Ecological aspects of forecasting the hydrological situation

A V Zvyagintseva¹⁵, O I Marar², S A Sazonova³ and V Yu Dorofeeva⁴

¹Department of Chemistry and Chemical Technology, Voronezh State Technical University, 84, October 20th Anniversary Street, Voronezh, 394006, Russia
²Department of Modeling and Organization of Social Systems, The Russian Presidential Academy of National Economy and Public Administration, 143, Moskovsky Prospect, Voronezh, 394005, Russia
³Department of Technosphere and Fire Safety, Voronezh State Technical University, 84, October 20th Anniversary Street, Voronezh, 394006, Russia
⁴Department of Criminal Procedure, Voronezh Institute of the Ministry of internal Affairs of Russia, 53, Patriotov Prospect, Voronezh, 394065, Russia

E-mail: zvygincevaav@mail.ru

Abstract. The article considers peculiarities of prediction of dangerous hydrological phenomena on water bodies of the Voronezh region. The types of activities performed by the Federal Service for Hydrometeorology and Environmental Monitoring (Federal State Budgetary Institution (FSBI) "Voronezh Regional Center for Hydrometeorology and Environmental Monitoring") are presented. The schematic functional diagram of the system of automated monitoring of hydrological characteristics and operational forecasting of high waters and floods, proposed.

1. Introduction

Monitoring of hydrological emergencies in the territory of the Voronezh region is organized by the following organizations: the Federal Service for Hydrometeorology and Environmental Monitoring (FSBI "Voronezh Regional Center for Hydrometeorology and Environmental Monitoring") [1, 2, 3]. The Federal Water Resources Agency (Department of Water Resources in the Voronezh Region of the Don Basin Water Administration) and the Ministry of Emergency Situations of Russia (General Department of the Ministry of Emergency Situations of Russia in the Voronezh Region) [4, 5, 6]. Federal Service for Hydrometeorology and Environmental Monitoring (FSBI "Voronezh Regional Center for Hydrometeorology and Environmental Monitoring") [7, 8, 9]:

- organizes and ensures the functioning of state monitoring subsystems for the state and pollution of the environment [10, 11];
- provides search, reception (collection), storage, processing (generalization, systematization) and analysis of information on the state of the environment, processes taking place in it, phenomena, changes in the state of the environment: Physical, chemical, biological and other indicators of the state of the environment and (or) their combination characterizing the quality of the environment, about chemical and radioactive contamination of surface waters of water bodies (including bottom sediments), about dangerous hydro meteorological phenomena and the state of the climatic system;
provides search, reception (collection), storage, processing (generalization, systematization) and analysis of information about objects that have a negative impact on the state of the environment, about the nature, types and about volume of such impact [12, 13];

assesses the state of the environment and predicts its changes under the influence of natural and (or) anthropogenic factors;

determines the relationship between the impact of natural and (or) anthropogenic factors on the environment and changes in the state of the environment [14, 15];

develops proposals to prevent negative impact on the environment and sends them to the government of the Voronezh region, to local authorities, to legal entities, to individual entrepreneurs;

sends information to the government of the Voronezh region, authorized to exercise state control (supervision), and to law enforcement authorities about violation of environmental standards with proposals to eliminate such violations [16, 17, 18];

sends to the government of the Voronezh region, to local self-government bodies proposals to take them into account when preparing territorial planning documents and (or) proposals to amend these documents in order to create favorable conditions for human life, to limit the negative impact of economic and other activities on the environment;

issues emergency information on the need to reduce the negative environmental impact of natural and (or) anthropogenic factors [19, 20, 21];

creates and operates databases of information systems providing storage, processing and systematization of information from subsystems of state monitoring of the state and environmental pollution;

ensures the submission to the government of the Voronezh region, local authorities, as well as legal and physical persons of data on the state and environmental pollution [22, 23, 24];

ensures compatibility of information resources of subsystems with the State Data Fund.

2. Method

Federal Water Resources Agency (Department of Water Resources of the Voronezh Region of the Don Basin Water Administration):

organizes and ensures the functioning of subsystems of state monitoring of water bodies, state monitoring of internal sea waters and territorial sea of the Russian Federation;

provides search, acquisition (collection), storage, processing (generalization, systematization) and analysis of information on the state of surface water bodies in terms of quantitative and qualitative indicators of the state of water resources, obtained within the framework of observations on the state of the bottom, banks, the state and mode of use of water protection zones and changes in morphometric features of water bodies, observation of federally owned water management systems, including hydraulic facilities, operating organizations under the authority of the Federal Water Resources Agency, as well as monitoring of water volume during water consumption and water disposal at all water bodies [25, 26, 27];

provides search, reception (collection), storage, processing (generalization, systematization) and analysis of information on objects having a negative impact on the state of water bodies and water resources;

prepares the prediction of changes in the state of water bodies, bottom, banks of water bodies, their morphometric features, water protection zones of water bodies, quantitative and qualitative indicators of the state of water resources, the state of water management systems, including hydraulic structures [28, 29, 30];

defines the links between the impact of natural and/or anthropogenic factors on the state of water resources and changes in the quality state of water resources;
develops proposals to prevent negative impact on the state of water resources and water bodies and sends them to state authorities, local self-government bodies, legal entities, individual entrepreneurs;

• sends to the State authorities authorized to carry out State control (supervision) and law enforcement agencies information on the detection of the unsatisfactory state of water bodies and water resources and proposals to eliminate such state [31, 32, 33];

• sends proposals to the Government of the Voronezh region, local self-government bodies to take them into account in the preparation of territorial planning documents and (or) proposals to amend these documents in order to create favorable conditions for human activity, to limit the negative impact of economic and other activities on the state of water resources and water bodies, to ensure the protection and rational use of natural resources for the benefit of present and future generations;

• in case of detection of negative impact on the state of water resources and water bodies, provides emergency information on the necessity to reduce negative impact [34, 35, 36];

• assess the effectiveness of environmental protection measures taken to protect water bodies;

• creates and operates databases of information system providing storage, processing and systematization of information obtained as a result of monitoring of water bodies, water resources;

• provides the Government of the Voronezh region, local self-government bodies, as well as legal entities and individuals with data on the state of water bodies;

• ensures compatibility of information resources of the subsystem of state monitoring of water bodies with the State Data Fund [37, 38, 39].

Emercom of Russia (Head department of the Ministry of Emergency Measures of Russia in the Voronezh region):

• together with the Government of the Voronezh region, organizes work on the establishment of a system for monitoring and forecasting emergencies, as well as on the development and implementation of risk indicators in the territories and facilities of the economy in accordance with the established procedure [40, 41, 42];

• provides information to the population through the mass media and other channels on predicted and emerging emergencies, measures to ensure the safety of the population and territories, techniques and methods of protection, as well as propaganda in the field of protection of the population and territories from emergencies and the safety of people on water bodies [43, 44, 45].

Of particular importance in improving the quality of both the input hydrometeorological information and the forecasts obtained is not only the improvement of measurement (determination) methods, but also the improvement of the methodology for monitoring hydrological characteristics.

3. Results
At present, there are quite a lot of technical solutions that allow to create an automated network to the required extent, including a group of data collection modules (instruments, sensors) located on the sections of the hydrological network of interest. In addition, communication channels and the received information processing center are required, where specialized software is used, which processes signals on observed hydrometric characteristics from data collection modules [1, 2].

For example, the schematic functional diagram of the system of automated monitoring of hydrological characteristics and operational forecasting of high waters and floods [1, 2], proposed by LLC "SPP" Energy and Information Technologies "of BelSU, is shown in the figure.

4. Conclusion
In the considered functional scheme, the application software of the automated workstation (AWP) should ensure implementation of the following services: filtering of input data of the concentrator, construction of vectors of parameters of input data from objects of location of measuring and computing...
complexes (MCS), construction of forecasts of development of dangerous hydrological phenomena on the basis of formed vectors of input parameters.

Output data of AWP software are current and predicted levels of water surface in the area of influence on the investigated object of water use, should be displayed in the form of vector objects on the digital map-diagram of adjacent area. On the basis of the forecast of development of a high water or a flood the decision on the preliminary notification of the population living in the area of possible flooding (flooding) of heads of the enterprises getting to a risk zone is made.

Unfortunately, information on the hydrological regime of rivers and water bodies, necessary for analysis of the risk of development of flooring and forecast of its characteristics, is available mainly for a small part of the river network of the Voronezh region. The network of hydrometeorological stations and posts that are mainly measured using obsolete methods and measuring instruments remains clearly insufficient for water bodies.

Figure. Functional diagram of the system of automated monitoring of hydrological characteristics and operational prediction of high waters and floods [1].

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