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Hydrological mofelling of large river basins using the ECOMAG software complex

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According to some hydrologists, the characteristic scale of river basins when using traditional physically based models of runoff formation is limited to the size of a small (elementary) river basin. Within its limits, these models can describe hydrological processes on the different parts of the slopes and in the river network in great detail. For hydrological simulation of large river basins, it is reasonable to use greater calculated cells of hundreds and even thousands square kilometers. The problem is to find a new (compared to the point) computational elements of a certain scale, generalization (filtering) of micro-scale fluctuations of the characteristics that are of secondary importance at this level of consideration and parameterization of hydrological processes models at the meso- and macroscale levels. In this case, such a spatial refinement as in detailed physically based models is not longer needed to describe hydrological processes, since aggregate models operate with flows averaged over the elementary catchments. In particular, such an ideology is adopted in a hydrological semi-distributed model ECOMAG, where a major river basin is covered with a grid of elementary catchments, for each of which a physically based model with lumped parameters is described by a system of ordinary differential equations, most of which obtained by integrating the basic equations of detailed physically based models over space.
For solving practical and research tasks with the help of up-to-date informational and technological background, a software complex (SC) was developed on the basis of the ECOMAG model with a daily time step resolution, which included a specialized geographical information system (GIS), databases of archival and operational data on hydrological, meteorological and water management monitoring for the whole Russia, watershed characteristics, as well as the command shell.
An ability of hydrological simulation of large river basins using SC ECOMAG is illustrated by examples of simulated dynamics of spatial patterns of the terrestrial water cycle components (soil moisture, snow water equivalent, runoff characteristics) and their comparison with the patterns of the respective observed components obtained from the monitoring datasets for the Volga River basin (area 1 380 000 km2) and the Lena River basin (area 2 488 000 km2) for multi-year periods. The results of using SC ECOMAG for application in operational practice of the Russian Federal Water Resources Agency for management of the Volga-Kama and the Angara-Yenisei cascade reservoirs are shown also.
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