Atmos. Chem. Phys. Discuss., 11, C2474–C2476, 2011
www.atmos-chem-phys-discuss.net/11/C2474/2011/

Atmospheric Chemistry and Physics Discussions

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.

Anonymous Referee #2

Received and published: 29 April 2011

In this paper, the authors derived a merged global radon emission map and showed this new map improves the agreement with near-surface radon concentrations observed at a number of sites around the globe. The global distribution of ionization rates associated with radon activity were calculated and compared with the values due to cosmic rays. The paper is well written and suitable for ACP, although some improvements can be made. I recommend the publication of manuscript in ACP after the following comments are properly addressed.

Major comments:

1. The merged global radon emission map (Fig. 1c) and resulting near surface ioniza-

tion distributions (Fig. c), key results of this study, could be useful to others. I would suggest that data files of these two figures be provided as supplementary materials. This will probably increase the citation and thus impact of the paper.

2. Abstract, lines 11-14, and in several places in the text: "In winter, strong radon-related ionization coincides with low temperature in China, USA, and Russia, providing favorable condition for the formation of aerosol particles." This statement is not fully justified. Firstly, temperature and ionization rate are not the only two parameters controlling new particle formation. Sulfuric acid vapor concentration ([H2SO4]) is another important parameter. In the winter, while temperature is low, [H2SO4] is also small due to weak photochemistry and probably also high condensation sinks. As far as I know, high nucleation rate/frequency in many places usually peak in the Spring or Fall, not in the winter. Secondly, depending on [H2SO4], high ionization rate doesn't always lead to higher nucleation rate (for example, see Yu, J. Geophy. Res., 115, D03206, 2010).

3. Figure 11c. It would be useful if the authors can compare their predicted ionization rates with some direct measurements. Gagne et al. (ACP, 2010) reported ionization rates of > 9 ion-pairs cm-3 s-1 in Hyytiala, Finland. If we assume a cosmic ray contribution of 2.5 ion-pairs cm-3 s-1, the contribution from radon activity should be above 6.5 ion-pairs cm-3 s-1 in Hyytiala which is a factor of 3-4 higher than the corresponding value (1-2 ion-pairs cm-3 s-1) given in Fig. 11c. Please provide some discussions on the possible reasons of this difference and uncertainty in the predicted ionization rates.

Minor comments:

4. Radon emission and ionization rate over Indian and China are much higher than other regions. It will be helpful to provide a brief discussion of the reasons behind the phenomena (difference in soil types?)

5. Some panels in Figures 4-10 are kind of too small. The authors may consider combining some panels to make figures bigger.

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11, C2474–C2476, 2011

Interactive comment on Atmos. Chem. Phys. Discuss., 11, 3251, 2011.

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11, C2474–C2476, 2011

Interactive Comment