

***Interactive comment on “Characterization of the
²²²Rn family turbulent transport in the convective
atmospheric boundary layer” by J.-F. Vinuesa and
S. Galmarini***

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General comments

Radon and its progeny are useful tracers of mixing processes within the atmospheric boundary layer and above. A good understanding of their behaviour within the mixed layer, and the way this is affected by varying external conditions and in particular a range of entrainment (ventilation) conditions at the boundary layer top, is therefore of great importance to researchers involved in the development and evaluation of boundary layer mixing schemes in weather and climate models on a range of scales. LES models have an important role in this regard, as they can help to bridge the gap be-

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tween our interpretation of the often sparse and problematic measurements of such quantities in the environment and their representation in mixing schemes. For these reasons, contributions such as the paper currently under discussion are extremely useful and topical, and certainly worthy of consideration for publication.

I am largely happy with the scientific content of this paper, and commend the authors for a interesting study. Also, the presentation quality and development of arguments is generally good. However, I do feel that the manuscript could be improved in a couple of ways that would enhance its usefulness to boundary layer experimentalists and the developers/evaluators of mixing schemes. Firstly, it would be very useful to see profiles of exchange coefficients for the various decaying species as compared to an inert scalar. Secondly, the authors need to present results from simulations with a range of entrainment (ventilation) conditions at the boundary layer top in the quasi-steady state, and discuss how variations in entrainment effects the profiles of concentrations, fluxes and exchange coefficients. This would be extremely interesting for researchers considering the use of radon as a proxy tracer for ventilation in box models, for example. It would also be a good way to touch on the important role of boundary layer cumulus in ventilating the mixed layer, without the need for introducing the complication of humidity and clouds into the simulation. Thirdly, the authors need to re-consider their set-up for the unsteady case, to make it more physically reasonable. In particular, they should consider using a surface heat flux that exhibits a diurnal (sinusoidal?) variation, and perhaps relax the strong potential temperature gradient in the residual ("reservoir") layer to a more realistic value (zero, or at least much weaker).

Specific comments / corrections

I also have some other minor comments for the authors to consider that may improve the clarity of their work:

- Radon and its progeny are not "compounds"; this term is incorrect and should be avoided.

- In several places in the text, the authors use the word "discrepancy" when discussing vertical variations in various quantities. Their use of this term is incorrect, or at best misleading, and should be avoided (can usually be replaced with "vertical variation").
- The authors use the word "unbalance" in several places, when they mean "imbalance". Also, change "unability" to "inability".
- The labels on graphs are often too small, and the lines could be thicker.
- The conclusion section could be made more concise.
- The discussion of "dilution" versus "ventilation" in the conclusions is a bit arbitrary/semantic, and could probably be removed.
- I suggest to change the sentence starting on line 17 of the Abstract to the following: "We also found that the relevant radioactive decaying contributions of radon's short-lived daughters (^{218}Po and ^{214}Pb) act as flux sources leading to deviations from the linear flux shape".
- I suggest to change the first line of the Introduction to the following: " ^{222}Rn is a naturally-occurring radioactive noble gas with a half-life of 3.8 days. Its unreactive nature makes it..."
- Line 2 of Section 3. Change "extent" to "extensive".
- Change sentence starting on line 15 in Section 3.1 to: "As radon and its daughters are unaffected by moisture, the simulated atmospheric boundary layers (ABL) are dry, convective ABLs driven by buoyancy only..."
- Change sentence starting on line 16 in Section 6 to: "This also allowed classification of the daughters with respect to..."
- On the final page of Section 6 (p8937), on line 14, change "collpase" to "collapse".
- In the heading line of Appendix A, change "pregony" to "progeny".

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