IAHS2017-274
IAHS Scientific Assembly 2017

Use of hydrological and reservoir regulation modeling systems in operational management of Volga-Kama cascade of reservoirs

Sergey Bednaruk (1) and Yury Motovilov (2)

(1) Russian State Agrarian University - Moscow Timiryazev Agricultural Academy, Moscow, Russia, (2) Water Problems Institute of the Russian Academy of Sciences, Moscow, Russia

Over the last 15 years the methodology for water management of river basins with cascades of reservoirs of complex appointment was developed in the Russia The application of this methodology is implemented in the form of computer technology that is used in order to provide information support for making optimal management decisions on regulation modes for Volga-Kama Water Resources System(VKWRS) in the operational practice of the Russian Federal Agency for Water Resources. The VKWRS is situated within the largest European Volga River basin (area 1.35 million km2) and consists of 11 reservoirs that are subject to seasonal and multiyear regulation. The volumes of the individual reservoirs range from 1 to 58 km3. The computer technology integrates two main components, namely the hydrological modeling system ECOMAG (ECOlogical Model for Applied Geophysics) and the reservoir operation modeling system VOLPOW (VOLga POWer). ECOMAG is a distributed hydrological model of runoff formation that describes the processes of infiltration and evapotranspiration, the thermal and water regimes of the soil, overland and subsurface flow, groundwater and river flow, snow accumulation and snowmelt. Daily data from about 350 meteorological stations in the basin are assimilated by ECOMAG in real-time mode. The forecasting technique makes use of two types of ECOMAG model runs. The first of these is a simulation that starts at least several years before the forecast date and produces the spatially distributed hydrological states of the river basin at the date of forecast beginning. The forecast horizon is 3 months. The second run is a simulation of river runoff formation for the lead time using ensembles of the weather scenarios which are assigned on the basis of historical observations in previous years. The output from the ECOMAG modeling system consists of the daily hydrographs of inflow (hydrological scenarios) into the Volga-Kama reservoirs for the forecast period. The most probable hydrological scenario is selected and used as an input to the VOLPOW reservoir operation model. This model is designed to simulate the operation of water resources systems. It is intended for a wide range of the water management objectives and can be used as a tool to support decision-making in the appointment of modes of reservoirs management taking into account information about the state of water bodies and waterworks, possible inflow into reservoirs, normative documents regulating the modes of the reservoirs, and current requirements of water users. The proposals for the regimes of the reservoirs are developed on the basis these two model components. These proposals are considered and discussed at the meetings of the Interagency Working Group (IWG), which include representatives of the interested ministries and departments, executive authorities of the Russian Federation, as well as the largest water user companies. On the basis of recommendations of the IWG, a decision is made to specific modes of operation of each of the Volga-Kama reservoirs, which in the form of instructions are communicated to the System Operator of the Russian Unit Power System and out comes in the form of directives on the hydro power plants.