DEVELOPMENT OF THE SOFTWARE COMPLEX FOR THE ENSEMBLE FORECASTING OF THE SPRING RIVER FLOOD IN THE BASIN OF THE YUZHNY BUG RIVER

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Actuality of the research work. Forecasting the possibility of occurrence of dangerous spills on rivers is a complex multilevel task, the urgency of which is determined by the state of modern economic systems, their vulnerability. The ongoing floods in the southwest of Ukraine within Khmelnitsky, Vinnytsia, Kirovograd, Odessa, and in the Mykolayiv regions make up a third of all cases of natural emergencies observed here. They affect greatly the economy and the population, causing flooding of agricultural lands and complexes, industrial buildings and residential areas, erosion of roads, destruction of hydrotechnical structures. Rapid and high-precision forecasting of occurrence of high snow and rain floods in order to minimize damage, improvement of the population's safety and sustainable use of floodwaters are possible with the availability of appropriate software. Therefore, the creation of a software package for operational forecasting of the maximum flow of spring high water and the timing of its occurrence is an extremely topical task.

Purpose of the research work – the development of a software package for the release of an ensemble (for several characteristics) long-term forecast of the maximum flow (volume, maximum flow rates and water levels), the timing of the beginning and passage of the maximum of spring flood in the basin of the Yuzhny Bug River.

Methods and main results. To perform calculations of the estimation of expected hydrological quantities, a large amount of initial information must be processed. In this case, operations on data are monotonous and their calculation by hand takes a lot of time. Previously, a table processor for working with spreadsheets created by Microsoft - Microsoft Office Excel was used to solve this problem. Despite the relative ease of working with spreadsheets, their use for production of the forecast has several disadvantages:

since the initial data for forecasting are in the same file, there is a possibility of accidental editing of another table;

the MS Excel spreadsheet processor does not allow you to check the input data and structure the tables, as necessary for the task.

The developed software package is completely devoid of these disadvantages, and besides, it has a convenient, intuitive interface for rapid forecasting and assessment of the situation.

To create the program complex we used C # [1] as the programming language and the Windows Forms graphics subsystem on the software platform. Net v3.5 allowing to develop applications with a full-featured interface that are simple to deploy and update, able to work with or without an Internet connection, and using more secure access to resources on the local computer than traditional Windows applications [2].

Modeling of the domain is represented in the form of a UML diagram showing the structure of classes and the connections between them (Fig. 1).
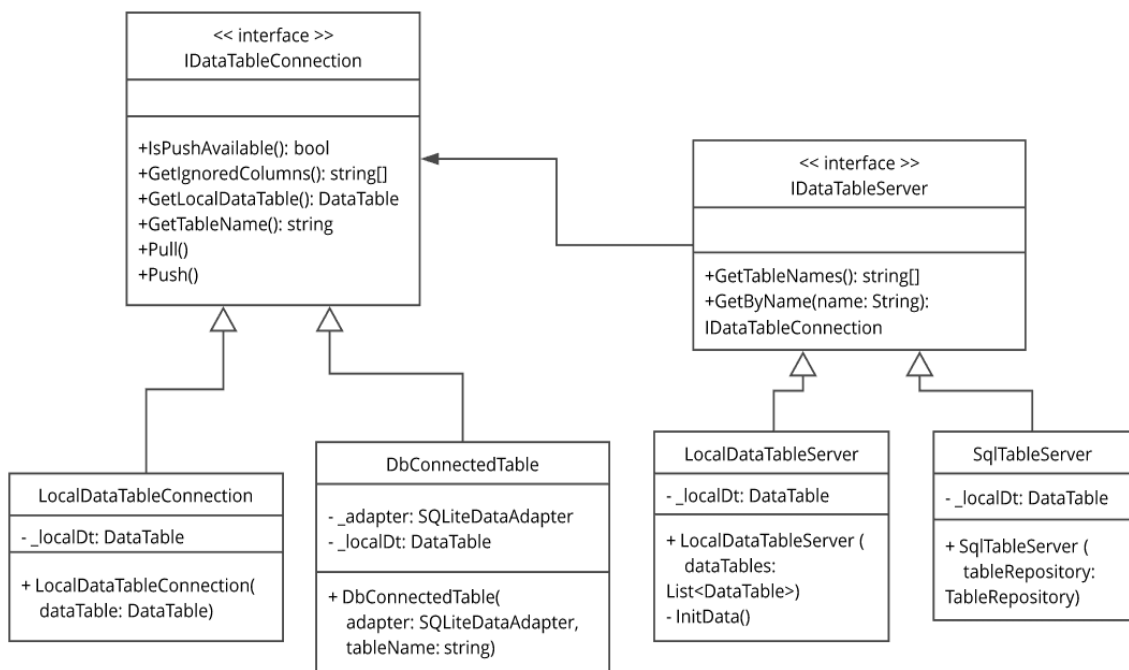

Fig. 1 – UML diagram of classes

When designing the interface, it was decided to indicate two main components of the future software product: the table manager and the form of forecast parameters. From the main program window (Fig. 2), you can open the desired component by clicking on the corresponding button.
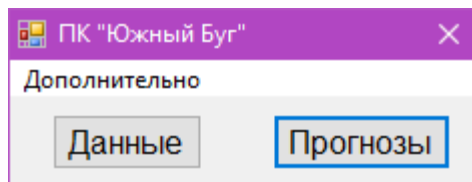
Fig. 2 – Main program window

The table manager allows you to enter, edit and delete data for subsequent calculations (Fig. 3).

The result of the calculation is presented in the form of a table, which can be displayed in an already developed component.

	Index	Hr	OI_Hydro	Hydro	OBL	F
▶	81361		187	Південний Буг- с.Тростянчик	Вінницька	17400
	81363		188	Південний Буг- с.Підгір`я	Миколаївська	24600
	81393		193	Рів- с.Демидівка	Вінницька	1130
	81414		197	Кодима- с.Катеринка	Миколаївська	2390
	81417		198	Синюха- с.Синюхін Брід	Миколаївська	16700
	81430		200	Велика Вись- с.Ямпіль	Черкаська	2820
	81433		201	Ятрань – с.Покотилово	Кіровоградська	2140
	81438		203	Чорний Ташлик- с.Тарасівка	Миколаївська	2230
	81446		207	р.Інгул-м.Кропивницький	Кіровоградська	840
	81450		209	р.Інгул-с.Новогорожене	Миколаївська	6670
	81439		204	Мертвовід-с.Крива Пустош	Миколаївська	252
	81442		205	Чичиклія-с.Василівка	Миколаївська	436
	81444		206	Гнилий Єланець-с.Женево- Криворіжжя	Миколаївська	1190
	81454		210	Громоклія-с.Михайлівка	Миколаївська	1410
			211	Тилігул-с.Новоукраїнка	Одеська	810
	81338		212	Тилігул-с.Березівка	Одеська	3170

Fig. 3 – Table manager

When creating the forecast parameters form (Fig. 4), the main attention was paid to creating a simple, user-friendly interface that will allow even to inexperienced user work quickly with a program.

As a result of creating a software package for the release of an ensemble long-term forecast of the hydrological characteristics of the spring flood, a product was developed that has the following functional capabilities:

- input of operational information on meteorological stations;
- spatial restoration of operational information on meteorological stations;
- input of operational information on hydrological posts;
- spatial restoration of operational information on hydrological posts;
- calculation of forecast values;
- viewing and printing of tables with initial data, results and evaluation of performed calculations.

Conclusions and prospects. The developed software package allows to create an initial base of hydrometeorological data, restore fields of values when passing observations, forecast and estimate the expected hydrological values on the rivers during the passage of the spring floods of the rivers of the Yuzhny Bug river basin.

Further prospects of work are related to the automation of the initial series of observations from the Internet (using the automated software complex of the Ukrainian hydrometeorological center ARM-hydro) into the tables of the program forecast complex presented in this paper.

Fig. 4 – Form of forecast parameters

In addition, a program block is planned that will allow with a help of GIS maps to link forecast information to a cartographic basis, which will make possible to assess the degree of risk of hydrological characteristics for significant areas, including hydrologically unexplored rivers.

References

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2.   Petzold C. Programming with Microsoft Windows Forms. Мастер-класс / Пер. с англ. М.: Русская Редакция; СПб.: Питер, 2006. 432 стр.