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Getting a feel for parameters: using interactive parallel plots as a tool for parameter identification in the new rainfall-runoff model WALRUS

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Recently, we developed the Wageningen Lowland Runoff Simulator (WALRUS) to fill the gap between complex, spatially distributed models often used in lowland catchments and simple, parametric models which have mostly been developed for mountainous catchments (Brauer et al., 2014ab). This parametric rainfall-runoff model can be used all over the world in both freely draining lowland catchments and polders with controlled water levels. The open source model code is implemented in R and can be downloaded from www.github.com/ClaudiaBrauer/WALRUS.

The structure and code of WALRUS are simple, which facilitates detailed investigation of the effect of parameters on all model variables. WALRUS contains only four parameters requiring calibration; they are intended to have a strong, qualitative relation with catchment characteristics. Parameter estimation remains a challenge, however. The model structure contains three main feedbacks: (1) between groundwater and surface water; (2) between saturated and unsaturated zone; (3) between catchment wetness and (quick/slow) flowroute division. These feedbacks represent essential rainfall-runoff processes in lowland catchments, but increase the risk of parameter dependence and equifinality.

Therefore, model performance should not only be judged based on a comparison between modelled and observed discharges, but also based on the plausibility of the internal modelled variables. Here, we present a method to analyse the effect of parameter values on internal model states and fluxes in a qualitative and intuitive way using interactive parallel plotting.

We applied WALRUS to ten Dutch catchments with different sizes, slopes and soil types and both freely draining and polder areas. The model was run with a large number of parameter sets, which were created using Latin Hypercube Sampling. The model output was characterised in terms of several signatures, both measures of goodness of fit and statistics of internal model variables (such as the percentage of rain water travelling through the quickflow reservoir). End users can then eliminate parameter combinations with unrealistic outcomes based on expert knowledge using interactive parallel plots. In these plots, for instance, ranges can be selected for each signature and only model runs which yield signature values in these ranges are highlighted. The resulting selection of realistic parameter sets can be used for ensemble simulations.

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