

Reply to Referee 2

We are deeply grateful for the referee’s comments on our paper. Following your comments, we revised the manuscript. Our responses to your comments are as follows. Lines are those in the revised version. For convenience, we attach a supplemental material which is the same as the revised manuscript except that the changed parts are written in red color.

1. ... *the Authors of the submitted manuscript claim to have corrected the eddy hopping model of GA17 by including a relaxation term that have been already included and studied by AGP18 ... the introduction of tuning parameters to fit the model to reference data cannot be regarded as a "correction" to the model (particularly when those fitting parameters turn out to be $O(1)$), unless theoretical expressions for the parameters and a rationale are provided. ...the Authors should state differently their contribution to the field.*

Thanks for the comment. We agree. Our main contribution is that we validated the eddy-hopping model [the original version by Grabowski & Abade (2017) and the extended version by Abade et al. (2018)], and not that we “corrected” the model.

In the revised manuscript, we first made the following revisions to correctly describe the contribution by Abade et al. (2018):

- Line 21–23: A sentence “*Abade et al. (2018) extended the model ... due to turbulent mixing.*” has been inserted.
- Line 125, section 4: The section title has been changed.
- Line 126: A sentence “*We next consider ... as follows:*” has been inserted.
- Line 131–132: A sentence “*The important change ... in Eq. (19).*” has been inserted.

We made the following revision to distinguish two versions of the model:

- Line 23–24: A sentence “*For clarity, we ... the second version.*” has been inserted.

Accordingly, we removed the word and the phrase such as “corrected”, “corrected model”, and so on, and we refer to the eddy-hopping model developed by Grabowski & Abade (2017) as the “original version”, and the extended model by Abade et al. (2018) as the “second version” in the revised manuscript. Also, to correctly describe our contribution, we made the following revisions:

- Line 4–6: A sentence “*Two versions ... simulations (LESs).*” has been inserted.
- Line 31–36: Three sentences “*These statistical properties ... leads to improvement.*” have been inserted.
- Line 254–256: Two sentences “*we showed that ... the reference data.*” have been inserted.

2. *Finally, the Authors suggest a simplification of the model that eliminates the vertical velocity fluctuations w' from the list of stochastic variables attached to computational particles (superdroplets) in LES Lagrangian cloud models. The discussion and procedure of model simplification is instructive and gives valuable insights into the model. However, this simplification does not necessarily imply in reduction of computational cost. This is because the velocity fluctuations of superdroplets are usually necessary to resolve the subgrid-scale*

transport of superdroplets. Also, the simplified model accurately reproduces time correlations in the Lagrangian supersaturation in the regime of large Damkohler numbers. This is exactly the regime of applicability of the GA17 model.

Thanks for the comment. You are right. The simplified model does not necessarily lead to a reduction in computational cost when not only S' but also w' is used for the subgrid-scale parameterization in LES.

In the revised manuscript, we removed the phrase such as “reduction in computational cost” and instead used the phrase such as “reduces the number of model variables”. We also removed the discussion on computational cost of the simplified model in section 5 and only discussed the convergence property of the model. Revisions are as follows:

- Line 7–8, Line 36: A phrase “*which may contribute to a reduction in computational cost*” has been replaced by “*which reduces the number of model variables*”.
- Line 230: The item discussing possible reduction of computational cost (“*1. Reduction of computational cost. ... reduction in computational cost.*”) has been removed.
- Line 260–262: The sentence “*Since the assumption ... after the simplification.*” has been replaced by “*This convergence property ... Lagrangian cloud model.*”.

We again appreciate the referee’s valuable comments which are very instructive to make the paper clearer and better.