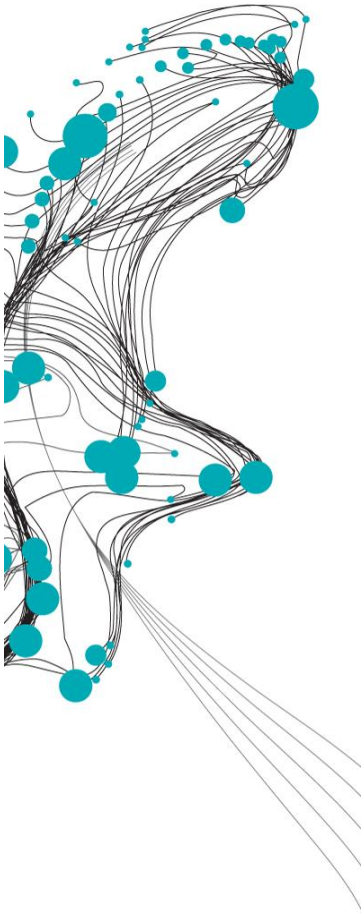
SOIL MOISTURE SIMULATIONS ON A REGIONAL LEVEL

THE ABILITY OF GROUNDWATER MODEL MIPWA TO REPLICATE SOIL MOISTURE OBSERVATIONS IN TWENTE



The groundwater model MIPWA simulates the groundwater dynamics in the North-Eastern part of the Netherlands. MIPWA combines the unsaturated zone model MetaSWAP and the saturated zone model iMODFLOW. The simulations of MetaSWAP have only been verified; no calibration or validation has been performed. However, previous research by Schuurman et al. (2011) suggests that the soil moisture simulation by MetaSWAP can be improved. The objective of this research was to evaluate and potentially improve the ability of MIPWA to simulate soil moisture dynamics by comparing the simulations of MIPWA to field measurements.

The model results are compared to the measurements of the ITC soil moisture network. This network contains 20 observations sites spread throughout Twente. The comparison of the model and the measurements shows that the model is able to simulate soil moisture dynamics in the root zone. Overall, the model is able to explain 71% of the variance in the measured soil moisture content in the root zone, but the model does systematically underestimate the soil moisture content (figure 1).

The individual observation sites that perform best are sites with similar measured and modelled porosity, a deep groundwater table and a loamy sandy soil type. In general, observation sites with a similar measured and modelled porosity are able to explain more of the model variance and are able to simulate the soil moisture content with a smaller root mean square error. The smaller error is also present for observation sites with a deeper groundwater table. The soil moisture dynamics in loamy sandy soils are in general better simulated than in sandy soils. At the other observation sites the model is still able to simulate the soil moisture content in the root zone reasonably well, however improvements could be made.

The observation sites where the simulation of the soil moisture content could be improved are typically sites with shallow groundwater tables. To improve the simulations, the capillary rise has been reduced. This improved the ability of the model to simulate the soil moisture dynamics. To prevent systematic underestimations the modelled porosity has been increased to better match the observed porosity. The combination of these measures proved successful in improving both soil moisture dynamics and absolute values (figure 2). These improvements not only affected the soil moisture content, they also increased the average groundwater level in regions where the model underestimated the groundwater level.

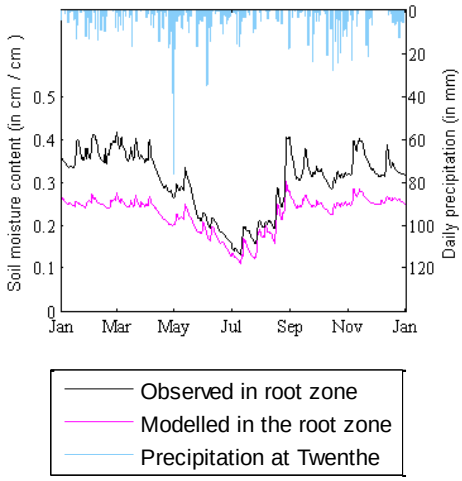


Figure 1:Average soil moisture content of all 20 observation sites in Twente during 2010.

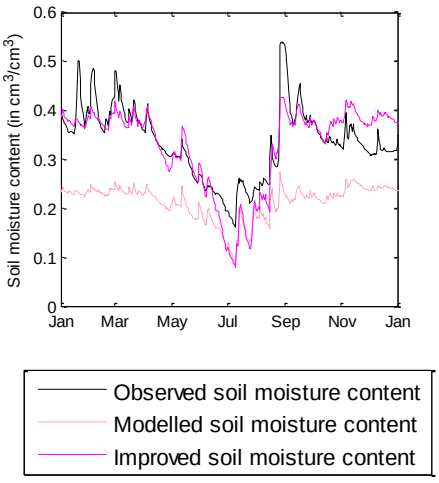


Figure 2: Effect of improvements on simulated soil moisture content at a single observation site in 2010.

Schuurmans, J. M., van Geer, F. C., & Bierkens, M. F. (2011). Remotely sensed latent heat fluxes for model error diagnosis: a case study. Hydrology and Earth System Sciences (15), 759-769.

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