

Geosci. Model Dev. Discuss., referee comment RC3
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Comment on gmd-2020-404

Anonymous Referee #3

Referee comment on "On numerical broadening of particle-size spectra: a condensational growth study using PyMPDATA 1.0" by Michael A. Olesik et al., Geosci. Model Dev. Discuss., <https://doi.org/10.5194/gmd-2020-404-RC3>, 2021

This manuscript examines the fidelity of various flavors of the MPDATA advection scheme for solving condensation of the drop size distribution. The writing style is clear and concise, the historical review of bin scheme and MPDATA development was illuminating, and the figures were simple and easy to understand. That said, the study suffers from a few key flaws that lead me to suggest the paper be rejected.

First, the authors recognize that the difficulty of numerically modeling condensation/evaporation is that drop growth processes (in the mass dimension) are fundamentally coupled to spatial advection. Yet the test case, which if I understand correctly was chosen because a reference analytical solution can be obtained, either did not include a spatial advection component or this was not discussed. Morrison et al. (2018) and Lee et al. (2021) both point out that satisfactory solutions can be obtained by a number of schemes in the absence of transport; it is when they are coupled that special consideration must be taken. Secondly, the physical feasibility of the test case is dubious; in any warm cloud, a mass mixing ratio of 10 g/kg is nigh impossible. Finally, another important aspect (in particular, of Lee et al., 2021) was not covered: the effect of refining grid spacing vs. refining algorithm formulation. These three factors combined leave me with the impression that this study, while rigorous, is not relevant to the current state of the field.

I strongly encourage the authors to reconsider the paper by formulating a test case that would demonstrate the relevance of the algorithms tested in dynamical models, and evaluating the tradeoff of increased algorithmic accuracy versus refined size grid.