Geoscientific Model Development Discussions

Geosci. Model Dev. Discuss., referee comment RC2
https://doi.org/10.5194/gmd-2021-350-RC2, 2022

Comment on gmd-2021-350

Michael Diamond (Referee)

Referee comment on "Earth System Model Aerosol–Cloud Diagnostics (ESMAC Diags) package, version 1: assessing E3SM aerosol predictions using aircraft, ship, and surface measurements" by Shuaiqi Tang et al., Geosci. Model Dev. Discuss., https://doi.org/10.5194/gmd-2021-350-RC2, 2022

This manuscript describes the ESMAC Diags version 1.0 package and provides useful examples of its application. I have only minor concerns and some hopefully useful suggestions below, but otherwise I believe the manuscript is ready for prompt publication. Kudos to the authors for this nice service to the community, and I hope the package gets good use. -MD

General comments:

Addition of future campaigns:

Would it be possible to discuss more about which other campaigns are being considered for inclusion in future versions of the diagnostics package? The southeast Atlantic smoke-cloud campaigns (NASA ORACLES, DOE LASIC, plus CLARIFY and AEROCLO-SA internationally) in particular could be great testbeds for aerosol representation and have good ground- and air-based sampling. ATom could also be really interesting for its global reach.

Treatment of observations as "truth":

At some locations in the text (e.g., "underestimation" in Line 303) the language sounds

like the observations are being treated as base "truth." Other locations more thoroughly discuss limitations in the observed data as well. It might be helpful to address the issue of how observations are treated (not truth, but useful baseline given limitations are known) more in the introduction or methods sections.

Specific comments:

Line 164: Specify that size is referring to aerodynamic dry diameter (or whatever it is you are using) for all uses thereafter. I'm assuming diameter but I don't remember seeing it in the text (but it is in some figure labels).

Line 208: Why choose only latitude? Are there any longitudinal variation issues that should be addressed?

Figures 4-5: It might be helpful to also place markers binned for >10 nm and >100 nm for easy comparison to Table 3 and the discussion in the text.

Line 256 (Table 3): Are there any issues worth discussing between the PCASP and UHSAS data, e.g., different size cutoffs and bins?

Lines 297-299: A citation from a relevant HI-SCALE paper would be useful here.

Lines 400-401: I'm not sure this concern is warranted, as above-cloud CCN concentration has only limited relevance to cloud properties because the timescale for entraining above-cloud air into the cloudy boundary layer is on the order of days (Diamond et al., 2018; Mardi et al., 2019). The below-cloud CCN concentrations seems better-represented, and these should be the relevant metric for ACI considerations.

Lines 440-441: Although this reads the "right" way based on the x-axis in Figures 13-14(a), it's backwards from the Lagrangian/cloud perspective. I'd recommend flipping it ("SSTs increase from CA to HI...").

Lines 452-458: The commentary here is really sparse as compared to the other sections/campaigns. I'm not as familiar with this region, but I know of a few papers from

Daniel and Isabel McCoy and colleagues that seem potentially relevant (listed below), and am sure there are many others that could be usefully discussed here.

Line 453: Do we not need to worry about ice water path here as well, given the mixed-phase regime? It seems difficult to interpret LWP-only results here, unless this is being subset for confidently warm or supercooled clouds only?

References:

Diamond, M. S., Dobracki, A., Freitag, S., Small Griswold, J. D., Heikkila, A., Howell, S. G., Kacarab, M. E., Podolske, J. R., Saide, P. E., and Wood, R.: Time-dependent entrainment of smoke presents an observational challenge for assessing aerosol–cloud interactions over the southeast Atlantic Ocean, Atmospheric Chemistry and Physics, 18, 14623-14636, 10.5194/acp-18-14623-2018, 2018.

Mardi, A. H., Dadashazar, H., MacDonald, A. B., Braun, R. A., Crosbie, E., Coggon, M. M., Aghdam, M. A., Woods, R. K., Jonsson, H. H., Flagan, R. C., Seinfeld, J. H., and Sorooshian, A.: Effects of Biomass Burning on Stratocumulus Droplet Characteristics, Drizzle Rate, and Composition, Journal of Geophysical Research: Atmospheres, 124, 12301– 12318, 10.1029/2018jd029134, 2019.

McCoy, D. T., Burrows, S. M., Wood, R., Grosvenor, D. P., Elliott, S. M., Ma, P.-L., Rasch, P. J., and Hartmann, D. L.: Natural aerosols explain seasonal and spatial patterns of Southern Ocean cloud albedo, Science Advances, 1, e1500157, 10.1126/sciadv.1500157, 2015.

McCoy, I. L., McCoy, D. T., Wood, R., Regayre, L., Watson-Parris, D., Grosvenor, D. P., Mulcahy, J. P., Hu, Y., Bender, F. A. M., Field, P. R., Carslaw, K. S., and Gordon, H.: The hemispheric contrast in cloud microphysical properties constrains aerosol forcing, Proceedings of the National Academy of Sciences of the United States of America, 117, 18998-19006, 10.1073/pnas.1922502117, 2020.

McCoy, I. L., Bretherton, C. S., Wood, R., Twohy, C. H., Gettelman, A., Bardeen, C. G., and Toohey, D. W.: Influences of Recent Particle Formation on Southern Ocean Aerosol Variability and Low Cloud Properties, Journal of Geophysical Research: Atmospheres, 126, 10.1029/2020jd033529, 2021.