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Climatic and basin factors affecting the extreme snowmelt floods: analysis on the basis of a physically-based model coupled with a stochastic weather generator

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Climatic and basin factors affecting the extreme snowmelt floods have been investigated on the basis of a dynamic-stochastic model, which combines a physically based model of snowmelt runoff generation with a stochastic weather generator. The investigations have been carried out for the Seim River basin (catchment area is 7460 km^2) in the European Russia. The physically based model is based on the finite-element discretisation of the catchment area and describes snow accumulation and melt, soil freezing and thawing, vertical soil moisture transfer and infiltration, detention of melt water by the basin storage, overland and channel flow. Calibration and validation of the model have been carried out on the basis of available peak flow records for 20 snowmelt floods. The weather generator developed on the basis of 101-years meteorological observations includes the stochastic models of time series of daily precipitation, air temperature, and air humidity deficit during a whole year. Weather scenarios have been generated by Monte Carlo method and transposed to snowmelt flood hydrographs by the physically based model. Special procedure has been developed to select along the generated weather scenarios such of them that can lead to the extremely high floods. The developed procedure has allowed one to minimize a number of the model runs needed to calculate floods of very low exceedance probabilities. Peculiarities of simulated winter-spring meteorological conditions as well as simulated dynamics of snow accumulation and melt, soil freezing and soil moisture content affecting the possible floods of low probabilities have been analysed.