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Infiltration kinetics model: effect of soil properties

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Soils physical properties largely affect overall soil fertility. Chernozem soils (Kursk region, Russia) under study which are highly fertile under natural vegetation, lose their aggregate waterstabilty during agricultural use and get highly compacted. This causes decline in infiltration rates and further leads to intensive water erosion. In this study we used field measured kinetics of water infiltration to parameterize a process-based physical model of water, vapor and heat transfer. Soil infiltration kinetics itself is related to various soil structural properties by a regression submodel.
Methods. Measurements of water infiltration were carried out on an agricultural field under sugar beat (4 year crop-rotation) in topographically different locations (top flat, slope, base of slope) with three independent replicates. Measurements at each location were carried out with Guelph-permeameter at two different water heads in triplicates. The topsoils (at depth 0-30 cm) and subsoil (plow pan at 30-40 cm) were characterized by such properties as: granulometric and microaggregate compositions (wet and dry) by Laser diffraction, aggregate compositions (wet and dry) by Savvin method of sieving, kinetics of aggregate waterstability loss by Adrianov method, kinetics of swelling and drying, full water retention curves, viscoelastic properties with modular rheometer and soil aggregates durability with cone-plastometer method of Rebinder (in dry and wet states). Soil profiles down to 1m were characterized by bulk density, kinetics of infiltration in tubes, temperature and moisture at a step of 10 cm. In addition continuous profiles of soil penetration resistance down to 80 cm.
Results. A dynamical model of water, vapor and heat transfer was parameterized and related to soil structural properties. The model is to be further applied on a landscape level to obtain distribution of soil physical properties.