Cold and Mountain Region Hydrological Systems Under Climate Change: Towards Improved Projections
Proceedings of H02, IAHS-IAPSO-IASPEI Assembly, Gothenburg, Sweden, July 2013 (IAHS Publ. 360, 2013) 105-112.

Assessing runoff sensitivity to climate change in the Arctic basin: empirical and modelling approaches

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Abstract Empirical and modelling approaches to assessing runoff sensitivity to climate change are presented by the example of the large rivers of the Arctic basin. The empirical approach has been carried out for seven large Arctic rivers. It is based on comparing the climatic mean of runoff estimated for the "warm" years of observations with the corresponding mean for the "cold" years. The registered differences in maximum annual runoff estimated for the "warm" and "cold" years have been found statistically insignificant, even under the large (up to 4°C) differences in the observed annual temperature for these years. The differences in minimum annual runoff turned out significant for three of the seven rivers. The modelling approach has been demonstrated on the basis of the ECOMAG modelling system applied for the Lena River (catchment area 2 488 000 km^2). The parameters of the model have been adjusted through calibration against runoff hydrographs observed for the 10-year period 2000–2009. Validation of the model has been performed for the period 1986–1999. The numerical experiments have been carried out to analyse the sensitivity of the Lena River runoff regime to possible changes in annual precipitation and air temperature. It has been shown that one-degree increase of the annual temperature leads to decreasing simulated annual runoff of about 5–7%, mainly due to increasing evaporation. Ten percent increase of precipitation leads to 15–17% increase in simulated annual runoff.

Key words cold region hydrology; climate change; sensitivity