

THE DEVELOPMENT OF THE FLOOD OBSERVATION AND FORECASTING SYSTEM IN THE UKRAINIAN PART OF THE TISZA RIVER BASIN: PROBLEMS AND NEEDS

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Abstract: The natural conditions of the Ukrainian part of the Tisza river basin are favourable for the flood runoff formation. High and fierce floods can be expected in any time of the year along the Tisza river basin. The territory of the Tysza river basin has been severely damaged during past years from extreme floods which have occurred in November, 1998 and March, 2001. Taking into account the fact that river floods affect large areas with intense economical development and high density of population and that Tisza is the transboundary river, one of the major requirements of comprehensive control resources developments is flood control. Among flood control measures the development of the flood observation and forecasting system in the Tisza river basin is the one of the most important. The present state, problems, needs and main ways of development of the observation and forecasting system within the Ukrainian part of the Tisza river basin are presented in the paper.

Keywords: flood control, hydrometeorological observation network, hydrological forecasting, problems, needs, ways of development.

FORTENTWICKLUNG DER HOCHWASSERBEOBACHTUNGEN UND VORHERSAGESYSTEME IM UKRAINISCHEN TEIL DES THEIß-FLUßBECKENS: PROBLEME UND BEDÜRFNISSE

Zusammenfassung: Die Naturbedingungen im ukrainischen Teil von Theiß-Flußbecken sind sehr günstig für die Hochwasserbildung. Hohe und gefährliche Hochwasser geschehen im ganzen Einzugsgebiet zu beliebiger Jahreszeit. Das Theiß-Flußgebiet hat große Schaden während der vorigen Jahre erlitten, die im November 1998 und März 2001 geschehen sind. Unter Berücksichtigung solcher Tatsache, daß Hochwasser große Flächen mit intensive ökonomische Entwicklung und hohe Bevölkerungsdichte erfassen und doch die Theiß ein Grenzfluß ist, wichtige Bedeutung hat effektiver Hochwasserschutz. Unter diesen Maßnahmen haben Beobachtungsentwicklung und Schaffung der Vorhersagesysteme im Theiß-Flußgebiet von nicht geringer Tragweite. In diesem Beitrag sind gegenwärtiger Zustand, Probleme, Bedürfnisse und Hauptwege der Beobachtungsentwicklung und Vorhersagesystemschaftung im Theißgebiet dargelegt.

Schlüsselworte: Hochwasserschutz, hydrometeorologisches Beobachtungsnetz, hydrologische Vorhersagen, Probleme, Bedürfnisse, Entwicklungswege.

1. Introduction

The natural conditions of the Ukrainian part of the Tisza river basin are favourable for the flood runoff formation. High and fierce floods can be expected in any time of the year along the Tisza river basin. The territory of the Tysza river basin (Trans-Carpathians district of Ukraine) has been severely damaged during past years from extreme floods which have occurred in November, 1998 and March, 2001. Floods are typical natural events in this region and they will continue to occur. The climatic variation and changes anticipate the increased occurrence of extreme meteorological and related hydrological events. Within the Tisza river basin several large cities are situated: Uzhgorod (about 125.000 citizens), Mukachevo (about 90.000 citizens). Taking into account the fact that river floods affect large areas with intense economical development and high density of population and that Tisza is the transboundary river, one of the major requirements of comprehensive control water resources developments is flood control. Among flood control measures the development of

the flood observation and forecasting system in the Tisza river basin is the one of the most important.

2. Present state of the flood observation and forecasting system

2.1. Institutional background

In Ukraine all activity on preventing the detrimental consequences of river inundation is coordinated by the State Government.

The State Hydrometeorological Service is the principal state institution responsible for providing hydrometeorological information, forecasting to economic sectors, authorities, and general population about flood dangers and flood development. The Hydrometeorological Service is also responsible for water quality monitoring on rivers.

The State Hydrometeorological Service manages national meteorological and hydrological network, and operates via its structural units that are responsible for:

- Ukrainian Hydrometeorological Center (Kyiv) and regional Transcarpathian Center on Hydrometeorology (Uzhgorod) for the operational processing of the monitoring of data, operational forecasting, official dissemination of monitoring data and forecasts for the governmental institutions, economic sectors and mass-media;
- Central Geophysical Observatory (Kyiv) for storage and long-term processing of hydrometeorological data, data archiving, methodological guidance of monitoring network;
- Ukrainian Research Hydrometeorological Institute (Kyiv) for research and development in the field of hydrological and meteorological forecasting.

The Transcarpathian Department of the State Committee of Ukraine on Water Management (Uzhgorod) is responsible for flood management and response in the Tisza river basin, maintenance of polders, channels and others engineering structures of water management.

2.1. Existing hydrometeorological measuring and observation network

The Hydrometeorological Service of Ukraine is a multifunctional system constructed according to the vertical principle. Different levels of organizational, methodological and technical management (e.g. state, regional, district) have been created in this system. The Hydrometeorological Service is working under the Ministry of Environment Protection of Ukraine.

The primary factors which influence the accuracy and lead - time of hydrological forecasts are the accuracy, speed and reliability with the real-time values of hydrological and meteorological variables are collected. For this purpose and extensive monitoring of hydrological and meteorological data is carried out.

The present hydrological and meteorological monitoring network system and hydrological forecast service of Ukraine have been inherited from the former Soviet Union. In particular, surface water quantity – operational network in Ukrainian part of Tisza river basin (including Latoritsa and Uzh river basins) includes 38 observing points. Ten meteorological stations are operated in the Tisza river basin. It should be noted that despite a critical economic position, the hydrometeorological network in Ukraine has not been decreased from 1990. On the contrary, four observing points was put in operation in the Tisza river basin during 1999 – 2000 (Manukalo, 2001).

But we understand that the density of the ground network for hydrometeorological observation (especially for precipitation measuring) is comparatively low, its distribution is unfavourable. So, State Hydrometeorological Service plans to extend number of points of observation, especially, in the mountain part of the basin.

The absence of automatic and long distance hydrometeorological information systems is an important deficiency of existing observation network.

The basic hydrometeorological instrumentations used in Hydrometeorological Service were produced in the 1960s and 1980s. Old kinds of propeller current meters are used for discharge measurements. Hydrological instruments have not been equipped with data loggers. Data transmissions are provided manually.

There is no meteorological radar in operation in the Ukrainian part of the Tisza river basin, but the digitalized precipitation intensity images produced by the Hungarian meteorological radar every 15 minutes are available for flood defense purposes in Ukrainian Hydrometeorological Service.

2.2. Flood forecasting

Ukrainian Hydrometeorological Center located in Kyiv is the main organization of the Hydrometeorological Service for making meteorological and hydrological forecasts. It coordinates the activity of the regional hydrometeorological forecasting center in Uzgorod, which is responsible for making meteorological and hydrological forecasts overall Tysza river basin. Among the predicted hydrological elements, forecasting of water stage is predominant.

The Trans-Carpathians Hydrometeorological Center (Uzhgorod) receives the satellite meteorological information from Ukrainian Hydrometeorological Center and from Hungary (Nyiregyhaza) for purposes of forecasting.

The Ukrainian Hydrometeorological Research Institute develops the scientific approach for hydrological forecasting including the necessary software. The development of automated forecast systems, which include some manual input of information for different river basins, is a main objective of the development. The prognostic systems are based on mathematical modeling of process that take place in basins and determine the conditions of flood formation precipitation type, soil moisture values and freezing of soil, relief.

These approaches allow one to forecast river runoff characteristics in the form of:

- a) spatial forecasts,
- b) continuous in time forecasts;
- c) combined forms of forecasts.

The spatial forecasts with different degrees of detail (depending on consumer demands) are of a high prognostic value. The system of continuous forecasting allows the development of prognoses that overlap in time. This provides a regular, more accurate, definition of prognoses. Continuous short-term forecasting of runoff values at 6-12 h and their possible variation over the next 24 h are forecasted for each forecast issue.

Governmental bodies, organization of water management, communal economy, hydropower economy, civil defense, engineer-building defenses, mass media are the recipients of flood forecasts of Hydrometeorological Service.

The Hydrometeorological Service of Ukraine exchanges information and forecasts with corresponding hydrometeorological and hydrological services of neighbouring countries in the Tisza river basin – Hungary, Romania and Slovak Republic – via the Global Telecommunication System of World Meteorological Organization and via local telecommunication systems.

3. The problems and needs

The experience of the floods in the region of the last years (especially in November, 1998 and in March, 2001) indicated number problems at the flood observation and forecasting system in the Tisza river basin. Managing of flood risk includes a number of cross-cutting technical, socio-economic, political and environmental themes.

The Hydrometeorological Service of Ukraine is rather well organized institution but it has many problems with technical equipment and using modern technology of observation. It is necessary to improve the national hydrological and meteorological systems and establish an operational and reliable system for the collection, transmission, processing, storage and dissemination of hydrological data in real or quasi-real-time. Hydrological data and especially those related to tributaries are not sufficient for the optimal operation of hydrological forecasting systems, particularly for small rivers, for which the data exchanged are not appropriate for the application of rainfall-runoff hydrological models.

A modern real-time water flow monitoring and forecasting system should be set up to meet the national and regional water development needs of Ukraine and neighbouring countries. The main task of this system should be increasing the lead-time of floods forecasts. The basic condition for a robust forecasting system is to have a core trunk system

based on on-line stations. On – line instrumentation plays an important role in updating procedures in forecast modeling. Without a basin-wide technical information system it will be difficult to provide the implementation of international law principles: equitable utilization and “no harm” principle.

Most Important needs in the field of the development of flood monitoring and forecasting system are as follows:

- a) put in operation new hydrometric station in the mountain part of the basin;
- b) modernization of hydrometric instrumentations;
- c) implementation of remote sensing techniques for obtaining hydrometeorological information, automatized stations, meteorological radar and automated working place of a forecaster;
- d) implementation of modern means of data processing;
- e) special interest is directed towards the utilization of developing meteorological products.

Applied hydrological models should be improved, hydrological staff could increase the level of their knowledge to gain certain experience in the use of modern equipment, method of observation, data transmission and processing.

The forecasts of flood within mountain catchments cannot be provided without improving the hydrological forecasting methodologies by using of specialized forecasts of precipitation quantity with distribution them upon orographical regions.

It is very important to start using in the hydrometeorological service the modern numeric model of weather forecasting.

The warning procedures are not as common as those for hydrological forecasting. They depend on the economic importance of hydrological warning creditability. The maximization of effective lead time between the using of forecasts and the response to warnings is one of main objectives of developing warning procedures appropriate to local conditions (Manukalo, 1997).

The State Hydrometeorological Service and the State Committee on Water Management undertake efforts to development of the system of flood observation and forecasting within the Tisza river basin.

The first Ukrainian (Soviet Union) plan for automation of measuring of hydrometeorological observation was prepared between 1986 – 1990 in the framework of a Hungarian – Soviet technical – scientific co-operation. Based on this plan the Ukrainian automation development plan was prepared, and then depending on financial sources the implementation began in the middle of 1990s.

The central building of the system was constructed in Uzhgorod in 1999. In the framework of a Hungarian-Ukrainian collaboration, establishment of an automatic data transfer system for flood forecasting commenced, financed by Hungarian government grant. Accomplished major Hungarian - Ukrainian developments are:

- installing structured computer network in the central building in Uzhgorod;
- creating hydrological remote data measuring network containing one center and two stations;
- constructing the backbone of a UHF network capable of voice – and data transfer, covering the whole Transcarpathian region.

During 2002-2003 twelve new automatic hydrometeorological stations were constructed in the Ukrainian part of the Tisza river basin with Hungarian government aid.

In 2003 two automatic hydrometeorologica stations have been established within the Tisza river basin in the frame of the technical assistance of the United States government.

In 2004 Ukraine should obtain 10 automatic hydrometeorologica stations in the frame technical assistance from Tacis Program, United States, Denmark and German governments.

In 2004 the elaboration of the Ukrainian automatic hydrometeorological station will be ended. The construction of 5-7 stations within the Tisza river basin during 2004 – 2005 has been planed by the State Hydrometeorological Service.

The modern computer systems of processing of data, new models of hydrological forecasting will put in operation during 2004-2005 in the Ukrainian Hydrometeorological

Center and in the Hydrometeorological Center in Uhzgorod. The numeric weather forecast model MM-5 and Danish hydrological forecast model Mike-11 are tested now in State Hydrometeorological Service.

Each of the Tisza river basin countries has its own hydrometeorological monitoring and forecasting system. The inconsistency among national systems calls for the development of hydrological monitoring and forecasting system through the implementation of a Regional Integrated Flood Monitoring and Forecasting System (RIFMFS).

In order to create the reliable RIFMFS a unified system approach for the entire Tisza river basin is crucial when designing the automatic monitoring system. The required minimum level of unity has to be defined in a way that the usage of various type model is possible in the system (instruments, data collecting, operating software, etc). Obviously the hardware operated in the system has to meet national and international standards, compatibility and as long as possible, most of the elements should show some similarity.

The improvement of technology can not be considered as a purely scientific and technical task. It requires the solution of complex of problems of economical, organizational kind. The political and economic changes in Ukraine have created a sever shortage of financial resources for hydrological and water management activities. Economical difficulties in Ukraine do not allow to support the Hydrometeorological Service completely. It compels us to solve the problems of technology development in close connection with financial and economical provision, to look for new key factors for regulating relations between the Hydrometeorological Service and consumers of hydrometeorological products which might promote the adaptation of the National Hydrometeorological Service to new economical conditions.

4. Conclusions

During the period from 1998 significant efforts have been undertook to develop the flood observation and forecasting system in Ukrainian part of the Tisza river basin. The State Hydrometeorological Service and the State Committee on Water Management are much more equipped to face the forecasting new floods now. But, it is very important to continue these efforts, especially, in the field of a construction of automatic on-line hydrometeorological stations, the use of developed hydrometeorological forecasting models. In the Tisza river basin the creation of the Regional Integrated Flood Monitoring and Forecasting System is very actual task in the nearest future. This system will provide more efficient cooperation in the Tisza river basin in hydrological monitoring, forecasting and warning of negative consequences of floods, integrated water management and environment protection.

5. References

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