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Atmospheric Chemistry and Physics Discussions



# *Interactive comment on* "Modelling tracer transport by a cumulus ensemble: lateral boundary conditions and large-scale ascent" *by* M. Salzmann et al.

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This is an interesting paper addressing the impact of lateral boundary conditions (LBC) for chemical tracers on the cloud-resolving and regional-scale simulations. The authors have brought up this issue to the chemistry modeling effort in cloud-resolving scale and also carefully studied it in a great detail (although under rather idealized conditions). The authors have tested both periodic and specified lateral boundary conditions. For the latter method, they have also examined the role of specified vertical transport, hypothesized to be attributed to the large-scale advection and supplied as an addition to the explicitly modeled convective transport, in the modeled redistribution patterns of tracers. Tracers originated in the lower, middle, and upper troposphere have been



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used in the tests. The most important result coming out of this paper, from my point of view, is the one of the SLBC tests that indicates the much needed consideration of large-scale (background) distributions and supplies of tracers for a "reasonable" cloud-resolving simulation.

This is an original result and it should be very informative to the atmospheric chemistry community. The paper appears to be well-organized and carefully prepared (much improvement from the original submitted manuscript is also appreciated, though there are still a few long sentences).

I suggest accepting the paper for publication after the authors' making certain revisions.

SPECIFIC COMMENTS AND SUGGESTIONS

Page 3383, line 8: "the time tau ...", it did not clearly tell what the tau is. Similar descriptions are in several other places.

Next page, line 8: "Mlawer et al. (1997)" should be "(Mlawer et al., 1997)".

P3387, line 21: An explanation of SLBC is needed for its first appearance in the paper.

P3390, line 6: Why the small difference in the TOTAL precipitation measured by mm or mm/day between model runs with various domain sizes should be a surprising result? In the same page, next paragraph: The authors realized the UT temperature bias, have they analyzed the difference between various runs in cloud top heights? Also, "approx." should not be used here.

Page 3393, line 14-15: Note that the upward transport (mainly in the convective core) is much more efficient than the mesoscale compensating downward transport in moving tracers. Also, in the same paragraph, "(Mari et al." should be "Mari et al. (".

Page 3396, line 24: "Tracer A can be considered ...", what about tracer B and C?

Page 3397, line 11-12: "measurement campaigns" should be "field campaigns".



**ACPD**

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Page 3398, last sentence to Page 3399: Under the circumstance given by the authors here, the convergence and divergence generated by the inside convection would dominate the mass fluxes in and out of the model domain, the large-scale influence on these fluxes should be very small.

Page 3399, line 3-8: The authors might want to briefly discuss on why the expected size-dependency did not occur in their tests?

A general comment to the Discussion: There is actually another commonly used LBC, i.e., the radiation type (RLBC) in cloud-resolving models. The tracer concentration at the boundary point on the inflow side is remained as a constant under RLBC. This would actually provide a flux to the internal of the domain, should a gradient in tracer concentration be created between the boundary point and the internal point. It is somewhat similar to the SLBC used in the study. However, the authors did not comment on RLBC in the current manuscript.

Page 3401: The citing of Ekman et al. (2004) should be: Ekman, A., C. Wang, J. Ström, and J. Wilson, 2004: Explicit simulation of aerosol physics in a cloud-resolving model, Atmos. Chem. Phys., 4, 773-791.

Page 3412, Figure 7: The label of the horizontal axis should be relative mixing ratio (?).

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Interactive comment on Atmos. Chem. Phys. Discuss., 4, 3381, 2004.