Geophysical Research Abstracts, Vol. 9, 04845, 2007
SRef-ID: 1607-7962/gra/EGU2007-A-04845

Long-term ensemble forecasting of spring/summer flood characteristics

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A methodology of long-term (with the lead time of 2-3 months) ensemble forecasting of spring/summer flood volumes and the peak discharges has been developed. The methodology is based on the use of a distributed physically based model includes description of snow accumulation and melt, soil freezing and redistribution of soil moisture during autumn and winter period, processes of runoff generation after the beginning of spring snowmelt. The physically based model has been applied to calculate, using meteorological data for the autumn-winter period, missing initial river basin conditions before forecasting (commonly, the soil moisture and depth of frozen soil; sometimes, the snow water equivalent) and to estimate the runoff hydrographs during the lead time period. The historical meteorological series, results of meteorological forecasting, or Monte Carlo simulations using weather generator have been used to provide opportunities of generating the meteorological inputs for lead time periods and to estimate the probability distributions of the forecasted runoff volumes and peak discharges. The weather generator consists of the stochastic models of daily temperature and precipitation. Two criteria (transinformation (reduction of the original uncertainty of the flood characteristics due to the knowledge of the forecast) and ranked probability skill score) have been used to estimate the performance of the obtained probabilistic forecasts and choose the proper lead time and initial data combinations (observed or calculated). The results of deterministic forecasting of flood volumes have been compared with the results received on the basis of using the averaged meteorological conditions for lead time periods and regression relationships between spring runoff volume and the initial indexes of river basin conditions before forecasting (the present day procedure of long-term flood forecasting). The case study has been carried out for the Vyatka River basin, Sosna River basin and for the Seim

River basin. It has been shown that the suggested methodology of the forecasting of snowmelt flood volumes and peak discharges using the physically based1 model can be efficiently applied for both deterministic and probabilistic long-term flood forecasts. The application of Monte Carlo simulations using weather generator has given better results then using the historical meteorological series.