Geophysical Research Abstracts
Vol. 19, EGU2017-10322, 2017
EGU General Assembly 2017

Hydrological changes in the Amur river basin: two approaches for assignment of climate projections into hydrological model

Alexander Gelfan, Andrei Kalugin, and Yury Motovilov
Water Problems Institute, Russian Academy of Sciences, Moscow, Russian Federation (hydrowpi@iwp.ru)

A regional hydrological model was setup to assess possible impact of climate change on the hydrological regime of the Amur drainage basin (the catchment area is 1 855 000 km2). The model is based on the ECOMAG hydrological modeling platform and describes spatially distributed processes of water cycle in this great basin with account for flow regulation by the Russian and Chinese reservoirs. Earlier, the regional hydrological model was intensively evaluated against 20-year streamflow data over the whole Amur basin and, being driven by 252-station meteorological observations as input data, demonstrated good performance.

In this study, we firstly assessed the reliability of the model to reproduce the historical streamflow series when Global Climate Model (GCM) simulation data are used as input into the hydrological model. Data of nine GCMs involved in CMIP5 project was utilized and we found that ensemble mean of annual flow is close to the observed flow (error is about 14%) while data of separate GCMs may result in much larger errors. Reproduction of seasonal flow for the historical period turned out weaker; first of all because of large errors in simulated seasonal precipitation, so hydrological consequences of climate change were estimated just in terms of annual flow.

We analyzed the hydrological projections from the climate change scenarios. The impacts were assessed in four 20-year periods: early- (2020-2039), mid- (2040-2059) and two end-century (2060-2079; 2080-2099) periods using an ensemble of nine GCMs and four Representative Concentration Pathways (RCP) scenarios. Mean annual runoff anomalies calculated as percentages of the future runoff (simulated under 36 GCM-RCP combinations of climate scenarios) to the historical runoff (simulated under the corresponding GCM outputs for the reference 1986-2005 period) were estimated. Hydrological model gave small negative runoff anomalies for almost all GCM-RCP combinations of climate scenarios and for all 20-year periods. The largest ensemble mean anomaly was about minus 8% by the end of XXI century under the most severe RCP8.5 scenario.

We compared the mean annual runoff anomalies projected under the GCM-based data for the XXI century with the corresponding anomalies projected under a modified observed climatology using the delta-change (DC) method. Use of the modified observed records as driving forces for hydrological model-based projections can be considered as an alternative to the GCM-based scenarios if the latter are uncertain. The main advantage of the DC approach is its simplicity: in its simplest version only differences between present and future climates (i.e. between the long-term means of the climatic variables) are considered as DC-factors. In this study, the DC-factors for the reference meteorological series (1986-2005) of climate parameters were calculated from the GCM-based scenarios. The modified historical data were used as input into the hydrological models. For each of four 20-year period, runoff anomalies simulated under the delta-changed historical time series were compared with runoff anomalies simulated under the corresponding GCM-data with the same mean. We found that the compared projections are closely correlated. Thus, for the Amur basin, the modified observed climatology can be used as driving force for hydrological model-based projections and considered as an alternative to the GCM-based scenarios if only annual flow projections are of the interest.