Geoscientific Model Development Discussions

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Comment on gmd-2020-404

Anonymous Referee #2

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-RC2, 2021

This study examined performance of various MPDATA variants in solving drop size distribution evolution by condensation. The authors reviewed many previous studies in the context of improving MPDATA and showed that MPDATA with three anti-diffusive iterations, third order term, infinite gauge, and the non-oscillatory option reduces the numerical diffusion to roughly a tenth compared to that of the upwind scheme, although it requires ~10 times longer than the upwind scheme.

Although this study examined the performance of MPDATA variants systematically, I would raise two serious problems this study bears. At the current stage, my recommendation is to reject the manuscript for publishing on GMD, and encouraging the authors to improve the manuscript accordingly.

1. Somewhat outdated

I can find several recent papers closely related to the topic this study focuses on: Morrison et al. (2018, doi: 10.1175/JAS-D-18-0055.1), Pardo et al. (2020, doi:10.1175/JAS-D-20-0099.1), and Lee et al. (2021, doi:10.1175/JAS-D-20-0213.1). All those papers already pointed out that drop condensation itself can be sufficiently converged with better schemes or better designed grids, but it is the condensation w/ vertical advection or w/ collision-coalescence that causes serious problems. Furthermore, those studies utilized LES model results in explaining their results, whereas this study only showed the box

model results. This study clearly exhibited the performance of MPDATA variants in solving drop condensation, but only the convergence test in solving drop condensation is somewhat outdated compared to the studies I mentioned. I strongly suggest the authors to improve their study by including vertical advection, collision-coalescence, and/or something we do not know its effects.

2. Experimental setting

In the authors' experimental setting, supersaturation is fixed so the liquid water content increases up to 10 g kg^{-1}, which is almost unrealistic except for tropical cyclones. I strongly suggest the authors to modify the experimental setting so the results become more realistic. For example, Morrison et al. (2018) and Lee et al. (2021) fixed the vertical velocity to be 1 m s^{-1} for ~ 20 min rather than fixed the supersaturation.