



## **Streamflow water sources estimation in catchments in permafrost zone using EMMA model**

Tatiana Gubareva (1), Boris Gartsman (1), and Ninel Vasilenko (2)

(1) Water Problem Institute RAS, Moscow, Russian Federation (tgubareva@bk.ru), (2) State Hydrological Institute, Sc. Petersburg, Russian Federation

Water sources of streamflow were quantified in catchments located in permafrost zone using hydrochemical tracers and geochemical mixing model. Five studied streams of the Nelka River Basin are flowing on the experimental station “Mogot”, organized by State Hydrological Institute and functioned from 1976 till 1985. “Mogot” is located in the Central Baikal-Amur Railway Zone, 65 km north from the Tynda city. The area of the Nelka River Basin at lower gage is 30 sq. km.

Hydrochemical regime observations and discharge series of five small nested catchments were used to adapt the tracers-based three source mixing model according to procedure end-member mixing analysis (EMMA) in combination with the diagnostic tools. The key procedure of this approach is to project streamflow chemistry by the Principal Component Analysis (PCA) to the principal components. First two orthogonal projections of all chemical characteristics are represent complex tracers needed for three source mixing model.

The period of hydrochemical observation is consists of five years, from 1979 till 1983, the number of observations for each catchment is about 110. The list of hydrochemical characteristics of streamflow and other types surface/subsurface water includes following water solutes (mainly major ions): chloride ion, sulfate ion, hydrogencarbonate ion, calcium ion, magnesium ion, sodium ion plus potassium ion,  $\sum i$ .

Results of the PCA-modelling and the Mixing Model testing show that all five streamflows were controlled by process of mixing of three water sources: rain, soil water, and aufeis water. The aufeis water source reflects a specific character of river runoff formation in the permafrost zone catchments, containing frozen ground, ice in the soil, floodplain ice, snow. Process of forming runoff is homogeneous within the Nelka River Basin; three sources water are typically for all research catchments and constant during the estimation period. Proportions of three water sources were quantified, and average flow hydrograph separated on water source was constructed for the Nelka River.