

## **MULTISTEP FORECASTING SYSTEM FOR DYNAMIC MODELING OF POLLUTION**

**Shpanko N.S., Shmatko O.V.**

*National Technical University «Kharkiv Polytechnic Institute», Kharkiv*

Considering the rapid scientific and technological development of mankind, it is extremely important to solve the problem of forecasting the level of pollution to make effective management decisions.

A very good example of the importance of solving this issue is the consequences of technogenic disasters, such as the explosion on the Deepwater Horizon oil platform, which became one of the world's largest technogenic disasters. This disaster caused extremely destructive consequences for the ecosystem, as it grew from a local to a regional scale, precisely in the absence of multi-step forecasting systems on the basis of which it would be possible to develop an action plan to prevent or reduce such terrible consequences.

To date, the direction of this research is just beginning to take shape, as the implemented and reviewed systems in this paper, such as AirNow, IQAir, Global Water Quality Monitoring (GEMStat) and Soil and Water Assessment Tool (SWAT), have a number of limitations due to their static architecture and fixed algorithms. Such systems are usually focused on processing data in a fixed form, have limited flexibility and often require manual parameter settings, and the system under development aims to overcome these limitations by using modern technologies

This paper presents an approach to multi-step forecasting of environmental processes based on the integration of machine learning, statistical analysis and multi-source data processing.

The developed system takes into account the temporal dynamics and spatial variability of pollution, using data from sensor networks, satellites, weather stations, and socioeconomic sources. The study applies hybrid models based on Long Short-Term Memory (LSTM), Convolutional Neural Network (CNN), and deep encoders, which allow to improve the accuracy of long-term forecasts.

Special attention is paid to the implementation of a prototype software for modeling pollution and its validation based on open environmental datasets. Experiments have been conducted to confirm the effectiveness of the chosen approach in a variable environment and incomplete data.

The results of the study can be used in environmental monitoring, environmental management, and decision support systems.