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# A meta-analysis of near-saturate hydraulic conductivities using the newly compiled Open Tension-disk Infiltrometer Meta-database OTIM

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Saturated and near-saturated hydraulic conductivities K (mm/h) are important soil properties that determine the partitioning of precipitation into surface runoff and infiltration and indicate soil susceptibility to preferential flow as well as soil aeration properties. Measurements of saturated and near-saturated soil hydraulic conductivities are time consuming and not practical for larger scales where they are mostly needed. The research community has therefore put effort in deriving pedotransfer functions to predict K using proxy variables. The precision of such pedotransfer functions has been very modest, however. As a result, recent studies have focused on assembling and analyzing bigger databases, aiming to find better predictors for the saturated and near-saturated soil hydraulic conductivities. A prominent example is the meta-database on tension-disk infiltrometer data compiled by Jarvis et al. (2013. Influence of soil, land use and climatic factors on the hydraulic conductivity of soil. Hydrology and Earth System Sciences 17(12), 5185-5195), who found that climate variables were better correlated with K than soil properties. OTIM (Open Tension-disk Infiltrometer Meta-database) builds on this database, adding 577 new data entries collated from 48 additional peer-reviewed scientific publications. OTIM contains more detailed information on local climate as well as land use and management than its predecessor. In this study, we present OTIM together with a meta-analysis on topsoil K from supply tensions ranging between 0 and 10 cm. Evaluating Spearman coefficients, we found that near-saturated K correlated best with the mean diurnal temperature range (0.54), the aridity index (-0.47) and the precipitation in the driest quarter of the year (-0.44). It may be speculated that larger diurnal temperature ranges stimulate the vertical movement of soil fauna while dry climates may lead to well-developed networks of shrinkage cracks. Notably, the correlations vanished for all considered climate variables at and close to saturation. At saturation, bulk density exhibited the highest correlation (-0.36). Furthermore, we found that arable land uses were related to strong decreases in saturated, but only moderate reductions in near-saturated K. This is well explained by effects of tillage and trafficking. Tillage disconnects macropores, diminishes the presence of macrofauna and thus leads to smaller saturated K; but for some weeks after seedbed preparation, it also improves near-saturated K by creating a well-connected inter-aggregate pore-network in the

topsoil. Trafficking, in contrast, leads to soil compaction and higher bulk-densities. We found that soil compaction strongly reduced K for all investigated tensions. In line with the above explanations, we observed that no-till agriculture was associated with decreased K compared to conventional and reduced tillage for all considered tensions. Moreover, infiltration measurements conducted soon after seedbed preparation led to larger K, also for all investigated tensions. Our study demonstrates the importance of land use, soil management and time of measurement relative to tillage for predicting saturated and near-saturated K. Besides, we found confirmation that climate variables have a large impact on near-saturated K. The underlying mechanisms are however not clear and should be investigated in future studies.