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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Simulation of radon-222 with the GEOS-Chem global model: Emissions, seasonality, and convective transport" *by* Bo Zhang et al.

Anonymous Referee #2

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As far as I am aware of, this study presents the most comprehensive piece of work to date using 222Rn to evaluate atmospheric transport and mixing on a global scale. It includes the assessment of four 222Rn emission scenarios, a CTM driven by two meteorological data sets, and the comparison of simulations with practically all atmospheric 222Rn observations currently available, including vertical profiles. The clear structure of the paper, its great readability and meaningful displays make it a pleasure to read. It leaves no open question to me. There is very little that I can suggest to further improve it.

Minor comments

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Differences between simulated and observed atmospheric concentrations occur for various reasons. One is the bias in measurement techniques, especially the underestimation of 222Rn concentrations derived from 222Rn progeny measurements near the surface (< 100 m above ground; cf. Grossi et al., 2020). Further, 222Rn concentration gradients within the first few metres above ground can be steep (e.g. Chambers et al., 2011). Several of the atmospheric observations in China were done between 1 and 1.5 m above ground (Jin et al., 1998, cited in Zhang et al, 2011, cited in the present study), which might explain some of the difference between simulation and observation for those sites. Are those sites represented in Figure 6 e-h by points indicating simulated values more than a factor of two smaller than observed values (or, better, observed values exceeding simulated values by more than a factor of two)?

Figure 6, y-axis label in the second row (Panel e) is "Observed ..." Should this not be "Simulated ...", as in the other rows?

Page 19, lines 7 and 8: "The seasonality in surface 222Rn concentrations is mainly affected by three factors: (1) the surface 222Rn emission flux rate determined by radium content and soil conditions; ..." This sentence is subject to eventual misinterpretation, in the way that radium content may be misunderstood as being seasonally variable. I would suggest to change the sentence to something like: "The seasonality in surface 222Rn concentrations is mainly affected by three factors: (1) seasonality in surface 222Rn emission flux rate resulting from seasonal changes in soil moisture, diffusivity, depth of the water table, snow and ice cover; ..."

Page 24, lines 1 and 2: Some 222Rn flux measurements from Antarctic soil are reported in Envangelista and Pereira (2002).

As mentioned in the text, there are vast regions without atmospheric 222Rn observations. Perhaps suggest, where from a modeller's perspective it would be desirable to see an atmospheric 222Rn detector established. Personally, I would very much like to see that happen at the tall tower (300 m) at Zotino (60° N 90 °E), in the middle of

Siberia (http://www.zottoproject.org/index.php/Main/Home).

References

Chambers et al. (2011) Separating remote fetch and local mixing influences on vertical radon measurements in the lower atmosphere. https://doi.org/10.1111/j.1600-0889.2011.00565.x

Grossi et al. (2020) Intercomparison study of atmospheric 222Rn and 222Rn progeny monitors. https://doi.org/10.5194/amt-13-2241-2020

Evangelista and Pereira (2002) Radon flux at King George Island, Antarctic Peninsula. https://doi.org/10.1016/S0265-931X(01)00137-0

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