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Atmospheric Chemistry and Physics Discussions

Interactive comment on "On the variability of atmospheric ^{222}Rn activity concentrations measured at Neumayer, coastal Antarctica" *by* R. Weller et al.

Anonymous Referee #1

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General comments

This paper describes a 17 year record of atmospheric radon-222 measured at a remote station on the edge of the Antarctic mainland. A typical application might be for studying large-scale atmospheric mixing and transport, including model verification, for which the authors conveniently provide a link to the daily data. But, as pointed out by the authors, a clear understanding of the source of the radon – whether it be oceanic or terrestrial – as well as the potential biases due to the measurement technique is necessary for the data to be well utilised. Both of these important questions are tackled,

if not completely resolved, in this well-written paper. It merits publication in ACP; further comments are given below.

Specific comment on the trajectory analysis

In Sect. 3.2 (on p32826, L32) the authors discuss the source of high radon air, the peaks in the Fig. 1 time series and, using results from a trajectory model, exclude direct transport from South America as a major cause of these peaks. The trajectory analysis is useful but I think that conclusions should be more strongly qualified because the simplify of the method leads to a number of problems with interpretation (most severely for the individual events in Fig. 4 & 5, but potentially also affecting Figs. 6 & 7):

1. Radon peaks ($\sim$0.05 Bq m^{-3}) are much lower than continental radon concentration ($\sim$5 Bq m^{-3}) which implies that not only advection but also mixing is important during the high radon events, even taking into account a transit time of 10 days ($\sim$3 half lives). Therefore it is plausible that a Lagrangian particle dispersion model, i.e. an extension of the trajectory model to include dispersion, and/or longer trajectories would show a stronger semi-direct contribution from South America;

2. High radon values can persist for less than a day (Lambert et al. 1970), and a method based on emitting a single trajectory per day might not capture the event (the backtrajectory start time should be noted);

3. The meteorological forcing is low-resolution (2.5 degree/6 hours); results might differ if Hysplit were forced with half-degree, three-hourly meteorology. This could be tested for the recent years of observations when high-resolution forcing is available.

Although a more sophisticated methodology would be desirable in the future, I nevertheless think that the authors modelling is appropriate in this context, provided that the method's limitations are more clearly spelled out.

Technical comments

1. [32818 L12] The abbreviation SIE should be defined again in the abstract, consider spelling out in full throughout
2. [32819 L10] Replace "excel" with "exceed"
3. [32819 L13] Replace "On" with "on"
4. [32821 Sect. 2.2] What is the sampling height above ground level? Does it change significantly over the 17 years, e.g with snow accumulation?
5. [32822 L21] Explain why a backtrajectory length of 10-days was chosen
6. [32822 L24] Note the spatial and temporal resolution of the meteorological data
7. [32823 L18] "a small fraction" - of what?
8. [32823 L21] Explain why it makes sense to compare Halley Station to Neumayer; consider including a small map showing all locations mentioned in the paper
9. [32825 L9] I found the paragraph beginning here to be confusing; perhaps it could be revised to improve clarity.
10. [32828 L10] The large difference between Dumont d'Urville and Mawson is no longer present with the more recent observations from Mawson (Zhang et al. 2011, Fig. 10)

11. [32827 L25] Mention whether or not these other studies were from comparable locations
12. [32833 L5] delete "with intend"
13. [32841 Fig. 4 - 7] Using the same scale on these maps would allow for easier comparison

References

Lambert, G., Polian, G., & Taupin, D. (1970). Existence of periodicity in radon concentrations and in the large-scale circulation at lower altitudes between 40° and 70° south. Journal of Geophysical Research, 75(12), 2341-2345.

Zhang, K., Feichter, J., Kazil, J., Wan, H., Zhuo, W., Griffiths, A. D., ... & Brunke, E. G. (2011). Radon activity in the lower troposphere and its impact on ionization rate: a global estimate using different radon emissions. Atmospheric Chemistry and Physics, 11(15), 7817-7838.

Interactive comment on Atmos. Chem. Phys. Discuss., 13, 32817, 2013.