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Hydrological modelling over different scales on the edge of the permafrost zone: approaching model realism based on experimentalists' knowledge

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Quantitative and qualitative experimentalists' data helps to advance both understanding of the runoff generation and modelling strategies. There is significant lack of such information for the dynamic and vulnerable cold regions. The aim of the study is to make use of historically collected experimental hydrological data for modelling poorly-gauged river basins on larger scales near the southern margin of the permafrost zone in Eastern Siberia.
Experimental study site "Mogot" includes the Nelka river (30.8 km2) and its three tributaries with watersheds area from 2 to 5.8 km2. It is located in the upper elevated (500 – 1500 m a.s.l.) part of the Amur River basin. Mean annual temperature and precipitation are -7.5ºC and 555 mm respectively.
Top of the mountains with weak vegetation has well drained soil that prevents any water accumulation. Larch forest on the northern slopes has thick organic layer. It causes shallow active layer and relatively small subsurface water storage. Soil in the southern slopes has thinner organic layer and thaws up to 1.6 m depth. Flood plains are the wettest landscape with highest water storage capacity. Measured monthly evaporation varies from 9 to 100 mm through the year. Experimental data shows importance of air temperature and precipitation changes with the elevation. Their gradient was taken into account for hydrological simulations. Model parameterization was developed according to available quantitative and qualitative data in the Mogot station.
The process-based hydrological Hydrograph model was used in the study. It explicitly describes hydrological processes in different permafrost environments. Flexibility of the Hydrograph model allows take advantage from the experimental data for model set-up. The model uses basic meteorological data as input. The level of model complexity is suitable for a remote, sparsely gauged region such as Southern Siberia as it allows for a priori assessment of the model parameters.
Model simulation of river runoff, snow depth, soil temperature and moisture in the Mogot study site are satisfactory. Model parameterization developed on the Mogot watersheds was employed to simulate runoff generation in the four river basins with area from 150 to 4060 km2 in the surrounded region.
We conclude that data about internal catchment processes is extremely helpful for the increasing model realism. Hard and soft experimental knowledge in the form of model parameters and settings could be transferred to larger river basins in the region.
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