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Expansion of the capabilities of conceptual hydrological models on the basis of physically based models

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For planning of water resources management, conceptual capacitive hydrological models are often used where the whole catchment area is represented into a few boxes with water reservoirs, usually associated with the surface of a river basin, a root unsaturated soil zone and a groundwater zone. Meteorological impacts on the catchment area are converted to river runoff using simple equations that are weakly related to real processes. The rates of moisture transfer between the reservoirs are set by parameters that are estimated by calibration. The weakness of conceptual capacitive models is the choice of parameters that are interrelated. Hence, effects such as overparameterization and equifinality of models follow.
The aggregated model parameters of the conceptual capacitive models reflect the integral properties of watersheds, they are difficult to physically interpret. However, by comparing the equations of processes in conceptual models with the equations of physically based models, it is possible to obtain the structure of a number of generalized parameters of conceptual models in the form of combinations of physically meaningful parameters. The physical interpretation of the parameters of the conceptual models allows to limit possible ranges of their changes during calibration and make the calibration results more reliable. Thus, the thesis expressed by a number of hydrologists is confirmed on the rather vague boundaries between conceptual capacitive and physically based models. In particular, using the method of hydrological similarity, the possibilities of conceptual models are shown not only to simulation of runoff in outlet points of watersheds, but also to the dynamics of soil moisture and groundwater levels at different points of the river basin for different types of soils and landscapes. Studies on the physical interpretation of parameters of capacitive conceptual models were carried out with help of the ECOMAG physically based model and the HYCYMODEL conceptual model based on the results of the detailed international field experiment NOPEX.
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