

Atmos. Chem. Phys. Discuss., referee comment RC2
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Comment on acp-2022-226

Anonymous Referee #2

Referee comment on "Modeling radiative and climatic effects of brown carbon aerosols with the ARPEGE-Climat global climate model" by Thomas Drugé et al., Atmos. Chem. Phys. Discuss., <https://doi.org/10.5194/acp-2022-226-RC2>, 2022

Review of "Modeling radiative and climatic effects of brown carbon aerosols with the ARPEGE-Climat global climate model" by Drugé et al.

This manuscript presents a global model simulation of brown carbon and its climate effect in the ARPEGE-Climat global climate model. The authors provided a detail review of current modeling schemes for BrC and a detail introduction to their own parameterizations. They evaluated the simulated AOD, SSA, AAOD with satellite and ground-based sun-photometer measurements.

The biggest issue of this manuscript is the model-observation comparison part, which in my mind, doesn't provide much useful information. The comparisons use AOD, SSA, and AAOD at 440nm as well as AOD at 550nm. Since BrC could contribute only a small part to those total aerosol properties, the model biases are more likely to be related to other aerosols:

- At 550nm, BrC absorption is too small to significantly affect total AOD. In contrast, the uncertainty of other aerosols in the simulation are much larger due to the assumptions such as: no anthropogenic SOA is considered, applying constant scale factors for emissions globally, etc.

- Even for AAOD at 440nm, black carbon usually contributes more absorption than BrC. An evaluation of BC AAOD is needed (at least based on previous literature) and its influence on the model-observation comparison should be discussed.

In addition, the authors should be clear about the datasets they used:

- How are the SSA and AOD retrieved in the satellite products? Are the retrievals including any assumptions? Are those assumptions consistent with those in your model?

- The OMI observations used here was in fact the OMAERO product, please clarify. On the other hand, OMAERUV may be a better choice for this work.

- For AERONET, level 2.0 data were used, which only have SSA and AAOD information when $AOD \geq 0.4$. Therefore, monthly average values are not able to represent the real monthly condition and tend to overemphasize the high AOD hours. They are not appropriate to be compared with monthly values from the model.

Specific comments:

p.4, line 31: Could you please provide which six bands are used in shortwave? This could be important as BrC absorption is very sensitive to spectral bands.

p.7, line 15: Please provide justification or reference for BrC size distribution. GMD of 100nm looks small for biofuel and biomass burning organics.

p.7, line 18: Does it mean you assume all the freshly emitted OA from biofuel and biomass burning are hydrophobic? Is there any difference between your hydrophilic and hydrophobic BrC, other than the optical properties? Are treatments in BRC and NOBRC simulations same?

p.7 line 11: I assume you mean "not all of the burning conditions are represented" for "all burning conditions are not represented".

p.9, line 21: Better use "with or without" for "including or not"

p.9, line 23: What do you mean for "two members"?

p.13, line 14: Change "Our last comparisons concerns" to "Our last comparison concerns"

p.17, line 17: Change "non only" to "not only". There are many grammar errors are

indicated in the above comments. Please check your writing carefully.