

Reply to Referee 2

5 This paper described and evaluated the updated ATTILA (Atmospheric Tracer Trans- port in a Lagrangian model) coupled
with the EMAC chemistry climate model. The model includes new physical routines for a Lagrangian convection scheme and
a formulation of diabatic vertical velocity. New infrastructure submodels were also developed. The authors evaluated the re-
sults from grid point simulations (EMAC), EMAC-ATTILA simulations with diabatic vertical velocity and kinematic vertical
velocity, respectively, against radon-222 surface and profile measurements. Their result shows an improvement of the tracer
transport in the ATTILA with the diabatic (vs. kinematic) vertical velocity. The documentation and evaluation are very useful,
especially for their model users. Generally the paper is well written, but still requires more careful editing (see examples be-
10 low). I recommend publication after minor revisions. .

Reply: We thank the referee for these positive comments.

Minor comments:

15 P3, L19: “(ECHAM5, Roeckner et al., 2006)”

Reply: Done.

20 P3, L20 (and elsewhere): add comma after “i.e.” (or “e.g.”)

Reply: Comma added.

P3, L21: remove “MA-“

25 Reply: Done.

P4, footnote of Table 1: make it one single line.

Reply: Done.

30 P6, L7: “such as for instance” – remove “for instance”.

Reply: Done.

35 P11, L23: “were selected similar as by Reithmeier and Sausen (2002)” – do you mean “following Reithmeier and Sausen
(2002)”?

Reply: Yes, we meant “following Reithmeier and Sausen (2002)” and corrected it in the revised manuscript.

40 P12, L6: “only, if” — “only if”

Reply: Comma removed.

P12, L12: remove “also”.

45 Reply: Removed.

P12, L13 and P14, L4-5: correct the unit on P14, and use the same unit.

Reply: Corrected.

P12, L24 and P13, L1: Kritz and Rosner (1993) was cited for the 1994 Radon profile data at Moffett Field. Should it be Kritz et al. (1998)?

Reply: The referee is right. We corrected this in the revised manuscript.

P12, L26 and P14, L4: remove “of”.

Reply: Corrected.

P13, L2: THE 3rd

Reply: "THE" was added.

P14, L9: “advantage that”

Reply: Corrected.

P14, L20-21: This is a repetition of what’s said in the first 2 lines of section 3.1, and should be deleted. L22: “Jöckel et al. (2010) showed that . . .”; L23: “assume here that. . .”; L26: “from the large”

Reply: We deleted the sentence of lines 20/21 and corrected the following text passage.

P14, L27-28: “The small local maximum at 80 south is related to . . . where small land areas in the land sea mask generate local ^{222}Rn emissions” – But it appears that Rn emissions in the model is only limited to 60S-60N (see top of page 14). Please clarify.

Reply: Thank you for this hint. Indeed, the emissions are over 90S-90N and not restricted to 60N-60S. We corrected the manuscript.

P15, L12 and Fig. 4 (panel and caption): ^{222}Rn lower than 1000 Bq m⁻²), “ $^{222}\text{Rn}[\text{mBq/m}^2]$ ” - the unit is incorrect. Please use “mBq/SCM” (i.e., mBq per standard cubic meter).

Reply: We corrected the units.

P15, L13: “And finally. . .” — “Finally. . .”

Reply: Corrected.

P15, L16: remove the symbols

Reply: Done.

P15, L25-27: Again, these are repeating what’s already said in section 3.1

Reply: We removed the sentence from the manuscript.

P16, L2: remove “stemming from radioactive decay of radium in soils”

Reply: Done.

5 P16, L27: use “upwelling” instead of “up-“ to avoid confusion.

Reply: Corrected.

10 P18, L15, Fig. 16: “The maximum levels of detrainment are between level index 43 and 38” — Are these shallow convection? Isn’t it better to use altitude instead of model level index in the plot? What’s the quantity shown on the color bar of Fig. 16-18?

Reply:

Only deep convective events are considered for this figure. However, your question triggered us to control our calculation with respect to the maximum level of detrainment. And in fact, we found out that a wrong data file was selected for the Figures 16-18. We corrected this and now provide correct figures. Additionally, we calculated the start and end levels in pressure levels instead of level numbers. Fig. 16 now shows the maximum detrainment level between 500 and 600 hPa. The color bar displays the number of moving parcels from a start level to its respective end level in the tropics between 20° north and south, normalised by the maximum number. The caption is modified in the revised manuscript.

20 P19, L4: during the . . . campaigns Fig.2: Are the concentrations averaged from the lowest 3 model layers? The caption needs this information. The concentrations at 100hPa are scaled up by a factor of 10, and it needs to be indicated on the panel, e.g., adding a right axis? Also explain what LG(diab) and LG(kin) are, or refer the reader to the text (section 4).

25 Reply:

The word "campaigns" is added to the revised manuscript. Yes, the concentrations are averaged over the lowest 3 model layers. We added this information to the caption. We added a right axis for the (lower) concentrations at 100 hPa in Fig.2 and put the information on the LG(diab) and LG(kin) simulations into the caption.

30 Fig.2-6: Consistently use mBq/SCM as the unit for ²²²Rn concentrations throughout the paper.

Reply: We modified the units consistently throughout the manuscript.

35 Fig. 5 caption: “Dashed lines” and “The thick dashed lines” are a bit confusing. “The thin dashed lines”? What are the triangles?

Reply: Yes, the text is confusing. We reformulated the caption.

Fig.6 caption: what are the circles?

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Reply: We added the explanation to the caption.

Fig.11: transit time (years)

45 Reply: Corrected.

Fig.12: typo “level)”

Reply: Done.

Fig.13: “Stippled area” or “NOT stippled area”?

5 Reply: We meant "Stippled area" as stated in the caption.

Fig.14: The mass fluxes are plotted in “kg/s”, which is dependent on the model grid- size (surface area). Without this model’s grid-size information, other modelers cannot compare their results to this figure. Thus it’s necessary to plot the mass fluxes in “kg/m2/s”.

10 Reply: We have modified the figure. The mass fluxes are now in kg/m2/s.

Fig. 15: “net downward mass flux” – remove “downward” since negative values already indicate “downward”. Here it’s OK to plot the mass fluxes in kg/s because the areas (30N-90N, 30S-90S) are given.

15 Reply: Done.

Suppl. Material: the cover page should use the same title as the one for the main text, and add one paragraph explaining what’s included in the supplementary materials.

20 Reply:
We changed the title and included a short paragraph describing the presented material in the supplement.