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ANALYSIS OF THE SITUATION OF FORECASTING FLOOD EVENTS IN EURASIAN COUNTRIES: THE PROBLEMS AND THE SOLUTIONS

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A R T I C L E I N F O.

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Abstract

In this article, the analysis of emergency situations related to floods occurring in foreign countries, the current state of flood protection measures and forecasting of the population, territories, material and cultural resources, organizational and legal problems arising in the implementation of protection measures, and measures to eliminate them is given.

Problems of creating modern innovative technologies or implementing existing innovative advanced foreign technologies in our republic in the direction of identification, monitoring and forecasting of flood-prone, but unregistered areas before engineering, and technical measures to protect the population, territories, material and cultural resources from floods have been highlighted.

Introduction:

In many countries, early identification of possible sources of natural emergency situations, organization and implementation of systematic monitoring and control over them, and advance forecasting of the possible nature and scope of the development of dangerous natural processes and events leading to emergency situations remain an urgent issue today.

The issues of forecasting emergency situations within the set of measures for the prevention of emergency situations, which are carried out in advance and are aimed at reducing the risk of emergency situations as much as possible, and in the event of such situations, saving people's lives and health, reducing the amount of damage and material losses to the environment rank among the first events[11].

In the direction of advance forecasting of flood events, which are considered to be one of the main types of natural emergency situations that require a scientific approach, world scientists are developing new innovative technologies and promoting forecasting methods created as a result of their

scientific research[1].

Main part. Why is it necessary to forecast flood events in advance and take measures to prevent emergency situations based on them, and should we pay great attention to the issues of forecasting flood events based on what conditions in general? To do this, we will study the scale of the flood emergencies in Eurasian countries, the resulting losses and property damage, and other consequences[12].

Figure 1. Aftermath of floods in

In November and December 2022, floods and landslides occurred in some areas of Peninsular Malaysia. 315 people in Perak and 186 in Selangor were evacuated. On 8 December, 45 students and staff were rescued from a school building after a flash flood in Seremban, Negeri Sembilan (Figure 1).

171 mm of rain fell in Terempeda, Indonesia in 24 hours on December 14-15, 2022. About 1,117 people were injured and 220 houses were damaged in Natuna Regency. In Kepulauan Meranti District, 3,195 people were affected and 639 houses were destroyed (Figure 2).

In Lhuentse, Bhutan
On July 20, 2023, 6 people were killed in a flood caused by heavy rain and
17 people are missing (Figure 3).
At least 12 people have been killed and 40 are missing after floods destroyed homes in

Afghanistan's Maidan Wardak province. On July 22, 2023, floods occurred in Jalrez, Saidabad, Chaki Wardak and Maidan Shahr districts after heavy rains.
The bodies of 32 people who died as a result of the floods that occurred on August 3, 2023 in Oni municipality of Georgia were found. 210 people were evacuated from the disaster area, 5 people are missing (Figure 4).

On August 27, 2023, heavy rain caused heavy floods and landslides in some regions of Tajikistan. As a result, 11 people died in Vahdat region, about 15 cars were buried under landslides and flood debris, and 100 farms were evacuated. 2 people were killed in Rudakii district, several cars were submerged in flood waters (Fig. 5).

On July 9, 2023, 37 people died as a result of the heavy rain that started in South Korea. 9 people are missing. The deaths were reported in Sejong (1), North Chungcheong (13), South Chungcheong (4) and North Gyeongsang (19). 8 people went missing in North Gyeongsang Province and 1 person went missing in Busan (Figure 6).

On July 8-10, 2023, more than 250 mm of heavy rain in 24 hours caused floods in the Black Sea region

of Turkey. Floods caused major damage in Bartin, Zonguldak, Duzje, Kastamonu, Samsun, Giresun, Bolu and Karabuyuk regions (Figure 7).

Hundreds of people were evacuated from flooded houses. 1 person died due to flood water in Charshamba city of Samsun region. In Amasra, Merkez and Kurukashile districts of Bartin region, about 70 people have been displaced from the flooded areas. About 150 people were forced to leave their homes in Devrek and Gokchebey districts of Zonguldak. About 500 people were rescued and moved to safe areas in Duzhe region. Dozens of houses were damaged by floods in Kastamonu region, especially in Side district. In June 2023, 2 people died as a result of floods that occurred in Kastamonu, Samsun, Amasiya and Sinop regions.

On July 6-7, 2023, floods and landslides occurred in Lumajang District, East Java Province, Java Island, Indonesia. As a result of floods, 3 people died, more than 1000 people were forced to leave their homes. Heavy rains also caused widespread flooding and flash floods in Bali, while strong winds uprooted trees and damaged buildings. In addition, heavy rain falling on the unstable soil caused many landslides (Figure 8).

In floods and landslides in the Philippines during 2023, 17 people died, and 71,442 people left their homes due to heavy rains (Fig. 9).

115,562 people in Central Luzon, 130,168 in Mimaropa and 80,082 in Davao Province were affected. At least 192 houses were destroyed, including 112 in Mimaropa. 123 evacuation points were established across the country and 71,442 people were accommodated in them. Deaths were also reported in Biko, Eastern Visayas, Zamboanga, Northern Mindanao and Davao.

Heavy rains have occurred in northern Syria since March 16, 2023. Due to heavy rains, floods occurred and caused extensive losses. As a result, 938 tents of the refugee camps where the citizens fleeing the war that has been going on for more than 12 years in Syria are located were damaged (Figure 10).

World scientists conducting research in the field of hydrometeorology recommend many methods for forecasting flood events. In particular, the application of these methods requires reliance on the area of occurrence of flood events, formation and formation of flood mass, composition of flood mass and other factors.

Scientist of the Institute of Automation and Information Technologies of the Kyrgyz National Academy of Sciences L.I. Velikanova suggests that the use of neural network technologies can provide effective results in short-term flood risk forecasting. As a rule, floods in mountainous areas occur during hot weather with heavy rains. In predicting flood events with complex glacial-glacial genesis, the relationship between weather events and the probability of a flood is so complex that it cannot be described with sufficient accuracy by mathematical apparatus at the current stage of scientific development. We can demonstrate the possibility of using neural network technology as a promising method of flood risk prediction. This approach is used when it is not possible to describe complex geospatial phenomena in detail.

A neural network's ability to predict comes directly from its ability to generalize and highlight implicit relationships between input and output data. After learning, the network can predict the future value of a given sequence based on several past values and/or current factors. A training set is a set of observational data with specified values of input and output variables.

It has been found that the problem of flood risk prediction can be successfully solved by identifying a system of indicators of hydrological conditions and developing forecasting technologies based on them, using neural network models.

Among the many indicators that affect the occurrence of floods, the most important features have been selected for the study of the neural network: water consumption in the river, air temperature and humidity, and the amount of precipitation taking into account the history of the forecast period.

In order to create a training data set, the conditions for the formation of floods and flood flows in the Ala-Archa mountain river basin, located in the Kyrgyz ridge zone, from 1953 to 2008, according to the hydrometeorological service, have been analyzed. Catastrophic floods and mudslides occur infrequently, and observational data alone may not be sufficient to train neural networks.

In this regard, a virtual learning set has been developed based on observational data with different noises. Flood and flood risk forecasting is carried out in two stages.

In the first step, a neural network is created and studied. It predicts the maximum (Qmax) and average daily (Qsr) consumption of water in a controlled reservoir with a lead time of N days.

$$\mathbf{Qmax = Qsr + N} \quad \mathbf{(1)}$$

The forecast results, along with other data, are the input for a neural network that predicts the probability of flooding during the forecast period.

Based on meteorological and hydrological data, the algorithm for short-term forecasting of flood probability with a duration of one day consists of performing the following actions:

- to identify a subsystem of features that create an information flood. Based on it, determine the structure of the input and output signals of the neural network.
- creating a virtual training complex based on field observation data.
- choosing the type, architecture, learning algorithms and other parameters of the neural network. Neural network training.
- testing the trained neural network on control and test sets.дала кузатиш маълумотлари асосида виртуал ўқ ув мажмуасини яратиш.

By continuously replacing the initial observational data, using the forecast of the hydrometeorological service and the modeled values of Qmax and Qsr, it is possible to obtain a forecast of the flood risk for a time interval of up to N days.

$$\mathbf{Qmax \geq Qsr \leq H} \quad \mathbf{(2)}$$

Many factors affecting the formation of the flood flow and the complex nature of their interaction at this stage of the study of the phenomenon exclude the possibility of accurate forecasting of the flood risk. However, the inclusion of new parameters obtained during the monitoring process into the training sets significantly increases the accuracy of the forecast[5].

Prediction of flood events is divided into temporal and spatial factors. Spatial forecasting focuses on determining the probability of occurrence of flood events in a given area, regardless of the time of occurrence. Forecasting that shows a specific time is periodical, divided into long-term, medium-term, short-term and very short-term forecasts[7,8].

In the field of short-term forecasting, D.K. Salihova [4] created a method for predicting flood events based on the analysis of their connection with hydrothermal properties of the atmosphere. The theoretical basis of this method is the task of deciding whether the predictor vector-predictor belongs to the selected class or not. This method was used in Fergana and Zarafshan valleys.

V.F. Perov and others [3] developed a forecasting method for two basins on the southern slopes of the Greater Caucasus mountain range, taking into account pre-wetting of hard rocks and precipitation.

A similar trend can be observed in A.I.Zak's [2] studies on Armenia. G. I. Kherkheulidze, E. D. Tsereteli [10] developed a flood risk methodology based on solving the discriminant equation for the Alazani river basin.

G. A. Tokmagambetov, P. A. Plekhanov [9] used statistical analysis methods based on the use of image recognition schemes in relation to Ile Alatau to assess the risk of a glacial flood. This method is implemented by machine processing flood generating situations according to 13 hydrometeorological parameters.

E. A. Talanov [6] developed a method of short-term probabilistic forecasting of flood flows in the genesis of heavy rainfall for cuts, depressions and scattered flood formation foci. The developed short-term probabilistic forecast of flood flows for specific sources is based on the short-term forecast of liquid precipitation.

Conclusion and recommendations. In general, forecasting flood events in advance, determining the extent of such a natural disaster, the amount of material damage, and other estimated losses, provide a great opportunity to develop and gradually implement measures for the prevention of emergency situations and rapid actions. That is why forecasting of flood events remains one of the important and urgent tasks within the complex of activities for the protection of the population and territories from natural disasters.

Based on the scientific research and experience of world scientists, it is recommended to widely use the forecast method based on the solution of the discriminant equation and the method of forecasting taking into account the pre-moistening of solid rocks and precipitation in the territory of our republic.

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