MODELLING OF ACTIVE LAYER DEPTH DYNAMICS AND RUNOFF FORMATION AT SMALL WATERSHED ENTIRELY COVERED BY BARE ROCKS

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In the zone of continuous permafrost frozen ground usually acts like impermeable layer but at the territories covered by bare rocks runoff formation mechanisms are different from “normal” ones. The data of unique research watershed of the Morozova Creek entirely covered by bare rocks landscape enables to highlight its specific thermal and water regime. The goal of the study was the analysis and combined modelling of ground thaw/freeze and flow formation processes in the Morozova Creek watershed (area 0.63 km^2). It is located in the Upper Kolyma river basin in mountainous zone of continuous permafrost within the Kolyma Water Balance station and represents about 30 % of underlying surface at the North-East of Russia.

Absence of any soil and vegetation cover makes thermal and water regime of bare rocks to be specific. The ground profile thaws quickly and deeply, up to the 1,5-2,5 m. During the freshet snowmelt water refreezes in upper 1-1.5 m of ground profile but never fully saturates all pore volume of stony layer. The rest of the melt water and liquid precipitation percolates to frozen aquiclude and reaches the creek channel quickly forming subsurface flow. High porosity and very low water holding capacity of rock stratum prevent water accumulation in the profile. Therefore it stays dry during whole warm period.

The Hydrograph, a process-based hydrological model, was applied in this study. The model describes all components of land hydrological cycle and integrates coupled algorithms of water and heat dynamics in soil profile enabling to use it for studying complicated interactions of soil, water and ice in permafrost. Main model parameters are observable land cover properties that can be systematized according to landscapes.

Land cover model parameters were derived based on literature review, measurement data and modelling experiments. Runoff formation simulations were conducted for continuous period of 1969–1990 with daily step interval for the Morozova Creek watershed. Good agreement of observed and simulated values of thaw/freeze depths and runoff enables to conclude that assessed model parameters and its algorithms have good potential for applications at other watersheds including ungauged ones with similar conditions.