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Calibration and uncertainty assessment of a distributed physically based model of snowmelt runoff generation

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The distributed physically based model of snowmelt and rainfall runoff generation for the Vyatka River basin (the catchment area is 124,000 km^2) has been developed. The model is based on the finite-element schematization of river basin and includes the description of the following hydrological processes: snow cover formation and snowmelt, freezing and thawing of soil, vertical soil moisture transfer and evapotranspiration, water retention in basin storage, overland and channel flow. Stochastic subgrid variations of snow cover and saturated hydraulic conductivity are taken into account. The meteorological inputs of the model are measurements of snow cover, liquid precipitation, air temperature, and air humidity. The basin area was presented by 477 finite elements. The hydrometeorological records obtained from 21 meteorological stations and 66 snow courses were used. Most parameters were taken from field measurements and empirical relationships. To determine the parameters of subgrid variations for different subgrid areas, a scaling procedure based on the fractal theory is applied. Six parameters (saturated hydraulic conductivities for open and forested terrains, two parameters of the evaporation model, maximum water detention by basin storage, and the celerity of the kinematic wave) are calibrated. Different procedures of calibrations and apriory assigning of parameters are compared. The statistical distributions of possible errors of calculation of runoff volumes and peak discharges under the various sources of uncertainty (initial conditions, assigning parameters, representation of input meteorological data) were assessed.