Review for **Geoscientific Model Development** (Feb. 24^{th} 2021)

On numerical broadening of particle size spectra: a condensational growth study using PyMPDATA 1.0

This study introduces a new Python library for advection of geophysical flows with the MPDATA scheme. More specifically, it concentrates on the broadening of cloud droplet distributions due to advection and compares those distributions to analytically derived functions. It is based on previous work by the authors in a C++ library and numerous studies that have been conducted since the 1980s up to now. The paper is clearly written in the introduction, the methodology, and results sections. The reader would profit from a more fluent overview of the background literature in this work (in **section 1.2**), as well as a brief motivation why this is such important work especially in the context of clouds. A short suggestion of how to incorporate this is given by the reviewer. Also, a brief description of the software for interested users would be very helpful. Overall, this work is unique in its focus on comparing 2-3 advection schemes in the context of cloud dynamics and could be a basis for many future applications after major revision.

First general comments from my side:

- To give a brief motivation, why your work is so important, I would refer to clouds in climate research, e.g.: Climate goals and computing the future of clouds, *Nature Climate Change* **volume** 7, pages3–5 (2017) or a more recent publication
- How do your simulations evolve in time? Besides the cloud distributions you show in Fig. 1ff, I would like to see Hovmoeller diagrams of cloud distributions of selected experiments to see their temporal evolution.
- Have you tried more advection schemes besides: upwind, mpdata 2, mpdata 3?
- You should point out the clear improvement of MPDATA compared to upwind scheme.
- What are the initial conditions in your simulation? What noise do you use?
- Please provide a comparison for the plot of mixing ratios versus R_d (Fig. 9) to observations from nature or experiments. Again, state explicitly in the caption of Fig. 9, what R_d symbolizes: Radius of …
- The error overview plots **Fig. A1ff** are a very interesting way to compare advection schemes and experiments, efficiently. Why do you not pull those into the results section for selected experiments? Is the truth for computing the error the analytical model?
- You should point out in the conclusion, that this study can be a basis for future work.

I am looking forward to providing more detailed comments in the next iteration of this manuscript. For now, some technical comments:

(a) **Fig.1:** … those are cloud droplet distributions, right? Please state this, explicitly.
(b) **Fig.1:** Can you provide the analytical functions for the distributions & its derivations?
(c) A better description of the Python library is required for interested readers to repeat your experiments. You can do that either in README file on github or in a section of this paper.