

GRAPH NEURAL NETWORK FOR IMPROVING WEATHER FORECASTING ACCURACY

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The increasing availability of meteorological data from various sources creates a significant opportunity for improving the accuracy of weather forecasting. The Graph Neural Networks (GNNs) [1, 2], have emerged as a promising alternative to numerical weather prediction (NWP) due to their ability to model complex relationships and dependencies within a network structure.

GNNs models used to forecast local weather conditions need to be improved. Despite the obvious successes of forecasting models based on GNN for practical application, GNNs require expert knowledge during training. And training, like other NN models, accompanies the entire life cycle of deep learning models.

This paper proposes a model for short-term and medium-term weather forecasting by presenting meteorological data in the form of a graph knowledge base. The knowledge base is formed on the results of global forecasting models on the state of atmospheric indicators of weather conditions and the results of the forecast in a local weather station. In the spatial graph of the base, each node represents a specific geographical location or weather station, and the edges indicate spatial and temporal dependencies between these locations. GNN is designed to study the complex relationships between different weather variables, such as temperature, pressure, humidity, and wind speed, at different locations and time steps. A GNN architecture is proposed for a given geolocation, allowing for more accurate forecasts. The model uses message passing mechanisms to propagate information across the graph, allowing for the study of the spatiotemporal dynamics of the weather system. It was investigated that the GNN model provides improved performance in forecasting extreme weather events to calculate the efficiency of accounting for the propagation of atmospheric disturbances in the presented geographical grid. This study provides a new basis for GNN in operational weather forecasting systems and more effective methods for forecasting local weather conditions.

References: 1. Sun, X. et al. (2025), “Utility of Graph Neural Networks in Short-to Medium-Range Weather Forecasting”, *Computers, Materials & Continua*, 84(2), pp. 2121-2149. 2. Yang, Q. et al. (2024), “Multi-modal graph neural networks for localized off-grid weather forecasting”, URL: <https://doi.org/10.48550/arXiv.2410.12938> (accessed Sep.2 2025).