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The use of the SMOS-Derived Soil Water Equivalent indeX (SWEX-SMOS) for assessment soil water resources in Poland

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The assessment of water resources in soil is of great importance in understanding the water cycle in the natural environment and the processes of water exchange between the soil and the atmosphere. It will also allow better use of water resources for agricultural, industrial and social purposes in anticipating and counteracting undesirable phenomena, such as floods, droughts or soil erosion. The main objective of the study was to assess water resources (years 2010-2013) in the surface soil layer for Poland from satellite and ground measurements using the SWEX (Soil Water Equivalent IndeX) index. Estimation of "water resources in soil" as seen from SMOS was conducted using the SWEX index proposed by W. Marczewski. SWEX is the result of multiplying soil moisture (SM) and radiation penetration depth (PD) for each pixel seen by SMOS satellite. SWEX is proportional to the water content in the soil "seen" by SMOS, but only in the PD. The PD being multiplication of the wavelength [U+F06C]0 equal to 21 cm was determined from the weekly SMOS L2 measurement data based on the relation between the real and imaginary dielectric constant. Soil moisture data from different depths from the agrometeorological stations were added up after weeks and multiplied for selected depths by soil moisture and then added up and statistically analysed. The relationship between the SWEX index calculated on the basis of SMOS satellite data and ground measurements data was analysed using Bland-Altman's statistics. Bland-Altman method was first proposed by J. Usowicz to compare soil moisture from SMOS and in-situ.
Linear regressions between the SWEX and the total soil water resources received from the agrometeorological stations for each depth were not statistically significant. On the other hand, Bland-Altman's statistics indicated that the differences between SWEX and the sum of soil water resources from the stations, i.e. bias, were close to zero for layers from the surface up to 20-28 cm depending on the location of the station. These differences were greater in the case of soil moisture from thinner layers (positive) and also greater but negative from thicker layers from measurements in ground agrometeorological stations. Also for SMOS pixels in the vicinity of the central one, in which the measurement station was located, similar average difference results (close to zero) were obtained for the same layers (to 20-28 cm). Thus, Bland-Altman's analysis suggests that the use of the SWEX index for assessing soil water resources is the most reliable for the above layers in the years under study. Further research concerning the estimation of soil water resources from satellite data using the SWEX index taking into account the thinner and thicker layers and other parameters of the Bland-Altman statistics (e.g. limits of agreement, regression lines) is required.
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