

Geosci. Model Dev. Discuss., referee comment RC2
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Comment on gmd-2021-370

Michael Schulz (Referee)

Referee comment on "Chemistry Across Multiple Phases (CAMP) version 1.0: an integrated multiphase chemistry model" by Matthew L. Dawson et al., Geosci. Model Dev. Discuss., <https://doi.org/10.5194/gmd-2021-370-RC2>, 2022

This paper attempts to document a flexible tool to construct code describing aerosol and chemistry processes in a variety of box and transport models. There are a lot of interesting thoughts layed out here and the paper is certainly worth publishing. Congratulations for this work.

I have some general comments which should be dealt with in a revision:

I wonder which aspects of an aerosol model are "outside of CAMP". This could be made more clear. I am wondering about advctive&convective transport, vertical mixing, sedimentation, transport in rain drops, radiation interaction, fog formation, emissions, aerosol uptake of in cloud/ice water. Can fast and slow chemical reactions treated differently, to the advantage of computational efficiency?

A second question I have is the computational efficiency of CAMP. Is there any chance this can be quantified? And if not now, how can this be done in the future?

Then - the chapter 4 is a bit disappointing. Shouldnt the box model and transport model simulations be compared to a classical code? Especially for MONARCH, there should be simulations available that are comparable.

Figure 8 in my pdf was not readable, legends disappeared, axis titles are absent, I dont understand what is shown. The discussion in 4.2 is too short to understand the result. Please rewrite.

Figure 9 results: "regions with high O₃ and ISOP concentrations rapidly produce 0.5 to 5 $\mu\text{g m}^{-3}$ of SOA. This is particularly clear in central Portugal where biomass burning emissions inject large amounts of primary organic aerosols during the day." I thought there are no primary aerosols in this CAMP version. How can BB primary emissions lead to SOA? Reconsider, rewrite please.

Fig 10: Bias: "The mean bias for all rural and urban background stations below 1000 m above sea level is shown in Fig. 10a for the period 28 July to 9 August 2016". What is the value of this figure if the model is only computing SOA? I really don't understand what I can take from this figure and bias calculation.

Ch 4.3 Why don't you show results of an ordinary MONARCH simulation for the same period compared to a CAMP-MONARCH simulation? Would be quite convincing if this would give similar results. At least for part of the chemical system.

Finally, I wonder if the tests in tab 7 could be explained, illustrated a bit more. How to quantify if the solution is comparable? Could this be discussed?

Conclusions: "Differences in results for the time evolution of SOA formation between the modal representation on the one hand, and the particle-resolved and sectional representations on the other hand, can be entirely attributed to the chosen aerosol representation." => I am not sure this attribution is really demonstrated.

"Results from a regional MONARCH simulation over Europe are consistent with expectations and demonstrate that CAMP is applicable to large-scale atmospheric models." => what did you expect? what is demonstrated? please expand with a critical evaluation.

small comments:

Table 3: I don't understand why the Parameter class has the same calculate jacobian contribution function as the Process class. The description text is just the same. Error, or - maybe I just don't understand.

Figure 4b: The entries into the json file are a cryptic for someone not knowing the UNIFAC model. How are users supposed to understand what needs to be changed within CAMP and what in json files?

Figure 6: what is a "CAMP state"?

