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Describing the soil-water retention curve between saturation and oven dryness

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In arid and semi-arid regions like those of Syria, it is not uncommon that soil-water content drops below the value at -1500 kPa pressure potential. In literature, many models have been presented that describe the soil-water retention curve (SWRC) across the complete range of soil water contents, from saturation to oven dryness. However, some of these expressions do not always perform well as we have earlier demonstrated [Cornelis et al. 2005; SSSAJ 69:1902–1911]. In the present work, we modified the Kosugi [1999, SSSAJ 63:270-277] function to describe the SWRC between saturation and oven dryness, and compared it with seven closed-form analytical expressions from literature. Retention data were taken for six soils with textures ranging from sand to silty clay from Campbell and Shiozawa [1992; van Genuchten et al. pp. 317-328] and for 137 soils covering nearly all USDA textures from the UNSODA data base. Our modification retains the form of the original Kosugi function in the wet range and transforms to an adsorption equation in the dry range. The predictive capability of our extended model was further evaluated under reduced sets of data that do not contain observations below a matric potential of -100 kPa. This evaluation showed that our model successfully predicted the water content with acceptable uncertainty, even when using the limited data set. In comparison with other models, the expression we present here was most consistent for different soils. Moreover, its prediction potential was relatively good as demonstrated by the significant correlation between its parameters and basic soil properties, which is promising for developing pedotransfer functions. A major achievement of our model is its ability to predict the entire SWRC when calibrated using a limited data set that includes only those measurements of water content at matric potentials greater than -100 kPa.