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Evaluation of the suitability of soil texture classification schemes for regional scale hydrological modelling

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Regional scale hydrological simulations are mostly based on the use of standard data sets such as soil maps which again are based on soil texture classification schemes. Soil maps mostly do not contain information on exact soil composition but rather provide information on stratification of representative soil profiles with respect to soil texture classification. The question arises how sensitive hydrological models are to the chosen texture classification scheme, and whether the variability within a texture class can be covered by representative such as the centre of gravity. Therefore this paper exemplarily analyses the suitability of the German soil texture classification for the application of a physically based soil-vegetation-atmosphere-transfer scheme. Theoretical soil columns are defined to be able to represent the entire soil texture triangle by a 1% grid of the three particle size classes: Sand, clay and silt. These theoretical soil columns are characterized by a homogenous soil texture and consist of two layers of increasing bulk density and decreasing content of organic matter with depth. Soil hydraulic parameterisation is performed by applying a pedotransfer function. Continuous water balance calculations are performed for a ten year period for all grid cells of the 1% grid. The results of the water balance calculations are compared to the simulation results of the centre of gravity of the respective soil texture class. Texture class specific mean deviations and root mean squared deviations are calculated from the differences between the 1% pixels and the texture class representatives. The results reveal that the loam and silt texture classes show only small deviations from the centres of gravity. For a few sand texture classes and most of the clay texture classes deviations are considerably large. Assuming an equal distributed probability of occurrence of all soil texture class realisations, an uncertainty in the order of 100-300 mm/a with respect to runoff and actual evapotranspiration is detected for four clay texture

classes, two sand texture classes and one silt texture class. These results are confirmed by a sensitivity analysis investigating the model response for one grid cell of the texture triangle compared to the neighboured grid cells. High sensitivities mainly appear for sandy and clayey soils while the sensitivity of the model for loam and silt soils is small. Resuming it can be stated that most of the texture classes of the German texture classification scheme are suitable for the application of a physically based model on regional scale in particular. Clay texture classes are expected to cause high simulation uncertainties. Finally it should be mentioned that the evaluation approach is transferable to any other soil texture classification schemes and provides basic information towards a soil hydrology based soil texture classification scheme.