



19 years of continuous observation of Radon and Thoron emissions: a Time Series Analysis

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Radon (Rn-222) and Thoron (Rn-220) concentrations were continuously measured, two times per day, from the 1st of January 1993 to present time. All measurements were performed for five hours during night (2 to 7 AM) as well day time (8 AM to 1 PM), at the Natural Radioactivity Laboratory in Arad (Romania), generating four complete time series (TS), each of them consisting of about 6580 values. Time Series Analysis (TSA) and Correlation Analysis were further used to evidence any peculiarity regarding Radon and Thoron emission with respect to local meteorological data or to other factors such as multi-annual astronomical cycles.

Accordingly, we have found that the Radon and Thoron concentrations display daily and seasonal variations, reaching the highest values in the early morning and the lowest values in the afternoon, and respectively in the autumn as well as in the spring and early summer. At the same time, we have noticed that their outdoor content presents a minimum during higher rainfall months and a relative maximum associated with the atmospheric stability.

A subsequent TSA showed, in the case of Radon, an excellent seasonality with the main period of one year, together with other less marked cycles, the most interesting being the Metonic cycle of 19 years. At its turn, Thoron emission showed a less noticeable periodicity, better illustrated by the autocorrelation function, whose maxims and minims were not very distinguishable. All these observations were well illustrated by the wavelet transforms of the corresponding TS.

Regarding multi-annual average values of the outdoor Radon concentrations, we have noticed a significant positive correlation between nocturnal and diurnal values in the winter months (December, January and February) and a weak correlation for all other months. In the case of Thoron, the positive correlation was found to exist from October to June while, between Radon and Thoron, the corresponding correlation coefficient showed values below 0.7 only for winter months.

Finally, the possible causes of the observed peculiarities are presented and discussed.