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Statistical-physical model of the hydraulic conductivity

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The water content in unsaturated subsurface soil layer is determined by processes of exchanging mass and energy between media of soil and atmosphere, and particular members of layered media. Generally they are non-homogeneous on different scales, considering soil porosity, soil texture including presence of vegetation elements in the root zone, and canopy above the surface, and varying biomass density of plants above the surface in clusters. That heterogeneity determines statistically effective values of particular physical properties. This work considers mainly those properties which determine the hydraulic conductivity of soil. This property is necessary for characterizing physically water transfer in the root zone and access of nutrient matter for plants, but it also the water capacity on the field scale. The temporal variability of forcing conditions and evolutionarily changing vegetation causes substantial effects of impact on the water capacity in large scales, bringing the evolution of water conditions in the entire area, spanning a possible temporal state in the range between floods and droughts. The dynamic of this evolution of water conditions is highly determined by vegetation but is hardly predictable in evaluations. Hydrological models require feeding with input data determining hydraulic properties of the porous soil which are proposed in this paper by means of the statistical-physical model of the water hydraulic conductivity. The statistical-physical model was determined for soils being typical in Euroregion Bug, Eastern Poland. The model is calibrated on the base of direct measurements in the field scales, and enables determining typical characteristics of water retention by the retention curves bounding the hydraulic conductivity to the state of water saturation of the soil. The values of the hydraulic conductivity in two reference states are used for calibrating the model. One is close to full saturation, and another is for low water content far from saturation, in a particular case of the soil type. Effects of calibrating a soil depends on assumed ranges of soil properties engaged to recognizing the soil type. Among those properties, the key role is for the bulk density, the porosity and its dependence on the specific area of the soil. The aim of this work is to provide such variables of auxiliary data to SMOS, which would bring a relation of the soil moisture to the water capacity, under retrieving SM from SMOS L1C data.

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