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Calibrating a Soil-Vegetation-Atmosphere system with a genetical algorithm

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Accuracy of model prediction is well known for being very sensitive to the quality of the calibration of the model. It is also known that quantifying soil hydraulic parameters in a Soil-Vegetation-Atmosphere (SVA) system is a highly non-linear parameter estimation problem, and that robust methods are needed to avoid the optimization process to lead to non-optimal parameters. Evolutionary algorithms and specifically genetic algorithms (GAs) are very well suited for those complex parameter optimization problems.
The SVA system in this study concerns a pine stand on a heterogeneous sandy soil (podzol) in the north of Belgium (Campine region). Throughfall and other meteorological data and water contents at different soil depths have been recorded during one year at a daily time step. The water table level, which is varying between 95 and 170 cm, has been recorded with a frequency of 0.5 hours.
Based on the profile description, four soil layers have been distinguished in the podzol and used for the numerical simulation with the hydrus1D model (Simunek and al., 2005). For the inversion procedure the MYGA program (Yedder, 2002), which is an elitism GA, was used. Optimization was based on the water content measurements realized at the depths of 10, 20, 40, 50, 60, 70, 90, 110, and 120 cm to estimate parameters describing the unsaturated hydraulic soil properties of the different soil layers.
Comparison between the modeled and measured water contents shows a good similarity during the simulated year. Impacts of short and intensive events (rainfall) on the water content of the soil are also well reproduced. Errors on predictions are on average equal to 5%, which is considered as a good result.

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