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14 May 2019

Dr Robyn Schofield, Associate Editor
Atmospheric Measurement Techniques

Dear Dr Schofield,

Please find below our detailed responses to the comments from the anonymous reviewer of our paper: "Identifying 'persistent temperature inversion' events in a Subalpine Basin using Radon-222".

We would like to thank the reviewer for taking the time to look over our manuscript and provide us with comprehensive constructive feedback.

Best regards,

Dafina Kikaj
(on behalf of all co-authors)

Response to Anonymous reviewer's comments

Comment #1: *I had the same objection on the precipitation influence as Dr. Salzano, but the authors' reply was acceptable to me on a first approximation, given the limited precipitation of the period in which the experiment was carried out (use of a seasonal average and inherent smoothing in radon emission) though I agree that assessment in flux variability would be necessary in case of higher precipitation rates.*

Indeed, we agree that in some extreme cases (as we have seen, for example, in Finland), seasonal changes in soil moisture and/or freezing can have such a large influence on radon emission that the radon-based method of diurnal timescale stability assessment can't be applied in some seasons. In most cases, however, as demonstrated by Williams et al. (2016) and Wang et al. (2016), even relatively substantial seasonal changes in radon emission can be effectively taken into account.

Comment #2: *I agree with Dr Salzano also with the use of a more rigorous terminology: 222Rn instead of radon. I'd like to point out however that the use of Alphaguard contains implicitly the fact that this instrument works on alpha spectrometry enabling the measurement of 222Rn and 220Rn separately though this is possible in the indoor or in soil radon assessment, while the device is not the best for atmospheric observation as commented by the authors. In this experiment therefore Radon is 222Rn, and Alphaguard (which is one of the most worldwide popular instruments in radon monitoring) does not yield thoron data for the insufficient detection limits in air; in any case if measurable it would be resolved.*

As mentioned in our reply above to a similar comment by Dr Salzano, it is certainly our intention in this manuscript that use of the word "radon" is understood to mean ^{222}Rn. We have clarified this in the revised text. Using an AlphaGUARD to monitor outdoor environmental atmospheric radon concentrations (which is not ideal, but economical), the typical uncertainty for an hourly measurement ranges from around 15% at concentrations of 20 Bq m^{-3}, to >50% at concentrations of ~3 Bq m^{-3} (Westphal, 2018). Kochowska et al. (2009) indicate that an AlphaGUARD operating in diffusion mode (as was the case for our experiment) only registers around 5% of ambient ^{220}Rn (thoron) concentrations when exposed to an equilibrium amount of thoron. Given that our instrument was operating 1.5 m above the surface, within a Stevenson's Screen enclosure, it is likely that less than 5% of its reported radon concentration would be attributable to thoron (as the reviewer points out, compared to the instruments uncertainty, this amount is negligible; as is the ~1% contribution of ^{219}Rn to outdoor ambient radon concentrations). Therefore, to a good approximation, the reported radon concentrations of our study are exclusively ^{222}Rn.

Comment #3: *An example of "atmosphere oriented" radon instruments with similar physical principle is the following: Tositti, L., Pereira, E.B., Sandrini, S., Capra, D., Tubertini, O., Bettoli, M.G. Assessment of summer trends of tropospheric radon isotopes in a coastal Antarctic station (Terra Nova Bay) (2002) International Journal of Environmental Analytical Chemistry, 82 (5), pp. 259-274. In this work not only radon main isotopes are obviously resolved based on the use of a home-made instrument lodging a highly sensitive silicon detector for alpha spectrometry, but both isotopes may be suitably applied for air masses identification even at extremely low concentration levels such as in Antarctica.*

We agree that a radon detector of the kind constructed and implemented by Tositti et al. (2002), which is capable of independently resolving contributions to ambient radon by ^{222}Rn and ^{220}Rn progeny through alpha spectrometry, would be more suitable than the commercial AlphaGUARD unit for most ambient environmental atmospheric monitoring purposes, if sufficient resources are available to acquire such an instrument. Unfortunately, this was not an option for our study.

Comment #4: *Improvements in the methodology are expected with the introduction on a routine basis of more sensitive devices for radon measurement (herein defined as "research-oriented": I would say "atmosphere-oriented) in respect to the classical Alphaguard herein used. I do agree that the extensive use of this method would greatly improve the study of boundary layer problems, even when atmospheric modelling will reach sufficient capability.*

We agree that as more high-quality, routine atmospheric radon (and radon progeny) observations become available in regions of complex topography, this technique could be further investigated and refined, and a range of other applications investigated.

References

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