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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Aerosol radiative effects with MACv2" *by* Stefan Kinne

Anonymous Referee #1

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The manuscript describes aerosol forcing calculations using the MACv2 climatology. The results presented are clear and interesting, which deserve publication after addressing my comments below.

Major comments

1. Necessary information about MACv2 are missing. The introduction is very short, with only two citations, one of which is the unpublished MACv2 climatology (Kinne, 2008). More details of both the MACv2 climatology and other aerosol climatologies are needed, especially with regard to how MACv2 was generated, how it is different from version 1 and how MACv2 is different from other aerosol climatologies, e.g. reanalysis products from MERRAaero (https://doi.org/10.5194/acp-15-5743-2015) and CAMS (https://doi.org/10.5194/acp-19-3515-2019).

2. Statements like "These global fields are the result of a data merging process for

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mid-visible aerosol optical properties" (p.3, l.8) are too generic to be informative, and the whole paragraph that follows that statement is not specific on how the database was created. Important information that needs to be present includes how the climatology used the data mentioned, what the regional adjustments mean, how the monthly ensemble median of the 14 models was used, how the spectrally-defined properties are constructed from aerosol mixtures, etc. In essence, the manuscript lacks all information needed to understand how the climatology was constructed, e.g. how the fine mode was separated by the coarse mode, the anthropogenic from the total AOD, presented in Figure 1.

3. Comparisons with specific satellite instruments at the same or similar wavelength are also needed, e.g. estimates from AERONET, MODIS, etc. As the manuscript stands right now, the user is left to discover from figure to figure and from table to table that the climatology includes extinction, SSA, asymmetry parameter, 4 wavelengths, interannual variability from preindustrial to future (under which scenario?), a vertical distribution from a model (which?), studies of individual aerosol components, etc.

4. Brown carbon (BrC) is virtually absent from the manuscript. There is a mention of weakly absorbing organic matter, but it is unclear whether all organics are treated as absorbing, or a fraction of them is absorbing (and that fraction is BrC).

Minor comments

1. The abstract, especially lines 8-12, needs some editing for clarity; the wording is a little awkward. The wording is frequently cryptic or convoluted (e.g. p.5, l.11-13: "Despite strong regional shifts in regional maxima (from US and Europe to SE Asia) changes to the annual global averages over the last three decades are relatively small and are presently near a global average maximum"). As this is a monograph manuscript, I would propose that the manuscript could benefit from a colleague reading it through and providing some advice on specific wording.

2. The aerosol direct effect is not "aerosol presence", as stated in the abstract and

introduction. It is, instead, the extinction of radiation by aerosols.

3. Page 2, lines 9-12: The double-radiation calls do have memory from previous timesteps in model simulations, so this statement is only accurate in a per-timestep basis. For example, the modified clouds at a given timestep will result in changes in precipitation later, which will impact aerosol concentrations.

4. Page 5, last line: Is the GISS model the one used for the vertical distribution of aerosols as well (same page, l.14-15)?

5. Figure 4: what exactly is the total albedo? Integrated spectral albedo over the solar spectrum? Something else?

6. Page 6, line 17: is the change of solar zenith angle (SZA) as a function of time of day and season taken into account, or a mean day/night SZA representative for an annual mean as a function of latitude used for the calculations? This statement is not clear. What are the 9 SZA? Do they change with season? Are there 9 calculations, one per time of day, or just one calculation per average SZA conditions?

7. Page 6, last line: For the indirect effect, there is no change in cloud droplet number concentration assumed? Just the size? And how much is the size reduced, a fixed value or depending on conditions? How is 3d specific humidity taken into account, via model output, or?

8. Page 7, line 5: Please provide a reference that supports this statement.

9. Figure 5: Is the anthropogenic column for the total or the solar effect? Also, I believe showing the thermal effect alone would be of value, as one additional column. How do these numbers and those in Figure 6 compare with other studies, and IPCC?

Technical corrections

1. Please add leading zeros to all decimal points in the manuscript, e.g. p.1 l. 14-15.

2. Organic carbon (OC) is defined with three different ways in the text: weakly absorb-

ing organic matter (p. 11), organic matter (p. 12), and organic carbon (p. 13). Please pick one, but if this is organic matter, consider using OM instead of OC, since the two are not the same (organic matter contains more elements than just carbon).

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