# VEGETATION EFFECTS ON MICROWAVE SIGNALS OBSERVED DURING THE CORN GROWTH CYCLE

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## 1. INTRODUCTION

Satellite missions carrying passive microwave instruments for monitoring soil moisture globally have recently been launched (e.g. Soil Moisture and Ocean Salinity (SMOS)) and are being prepared for launch (e.g., Aquarius (expected launch: May 2010) and Soil Moisture Active Passive (SMAP, expected launch: 2014)). Among the challenges in retrieving soil moisture from passive microwaves is, however, the requirement to account for the effects of vegetation. Accounting for the vegetation effects is based on the parameterization of the transmissivity coefficient ($\gamma$) and the single scattering albedo ($\omega$). For large scale soil moisture retrieval applications, the $\omega$ is assumed to be a time-invariant constant depending only on the vegetation morphology, while the $\gamma$ is implemented as a time-dependent variable affected by the vegetation morphology and the density of the vegetation. Single channel retrieval algorithms are generally considered as a solution, but it makes use of the ancillary data approach to derive the $\gamma$.

The ancillary data approach is based upon the formulation of the $\gamma$ as a function of the vegetation water content ($W$) and an empirical constant, the $b$ parameter. Experimental investigations [e.g. 1-3] have shown that the empirical constant is specific for each crop type and may depend on the morphology of the vegetation cover. Although the empirical constant is often implemented as a single time-invariant parameter, there is evidence that variations in the vegetation morphology throughout the growth cycle may affect the empirical constant and, thus, the determination of the $\gamma$ and the retrieval of soil moisture.

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 to October 2nd, 2002), in which both passive and active microwave instruments were deployed. C- and L-band (4.75 and 1.6 GHz) active microwave measurements were provided once a week at incidence angles of 15, 35 and 55 degrees by the NASA GSFC / George Washington University (GWU) truck mounted quad-polarized (HH, HV, VV, VH) radar system. An automated dual-polarized (H and V) L-band (1.4 GHz) radiometer, called Lrad, was scheduled to acquire measurements on an hourly basis at five incidence angle (25, 35, 45, 55 and 60 degrees). However, mechanical difficulties with the scanning system produced gaps in its data record. In support of these microwave observations, a comprehensive sampling scheme was executed for monitoring the soil and vegetation conditions aprroximamately once every week. These measurements included soil moisture, soil temperature, vegetation biomass and vegetation morphology. Figure 1 gives an impression of the experimental setup and field conditions (e.g. soil moisture, vegetation biomass and rainfall) throughout the campaign.

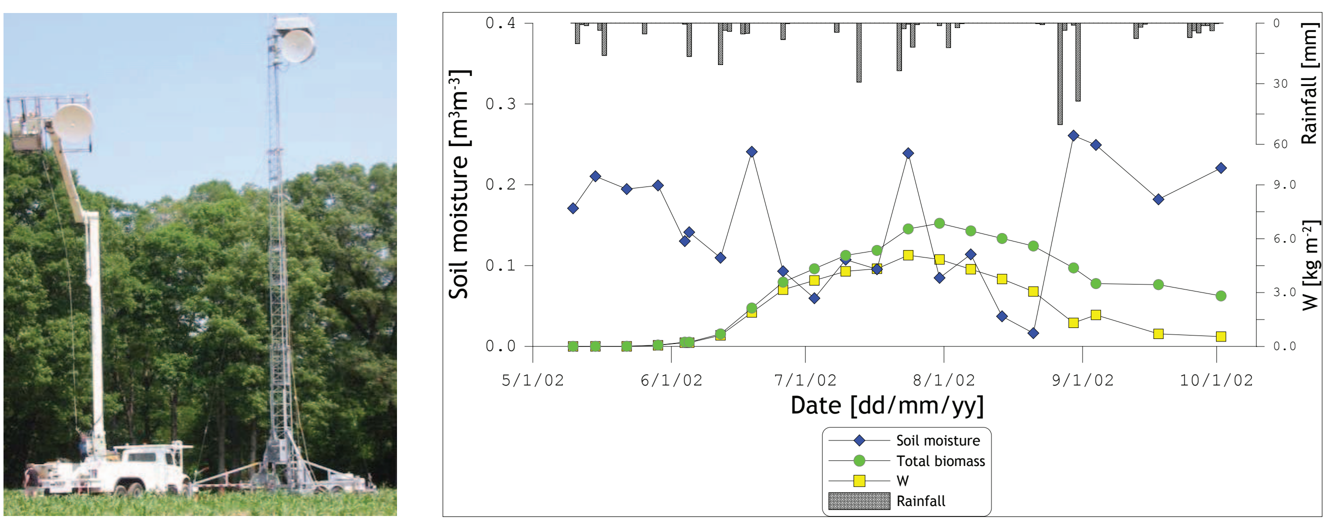


**Figure 1:** Impression of the experimental setup and field conditions (soil moisture, vegetation biomass and rainfall) measured throughout the campaign.

## 2. RESULTS

In this investigation, we use the radar measurements and discrete medium scattering models [e.g. 4-6] to estimate the $\gamma$ throughout the corn growth cycle. Subsequently, the obtained values for the $\gamma$ are used for the retrieval of soil moisture from the passive microwave measurements. The comparison of measured to retrieved soil moisture is quite good, with a root mean square error of about ~ 0.03 $m^3$ $m^{-3}$. The presented method similar to one presented by O'Neill et al. [7] can be seen as a contribution to the development of a truly combined passive/active microwave soil moisture retrieval algorithm desired for future missions, such as SMAP and Aquarius.

## 3. REFERENCES


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