

Interactive comment on “Radon activity in the lower troposphere and its impact on ionization rate: a global estimate using different radon emissions” by K. Zhang et al.

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Reply to comments from reviewer 1

We thank the reviewer for the constructive comments. Our replies are listed below.

1) Introduction. It is quite long and contains parts that should be moved to other paragraphs of the manuscript: - The reference to Fig 1a should be moved to paragraph 2.3 - page 2, left column, line 6 to 30 (According to these criteria... ionization in this study) contains a very detailed description of the radionuclides' properties, which could fit

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better in paragraph 2.2 “Decay of radon and its progeny” - page 2, right column, line 36 to 53 (Based on the studies... Global mean emission) contains the description of the global radon emissions compiled in this study. This part should be moved to a new paragraph in “2 Model and simulations” and form a new emission paragraph.

We have followed the reviewer's suggestion and re-organized the first two sections in the revised manuscript. Details about the radionuclides' properties and radon emission are moved into Section 2. The literature review on evaluation of tracer transport in ECHAM5 is removed, which we think is not so relevant to the focus of this paper.

2) 2.3 Ionization. Equation (1), the units of mean ionization rate are missing

Unit has been added in the revised manuscript.

3) 3.4 radon concentrations at individual sites: - Figure 8 displays the comparison of model results and the radon measurements in cities. The model has a coarse resolution compared to a scale necessary to resolve a city, could you comment on that in the text?

We presume the reviewer was concerned about comparing climate model results with measurements in cities because (a) cities might be strongly affected by micro-scale meteorological conditions, and (b) the substitution of natural surfaces for built ones, within cities, might lead to an observable change in the radon emission flux. However, the observation data we are using in Fig. 8 do not have these problems. At each of the five inland cities (Beijing, Wulan, Changchun, Xi'an and Huhehaote), the data from Jin et al. (1998) are in fact averages of measurements collected at several outdoor locations over bare soil. The individual locations were carefully chosen and were good representatives of the typical regional features, especially the soil characteristics. The

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measurements in Hong Kong (Zahorowski et al., 2005) were not collected in the downtown area but at Hok Tsui, an ACE-Asia (Aerosol Characterization Experiment in East Asia) network site. We thus believe that the measurements used in Fig. 8 represent typical near-surface radon concentrations in the corresponding regions, and are suitable for model evaluation studies. A footnote has been added to the manuscript to clarify this point.

- *Figure 10, why the gray areas are not calculated for all the sites in the figure?*

Most panels in this figure do not have a gray box in them because at these sites the radon family induces much less ionizing energy than the cosmic rays. The gray box is therefore literally off the chart. We have added this note to the caption of Fig. 10 in the revised manuscript.

4) *Typo correction: Introduction, page 2, right column, line 23: . . . TM5 atmospheric tracer model and results showed that (delete: the) it improves the average model predictions*

Typo has been corrected.

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