EGU21-2138
https://doi.org/10.5194/egusphere-egu21-2138
EGU General Assembly 2021

Assessment of spatial and temporal variations in soil moisture from satellite observations and ground-based measurements and their relationship with plant cover

Boguslaw Usowicz and Jerzy Lipiec
Institute of Agrophysics, Polish Academy of Sciences, Lublin, Poland (b.usowicz@ipan.lublin.pl)

The dynamic processes of mass and energy exchange on the soil surface are mainly influenced by plant cover, soil physical quantities and meteorological conditions. The aims of the research were: (a) to identify spatial and temporal changes in soil moisture (SM) obtained from satellite observations and ground measurements at the regional scale and (b) to determine the temporal variability of soil moisture in the soil profile with and bare soil (reference). The study area included 9 sites in the eastern part of Poland. Agro-meteorological stations in each site allowed monitoring soil moisture (SM). Satellite SM data (time series) for the years 2010–2016 (every week) obtained from the Soil Moisture and Ocean Salinity satellite (SMOS L2 v. 650 datasets) were gridded using the discrete global grid (DGG) with the nodes spaced at 15 km. Seven DGG pixels per each site were considered in a way that the central one (named S0) containing the agrometeorological station was bordered with 6 others (S1÷S6). The measurements of SM were performed at depths of 0.05, 0.1, 0.2, 0.3, 0.4, 0.5 and 0.8 m once a day in April-July in plots of spring barley, rye and bare soil. The temporal dependence of the SMOS surface soil moisture was observed in S0÷S6 with the radius of autocorrelation time from 8.1 to 25.2 weeks. The smallest autocorrelation time (3 weeks) was found in pixels with dominance of arable lands and the largest one - with dominance of wetlands (16.8 weeks) and forests (from 12 to 15.6 weeks). The autocorrelation times in S0 were much greater for ground-based SM data (11.1 to 43.1 weeks) than those for SMOS SM data. The autocorrelations enabled satisfactory predicting changes in SM forwards and backwards using the kriging method and filling gaps in the SM time series. As to ground measurements the highest autocorrelation times were in the soil below the plough layer under rye (170 days) and the lowest in the surface soil under barley and bare soil (18 and 19 days). In the plot of rye with the highest soil density the autocorrelation radius was over 1.5 months. The fractal dimensions (D0) indicated a large randomness of the surface SMOS SM distribution (D0 1.86–1.95) and the ground SM measurements (D0 1.82–1.92). The D0 values clearly decreased with the depth (from 1.7 to 1.15) in plant-covered soil while in the bare soil they did not change much throughout the profile (D0 1.7–1.8). The D0 values indicated that the temporal distribution of SM in the soil profile was more random in bare than plant-covered soil. The results help to understanding autocorrelation time ranges in surface and deeper soil and spatial changes in soil moisture depending on plant cover.

Acknowledgements. Research was conducted under the project "Water in soil – satellite monitoring and improving the retention using biochar" no. BIOSTRATEG3/345940/7/NCBR/2017 which was financed by Polish National Centre for Research and Development in the framework of “Environment, agriculture and forestry" – BIOSTRATEG strategic R&D programme.