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# Scaling Effects observed in in-situ Soil Moisture and Remote Sensing Data over an semi-arid Region in Spain

C. Pathe (1) and W. Wagner (2)

(1) Vienna University of Technology, Institute of Photogrammetry and Remote Sensing, Gusshausstrasse 27-29, A-1040 Vienna (cp@ipf.tuwien.ac.at), (2) Christian-Doppler-Laboratory "Spatial Data from Laser Scanning and Remote Sensing", Gusshausstrasse 27-29, A-1040 Vienna (ww@ipf.tuwien.ac.at)

Soil moisture is an important parameter in a variety of environmental processes. There are a number of different direct and indirect techniques for measuring soil moisture. In-situ measurements of soil moisture provide exact values but they only represent point observations. Space borne remote sensing methods can provide indirect measures for extracting areal estimates of soil moisture. Due to their high sensitivity to soil moisture, especially active remote sensing systems such as Scatterometers and SAR´s have been used in the past for soil moisture retrieval studies. Scatterometers are characterised by high temporal but only a coarse spatial resolution, whereas conventional SAR systems provide spatial high resolution data at low repeat intervals. ScanSAR systems like the ASAR installed on ENVISAT combine the advantages of both scatterometers and SAR´s. The ScanSAR modes of the ASAR sensor can obtain data on a weekly basis at a spatial resolution of 150 m in Wide Swath Mode and 1000 m in Global Monitoring Mode.

Soil moisture retrieval using active systems is affected by the influence of surface roughness and vegetation cover. Most studies on soil moisture retrieval from radar data work on a field scale or even smaller. To make use of the newly available ENVISAT ASAR ScanSAR modes, they first have to be understood. Therefore we were interested in answering the question, if radar data at spatial scales of 150 m and 1000 m can be linked with in-situ soil moisture measurements, when assuming, that surface roughness effects can be neglected at these resolutions and the influence of the vegetation remains constant throughout the observed period.

Our study is based on an extensive and valuable in-situ soil moisture data base. A test site of 1285 $km^2$ situated in an semi-arid, Mediterranean environment in the Duero Basin in Spain is equipped with 24 permanent TDR soil moisture stations, measuring soil moisture at four depths on a regular basis since 1999. Envisat ASAR Wide Swath images have been recorded during autumn 2003 as well as throughout spring and early summer 2004.

When linking in-situ soil moisture data and active remote sensing data, scale effects have to examined first. Therefore in-situ soil moisture data were analysed on two different spatial scales. Regional means of the soil moisture measurements for one date were calculated and compared to soil moisture values at single TDR soil moisture stations. It can be shown, that locally measured soil moisture correlates well with the regional mean of all stations for one date. Knowing the residuals and their standard deviations for each measurement station, conclusions can be drawn from the regional trend to the local value of the soil moisture. Repeating this method for the radar data by extracting and using the radar backscattering coefficients, similar good correlations and relations between regional and local data were observed. Finally, we tried to establish an appropriate backscatter model for extracting soil moisture information from radar data.