SMALL MOUNTAINOUS CATCHMENTS OF EAST SIBERIA – EXPERIENCE OF RUNOFF FORMATION SIMULATION

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East Siberia, which is located in the zone of permafrost, especially its mountainous areas which are difficult of access, is up to now a territory that is insufficiently explored from the point of view of hydrology. Intensification of economic activities in the areas of permafrost, as well as their vulnerability to global climate and anthropogenic change stipulate for the actuality of development of conception of runoff formation processes on these territories which due to limited nature of observation data can be realized only on the basis of mathematic simulation methods.

This paper presents the results of runoff formation processes simulation for small mountainous watersheds in East Siberia. The watersheds located in the highlands of Upper-Kolyma (average elevation 1000 m) and at the Suntar-Hayata Range (average elevation 1500 m) are chosen as object of investigation. Table 1 lists general information about the chosen basins and their location is shown at Figure 1.

The climate of the study area has distinctly continental character – the winter is cold, long, the summer is short with frequent and intensive precipitations. Climate, permafrost, and also tectonic structure features result in formation within the territory under investigation of thick ice mounds occupying small areas that represent one of the sources of river feed during the summer period. The main types of landscapes of the region, depending on elevation are the mountainous tundra and taiga.

Kolyma water-balance station (KWBS) that is unique in Eastern Siberia is situated within the immediate vicinity of water collection areas 1-4. Since the forties of the 20th century, special observations of water balance components, soil and vegetation characteristics, snow cover and other characteristics

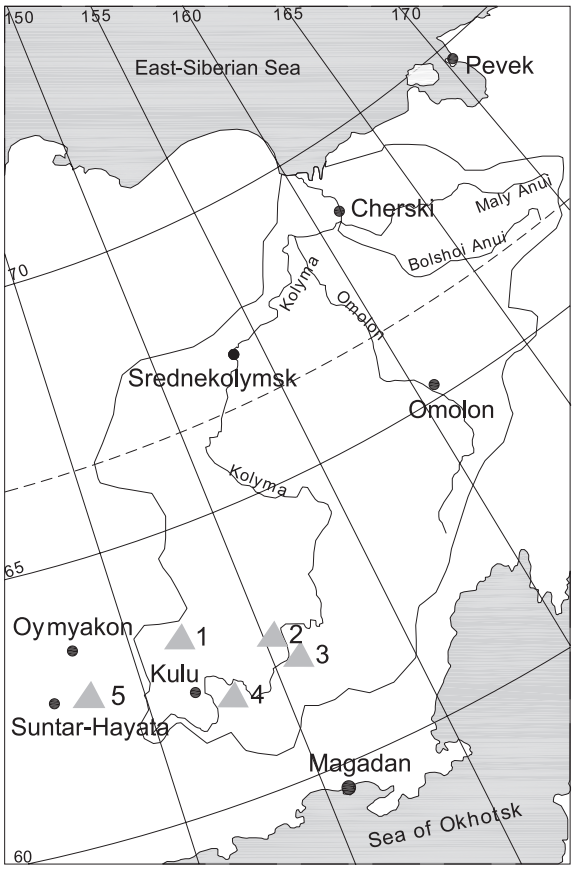

Figure1. Investigation area with small watersheds location

Table 1. Description of watersheds chosen for investigation

№	Object name	Catchment area km^2
1	Ayan-Uryah river, Emtegey	9560
2	Debin river, Belich'e	3460
3	Detrin river, the mouth of Vakhanka river	5630
4	Tenke river, in 2.2 km upper the mouth of Nilkoba river	1820
5	Suntar river, mouth of Saharynia river	7680

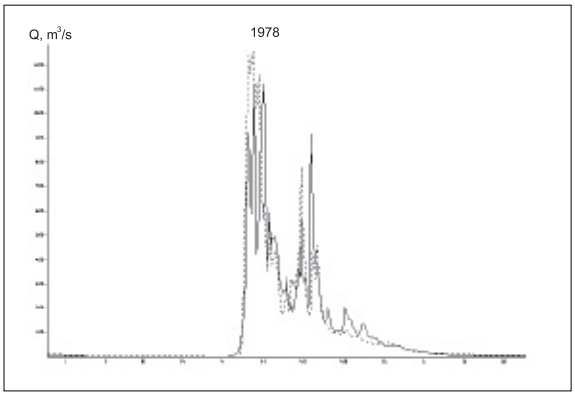

Figure 2. Calculated (dotted line) and observed (solid) hydrographs, Ayan-Uryah river at Emtegey, 1978

are carried out at this station. During eight years, mountain meteorological station Suntar-Hayata (absolute elevation 2068 m) was working at the head of water collection area 5. This station was opened in 1957 within the framework of International Geophysical Year.

All these data (both materials of observations at KWBS and results of investigations carried out during the international geophysical year) played an important role in the process of collection and analysis of information needed for simulation and also for evaluation and assignment of model parameters.

Modeling part of the research employed a deterministic hydrological model "Hydrograph" with distributed meteorological input, parameters and characteristics (Y.B.Vinogradov, State Hydrological Institute, Saint-Petersburg, Russia). This model covers all types of runoff and can be applied for all geographical regions and river basins of any size. Parameters are supposed to be distributed across the basin area (system of reference points) and vertically within soil-vegetation column. Local variations of snow coverage are taken into account. The hydrologic output of the model is a continuous flow hydrograph that can be incremented according to required time interval (e.g. 12-hour, 24-hour). The model output can include such variables as soil temperature and humidity, water content, snow density and moisture that are computed in the model for any representative point.

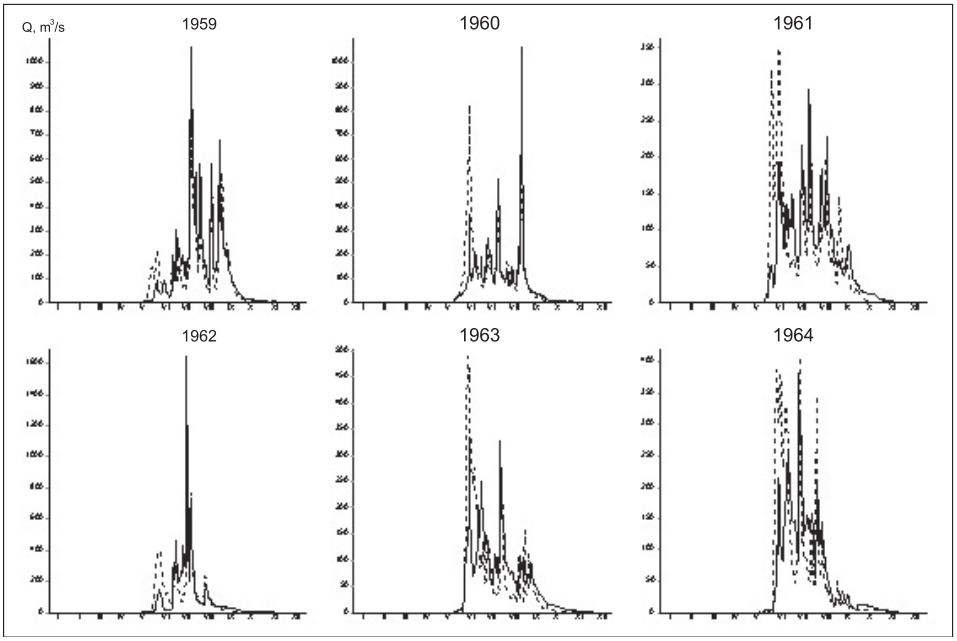

Figure 3. Calculated (dotted line) and observed (solid) hydrographs, Suntar river at Saharynia river mouth, 1959-1964

The accurate evaluation of model parameters characterizing the physical, water-physical and thermophysical properties of the soil is very important for getting acceptable results of streamflow simulations in the considered region. They represent limitations when calculating timing and intensity of soil thawing. All these factors resulted in major difficulties due to extreme scarcity of available information, the unique source of which consisted in the data of observations at KWBS.

The following characteristics are obtained as results of simulation and compared with observed values:

1. Hydrographs of daily runoff for Ayan-Uryah, Debin, Detrin Tenke rivers for the period 1977-1984 and Suntar river for the period 1958-1964 (Figures 2-3).
2. Conditional variables, e.g., soil temperature and moisture for each soil layer, water capacity, density and saturation of snow cover at different types of landscapes.
3. Annual watersheds averages for precipitation, evaporation, and runoff discharge including that of surface, soil and ground water.

"Hydrograph" model has shown acceptable match of model-predicted discharges and conditional variables with observations. The further specification of the model parameters and attraction a wider range of experimental and research expeditions data are needed for the better understanding of the flow formation processes which are much specific for mountainous watersheds located in the zone of permafrost