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Spatio-temporal variations of soil radon patterns around the Sea of Marmara

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Typically, the noble gas radon displays cyclic daily (S1), semidiurnal (S2) as well as seasonal variations in geological environments like soil air, groundwater, rock, caves, and tunnels. But there are also cases where theses cycles are absent. We present examples from a radon monitoring network of 21 sites around the Sea of Marmara. The works were carried out in the frame of MARsite, a project related to the EU supersite initiative (MARsite has received funding from the European Union's Seventh Programme for research, technological development and demonstration under grant agreement No 308417). Alpha-meters from the Canadian company alpha-nuclear are used to measure the radon concentration in counts per 15 minutes at a depth of 80 cm.

The long-term average radon concentrations at 21 sites vary between 35 and 1,000 counts per 15 minutes. Typical seasonal variations are absent at more than 6 sites. Sites with seasonal variations have radon minima usually during winter (December to April), radon maxima during summer months (June to October). We carefully investigated radon time series for all the monitoring stations. We find that at some sites the empirical distribution of radon counts is clearly bimodal and in other bimodality is absent. In those stations we analysed the time series in different time intervals in order to highlight seasonal periodicity in the radon emission. The empirical distributions obtained by time-windowing of the radon signals results to be statistically different one another after applying a Kolmogorov-Smirnov test at significance level of 0.1. Usually the maxima in radon emission occur in summer time but, interestingly enough, two sites are characterized by radon maxima in winter periods. We further investigate the radon signals seeking for smaller scale periodicity. We calculated Fourier spectra of all 21 sites. Daily cycles are absent at 6 sites which is an unusual phenomenon. Daily cycles may disappear, if the local system is heavily disturbed, e.g. by fluid extraction from geothermal systems or during earthquakes.