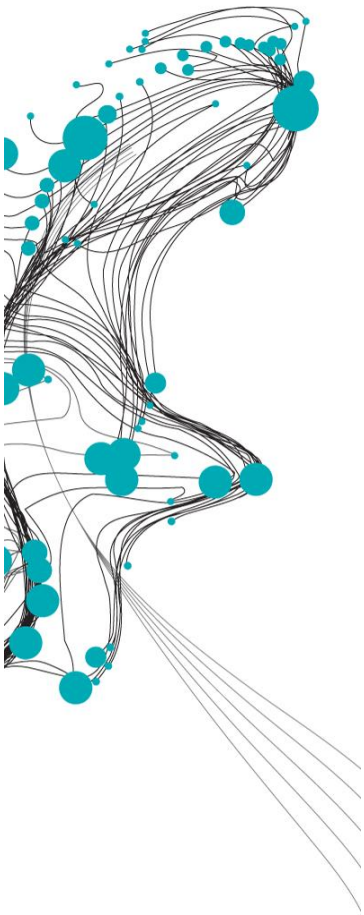
LOCAL AND CATCHMENT SCALE VALIDATION OF SOIL HYDRAULIC PEDOTRANSFER FUNCTIONS FOR AN INDONESIAN WATERSHED



In order to accurately model the hydrological processes in a catchment, information on the soil hydraulic properties is of great importance. This data can be obtained by conducting field work, which is costly and time consuming, or by using pedotransfer functions (PTFs). A PTF is an empirical relationship between easily obtainable soil characteristics and a soil hydraulic parameter. PTFs have been developed for a range of parameters. For this thesis, PTFs for the saturated hydraulic conductivity (K_s) and the available water content (AWC) are investigated.

PTFs are empirically determined relations for a specific area. Tropical soils often have a different composition and hydraulic behaviour compared to temperate soils. Application of temperate soil PTFs on tropical soils might result in poor performance, which is a problem as few tropical soil PTFs are available. The objective of this research is to determine whether K_s and AWC can be accurately approximated using PTFs, by analysing their performance at both the local scale and the catchment scale.

Four published PTFs for K_s and AWC are validated on a data set of 91 soil samples collected in the Upper Bengawan Solo catchment, Java Indonesia. The AWC is predicted very poorly, with R^2 values below zero for all selected PTFs. For K_s PTFs better results were found. The Wösten and Rosetta-3 PTFs predict the K_s moderately accurate, with R^2 values of 0.28 and 0.39, respectively. New PTFs for both AWC and K_s were made using multiple linear regression. R^2 values of 0.37 (AWC) and 0.55 (K_s) were obtained. Although these values are not very high, they are significantly higher than for the published PTFs.

The SWAT model was set up for the Keduang, a sub-catchment of the Upper Bengawan Solo. Monthly catchment outflow was modelled. Eleven cases were defined to validate the PTFs at the catchment scale. For the K_s-PTF cases Nash-Sutcliffe values of around 0.84 were obtained for the validation period. The use of AWC PTFs resulted in slightly lower NS values, although the differences in model accuracy are still low. The small differences between the cases are caused by the soil homogeneity in the Keduang catchment. Without model calibration an NS-value of 0.51 was found.

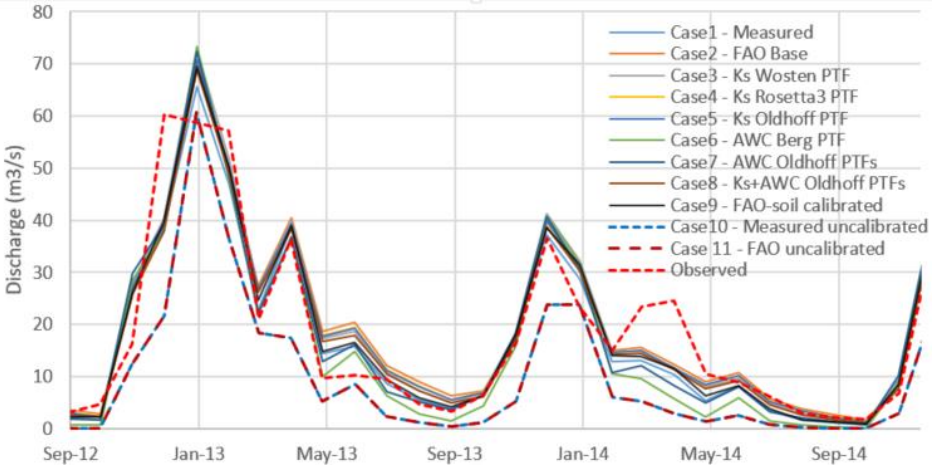


Figure 1: Best simulation for each case, plus uncalibrated model results and observed discharge, validation period

At the local scale the Wösten and Rosetta-3 PTFs can be used to predict K_s. AWC PTFs show insufficient accuracy at the local scale. At the catchment scale, the Wösten and Rosetta-3 K_s PTFs and the Oldhoff AWC and K_s PTFs are validated. It is recommended to use the Oldhoff PTFs in the Upper Bengawan Solo catchment. More research is needed on the effect of PTF input on hydrological state variables, such as soil moisture content. The effect of catchment soil heterogeneity also requires more research.

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