Atmospheric Measurement Techniques Discussions

Interactive comment on "An automated system for selective and continuous measurements of vertical Thoron profiles for the determination of transport times near the ground" *by* D. Plake and I. Trebs

Anonymous Referee #1

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General comments: A well-established commercially available Radon and Thoron monitor based on alpha-spectrometry is adapted and validated as field instrument for the measuring of vertical concentration gradients. Thus, this publication renders an additional and useful tool for the determination of vertical turbulent exchange near the ground. Together with first field tests, a thorough uncertainty analysis renders precise information on the performance of the presented method.

Specific comments:

As a major aspect of the manuscript is concerned with uncertainty analysis, general prerequisites of the tracer technique, like homogeneity of the exhalation rate and reasonable flatness of terrain should be mentioned.

The usage of "error" and "uncertainty" should be checked throughout the text as these cannot be considered as synonyms.

For the uncertainty considerations and nomenclature, an approach according to ISO 11929 seems to be more appropriate.

The influence of the Nafion dryers on the uncertainty are not discussed. Dankelmann et al. (Radiat. Prot. Dosim. 94/4, 2001, pp 353-357), for example, reported for Po-218 an increased dependence of the neutralisation rate (and thus of the efficiency of ins5truments using electrostatic precipitation) for low humidities. Test results of laboratory measurements, if available, could enhance the manuscript in this respect.

Technical corrections:

Page 869 line 4: Delete "most". 232Th and 238U are common radioactive isotopes, but the typical activity concentration of 40K in soil is approximately ten times larger.

Page 869 line 10: Check: "Tn and Rn concentrations therefore always decrease with height." This statement should be formulated less global as locations with inhomogeneous exhalation rate or difficult terrain can easily produce an inverse profile over a height interval due to competing horizontal transport.

Page 869 line 23: Spelling: Change "Dearellano" to "De Arellano".

Page 870 line 2: Suggestion: Replace "compares" with "compare" as the verb refers rather to the Damköhler numbers than the process of the calculation.

Page 870 line 11: Suggestion: Martens et al. 2004 prefers the expression "mean residence time" to "flushing time", which could be mentioned as it seems to be a more precise definition.

Page 870 line 14: Ambiguous: "...who calculated vertical τ profiles for six layers ..." Simon et al 2005 calculated for 6 measuring heights, but only for two source layers.

Page 870 line 27 and page 871 line 1: Check: "These authors call this approach a perfect tool for studying near-surface gas transport, independently of any particular transport model." Actually, the authors are a bit more cautious with "In conclusion, we have demonstrated that the radioactive isotope 220Rn with its half-life of 55.6 seconds is a perfect tool to study near-surface gas transport in stable situations when more conventional micrometeorological methods cannot be applied."

Page 871 line 4 and line 5: Check: A reference to "Saphymo GmbH, Frankfurt, Germany" seems to be appropriate.

Page 874 line 10: Reference missing: "Mauder and Foken, 2011" does not appear in the reference list.

Page 874 line 19 and line 20: Rephrase: The residence time does not change the Tn concentration at the inlet, but the measured Tn concentration.

Page 876 line 5: Spelling: Replace "setup" with "set up".

Page 876 line 8: Spelling: Change "Rottger" to "Röttger".

Page 880 paragraph 3.1.3: Explain: The findings in the side by side measurements (i.e. increased scatter at higher concentrations, Rn not well adjustable) are not readily comprehensible. Which are the physical reasons for such behaviour?

Page 880 paragraph 3.1.4: Explain: The reason for the larger varying LODs of Tn in comparison to Rn should be explained.

Page 884 line 28 and page 885 line 1: Check: Following the chain of references (Butterweck et. al. 1994, Wicke and Porstendörfer 1983, Porstendörfer et al. 1991, Butterweck, 1991), it seems that the cited LODTn of 37 Bq/mˆ3 (Wicke) was determined for a different configuration (14 l sphere, 1.6 l/min, 20 kV) than those used by Butterweck

(2 to 14 l spheres, 1.7 to 17 l/min, 6 to 18 kV, with and without drying).

Page 885 lines 9 and 10: Check: The cited reference (Wicke and Porstendörfer) gives a LODRn of 3.7 Bq/mˆ3 (0.1 pCi/l). The value of 1 Bq/mˆ3 can be found in Butterweck et al., 1994. Both were determined for a 3 h counting interval. As the integration time determines the LOD, an adjustment to the integration time of the presented system (for example, using a multiplication with the square root of the ratio of integration times)could render better comparability.

Page 889 line 20: Introduce blank between "impacts" and "τ".

Page 890 line 21: Spelling: Change "month" to "months".

Page 894 line 11: Spelling: Change "Rottger" to "Röttger".

Page 902 Fig. 5: Check: The influence of the residence time should follow the decay law C(t)=C(0)*0.5ˆ(t/T0.5). With T0.5=55.6 s, the black line is expected to intersect the 0.89 level at 9.34 s and the 0.87 level at 11.17 s. These values deviate from the plotted line for Tn. A half-life time of 55.8 s (published in the recommended values at www.nucleide.org) would even enlarge the discrepancy.

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