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Assessing the parameters of a physically based runoff generation model at lack of runoff data

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A physically based model of runoff generation is presented which is founded on the finite-element schematization of a catchment area and describes processes of interception of liquid and solid precipitation by vegetation, snow accumulation and melt, soil freezing and thawing, infiltration of rainfall and melt water into the frozen and unfrozen soil, overland, subsurface and channel flow. The structure of the models is identified by the analysis of specific peculiarities of runoff generation mechanisms in a particular catchment. The model parameters have physical meaning and can be, in principle, measured or estimated directly from the empirical dependencies relating the model parameters to the measured catchment characteristics (topography, soil and vegetation properties, etc.). However, because of a number of reasons (e.g. inadequacy of the model, poorly defined boundary and initial conditions, heterogeneity of catchment characteristics) some key parameters need to be back-calculated from runoff data. Lack of local runoff data that could be used for calibrating the model parameters is the main challenge with application of the presented model to runoff prediction in ungauged or poorly gauged catchments. As the alternatives to calibration on runoff data two approaches are considered: (1) transferring parameters from hydrologically similar catchment, and (2) adjusting parameters through calibration against available observations (other than runoff observations) in the catchment of interest. Applicability of these approaches and their effectiveness for runoff prediction in ungauged catchments are studied by the developed model for river basins located in different physiographic zones of Russia.