EGU2020-1095
https://doi.org/10.5194/egusphere-egu2020-1095
EGU General Assembly 2020

The impact of thermokarst lakes on streamflow generation in Central Yakutia (Russia): data assessment and modelling

Olga Makarieva[1,2], Nataliia Nesterova[2,3], Alexander Fedorov[1], and Andrey Shikhov[4]
[1]Melnikov Permafrost Institute, Yakutsk, Russia (omakarieva@gmail.com)
[2]St. Petersburg State University, Institute of Earth Sciences, St. Petersburg, Russian Federation
[3]State Hydrological Institite, St. Petersburg, Russia
[4]Perm State University

Central Yakutian Plain (Russia) is situated in Eastern Siberia in the Lena River basin and is characterized by severe continental climate, continuous permafrost and flat relief. The combination of semi-arid climate, gentle topography and ice-rich permafrost provides favorable conditions for the development of thermokarst lakes. Poorly developed river drainage system and the distribution of thermokarst lakes within the river basins form the areas with internal drainage which contribute runoff to river network only in wet conditions. The results of such environment are the special hydrological regime of the region which is characterized by extreme seasonal and annual variability of streamflow.

In this project we study the hydrological processes in four rivers of Central Yakutia with the basin area from 1270 to 8290 km^2 and available long-term streamflow data. Thermokarst lakes take up to 5-10 % of the area of those basins. Annual precipitation of this area is about 240 mm, while average annual streamflow varies from 1 to 15 mm depending on the river basin. Due to climate warming the number and area of thermokarst lakes in Central Yakutia is increasing (Kravsova, Tarasenko, 2011). The aim of the project is to investigate the impact of thermokarst lakes on hydrological regime and provide some reasonable projections of its changes in the future. Previous study (Lebedeva, 2018) has shown that the results of streamflow simulations in this region based on standard hydrological modeling approach were not satisfactory.

We used remote sensing data (Landsat images) to assess the seasonal and annual variation of thermokarst lakes area and their contributing area and combined that data with hydrological modelling of runoff formation processes. The hydrological model Hydrograph (Vinogradov et al., 2011) was applied in this study. The model contains the algorithms of heat and moisture dynamics in the upper part of soil profile which allow its use in the permafrost conditions. New part of the model algorithm was developed which considers the variations of thermokarst area depending on meteorological conditions, evaporation from open water areas and the dynamic of surface runoff retention depth. These model improvements allowed for the satisfactory results in streamflow simulations for historical period and future projections. In general, with the future development of thermokarst lakes in Central Yakutia one may expect the decrease of annual streamflow and its

higher variation from one year to another.

Th results of the study will be presented. The study was funded by RFBR, project number 19-35-50030.