Goldschmidt 2024 Abstract
https://doi.org/10.46427/gold2024.23866

Mapping soil gas radon concentration using machine learning in an urban section of the Lima Metropolitan Area of Peru

RAFAEL PONCE-AMANCA[1], CÉSAR J. GUEVARA-PILLACA[2,3], DR. BERTIN PÉREZ, PHD[2,3,4], DANIEL PALACIOS FERNANDEZ[2] AND PATRIZIA PEREYRA ANAYA[2]

[1]Universidad Nacional de San Antonio Abad del Cusco
[2]Pontificia Universidad Católica del Perú
[3]Anphysrad SAC
[4]Rad Elec Inc.

Presenting Author: 161316@unsaac.edu.pe

Radon, a radioactive noble gas originating from the natural decay of radium atoms in rocks and soils, migrates through soil to the atmosphere and can accumulate indoors. Because of its health implications, mapping radon distribution is an important tool for assessing exposure risk. The spatial variability of soil gas radon concentration presents complex and nonlinear dynamic characteristics [1]. In this context, machine learning (ML) techniques have demonstrated better performance and accuracy in generative and predictive tasks compared to classical geostatistical approaches [2]. This study aims to develop an ML-based tool for generating radon soil-gas maps using physical and geological parameters. A neural network algorithm analyzes geospatial data and in situ radon measurements for training and validation [3]. Our approach was tested in the northern section of the Lima Metropolitan Area of Peru, where 55 radon concentration measurements were sampled using a RAD7 continuous monitor over 138.15 km^2. Radon levels ranged from 0.2 to 7 $kBqm^{-3}$ in this area. The proposed model identifies radon-prone areas; statistical indices, including RMSE (0.1047) and MSE (0.3235), demonstrate the model's accuracy in predicting radon concentration in soil. Thus, this approach enables radon concentration mapping with minimal point measurements relative to the area size, beneficial for areas affected by anthropization.

[1] Elío, J., Petermann, E., Bossew, P., & Janik, M. (2023). Machine learning in environmental radon science. *Applied Radiation and Isotopes*, *194*, 110684.
[2] Tziachris, P., Aschonitis, V., Chatzistathis, T., Papadopoulou, M., & Doukas, I. J. D. (2020). Comparing machine learning models and hybrid geostatistical methods using environmental and soil covariates for soil pH prediction. *ISPRS International Journal of Geo-Information*, *9*(4), 276.
[3] Duong, V. H., Ly, H. B., Trinh, D. H., Nguyen, T. S., & Pham, B. T. (2021). Development of Artificial Neural Network for prediction of radon dispersion released from Sinquyen Mine, Vietnam. *Environmental Pollution*, *282*, 116973.