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Modeling spatial patterns of terrestrial water cycle components for large river basins

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The ECOMAG model (ECOlogical Model for Applied Geophysics) was applied for simulating spatial patterns of the terrestrial water cycle components (soil moisture, snow water equivalent, specific runoff) for the Volga River basin (area 1 380 000 km2) and the Lena River basin (area 2 488 000 km2). The simulated patterns were evaluated through their comparison against the corresponding patterns obtained from multi-year observation data.
The semi-distributed hydrological model ECOMAG utilizes semi-distributed approach, where a major river basin is covered with a grid of elementary watersheds taking into account structure of river network, topography, soil and land cover characteristics. For each elementary watershed a model of land hydrological cycle with lumped parameters (water infiltration into unfrozen and frozen soil, evapotranspiration, thermal and water regime of soil, overland, subsurface and channel flow) is described by a system of ordinary differential equations. Most of them are obtained by integrating the basic equations of detailed physically based models over space. Most of the model land surface parameters are physically meaningful and can be assigned from global data sets. Some key-parameters are calibrated against streamflow measurements and monitoring of the internal basin variables (patterns of snow characteristics, soil moisture, soil frost depth, etc.). The methodology of the spatial calibration parameters and appropriate criteria of the model performance are considered. Minimal and maximal sizes of elementary watersheds for considered river basins are estimated on the basis of numerical experiments with using such criteria.
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