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Spatial distribution of soil moisture obtained from gravimetric and TDR methods for SMOS validation, at the Polesie test site SVRT 3275, in Poland

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The purpose is obtaining trustful ground based measurement data of SM (Soil Moisture) for validating SMOS, respectively to spatial and temporal distribution and variations. A use of Time Domain Reflectometric (TDR) method is fast, simple and less destructive, to the soil matter, than a usual standard gravimetric method. TDR tools operate efficiently, enable nearly instant measurements, and allow on collecting many measurements from numerous sites, even when operated manually in short time intervals. The method enables also very frequent sampling of SM at few selected fixed sites, when long terms of temporal variations are needed. In effect one obtains reasonably large data base for determining spatial and temporal distributions of SM. The study is devoted to determining a plan on collecting TDR data, in the scales of small and large field areas, and checking their relevance to those available from gravimetric methods. Finally, the ground based SM distributions are needed for validating other SM distributions, available remotely in larger scales, from the satellite data of ENVISAT-ASAR, and from SMOS (Soil Moisture and Ocean Salinity Mission) when it becomes operational. The ground based evaluations are served mainly by geo-statistical analysis. The space borne estimations are retrieved by image processing and physical models, proper to relevant Remote Sensing (RS) instruments on the orbit. Finally, validation must engage again the geo-statistical evaluations, to assess the agreement between direct and remote sensing means, and provide a measure of trust for extending the limited scales of the ground based data, on concluding the agreement in scales proper to the satellite data. The study is focused mainly on trustful evaluating data from the ground, provided independently on satellite data sources.

SM ground based data are collected permanently at 2 selected tests sites, and temporary in areas around the tests sites, in one day sessions, repeated several times per vegetation season. Permanent measurements are provided in profiles, down to 50 cm below surface. Temporary SM measurements are collected by hand held TDR (FOM/mts type, Easy Test Ltd., Lublin, Poland) from the top surface layer (1-6 cm), in a grid covering small and large areas, containing few hundred sites. The same places are served by collecting soil samples for the gravimetric analysis of SM, bulk density, other physical and textural characteristics. Sessions on measurement in large areas on the scale of community are repeated for separate days. The two methods used were compared with correlation coefficient, regression equation and differences of values. The spatial variability of soil moisture from gravimetric and TDR measurements were analyzed using geostatistical methods. The semivariogram parameters were determined and mathematical functions were fitted to empirically derived semivariograms. These functions were used for estimation of spatial distribution of soil moisture in cultivated fields by the kriging method.

The results showed that spatial distribution patterns of topsoil soil moisture in the investigated areas obtained from TDR and gravimetric methods were in general similar to each other. The TDR soil moisture contents were dependent on bulk density and texture of soil. In areas with fine-textured soils of lower soil bulk densities (approximately below 1.35 Mg m-3) we observed that TDR soil moisture and spatial differentiation were greater compared to those with gravimetric method. However at higher bulk densities the inverse was true. The spatial

patterns were further modified in areas with domination of coarse-textured soils. Decrease of measurement points results in smoothing soil moisture pattern and at the same time in a greater estimation error. The TDR method can be useful tool for ground moisture measurements and validation of satellite data. The use of specific calibration or correction for soil bulk density and texture with respect to the reflectometric method is recommended.

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