

**STUDYING THE IMPACT OF THE BOREAL SPRUCE FOREST ON
HYDROLOGICAL PROCESSES AND WATER BALANCE OF A CATCHMENT:
MODEL RESULTS AND OBSERVATIONS**

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The aim of this paper is studying the impact of boreal spruce forest on hydrological processes and water balance of a catchment. The effective tool for such investigations may be advanced land surface models (LSMs) which adequately treat energy balance and hydrology of the boreal forests. Here, a physically based LSM, developed and validated (against a vast number of heat and water balance components measured in the boreal spruce forest and non-forested areas on a long term basis) by the authors, is used.

The work is based on model results and observations obtained during 18 years (1966-1983) at the Tayozhniy catchment (covered by boreal forest, mainly composed by spruce) and Usadievskiy catchment (grassland) situated in the central part of Valdai Hills (Russia). The results of model simulations for the forested and non-forested catchments were compared with each other to reveal the role of the spruce forest in the land surface - atmosphere interactions and with measurements to confirm the validity of conclusions. Among the processes under considerations there were the following processes simulated by the model: (1) partitioning snowfall and rainfall between interception by the canopy and falling to the ground; (2) formation of snow cover on the ground (under the spruce crowns and in the open site); (3) evapotranspiration from the spruce forest and grassland including evaporation/sublimation of intercepted rainfall/snowfall, sublimation of snow accumulated on the ground, transpiration, and soil evaporation; (4) formation of soil water storage in the forested and non-forested areas; (5) runoff from the forested and non-forested catchments.

Simulated annual evapotranspiration from the spruce forest is found to be 1.4 times greater than that from grassland. Evapotranspiration during the cold season is also higher in the forest (52 mm) than that in the open site (2 mm). Snow water equivalent in the open site is 10 mm greater than that in the spruce forest. Total runoff from the forested catchment is nearly a half less than that from the non-forested catchment. The model results are in a good agreement with in situ measurements. This confirms that the advanced land surface model can be used for studying the impact of boreal forests on hydrological processes and water balance of catchments provided that input meteorological data and model parameters values of high quality are available.