Geoscientific
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Interactive comment on "ATTILA 4.0: Lagrangian Advective and Convective Transport of Passive Tracers within the ECHAM5/MESSy (2.53.0) Chemistry Climate Model" *by* Sabine Brinkop and Patrick Jöckel

Anonymous Referee #1

The study by Brinkop and Jöckel describes an extension of the Lagrangian transport module ATTILA, which is online coupled to the ECHAM5/Messy model through the Messy coupling framework. The extension includes several new modules for diabatic vertical velocities, convective transport, and inter-parcel mixing, as well as new tools for diagnosis and emission treatment. Furthermore, MPI paralellization (decomposing by parcels rather than by subdomains) and a careful treatment of the random number generator (essential for this type of modelling) have been implemented.

This reviewer considers these extensions as relevant and significant. The manuscript

is very well written and easy to follow. A model evaluation against Radon (troposphere) and Age-of-Air observations is presented, which highlights the benefits of diabatic vertical velocities to better represent the stratospheric age-of-air distribution. Although this is not a new finding, the model evaluation suggests that the implementation of diabatic velocities within ATTILA has been done properly.

The only weak point of the manuscript is the fact that the evaluation of the convective transport does not receive similar attention as the evaluation of the diabatic velocities. It would have been nice to see the effect of the convective transport on the vertical profiles of Radon in the troposphere. Why has this not been done? I clearly recommend publication of this manuscript with only minor corrections (and after addressing the weak point mentioned above).

Small points:

Introduction section: It would be useful to mention some typical (planned or past) applications of ATTILA End of page 4, beginning of page 5: In the list of new modules, it is not necessary to state "have been added" , "has been implemented" after each point. This could be stated once at the beginning, e.g. "the following new modules have been implemented:"

Page 5, Line 10: What do you mean by "transformations"?

Page 6, line 5: "depending whether" -> "depending on whether"

Page 8, line 21: I didn't really understand, how the "kinematic velocity" mixes with the "diabatic velocity" in equation 7. Rather it seems that vertical transport in these coordinates can occur by pressure changes (since f depends on pressure).

Page 10, Line 17: Isn't the convection scheme only mass conserving in the limit of a large number of air parcels? What happens if there is no air parcel available in the column that could be used to compensate the up- and downward motions?

Page 11, Line 14: Doesn't the mixing parameter d depend on the time step?

Page 13, Line 22: What do you mean by "working space"? Memory?

Page 15, Line 1: How can the overall burdens be different between the simulations, if the emissions of Radon are identical and Radon decays with a constant e-folding time?

Page 16 Line 3: You may also refer to Karstens et al. (2015): https://www.atmos-chem-phys.net/15/12845/2015/

Caption of Figure 12: "difference between and" -> "difference between"

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Interactive comment on Geosci. Model Dev. Discuss., https://doi.org/10.5194/gmd-2018-302, 2019.