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Predictive model for reducing radon risk in scheduling visits in an underground quarry

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Radon volumic activity has been monitored almost continuously for more than five years in the atmosphere of an abandoned underground quarry located in the north of France. The quarry is used as a test bench for studies of the subsidence risk, and is subject consequently to regular visits by scientific teams. Despite its geological setting – chalk marl covered by an impervious layer of clay and alluvial deposits – suggesting a low radium content of the source rock, the radon background level in the atmosphere of the quarry is not less than 12 000 Bq.m^{-3}. The floor of the quarry is 20 m below the flat ground surface and the height of the galleries is no more than 2 m, portions of the rock being left in place as pillars to support the roof. The horizontal extension of the qarry is at least 100 000 m^2.

Notwithstanding a very weak natural ventilation, due to a single vertical access pit for the whole quarry, the radon volumic activity is affected by seasonal variations, with anomalous high levels reaching 30 000 Bq.m^{-3} for several days or weeks during winter, an unexpected pattern for an horizontal subterranean cavity. Such high levels prohibit long visits in the quarry, all the more so as equilibrium factor in the underground atmosphere in consistently of the order of 0.7.

Spectral decomposition of the radon time series, and correlations with meteorological parameters enabled to propose a mechanism explaining the conspicuous radon variations and allowing to predict the radon surges for scheduling visits accordingly.