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Earthquake Early Warning System and Mitigation Based on the Fluctuation of Radon Gas Concentration
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ABSTRACT

Indonesia, located at the convergence of the Eurasian and Indo-Australian tectonic plates, is prone to frequent and potentially destructive earthquakes. The urgency to strengthen earthquake early warning systems (EEWS) has encouraged researchers to explore non-seismic precursors such as radon gas concentration. This research builds upon previous findings that radon anomalies may precede earthquakes, especially in areas near active faults. The primary objective of this study is to develop a statistical and machine learning-based algorithm capable of predicting earthquake magnitude using fluctuations in radon concentration measured from telemonitoring stations on Java Island. This work also extends earlier studies that modeled earthquake occurrence time using similar data sources and includes an analysis of society's perception of earthquake prediction.

The methodology involves real-time radon monitoring stations placed near active fault zones. The collected data are processed using a hybrid model that integrates time-series statistical techniques with machine learning algorithms to identify pre-seismic anomaly patterns and estimate earthquake magnitude based on four radon stations. A survey was also conducted to understand societal perceptions of earthquake prediction among residents in Southern Java.

The results indicate that radon concentration data can be used not only to identify pre-seismic anomalies but also to predict earthquake magnitude with reasonable accuracy. The evaluation shows that the Root Mean Square Error (RMSE) reached 0.247 and the Mean Absolute Error (MAE) 0.203, reflecting strong model performance. In addition, public responses show positive acceptance toward the importance of early warning systems, along with a need for more accurate information. Trust in earthquake prediction is closely linked to the reliability of the model, suggesting the importance of strengthening risk communication and preparedness alongside technological development.

Keywords: *Radon, Earthquake, Magnitude, Prediction, Machine Learning*