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Assessment of climate and land use changes impacts on the rivers inflow to the Lake Baikal

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Baikal is the deepest lake in the world and one of the biggest reservoirs of fresh water. The aim of this research was to analyze the long-term variability of characteristics of river inflow to the Lake using the historical data and project possible changes in the face of non-stationary climate and land use based on hydrological modelling.
The basin of the Lake Baikal has area about 545 000 km2, half of which is situated in Russia. It is characterized by different climate and landscape conditions with annual flow depth varying from 30 to more than 600 mm. Nowadays active development and use of natural resources as well as climate changes have a strong impact on the regime of rivers inflow to the Lake. The watersheds response caused by environmental non-stationarity can be variable and unpredictable. Therefore adequate hydrological models with robust parametrization are required for future projections.
This study consisted of two parts. Initially we compiled the database of daily runoff data for about 50 gauges in the basin of the Baikal Lake with continuous period of observations 30-50 years. The data was used to assess the characteristics of river inflow to the Lake for the historical period and estimate observed changes due to current climate change.
For the development of future projections we have chosen several small and middle-size representative watersheds in different parts of the Lake basin with area from 151 to 7800 km2 and various types of hydrological regime. The data base for modelling was developed which included the information about landscapes, soils, dominating hydrological processes. The hydrological model parameters for different dominant landscapes were estimated based on that information.
We applied distributed process-based hydrological model Hydrograph developed in State Hydrological Institute, Russia (Vinogradov et al., 2011; Semenova et al., 2013). It describes all essential processes of land hydrological cycle including detailed algorithm of water and heat dynamics in soil accounting for water phase change. The model parameters relate to basin characteristics and could be assessed in the field or according to the landscape descriptions. The use of the model require very little parameters calibration and the model parameterization schemes can be transferred to ungauged basins in similar conditions. The validation of the model is conducted not only on runoff data but against internal states of watersheds (snow, soil thawing/freezing, etc.).
The Hydrograph model was validated for the historical period and then used in projection mode with the conceptual scenarios of climate change. The results of modelling projections were explored and the conclusions about possible changes of river inflow to the Lake Baikal were drawn.
We propose that the Hydrograph model can be applied as the tool to estimate riverine inputs into the lake's systems. The example of such approach is demonstrated here by the example of the Baikal Lake.

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