Geophysical Research Abstracts
Vol. 18, EGU2016-16447, 2016
EGU General Assembly 2016

Using isotope, hydrochemical methods and energy-balance modelling to estimate contribution of different components to flow forming process in a high-altitude catchment (Dzhancuat river basin case study)

Ekaterina Rets (1), Nadezhda Loshakova (2), Julia Chizhova (2), Maria Kireeva (2), Natalia Frolova (2), Igor Tokarev (3), Nadine Budantseva (2), and Yurij Vasilchuk (2)

(1) Water Problems Institute Russian Academy of Sciences, Russian Federation, (2) Moscow State University, Russian Federation, (3) St. Petersburg State University, the Resource Center "Geomodel", Russian Federation

A multicomponent structure of sources of river runoff formation is characteristic of high-altitude territories: ice and firn melting; seasonal snow melting on glacier covered and non-glacier area of a watershed; liquid precipitation; underground waters. In addition, each of these components can run off the watershed surface in different ways. Use of isotopic, hydrochemical methods and energy balance modelling provides possibility to estimate contribution of different components to river runoff that is an essential to understand the mechanism of flow formation in mountainious areas.

A study was carried out for Dzhancuat river basin that was chosen as representative for North Caucasus in course of the International Hydrological Decade. Complex glaciological, hydrological and meteorological observation have been carried in the basin since 1965. In years 2013-2015 the program also included daily collecting of water samples on natural stable isotopes on the Dzhancuat river gauging station, and sampling water nourishment sources (ice, snow, firn, liquid precipitation) within the study area. More then 800 water samples were collected.

Application of an energy balance model of snow and ice melt with distributed parameters provided an opportunity to identify Dzhancuat river runoff respond to glaciers melt regime and seasonal redistribution of melt water. The diurnal amplitude of oscillation of the Dzhakuat river runoff in the days without precipitation is formed by melting at almost snow-free areas of the Dzhancuat glacier tongues. Snowmelt water from the non-glacierized part contributes to the formation of the next day runoff. A wave of snow and firn melt in upper zones of glacier flattens considerably during filtration through snow and run-off over the surface and in the body of the glacier. This determines a general significant inertia of the Dzhacuat river runoff. Some part of melt water is stored into natural regulating reservoirs of the watershed that supply the Dzhancuat river flow during the winter period.

Due to complexity of water flow nourishment structure in alpine conditions a solution of ion and d18O balance equation was carried out for seasons, when it is possible to neglect some of the components in order to reach a needed amount of variables. A substantial excess of d18O content in spring snow and liquid precipitation over winter snow, ice and firn allowed to distinguish these components in the Dzhancuat river runoff in June and August. Unlike d18O mineralization is a nonconservative characteristic, it can show how the water ran down the watershed: over a glacier surface and then through stream channels or over a non-glacier surface, filtrating through comminuted surficial deposits. A solution of conductivity balance equation provide possibility to identify a base flow component in the Dzhancuat river runoff in August and to separate an on-glacier snow melt component from snow melt on non-glacier part of the watershed.

The study was supported by the Russian Foundation for Basic Research (Projet № 16-35-60042), Russian Scientific fund (Project № 14-17-00766, 14-27-00083)