Geogenic radon potential mapping using geospatial analysis of multiple radon-related variables: a case study from Southeastern Ireland

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A detailed investigation of geogenic radon potential (GRP) was carried out using geostatistical analysis on multiple radon-related variables to evaluate natural radiation in an area of Southeast Ireland. The geological setting of the study area includes basal Devonian sandstones and conglomerates overlain by an offshoot of the Caledonian Leinster Granite, which intrudes Ordovician sediments. The Ordovician sediments contain traces of autunite \((\text{Ca(UO}_2\text{)}_2\text{(PO}_4\text{)}_2\cdot \text{H}_2\text{O})\), which is a uranium-bearing mineral and a source of radon. To model radon release potential at different locations, a spatial regression model was developed in which soil gas radon concentration measured in-situ using a Radon RM-2 detector was considered as a response value. Proxy variables such as local geology, soil types, terrestrial gamma dose rates, radionuclide concentrations from airborne radiometric surveys, soil gas permeability, distance from major faults and a Digital Terrain Model were used as the main predictors. Furthermore, the distribution of indoor radon concentration was simulated using a soil-indoor transfer factor. Finally, the workability of the proposed GRP model was tested by evaluating the correlation between previously measured indoor radon concentrations and the estimated values by the GRP model at the same measurement locations. This model can also be used to estimate the GRPs of other areas where radon-related proxy values are available.

Keywords: Natural radiation, geogenic radon potential, geostatistical analysis, spatial regression model, indoor radon simulation