ON THE ABILITY OF THE ERS SCATTEROMETER TO DETECT VEGETATION PROPERTIES

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Thorough observations of the vegetation characteristics are provided by the optical and thermal remote sensing data. These data provide information on vegetation greenness (NDVI, EVI), structure (LAI), as well as biomass (NPP) and were applied in a variety of fields ranging from the phenological variability at local or regional scale [5] to the global detection of the carbon sinks and sources [3]. The greenness products representing the energy absorption of the vegetation have significantly improved our understanding on vegetation characteristics. Although the biomass and structural products are often derived from the NDVI datasets [2, 8], they have not been yet clearly understood and lag thorough validation studies.

The limitations of the biomass estimates with use of optical data encouraged recent research in microwave remote sensing of vegetation. An ability of the microwaves to partially penetrate vegetation and the sensitivity to the vegetation properties has been introduced [4, 7, 9]. According to latter studies the active and passive microwave data may provide complementary measurements to optical and thermal data. In addition, the microwave signal was shown sensitive to the leafy part as well as to the vegetation structure and biomass.

The sensitivity of active microwave sensors – like the ERS-1/2 scatterometer - to vegetation properties has been demonstrated by Frison [1] and Wagner [9]. A substantial agreement was found between vegetation development as indicated by the NDVI and backscatter especially at large incidence angles [1]. Wagner [9] then studied the capability of ERS to monitor seasonal vegetation development over Iberian Peninsula. In particular, he studied the slope representing the change of the ERS backscatter with incidence angle and concluded that by averaging the slope values over several years, the noise is suppressed and the resulting values may be useful for vegetation phenology, in particular biomass.

In this study, the contribution of different vegetation parameters to the ERS backscatter characteristics is investigated. The focus is brought on relationships between slope of the backscatter and vegetation parameters representing vegetation structure (LAI) and biomass (NPP). For this purpose, the long time series of ERS-1/2 scatterometer processed at the Vienna University of Technology are applied together with optical data product – MODIS Leaf Area Index – Fraction of Photosynthetically Active Radiation (MYD15A2) acquired from the Land Processes Distributed Active Archive Center (LPDAAC: https://wist.echo.nasa.gov/api/). The temporal characteristics of the backscatter and slope are studied over the main agricultural areas in the Great Plains, USA. Change in the slope values over a soy bean field at the end of April and August, respectively, is demonstrated in Figure 1.

Taking into account the contribution of the soil and vegetation to the backscatter at different incidence angles, an optimal incidence angle for vegetation studies is determined, at which the influence of the soil is limited to minimum. Further, the temporal patterns of the backscatter slope and the operational optical vegetation indices are related. Since the slope represents the situation over several years, also the vegetation indices are averaged over several years. The similarities and discrepancies in the temporal characteristics of the optical and microwave characteristics are introduced and their relationship to the vegetation structure as identified by LAI and classes of the Simple biosphere model [6] are discussed.

Despite the broad research focusing on vegetation characterization with use of data from optical and thermal remote sensing, considerable gaps exist especially in the characterization of vegetation structure and biomass. The synergistic use of optical, thermal and microwave data can be of merit for these characteristics at large scale. Preliminary results provide an improved understanding of the vegetation backscatter over selected agricultural areas with the use of the ERS scatterometer. These

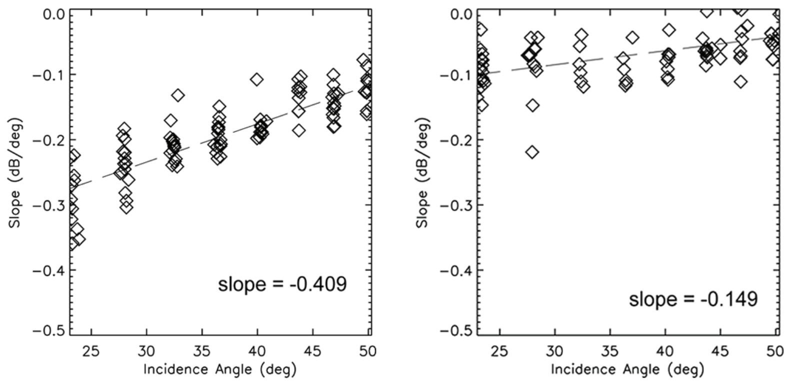

Figure 1. Scatter plot of the slope versus the incidence angle for the cropland site (43.04, -96.90) at the end of April (left) and the end of August (right), respectively. The values are based on data from the ERS-1/2 scatterometer.

findings may further improve the ecosystem and climate modeling and monitoring and in particular, may bring benefit for crop yield monitoring and carbon modeling. With the recent launch of the METOP satellite, the continuity of the ERS mission has been assured until 2021 allowing for long-term studies of the vegetation characteristics.

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