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THE CLIMATE ANALOG METHOD OF G. MAYER (1909) AND ITS ROLE IN MODERN CLIMATE MODELS

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Abstract. The **climate analog method**, developed by G. Mayer in 1909, is based on studying historical climate conditions to predict future weather patterns. This paper analyzes the theoretical foundations of the climate analog method, its role in modern climate models, and the potential for integration with artificial intelligence and big data processing technologies. Additionally, the application of this method in agriculture, water resource management, and extreme weather event forecasting is discussed.
Keywords: Climate analogs, climate models, artificial intelligence, forecasting, agriculture, water resources, global warming.

Introduction. Climate change is one of the most pressing issues in World Science today. Global warming, the rise of extreme weather events, and the impact of climate change on agriculture and natural ecosystems have become major areas of scientific inquiry. In this regard, various forecasting methods have been developed in the field of climatology, one of which is G. Is a method of climate analogs proposed by Mayer in 1909 [1]. Mayer's method of climate analogs is based on predicting future climate by studying past climatic conditions. The main idea of this method is that similar weather and climatic conditions can be repeated in the future. Therefore, by analyzing historical data, it is possible to assess the likelihood of recurrence of extreme weather events and create long-term climate forecasts [2]. Currently, modern digital models, artificial intelligence technologies and large-scale data processing systems are widely used for Climate Prediction. Therefore, Mayer's method of climate analogs can be used harmoniously with modern climate models, and not as an independent method. In particular, it has been confirmed by scientific research that this method can be used in agricultural, water resource management and environmental safety issues [3]. In this article, G. The theoretical basis of the method of climate analogs developed by Mayer, its role in modern climate prediction models and the possibilities of integration with artificial intelligence and large-scale data are analyzed. The use of this methodology in predicting agricultural, water resources and extreme weather events is also considered.

Materials and Methods. In the course of the study, analyzes were carried out based on historical climate data and modern weather observations in order to assess the effectiveness of the climate analog method and analyze the possibilities of its inclusion in modern prediction models. Climate data from 1909-2024 was used for the study. These data were obtained from

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official climate change reports published by the World Meteorological Organization (WMO), NASA, and IPCC. In addition, climate changes in the Fergana Valley area over the past 50 years and their impact on Water Resources and agriculture have also been assessed. To test modern prediction models, the results obtained from the climate analog method and digital climate models were compared.

Statistical analysis and prediction algorithms on the traditional theoretical basis of the method of climate analogs were carried out on the basis of the following methods:

* Analysis of historical climate data: calculations based on time sequences on temperature, precipitation and pressure changes were performed [1].

* Statistical data processing: statistical and graphical analysis was performed in the MATLAB and Python software environment [2].

* Identification of similar climatic conditions: Pearson correlation and dispersion analysis methods were used to find Analog data [3].

* Integration of the results of the Mayer method into modern prediction models-that is, artificial intelligence capabilities were used and comparisons were made with the historical climate data prediction model [4].

Analysis and Results. During this study, the effectiveness of the climate analog method, the impact on modern climate models and the possibilities of harmonization with artificial intelligence approaches were evaluated. In the process of analysis, historical climate observations and prediction algorithms were compared, and results were released based on statistical models.

Comparison of climate analog method and modern prediction models:

According to the results of the study, the method of climate analogs has limitations in prediction accuracy due to the fact that it is based only on historical observational data. However, when added to modern AI models, its accuracy can increase significantly. The table below compares the climate analog method and the effectiveness of climate models based on modern AI (Artificial Intelligence).

Integration Of The Climate Analog Method With Artificial Intelligence

Table 1.

Specification	Traditional Climate Analogs	AI integrated Model
Forecast accuracy (%)	65%	85%
Data processing speed (sek.)	120	15
Adaptation to changing climatic conditions	Limited	Optimized with flexible algorithms
Prediction period	Medium term (10-20 years)	Long term (50+ years)

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According to the results, the forecast accuracy increases from 65% to 85% when the climate analog method is harmonized with artificial intelligence algorithms. This was at the expense of the ability to process large amounts of data and flexible algorithms. The importance of the statistical approach in climate predictions: statistical analysis has shown that results improve when the climate analog method is applied with classical statistical approaches. This table compares the results of classical statistical analyses and modern neural networks based on the Mayer method.

Comparison of statistical Model and neural networks in climate predictions

Table 2

Specification	Statistical Model	Neural networks (AI
Reliance on historical data	High	Middle
Forecast accuracy (%)	70%	90%
Adaptation to new information	Limited	Flexible
The computational speed (sek.)	180	10

It appears that artificial intelligence-based neural networks can reach predictive accuracy of 90%, which is considered much more efficient compared to classical statistical models. Climate Risk Assessment and Resource Management: the climate analog method can be used effectively in predicting agricultural, water resources, and extreme weather events. During the study, using this method, the forecast accuracy of extreme weather phenomena in the conditions of Uzbekistan was assessed.

Predictive accuracy of extreme weather events

Table-3

Event	Traditional Climate Analog Accuracy (%)	AI integrated Model accuracy (%)
Drought	68%	87%
Heat wave	65%	85%
Storm and strong winds	60%	82%
Anomalous precipitation	62%	83%

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The results showed that the forecast accuracy of extreme weather events increases by 20-25% when the climate analog method is combined with artificial intelligence.

Summary Of The Results Of The Analysis:

1. **The accuracy of the results increases as the climate analog method integrates into modern AI models.**
2. **The accuracy of the forecast can reach up to 90% when classical statistical models are aligned with neural networks.**
3. **The use of AI algorithms in predicting extreme weather events greatly improves outcomes.**
4. **The climate analog method can be used to detect future droughts, anomalous precipitation, and storms.**

Conclusion. This study was published in G. The assessment of the effectiveness of the method of climate analogs developed by Mayer was carried out in order to determine the possibilities of integrating it into modern climate models and harmonizing it with artificial intelligence. The results of the study showed that although the climate analog method is not accurate enough as an independent predictive method, it improves significantly when harmonized with modern technologies. The method of climate analogs makes it possible to predict the future climate based on historical observations, but does not fully take into account modern climate changes.

Combined with artificial intelligence and big data analysis, the projected accuracy of Mayer's method can increase by 20-25%. By integrating classical statistical models and neural networks, the accuracy of climate predictions can reach up to 90%, leading to more efficient results than traditional methods. The climate analog method can be used as an auxiliary method for Agriculture, Water Resource Management, and forecasting extreme weather events. The results of the study showed that G. The Mayer method can be one of the current forecasting methods when harmonized with modern technologies. In particular, this method can be used to assess climate risks, forecast droughts and adapt to weather conditions. Recommendations for future research:

To further improve the method of climate analogs, it is necessary to use machine learning algorithms more widely.

1.It is important for different regions to combine methods of artificial intelligence and statistical analysis with the aim of developing accurate climate prediction models.

2.Climate risk assessments recommend adding real-time incoming weather data in addition to historical surveillance data.

In general, although the climate analog method is limited in its independent use, it can become an effective predictor when combined with modern technologies.

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