Seasonal variability of radon concentrations and meteorological parameters measured in a shallow test borehole at the University of Coimbra, Portugal

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Soil gas radon concentration can be a useful tracer for geophysical time-varying processes. However, its effective use requires a solid understanding of the different geologic, meteorological and geodynamic factors affecting radon generation and mobility in natural environments.

Radon emanation is influenced by the moisture content of the porous medium. The fraction of water saturation of the pores affects radon's sorption on the soil particles influencing both the emanation coefficient and the diffusion parameter. Pressure-driven flow of pore gas results in radon advection depending on the magnitude of the pressure gradients and on the permeability of the material. Meteorological conditions are thought to play a fundamental role on radon migration since rainfall, winds, atmospheric pressure and temperature gradients induce pressure differences and influence the water saturation of the porous medium.

In order to quantify the influence of meteorological parameters on the temporal variability of radon gas concentration a continuous radon monitoring station was installed at a depth of 8 meters in 10 m borehole carried out inside the historical building occupied by the Department of Earth Sciences of the University of Coimbra, made for geotechnical prospecting works. The borehole crossed a local bedrock made of Jurassic limestones, and was capped at the surface to avoid contact with atmospheric air.

Radon monitoring was carried out during 1 year with data acquisition every 15-minutes with a NaI(Tl) gamma scintillator (Scionix, Holland) measuring in the 475-3000 keV range. Humidity and temperature were simultaneously measured with sensors located at the same depth of the gamma scintillator.

Data analysis shows that the resulting time series of radon concentration exhibits a complex, multi-scale temporal structure, including daily and intra-seasonal signals as well as sharp increases followed by a slower return to average levels. However, the analysis of the temperature and humidity data does not suggests a direct influence of these parameters on the observed variability of soil gas radon concentration.