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Uncertainty estimation of long-range ensemble forecasts of snowmelt flood characteristics

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Long-range forecasts of snowmelt flood characteristics with the lead time of 2-3 months have important significance for regulation of flood runoff and mitigation of flood damages at almost all large Russian rivers At the same time, the application of current forecasting techniques based on regression relationships between the runoff volume and the indexes of river basin conditions can lead to serious errors in forecasting resulted in large economic losses caused by wrong flood regulation. The forecast errors can be caused by complicated processes of soil freezing and soil moisture redistribution, too high rate of snow melt, large liquid precipitation before snow melt. or by large difference of meteorological conditions during the lead-time periods from climatologic ones. Analysis of economic losses had shown that the largest damages could, to a significant extent, be avoided if the decision makers had an opportunity to take into account predictive uncertainty and could use more cautious strategies in runoff regulation. Development of methodology of long-range ensemble forecasting of spring/summer floods which is based on distributed physically-based runoff generation models has created, in principle, a new basis for improving hydrological predictions as well as for estimating their uncertainty. This approach is illustrated by forecasting of the spring–summer floods at the Vyatka River and the Seim River basins. The application of the physically - based models of snowmelt runoff generation give a essential improving of statistical estimates of the deterministic forecasts of the flood volume in comparison with the forecasts obtained from the regression relationships. These models had been used also for the probabilistic forecasts assigning meteorological inputs during lead time periods from the available historical daily series, and from the series simulated by using a weather generator and the Monte Carlo procedure. The weather generator consists of the stochastic models of daily temperature and precipitation. The performance of the probabilistic forecasts were estimated by the ranked probability skill scores. The application of Monte Carlo simulations using weather generator has given better results then using the historical meteorological series.