Atmos. Chem. Phys. Discuss., 13, C4670–C4672, 2013
www.atmos-chem-phys-discuss.net/13/C4670/2013/

Atmospheric Chemistry and Physics Discussions

Interactive comment on "Estimation of nocturnal ^{222}Rn soil fluxes over Russia from TROICA measurements" *by* E. V. Berezina et al.

Anonymous Referee #1

Received and published: 10 July 2013

Results of atmospheric radon-222 measurements (4 m above ground) during several journeys aboard the Trans-Siberian Railway were used to estimate time- and space-resolved radon-222 flux densities along a 9300 km West-East transect through the Russian Federation. Simultaneously determined temperature profiles up to 600 m height were used to calculate vertical diffusion rates, based on a number of assumption. Regional weighed mean flux density estimates range from 0.03 to 0.09 Bq m-2 s-1 (or 1.4 to 4.3 atom cm-2 s-1).

Estimates of radon-222 flux densities with the same instrument and approach over a large area provides very useful insights into its variation over space and time. I have no doubts about the reliability of relative differences reported. These are interesting and well worth being published. However, the absolute values are very high, compared

Full Screen / Esc
Printer-friendly Version
Interactive Discussion
Discussion Paper

to the well documented global average of around 1 atom cm-2 s-1 and I would like the authors to be much more critical in discussing them. Winter time measurements of radon-222 in the marine boundary layer off the West coast of Japan, for example (Williams et al. (2009) Tellus, 61B, 732-746), suggest an about three times smaller flux density (0.014 Bq m-2 s-1, or 0.7 atom m-2 s-1) for the area corresponding to the eastern half of the domain covered in the present paper. The estimation procedure in itself seems correct, but the underlying assumptions may no necessarily apply.

Nocturnal near surface gradients in atmospheric radon concentrations can be extremely steep in the lowest 50 m (see for example Fig. 3 in Servant (2006) Tellus, 18, 663-671). The lower tens of metres may even retain most of the radon emitted during a night (see for example Lehmann et al. (2001) Radiochimica Acta, 89, 839-843; Xia et al. (2011) Boundary-Layer Meteorology, 138, 163-170). Therefore, an estimate of radon flux density, based on concentration measurements at 4 m height, depends very much on the the accurate representation of the concentration profile within the first tens of metres above ground. The 50 m vertical resolution of the temperature profiler used in the present study did not allow to resolve this critical section of the nocturnal inversion. An extrapolation of the vertical diffusivity profile from greater heights to the near-surface layer may therefore have lead to an over-estimation of radon flux densities. A few other studies with similarly high radon flux denisities directly measured in different parts of Russia are cited in support of the estimates derived in the present study. Most of them are in conference proceedings to which I do not have access, so I can not assess how reliable these data may be. One study cited in support, the radioactivity report of the county of Perm, is available online, but information on radon flux density is limited to one average number in a table (Table 17.8) with no information at all on materials and methods used to derive it. That Kirichenko (1970) is cited in support of the high values found, is surprising and not appropriate. The values he derived for larger areas are all < 1 atom cm-2 s-1. As summarised by Turekian et al. (Ann. Rev. Earth Planet. Sci. 1977, 5, 227-255), Kirichenko's regional estimates range from 0.18 to 0.88 atom cm-2 s-1, with an average of 0.52 atom cm-2 s-1 (or 0.011 Bq

ACPD
13, C4670–C4672, 2013

m-2 s-1), so 3 to 8 times smaller than the regional weighed mean flux density estimates presented here.

Please provide more information on the radon detector used in this study. In a phone call with someone at Tracer Lab, I have learned that the instrument was a specially made some time ago for low level detection of radon-222. Since there is no documentation available to the interested reader (or reviewer), please put more effort in describing the technical details (flow rates, calibration, ect.).

Minor issues:

Page 14548, line 24: What do you mean with “anthropogenic origin” of radon? Uranium mine tailings?

Page 14548, lines 9-10: Calling measurements of radon and temperature an experiment is not appropriate from my point of view. An experiment is a procedure in which a hypothesis is tested, which is not the case here. Observations were made along several journeys. Therefore, the terms ‘expedition’ or ‘campaign’ would be more appropriate.

The use of English language could be improved in many instances. Long-winded sentences (e.g. Page 14558, lines 24-28) should be rephrased to form two or more shorter ones.

Interactive comment on Atmos. Chem. Phys. Discuss., 13, 14545, 2013.