

Atmos. Chem. Phys. Discuss., referee comment RC3
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Review on acp-2021-256

Anonymous Referee #3

Referee comment on "Combining POLDER-3 satellite observations and WRF-Chem numerical simulations to derive biomass burning aerosol properties over the southeast Atlantic region" by Alexandre Siméon et al., Atmos. Chem. Phys. Discuss., <https://doi.org/10.5194/acp-2021-256-RC3>, 2021

Review of: Combining POLDER-3 satellite observations and WRF-Chem numerical simulations to derive biomass-burins aerosol properties over the Southeast Atlantic region. Authors: A. Simeon, F. Waquet, J-C Pere, F. Docos, F. Thieuleux, F. Peers, S. Turquety, and I. Chiapello.

Recommendation: Accept with Minor Revisions

In this study, the authors focus on biomass burning (BB) particle plumes transported above clouds over the Southeast Atlantic (SEA) region, off the southwest coast of Africa. They employ simulations from a regional model (WRF-Chem) coupled with meteorological reanalyses data and aerosol retrievals from POLDER in clear sky (POLDER/GRASP) and cloudy scenes (POLDER-3/AERO-AC), to better characterize the physico-chemical and absorption properties of aerosols.

Other reviewers have asked relevant questions, so I will just add some additional comments below:

Page 7, line 155: What is the temporal resolution of the WRF-Chem configuration?

Are the vertical levels evenly distributed from surface to 50hPa or the vertical resolution is finer near the surface? Could you clarify in the text?

Line 157: Whilst I agree that the first half of July is representative for the whole month, this short period is not representative for the entire biomass-burning season. As Adebiyi et al, 2015 and Deaconu et al, 2019 showed, September and October months are characterized by different meteorological conditions and larger amounts of BBA transported over the SEAO. Also, the BBA are lifted at higher altitudes, limiting the contact aerosol-clouds. How do you justify choosing this period to study?

What was the computational cost of the 30 days (with 15 days spin-up) simulation and could you apply the optimized model configuration over September/October 2008 to check the consistency over this period?

Figures 1 and 2: From these figures looks like you could have chosen a different study area for the clear-sky cases, say between 5° and 15° N, that would have covered more of the biomass-burning emissions (correlated with the PM_{2.5} in Fig.1) and also more clear-sky days (Fig.2). Why did you choose this particular box?

Page 10, Fig2b: You are showing number of observation days of clear and cloudy scenes. It would be useful to plot also the data with coincident aerosol retrievals (e.g. number of observation days used in the study) for clear and cloudy skies.

Page 16, line 395: What is the scale of the biases between the AOD in clear-sky POLDER/GRASP compared to WRF-Chem reference configuration? From Fig. 7, it looks like the model is still strongly underestimating the AOD over land. Since the range of uncertainties for BB emission inventories reported in literature is in 2 to 4, why did you choose to scale the APIFLAMEv1 with a factor of 1.5?

Page 17, line 408: Deaconu et al., 2019 showed that oxygen pressure method underestimates the cloud height compared to the CALIOP retrieval, by about 2-300 m for low clouds. Therefore, the WRF-Chem underestimation of cloud top could not be as high as 500 m. Could you have used the CTH from CALIOP instead of POLDER for the model optimization (or scale up the POLDER CTH using CALIOP retrievals)?

In the beginning of the paper, you mention having simulated only half of July as representative for the entire month. In Fig.2 you mention '01-15 July period' and everywhere else you mention only 'July 2008', which leaves the wrong impression the data (satellite and/or model) are averaged over the entire month. Please clarify in the captions and in the text where necessary.

Minor corrections:

Page 10, line 279: ‘...to evaluate the aerosol extinction simulated with WRF-Chem at 550, as well as...’

Page 16, line 360: ‘...This bias could be due to...’

Page 17, line 399: ‘...besides the simulated aerosol loads...’

Page 18, line 431: ‘...WRF-Chem configuration simulates well the ...’

line 447: ‘...depolarization ratio method...’

Sometimes the phrases are too long, and there are missing commas or linking words that could make reading more elegant and easier.