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Uncertainty assessment in complex models - Application of DYNIA for WASIM-ETH

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Powerful methods exist to assess parameter and structural uncertainty for simple/parsimonious hydrologic models. In most of the applications, the physical meaning (in relation to the real system) of model structure and parameter values is very limited and the model performance can easily be determined.

More complex models often combine conceptual parts (e.g. single or multiple linear storages) and more physically based parts (e.g. water flow in soil column calculated by solving the Richards equation, where the soil hydraulic conductivity is parameterized using the van Genuchten/Mualem parameterisation scheme). This allows measured soil properties to be used for model parameterization.

The parameterization of physical soil properties in a distributed, Richards-based model is equivalent to pre-defining a model structure and therefore the basic signal transformation properties. I.e. the bandwidth of theoretical model responses is confined to a "*feasible signal space*" by determining the distributed physical parameters.

Subsequent calibration of the remaining sensitive conceptual parameters is done in order to preserve the physical meaning of the soil parameters and to compensate for structural inadequacies induced by the configuration of the basic signal transformation properties.

In this study WASIM-ETH (Version 2) is used to:

(a) determine the "*feasible signal space*" of a simulated 1-D soil column (i.e. the

mechanism responsible for surface runoff production, interflow production and water storage in the unsaturated and saturated zone)

(b) analyse the parameter sensitivity during a single strong rainfall event through application of the DYNIA procedure.

The results show the strong influence of 1-D soil column properties on the basic input signal transformation but also stress the important role of the conceptual parameters (e.g. single storages for surface runoff and interflow, drainage intensity).

The parameter sensitivity study (using DYNIA) can only be interpreted properly by taking into account the underlying concept and the specific structure of the (soil) model.

E.g. unsupervised calibration leads to a best fit for the single event for almost impervious soils allowing to generate the output signal directly from the input signal.

The result is quite insensitive to initialization values and resembles the model behaviour known from applications of the unit hydrograph concept, where the output is mainly influenced by the travel time distribution.

Another interesting result is the fact, that a best fit for the rainfall driven parts of the hydrograph and the non-driven parts of the hydrograph produced very different parameter sets. This leads to the question, whether the model is able to cover all system stages of the real system because of its limited dynamic range.