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Atmospheric Measurement Techniques Discussions

Interactive comment on "Increasing the accuracy and temporal resolution of two-filter radon–222 measurements by correcting for the instrument response" *by* A. D. Griffiths et al.

Anonymous Referee #2

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The authors discuss a new method to deconvolute measurements of a slow-response dual filter measurement system for atmospheric 222Rn concentrations. They use three mathematical models to estimate the Rn variability at high temporal resolution from their instrument. They use indirect methods (e.g. CO2 concentrations) and grab samples to assess the performance of these algorithms as well as a short-term experiment with an hour long concentration step-change to retrieve the instruments response function. The impact of environmental parameters such as temperature difference between delay chamber and ambient conditions are also discussed and corrected for - also allowing the model to adjust parameters (e.g. recoil). This manuscript addresses a significant short-coming of the dual filter technique, which is widely used in the community.

They discuss the mathematical models they apply in a concise and clear way. The general quality of the description and language is very good. However, the study falls short to demonstrate the performance against a fast response instrument or to conduct a true pseudo-data experiment with a long time series to benchmark the (theoretical) performance (see general comments). Those shortcomings have to be addressed before the paper should be accepted for AMT. If included, this study by Griffiths et al. is surely of great interest to the Rn measurement community and to the wider readership of AMT.

General comments: Unfortunately, the author only benchmark the new "high-resolution" Rn derived from their instrument with proxy data or few grab samples. There are two additional experiments, either of which would add great value and underline the validity of the new deconvolution method. A.) Experimental evaluation of improvement of temporal resolution: previous studies in AMT e.g. XIA et al. 2010 (http://www.atmos-meas-tech.net/3/723/2010/) have compared two and single filter instruments. Reprocessing the data of the dual filter instrument for this experiment would immediately highlight the improvement of the deconvoluted data B.) Theoretical evaluation of improvement of temporal resolution: the authors have conducted a single pulse experiment and thus determined the response function of their sensor to Rn concentration changes. It would be straightforward to take a long-term time series of a fast-response instrument (or theoretical Rn variations) convolute it with the known instrument response and demonstrate that the 3 deconvolution algorithms are capable of retrieving the initial time-series

Also, it is unclear if a larger set of instruments has been tested in the same way, to demonstrate that the response function is the same/similar for all instruments of the same make. Other Rn and GHG instruments are known to (sometime) display slightly different behaviour. Would this have implications for the suggested deconvolution method?

Specific comments:

Page 1 line 14 . . . (radon) is *a* radioactive noble gas emitted. . .. Page 2 line 6ff Please consider also discussion the “no-filter” Rn measurement methods (e.g. Grossi Radiat Meas.) Page 6 line 4 Please consider adding the full analytical solution for the progeny in the appendix Page 9 Figure 3 caption How much do Rn concentrations vary for different experiments/days presented here? Page 11 line 1 Please expand how/why the temperature measurements are “better” in the newer detector. Improved sensor or better placement of sensor/detector to allow measuring a more representative temperature compared to the old system? Do you have a comparison of the delay chamber measurements from the new Vaisala, compared to the temperatures measured in the previous system to be able to compare the time-series? Page 12 line 10 Please consider clarifying that you use “*” as symbol for convolution to avoid misunderstandings e.g.. . . . written as a convolution “(*)” if known. . . Page 15 Figure 5 Please add a comment what the inlay figure shows and why it is added in the Figure capton

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