**Atmospheric
Chemistry
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Discussions**

Interactive
Comment

# *Interactive comment on* "TransCom continuous experiment: comparison of $^{222}$Rn transport at hourly time scales at three stations in Germany" *by* S. Taguchi et al.

**S. Taguchi et al.**

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**General comments**

The authors would like to thank Dr Cameron-Smith for the valuable comments that have improved the manuscript. Please find below a point by point answer to the comments. The answers are displayed in italics.

**– Moderate change –**

+) In figure 6 there are vertical lines indicating the 1-sigma variability in the monthly-mean difference. It isn't totally clear whether this variability is the spread among the

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datapoints in each month, or the uncertainty in the mean (ie the data spread multiplied by 1/SQRT(N)). I suspect it is the former. I think it is important to include the uncertainty in the mean in some way, so that it is clear whether the differences in figure 6 are statistically significant or not.

*We think that the data spread within 6 hours is quite small and is not relevant to evaluate the significance of the emanations. To avoid the confusion pointed out by the reviewer, we revised the vertical bar in Fig.6 using day to day variations of the 6 hourly mean of 14 model mean (N_Max=31). The significance of monthly variations of mean model may be demonstrated against day to day variations. The uncertainty among the models is discussed in Sect. 4.3.*

**– General, but minor, suggestions for the authors –**

+) I am not familiar with the distinction between local and non-local boundary layer schemes, so I suggest this be explained briefly somewhere in the manuscript.

*p19257, line 17. A sentence is added after (Olivie et al.,2004). "Local schemes simulate vertical diffusion based on local gradient of wind and virtual temperature whereas non-local schemes take into account counter gradient transport due to eddies (Troen and Mahrt, 1986; Holtslag and Boville, 1993; Lock et al. 2000)." We delete all description of non-local scheme at p19262, line 21, and p19269, line 17, because we became aware that the PBL scheme in A and B (Lock et al. 2000) cited in GFDL (2004) is stated explicitly as "non-local".*

+) For heights and altitudes I would like to see a clarification of the reference level, ie whether the heights are above mean sea-level (AMSL), above ground level (AGL), or above the model surface.

*AMSL*

+) I usually see the diagrams invented by Taylor (2001) referred to as "a Taylor diagram"

rather than "Taylor's diagram".

*changed*

**– Specific minor suggestions for the authors –**

+) 19255, line 4: After "simulated" insert "by the models".

*added.*

+) 19255, line 20: Replace "for emission control to" with "to understand and".

*replaced*

+) 19256, line 8: Replace "is simulated are" with "was simulated were".

*replaced*

+) 19256, line 16: Insert commas after "air" and "concentrations".

*inserted*

+) 19256, line 17: Insert comma after "level".

*we re-write this sentence as "The aim of observations at mountain sites is to measure background, non-polluted air but the observed concentrations (and modelled concentrations) at a fixed level may not always satisfy that criterion."*

+) 19256, line 24: I suggest avoiding "etc".

*we re-write this sentence as "the soil material, the grain size of the soil, and the water content of the soil"*

+) 19256, line 25: Replace "while it is" with "and".

*replaced*

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+) 19257, lines 7-8: Replace "considered to be appropriate in terms of horizontal distances as well as vertical separation" with "generally within the same model gridbox horizontally, but Freiburg is a low-level site and Schauinsland is a mountain site"

*replaced*

+) 19257, line 15: It is unclear whether the intention is to say that the ABL schemes were evaluated in the current manuscript or by Olivie, et al., 2004.

*ABL in TM3 were evaluated in Olivie et al.(2004) not here*

+) 19257, line 15: Replace "TM3" with "the TM3 chemistry transport model".

*replaced*

+) 19257, line 29: I suggest avoiding etc.

*deleted*

+) 19258, line 1: Insert "and" before "a spatially".

*inserted*

+) 19258, line 15: After "used", insert ", including the Transcom4 simulations analyzed for this paper and ..."

*inserted*

+) 19258, line 24: I suggest splitting the paragraph after "BLH".

*modified*

+) 19260, line 27: It is unusual to use seven-hour means for "12-18 UTC", so please check that this is what was intended.

*Averaging period has been changed to six-hours i.e. 1-6 and 12-17 UTC. Fig.2 , Fig.6, and Fig.7 were revised.*

+) 19260, line 29: Delete comma.

*deleted*

+) 19261, line 7: Delete comma.

*deleted*

+) 19261, lines 15-23: I suggest mentioning whether or not differing soil types and conditions could provide an explanation.

*We add a sentence. "One could explain the horizontal gradient by assuming higher exhalation around Freiburg due to soil type, but this cannot explain the vertical gradient."*

+) 19262, line 22: I prefer "hybrid" rather than "mixed".

*replaced*

+) 19263, line 6: The dashes look like minus signs.

*modified*

+) 19263, line 21: I suggest referencing the paper by Taylor: Taylor, K. E. (2001), Summarizing multiple aspects of model performance in a single diagram, J. Geophys. Res., 106(D7), 7183-7192.

*added*

+) 19264, line 10: I suggest referring to section 4.2.

*added*

+) 19264, line 17: Add "of 222Rn" at end of sentence.

*added*

+) 19264, line 23: Could you clarify how the sampling of model K was done? Was it by interpolation?

*Linear interpolation in space.*

+) 19265, lines 9-12: Replace sentence with "We compared the model 222Rn concentrations at each altitude in the model to the observed concentrations at Schauinsland (1205m) using hourly data (Fig. 5)"

 *replaced*

. +) 19265, lines 12-13: I am not sure what this sentence is meant to convey. I suggest clarification.

*This sentence intends to describe the actual procedure of the interpolation. We rewrite this sentence as "Concentrations at the site altitude were estimated using an interpolation based on pressure value at each model level."*

+) 19265, line 19: Add "of Fig. 5" to the end of the sentence.

*added*

+) 19265, line 26: Replace "near" with "slightly below".

*replaced*

+) 19265, line 26: At end of sentence add "as seen by Patra, et al., 2008"

*added*

+) 19265, lines 26-28: Were the modeled concentrations from the nearest level or from interpolation?

*interpolation - this has been added to the text*

+) 19266, line 13: Replace "models overestimate" with "mean-model overestimates".

*replaced*

+) 19266, lines 21-24: Comment on whether or not this could be explained by uncertainties in the observations.

*Uncertainties in the observations does not provide an explanation. Accuracy of the observations is a few orders of magnitude smaller than the daily variations of mismatch. We added a sentence "in terms of one standard deviation of daily mean of the mean model".*

+) 19266, line 24: Start new paragraph before "At".

*modified*

+) 19267, line 1: It might be good to show the 800m mismatch in Fig 6.

*added*

+) 19267, line 8: Replace "which" with "that".

*replaced*

+) 19268, line 4: Replace "the same" with "similar".

*replaced*

+) 19268, lines 16-18: Should also mention that "models also implicitly average over small scale features within a grid-box which reduces their variability."

*done*

+) 19269, line 4: Delete "Letters correspond to each model." This is stated in the figure caption.

*deleted*

+) 19269, lines 22 & 24: Should "emanation" be "exhalation"?

*Yes. Exhalation is correct.*

+) 19270, line 6: Replace "super simplified, primitive" with "simple".

*changed*

+) 19270, line 19: The usual spelling is "Heaviside". However, I believe that the function used by the authors is not a Heaviside function. Rather, the function is variously known as a "top-hat" function, rectangular function, and boxcar function.

*changed*

+) 19270-1: I suggest making the second letter a subscript for hx, hi, is, and ie.

*changed*

+) 19271: I do not understand equation 2 as it is written. I think it is intended that it be a piecewise function with the first line applying when i = ie, and the second line applies when i=ie. It current looks like f is a function of (i=ie).

*changed*

+) 19271, lines 10-11: It might be clearer for the reader to put these numbers in a table.

*We do not think this is necessary. Retained*

+) 19271, line 11: Add commas around "respectively".

*added*

+) 19271, line 13: I think "cyclonically" should be "cyclically".

*changed*

+) 19271, line 27: I think it is false to say that a reduced nighttime BLH will make day time concentrations higher in the model. The daytime concentrations will only depend on the nighttime mass and the daytime ABL height.

*Yes.*

+) 19272, line 2: I think it will be clearer to replace "entrainment" with "loss due to that ventilation".

*changed*

+) 19272, line 2: Insert "subsequent" before the second "daytime".

*changed*

+) 19272, lines 10 & 15: I would prefer "regions" rather than "patches".

*changed*

+) 19273, lines 4-5: Replace "Future work might want" with "It may be appropriate in future work".

*changed*

+) 19273, line 12: This seems to be too strong a statement. I suggest replacing "not reproduced in any model" with "poorly reproduced by the models".

*changed*

+) 19273, line 14: Insert "observations" after "daytime"

*changed*

+) 19273, line 17: Insert "the" before each "seasonal".

*changed*

+) 19274, line 3: Delete "at sites", and replace "reliable" with either "insufficient" or "accurate".

*changed*

+) 19274, line 8: Modify line to say $\cdots$ has largely been ignored up until now. Unfortunately, $\cdots$

*changed*

+) 19274. The Acknowledgements could be shortened by referring to Law, et al., 2008.

*We believe it is important to include full acknowledgements in this paper.*

+) 19280. Table 1.

-) The resolution for model J should be "2.5x2.0".

*corrected*

-) I think all the semi-colons should be changed to colons.

*the footnote has been deleted.*

-) In the caption, I prefer hybrid instead of mixture.

 *replaced.*

-) In the caption, definitions are needed for on, off, NL, and Kzz. For Kzz, the description could be implicit scheme using diffusion coefficients from the metdata. A more concise option is to reference Rotman, et al., 2008: D. A. Rotman, C. S. Atherton, D. J. Bergmann, P. J. Cameron-Smith, C. C. Chuang, P. S. Connell, J. E. Dignon, A. Franz,

K. E. Grant, D. E. Kinnison, C. R. Molenkamp, D. D. Proctor and J. R. Tannahill, Journal of Geophysical Research-Atmospheres 109 (D4) (2004).

*We added all references in the table and removed all unrelated items from the caption.*

+) 19281. Figure 1. It will help many readers if the names of the countries are added to the figure.

*plotted*

+) 19282, Figure 2 caption.

-) Add "(a)" before "midnight".

*added*

-) Delete "a" from the brackets.

*deleted*

-) Insert "(b)" before "afternoon"

*added*

+) 19284, Figure 4 caption.

-) Add "of 222Rn" after "concentrations".

*added*

-) At end of caption add: "See text for details. Where sampling locations are the same for different models only one letter is shown."

*added*Âěitem

+) 19285, Figure 5:

-) Add "(N.S.D.)" after "deviation".

 *added*

-) Replace "and" with "to" in first line.

 *replaced*

-) Replace "in the left side" with "on the left side".

*corrected*

-) What are the strange bars that the arrows point to?

*It correspond to simulated concentrations at exact altitude. A description is added in the caption.*

+) 19286, Figure 6.

-) As mentioned above, I think it is important to show the uncertainty in the mean for each month.

*We revised the vertical bar in the figure to indicate day to day variations of the ensemble mean model.*

-) Some of the letters appear to be strangely bold.

*corrected*

+) 19287, Figure 7: Replace lowercase "o" in the caption with an uppercase "O" to match the figure.

*replaced*

+) 19289, Figure 9: I suggest adding the simplified ABL function used in the box-model.

*modified*

+) 19290, Figure 10, caption: replace "one dimensional model" with "our one dimensional model, as described in section 5.1"

*replaced*

Interactive comment on Atmos. Chem. Phys. Discuss., 11, 19253, 2011.