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Long-range hydrological forecasts and predictions: efficiency, failures, and scientific background (Russian experience)

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Abstract The flow of almost all large Russian rivers is regulated by means of reservoir cascades. Long-range forecasts of snowmelt flood characteristics have a special significance for regulation of flood runoff and mitigation of flood damages. The use of these forecasts in Russia commonly results in increases of the hydropower output by 3–5%. At the same time, the application of current methods and techniques has on many occasions led to serious failures and damage (e.g. the enormous errors in forecasting of the Volga River spring flood runoff in 1973, the prediction of variations of the Caspian Sea water level). Analysis of these failures has shown that the damage could, to a significant extent, be avoided if the decision makers had an opportunity to take into account the uncertainty in prediction and could use more cautious strategies in water resources planning and operations. At present, most hydrological forecasts and predictions that are issued in Russia are based on methods and techniques developed in the period 1950–1970. Development of distributed physically-based and dynamic–stochastic models, which properly describe the main spatio-temporal processes of runoff generation, has created, in principle, a new basis for hydrological forecasting and prediction, providing the means to improve the accuracy and reliability of hydrological predictions as well as enabling their presentation in a probabilistic form. This approach is illustrated for forecasting of the spring–summer flood volume and peak discharge of the Vyatka River.

Key words hydrological forecast; hydrological prediction; Russian experience; physically-based runoff generation models