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Distributed model of rainfall and snowmelt runoff generation for a mountainous river basin

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The distributed physically based model of snowmelt runoff generation for a mountainous river basin which allows for taking into account horisontal and vertical heterogeneity of hydrological processes has been developed. The model is based on a finite-element schematization of the river basin and includes the description of processes of snow cover formation, snow and ice melting, evaporation and infiltration, overland and subsurface flow, water movement in the river network. Choice of finite element areas is based on difference in topography, soil, vegetation, land use. In the basin, 512 finite element areas and 64 finite-elements of river channels have been singled out. The input data (the air temperature, precipitation, air humidity, wind speed and cloudiness) are calculated using available observations, as well as interpolation and extrapolation procedures accounted for vegetation and exposition of finite-element areas. The case-study was carried out for the upper part of the Kuban River basin (the North Caucasus region). The catchment covers an area of 16,900 km2 and includes the highest Caucasus peak Elbrus (5600 m). The highest meteorological station is located at the altitude 2039 m. The flood runoff is commonly of mixed rainfall-snowmelt origin. The ice melt gives about 10% of annual runoff. Six parameters of the model have been calibrated, against the observed hydrographs and snow measurements. The test of the model was carried out on the basis of observed hydrographs for 11 year period, including the catastrophic flood of 2002. The satisfied correspondences of observed and calculated hydrographs have been obtained.