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Compilation of an integrated 3D soil and agrogeological database for the hydrophysical characterization of the unsaturated zone

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Describing the water movement in the unsaturated zone, numerous soil hydraulic data as input parameter are required concerning the water retention curve and the hydraulic conductivity function as the main hydraulic properties. The direct measurements of the hydraulic parameters are quite difficult and time-consuming; the estimation of them can be an alternative especially for large areas. The most commonly used basis of the estimation is the particle-size distribution (PSD) data or texture class.
The aim of our work was to compile an integrated and harmonized 3D pedo- and agrogeological database with the physical properties and stratification of the formations to the depth of the permanent groundwater level, which describes the unsaturated zone in a 690 km2 pilot area. Since the existing pedo- and agrogeological databases are not able to serve separately these 3D model requirements, their integration was necessary.
Due to its appropriate spatial and thematic resolution and data processing status, the Digital Kreybig Soil Information System (DKSIS) was chosen as pedological data source of the 3D model. The DKSIS has been compiled in the Research Institute for Soil Science and Agricultural Chemistry of the Hungarian Academy of Sciences, based on the 1:25,000 scale, national soil mapping program in Hungary. The survey sheets indicate the location of the observation sites. Due to the lack of measured PSD data, the field estimation of the textural classes, and the so-called “capillary rise of water” were used for the definition of the texture classes. The measured water uptake is supposed to have good relation with the textural class of the sample. During the data processing the inconsistent fields vs. capillary data pairs were excluded. In the DKSIS 649 polygons cover the pilot area, 484 soil profiles are occurring and characteristically each profile has two or three horizons.
The agrogeological dataset is maintained by the Hungarian Geological Institute and derives from a net of 10 m depth boreholes. 152 boreholes lay within to the model area. In each borehole all of the different geological formations were sampled, at least in each meter. Based on the borehole description and particle size distribution data, 110 similarly stratified patches were delineated on 1:100,000 scaled maps. 134 boreholes have complete stratification description and PSD analysis. The geological practice for describing the sediments differs from the pedological nomenclature; therefore we returned to the detailed PSD data and re-defined their particle-size classes according to the USDA soil texture triangle. Significant gravel-sediments were not exposed in the unsaturated zone.
The location of the soil profiles and boreholes as point features were joined to the mapping units, thus providing the polygons with “deepness”, as third dimension. After filtering the attributes, the repetitions in depth intervals were excluded originating both from the pedological and agrogeological datasets. The structured (depth and texture) data follow each other not equidistantly; the resulted data layers preserve the stratification characteristics of the profiles and boreholes.
The harmonized 3D database in grid form is indispensable in coupled (deterministic - stochastic) model simulation based analysis of regional water management problems like drought, flood and inland inundation.