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Interactive comment on "Predicting terrestrial ^{222}Rn flux using gamma dose rate as a proxy" *by* T. Szegvary et al.

T. Szegvary et al.

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Thank you very much for your comments and your valuable suggestions for improving our manuscript.

Inter-comparison of instruments to measure radon flux are an important issue and large differences between instruments have been reported (Hutter and Knutson, Health Physics 74: 108-114, 1998). The instrument we used in our study was compared to the one described in Iida et al. (Environment International, 22: S139-S147, 1996) in 2003 (Lynnette Robertson, PhD Thesis, University of Edinburgh, 2005). The mean flux determined at six locations was with our instrument (52 Bq m-2 h-1, standard error 9 Bq m-2 h-1) and compared well with the mean flux measured with the instrument described in Iida et al. (1996) (49 Bq m-2 h-1, standard error 8 Bq m-2 h-1).

As for other possible correlations between environmental parameters and radon flux, we have tested for correlations with air temperature, atmospheric pressure, soil temperature and difference between air and soil temperature. If one of these parameters was correlated with radon flux, it was very weak. We do not think these parameters have a strong direct effect on radon flux but rather coincide with precipitation events or dry spells. In principle, diurnal pressure variations may cause mass flow through periodic expansion and contraction of the soil gas volume and influence the otherwise mainly diffusion-driven exchange of radon between soil pore space and atmosphere. We would expect this to be a major factor in deeply weathered dry soils with large air volumes. In the commonly humid regions in Europe we studied, it might not be a major issue.

Also, the scale of the problem with back diffusion in chamber measurements is particularly large for soils with large air-filled porosity and with shallow chamber heights. Theoretically, it is possible to correct for back diffusion, if air-filled porosity is known (Conen & Smith, Europen Journal of Soil Science 51:111-117, 2000). As we did not measure this parameter, we can not make reliable corrections. However, we estimate that not accounting for back diffusion might have lead to an average under-estimation of radon flux by up to 5 %.

You mention pressure differences between inside and outside of the chamber as possible source of error. This is another issue that has received much attention in the past and still does (e.g. Xu et al., Journal of Geophysical Research, 111: D08S10, doi:10.1029/2005JD006435, 2006). Small pressure differences can cause major errors in flow-through (dynamic) chambers because they induce a sustained and continuous mass flow into or out of the chamber. In static chambers like ours, pressure differences cause smaller errors because they are equilibrated quickly by a much smaller mass flow (i.e. a pressure deficit of 1 Pa in a 10 litre closed chamber is equilibrated by an inflow of 0.1 ml of soil air).

A table with field site coordinates, measurements, air pressure, soil texture properties

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etc. (i.e. all information a reader would need to go back to our sites and replicate our measurements) will be included in an improved version of our manuscript and made available for down-load from our website (http://www.radon.unibas.ch), which is under construction at the moment. All the in-situ measurements were carried out during day-time (between 10 a.m. and 4 p.m. local time) during summer and autumn 2005. The website will also provide downloadable data for all kind of 222Rn flux maps we develop based on the approach discussed in the present manuscript.

The correlation between radon flux y (in Bq m-2 h-1) and terrestrial gamma dose rate x (in nSv h-1) we found was: y = 0.995 (+/- 0.10) x + 14.97 (+/- 8.11).

Proportion of U decay series to total gamma dose rate is relatively constant in Europe (see reply to Heinz Surbeck). Outside Europe, we will have to investigate this in a further study. For further publications we are investigating possibilities to compare our model to data and models for other countries (e.g. China, North-America).

Interactive comment on Atmos. Chem. Phys. Discuss., 7, 1877, 2007.