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Soil moisture optimal sampling strategy for Sentinel 1 validation super-sites in Poland

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Soil moisture (SM) exhibits a high temporal and spatial variability that is dependent not only on the rainfall distribution, but also on the topography of the area, physical properties of soil and vegetation characteristics. Large variability does not allow on certain estimation of SM in the surface layer based on ground point measurements, especially in large spatial scales. Remote sensing measurements allow estimating the spatial distribution of SM in the surface layer on the Earth, better than point measurements, however they require validation.
This study attempts to characterize the SM distribution by determining its spatial variability in relation to the number and location of ground point measurements. The strategy takes into account the gravimetric and TDR measurements with different sampling steps, abundance and distribution of measuring points on scales of arable field, wetland and commune (areas: 0.01, 1 and 140 km2 respectively), taking into account the different status of SM.
Mean values of SM were lowly sensitive on changes in the number and arrangement of sampling, however parameters describing the dispersion responded in a more significant manner. Spatial analysis showed autocorrelations of the SM, which lengths depended on the number and the distribution of points within the adopted grids. Directional analysis revealed a differentiated anisotropy of SM for different grids and numbers of measuring points. It can therefore be concluded that both the number of samples, as well as their layout on the experimental area, were reflected in the parameters characterizing the SM distribution.
This suggests the need of using at least two variants of sampling, differing in the number and positioning of the measurement points, wherein the number of them must be at least 20. This is due to the value of the standard error and range of spatial variability, which show little change with the increase in the number of samples above this figure. Gravimetric method gives a more varied distribution of SM than those derived from TDR measurements. It should be noted that reducing the number of samples in the measuring grid leads to flattening the distribution of SM from both methods and increasing the estimation error at the same time.
Grid of sensors for permanent measurement points should include points that have similar distributions of SM in the vicinity. Results of the analysis including number, the maximum correlation ranges and the acceptable estimation error should be taken into account when choosing of the measurement points. Adoption or possible adjustment of the distribution of the measurement points should be verified by performing additional measuring campaigns during the dry and wet periods.
Presented approach seems to be appropriate for creation of regional-scale test (super) sites, to validate products of satellites equipped with SAR (Synthetic Aperture Radar), operating in C-band, with spatial resolution suited to single field scale, as for example: ERS-1, ERS-2, Radarsat and Sentinel-1, which is going to be launched in next few months.

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