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Spatially Distributed Estimation of Mesoscale Water Balance Model Parameters using Hydrological Soil Maps

O. Gronz (1,2), M. C. Casper (1), and P. Gemmar (2)

(1) University of Trier, Physical Geography, Trier, Germany, (2) Fachhochschule Trier, Institut für Innovative Informatik-Anwendungen, Germany (gronzo@fh-trier.de)

In mesoscale water balance models, the relevant hydrological processes in runoff generation are abstractly simulated. One aspect of this abstraction is grouping areas to model elements, each of which simulated individually, resulting in a set of model elements. A single element might be homogeneous by means of a certain characteristics, e. g. land use, but it might also be heterogeneous considering a different feature, e. g. slope. Due to this abstraction and grouping, the processes cannot be described in detail by physical laws and thus, parameters to be calibrated will occur in the model's assumptions. Typically, the same value is used for all elements of a catchment, mainly due to the quantity of all possible parameter value configurations. Thus, the spatial distribution of the occurrence of processes and their specific strength, which can be observed in the real catchment, will not be represented by the model. The model might rather represent the mean behavior. As a result, the distribution of water in the model might not match the real system. This strongly limits the applicability of the model and it increases the complexity of calibration. To support a spatial distributed parameterization of a model, new sources of information need to be incorporated.

One way of incorporating additional information is the usage of hydrological soil maps, which are available today. They indicate the potentially dominant runoff processes like Horton overland flow, subsurface flow, deep percolation etc. These maps are e. g. generated by artificial neural networks using various different sources like geological maps, digital terrain models and characteristics derived from this model, land use maps etc.

An interdisciplinary project has started to integrate these maps in the calibration process. The main aim is to represent the spatial distribution shown by the map in the model. An initial idea is to find parameter prototypes for each of the runoff processes. These parameter prototypes are assigned to the corresponding model elements. In the following calibration process, these prototypes are scaled on a global level to adapt to a specific catchment. For it, the water balance model LARSIM is used. At first, we will examine the influence of a spatially varying parameterization in the model by applying Monte Carlo methods and the subsequent analysis of the results using self-organizing maps.
Then, we will adapt soft computing optimization strategies that will be used in the next step: the development of parameter prototypes and the parameterization strategies. This step is the most complex part and it also might include modifications of the model structure, especially in the parts representing hydrological soil processes.

As a result, the developed parameter prototypes and parameterization strategies will possibly make the calibration process easier and more transparent. Additionally, the improvement of representing the spatial distribution of processes will enhance the model's efficiency. The more appropriate representation of the distribution of water allows for new applications of the model or will enhance the application, respectively.
This also includes an improved performance considering kinds of problems like prediction of behavior in different conditions (land use change, climate change).