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Dear Reviewer #3,

Please find below our detailed responses to your comments on "Characterising terrestrial influences on Antarctic air masses using radon-222 measurements at King George Island", by Chambers et al.

Thank you for your time and constructive feedback on this manuscript.

Kind regards,

Scott Chambers

General comments:

I am much less convinced by the overview of the radon measurements at Antarctic stations, at least in the context of the KSG analysis. I think this section (4.1) is a different story and should be moved to another paper. The descriptions of the different measurements and their uncertainties, as well as the local characteristics of each station, would need more details.

As a result of the seasonal migration of the boundaries between the Hadley/Ferrel and Ferrel/Polar circulation cells, and the subsidence of tropospheric air at the pole, the seasonal cycles of terrestrial influence on Antarctic and sub-Antarctic air masses are completely out of phase. Since King Sejong Station is situated so close to the nominal boundary between Antarctic and sub-Antarctic regions (~60°S) the authors feel that confirming the characteristics of the site as decidedly "Antarctic", as well as comparing the magnitude of the seasonal cycle of terrestrial influence at this "fringe" site to that of other Antarctic sites, is of considerable value (particularly since KSG and Ferraz stations are closer to terrestrial radon sources than any other Antarctic sites). Also, in our research of existing Antarctic radon observations we became aware of several inconsistencies with earlier published work which, in the case of the Mawson data, we were able to directly address (this independent correction of the Mawson radon record yields a greatly improved comparison with the simulations of Zhang et al., 2011); in other instances, we felt it valuable to at least bring these inconsistencies to the attention of the reader. Furthermore, the amplitude of the seasonal cycle at South Pole station (see Figure 8a) is closely linked to descending tropospheric air masses, a key discussion point of the paper (see Section 4.2.1). Lastly, we were not able to find any other publications that provided a synthesis of existing seasonal radon observations in the Antarctic, which we felt would be a valuable resource for the global modelling community. For the above reasons, we would prefer to leave Section 4.1 as is in the present manuscript. Full citations have been provided for all Antarctic radon datasets, which would enable the interested reader to investigate the individual site descriptions and measurement uncertainties in more detail.

Specific comments:

p.3: ": : :its atmospheric lifetime is comparable to that of many anthropogenic emissions, : : :": unclear statement.

Please refer to our response made to a similar comment by Reviewer #1.

Section 2.2: it is not very clear what is the overall uncertainty for typical Radon concentrations at KSG?

Please refer to our error analysis provided in response to a similar comment by Reviewer #1.

… deeper analysis of variations of trace gases measured at the station and correlations with the air mass regimes described for Radon, would be more in agreement with the purpose of the paper.

And

Section3.4: together with the convincing fetch analysis using back trajectories, it would be interesting to see the equivalent signatures for trace gases observed at the station.

Also, as previously mentioned (Reviewer #2 comments), follow-up studies at this site in which radon observations are used to interpret trace gas as well as aerosol data from local, nearby (South America), and distant (Australia) sources are planned. To do justice to these findings, and keep the present manuscript to a manageable length, the authors would prefer not to include subsets of such findings here.