Climatic and Seasonal Influence on Radon Time-Series in Environment of Low Anthropogenic Activity

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1: Introduction

- Seasonal Correction Factors (SCFs) are used to convert radon concentration over a sub-year period to a notional annual mean, although it is recognised that this approach is not universally valid.
- Miles (1998) showed that the mean monthly domestic radon concentration was a linear function of the mean external temperature, T (degrees C).
- Ibrahimii and Miles (2009) presented a general formula relating mean annual radon concentration, R, (units of Bq.m$^{-3}$), in a dwelling to the occupancy-weighted mean radon concentration, C, observed during a 2-week measurement period and the mean external temperature, T, during this period:

$$R = (C - 4) \times \left(1 - \frac{1.645 - 0.063T}{1} \right) + 4$$

2: Method

- Between June 2003 and March 2008 (1766 days), radon concentration and ambient temperature were monitored at hourly intervals in an environmentally-stable, rarely-visited partially-subterranean store-room in a public-service building (Figure 1).
- Sampling periods totalled 1025 days, the longest continuous sampling period and interval between sampling periods being 335 and 271 days respectively.
- Mean daily, monthly (calendar) and annual concentrations and temperatures were derived. For each calendar month, averages over corresponding months of at least three separate years were calculated.
- Similar statistics were generated from daily meteorological data collected 10 km from the measurement site (Figure 2).
- Overall mean and standard deviation (SD) radon concentrations were 73.0 Bq.m$^{-3}$ and 62.7 Bq.m$^{-3}$ respectively, corresponding mean and SD internal temperatures being 29.2 C and 1.7 C, respectively.

3: Results

4: Discussion

- Pearson Correlation factors between mean monthly radon concentrations and corresponding climatic parameters were determined.
- Surrogate SCF sets were derived directly from monthly mean radon concentration and from external temperature and internal-external temperature-difference (both using Eq. 1).
- These were correlated with each other and with the UK 1-month SCF set to quantify goodness-of-fit.

5: Conclusions

- Radon concentration shows minimal or zero correlation with the three temperature parameters, atmospheric pressure and wind-speed, limited correlation with rainfall and minimal correlation with relative humidity.
- Relatively good correlation ($|r| = 0.59$) exists between radon seasonality and the internal-external temperature difference, but poorer correlation with external temperature ($|r| = 0.18$), using the temperature-based formula (Eq. 1).
- Formula-derived SCFs based on external temperature correlate well ($|r| = 0.98$) with the 1-month SCF set.

6: References