

Interactive comment on “libcloudph++ 0.2: single-moment bulk, double-moment bulk, and particle-based warm-rain microphysics library in C++” by S. Arabas et al.

Anonymous Referee #2

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General comments

I acknowledge the efforts of the authors to provide an open-source library of warm-rain microphysics. One strength is certainly that three types of microphysical representations with different complexities are bundled within one framework. This facilitates conclusive comparisons between the different model approaches.

I have no real major comments. However, I think that the presentation (language and style) must be substantially improved in order to make the reading easier and the paper acceptable. This can eventually turn out to be a major task, though.

In the following, I list a few general remarks and several specific issues which are
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selected examples and serve as a guideline for a more thorough revision. The list is not complete and I encourage the authors to go over the whole manuscript.

Major comments

In general, I found it quite challenging to understand the paper. This is certainly due to the fact, that a background in physics, numerics and programming is necessary. The sections 3 to 5 are similarly structured which is helpful for orientation. Nevertheless, the presentation can be made more consistent.

Section 3 shows many formulae, whereas section 4 shows none. You could at least add formulae in section 4.1.4 to be clearer on how sedimentation is treated for both moments.

Section 5.1.2 starts already with a formula on the numerical implementation. Wouldn't it be better to start with the fundamental transport equation, something like $d(x_p)/dt = U_p$ (x_p particle position and U_p particle velocity).

Section 5.1.3: Wouldn't it be better to change the order of the formulae? First start with the fundamental equation of crystal growth (your Eq. 20) and then talk about the numerical solution procedure (Eq. 17-19)

Figure 10: The particle-based approach is much more expensive, once condensation is turned on. Why is the increase (once you turn on condensation) much stronger than for the single and double moment scheme? Or am I misled by the logarithmic x-scale and all components (condensation, coalescence and sedimentation) are similarly expensive? Is it possible to make the implementation more efficient, in particular that of the particle-based approach? How do you generally rate the potential of speeding up the particle-based approach? I guess in the present implementation user-friendliness was a more important goal than cost-effectiveness. You could add some more discussion in Section 6.

Minor comments

p.8279, l.17: What is C++11? Please explain.

The single and double moments schemes use header-only libraries. Can you explain what this means? What are the implications and advantages?

p8291, l.25: In two-moment schemes you do not have information on the shape of the size distribution. So I do not understand this sentence.

Section 5.1.4: p8305, l8 and l10: Did you mix up "larger multiplicity" and "smaller multiplicity"? I thought the particle with smaller multiplicity retains its multiplicity.

Technical corrections

p.8287,l.17: 2005 is not recent

p.8298, l.4: r_d or r_d^3 : What is the proxy for the volume?

p8310,l.19: You write twice "rhod_courant_1" and the dimensions disagree. Is there a typo?

Language issues

I list phrases or sentences that I do not understand or are misleading:

p.8297,l.10: "distinction" is the wrong word I guess. You will certainly treat the aerosol and the droplets/drops differently in physical terms.

p8279,l19-22: Please reformulate.

p8298,l19: "condensation and evaporation are not treated as instantaneous"

p8298,l.14: "lifted"?

p.8279,l.24: "context"?

p8296,l19-21: Please reformulate. A concentration cannot have a shape, nor does it have a fall velocity.

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p8308,l.22-25: Please reformulate

p.8310, l.18: "to be laid out"?

p8284,l.8/9: Please reformulate

Interactive comment on Geosci. Model Dev. Discuss., 7, 8275, 2014.

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