Soil Moisture Retrieval From C- And L-Band Radar Observations Acquired 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, 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]International Institute for Geo-Information Science and Earth Observation (ITC), 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

Abstract

A field campaign was conducted to analyze the impact of vegetation on microwave observations at the USDA[1]'s Optimizing Production Inputs for Economic and Environmental Enhancement (OPE[3]) experimental site in Beltsville (Maryland, USA). This campaign took place during the corn growth cycle from May 10th to October 2nd, 2002. Ground conditions were observed through in-situ measurements. These measurements included soil moisture, soil temperature, vegetation biomass and surface roughness and were taken around the periphery of the radar footprint to preserve the integrity of the footprint. Soil moisture of the top 5-cm was measured using a gravimetric sampling technique and portable impedance probes (Delta-T theta probe) at twenty-one sites located at the edge of a 67.1m x 33.5 m rectangular area situated around the radar footprint. Vegetation biomass was quantified through the destructive measuring technique applied to a 1 m^2 area (approximately 12 plants). During this period the corn crops reached at peak biomass a vegetation water content of 5.1 kg m^{-2} and soil moisture values ranging between 0.00 to 0.26 cm^3cm^{-3}. The range in biomass and soil moisture conditions observed during this field campaign forms a solid basis for a robust validation of the soil moisture retrieval algorithms.

One of the microwave instruments deployed for this campaign was a multi-frequency (C-band (4.75 GHz) and L-band (1.6 GHz)) and quad-polarized (HH, HV, VV, VH) radar. In the OPE[3] field campaign, radar observations were collected once a week (usually on Wednesdays weather permitting) at 8 am, 10 am, 12 noon and 2 pm. During each data run the radar acquired sixty independent measurements within an azimuth of 120 degrees from a boom height of 12.2 m and at three different incidence angles (15, 35, and 55 degrees). The sixty observations were averaged to provide one backscatter value for the study area and its accuracy is estimated to be 1.0 dB. By averaging of the measurements, row effects are assumed to be reduced.

In this investigation, an analysis is presented of the vegetation effects on C- and L-band radar observations and their sensitivity to soil moisture. It is shown that when the observations are corrected for the effects of vegetation soil moisture uncertainties can be obtained of 0.033 – 0.064 cm^3cm^{-3} for C- as well as L-band depending on the view angle and polarization.

[1]USDA ~ United States Department of Agriculture

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