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Real-time short-term forecast of water inflow into Bureyskaya reservoir

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During several recent years, methodology for operational optimization in hydrosystems including forecasts of the hydrological situation has been developed on example of Burea reservoir. The forecasts accuracy improvement of the water inflow into the reservoir during planning of water and energy regime was one of the main goals for implemented research. Burea river is the second left largest Amur tributary after Zeya river with its 70.7 thousand square kilometers watershed and 723 km-long river course. A variety of natural conditions – from plains in the southern part to northern mountainous areas determine a significant spatio-temporal variability in runoff generation patterns and river regime. Bureyskaya hydropower plant (HPP) with watershed area 65.2 thousand square kilometers is a key station in the Russian Far Eastern energy system providing its reliable operation. With a spacious reservoir, Bureyskaya HPP makes a significant contribution to the protection of the Amur region from catastrophic floods. A physically-based distributed model of runoff generation based on the ECOMAG (ECOlogical Model for Applied Geophysics) hydrological modeling platform has been developed for the Burea River basin. The model describes processes of interception of rainfall/snowfall by the canopy, snow accumulation and melt, soil freezing and thawing, water infiltration into unfrozen and frozen soil, evapotranspiration, thermal and water regime of soil, overland, subsurface, ground and river flow. The governing model's equations are derived from integration of the basic hydro- and thermodynamics equations of water and heat vertical transfer in snowpack, frozen/unfrozen soil, horizontal water flow under and over catchment slopes, etc. The model setup for Bureya river basin included watershed and river network schematization with GIS module by DEM analysis, meteorological time-series preparation, model calibration and validation against historical observations. The results showed good model performance as compared to observed inflow data into the Bureya reservoir and high diagnostic potential of data-modeling system of the runoff formation. With the use of this system the following flowchart for short-range forecasting inflow into Bureyskoe reservoir and forecast correction technique using continuously updated hydrometeorological data has been developed: 1 - Daily renewal of weather observations and forecasts database via the Internet; 2 - Daily runoff calculation from the beginning of the current year to current date is conducted; 3 - Short-range (up to 7 days) forecast is generated based on weather forecast. The idea underlying the model assimilation of newly obtained hydro meteorological information to adjust short-range hydrological forecasts lies in the assumption of the forecast errors inertia. Then the difference between calculated and observed streamflow at the forecast release date is "scattered" with specific weights to calculated streamflow for the forecast lead time. During 2016 this forecasts method of the inflow into the Bureyskaya reservoir up to 7 days is tested in online mode. Satisfactory evaluated short-range inflow forecast success rate is obtained. Tests of developed method have shown strong sensitivity to the results of short-term precipitation forecasts.