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A novel set of global soil hydraulic parameters, with integrated sub-grid variability quantification, for soil hydraulic conductivity and water retention curves

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Climate and numerical weather prediction models, re-analyses, as well as agroecosystem models, require adequate parameter values for soil hydraulic properties (describing e.g. the shape of the soil water retention and hydraulic conductivity curves) at the global scale. Resampling of soil hydraulic properties to a model grid is typically performed by different aggregation approaches such a spatial averaging and the use of dominant textural properties or soil classes. These aggregation approaches introduce imprecision and parameter value discrepancies throughout spatial scales due to nonlinear shape of the hydraulic conductivity and water retention curves. Therefore, we present a method to scale van Genuchten hydraulic parameters (theta_s, theta_r, alpha, n, Ks) to individual model grids and provide a global data set that overcomes the mentioned problems. The exemplified analysis is based on the ROSETTA pedotransfer function of Schaap et al. (2001) applied to the SoilGrids1km data set of Hengl et al. (2014). The approach is based on Miller-Miller scaling that fits the shape parameters of the water retention curve to all sub-grid water retention curves to provide the best-fit parameter values for the grid cell at model resolution; at the same it maintains the information of sub-grid variability of the water retention curve by deriving local scaling parameters. Based on the Mualem van Genuchten approach we also derive the unsaturated hydraulic conductivity from the water retention functions, thereby assuming that the local scaling parameters are also valid for this function. In addition, information on global sub-grid scaling variance is given that enables modelers to improve dynamical downscaling of (regional) climate models or to perturb soil hydraulic parameters for model ensemble generation. These improvements should allow for more informed studies of the effects of variability in soil physical properties on land surface-atmosphere exchange. The final data set for 0.25° resolution will soon be made available under https://doi.org/10.1594/PANGAEA.870605.