropriate parameterization can accurately simulate backscatter measurements and, as such, have the potential of being used for the retrieval of biophysical variables (e.g. soil moisture and vegetation biomass).

P. Ferrazzoli, and L. Guerriero, "Passive microwave remote sensing of forests: a model investigation", *IEEE Transactions on Geoscience Remote Sensing*, vol. **34**, pp. 433-443, Mar. 1996.