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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Global modelling of direct and indirect effects of sea spray aerosol using a source function encapsulating wave state" *by* A.-I. Partanen et al.

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In this paper, the authors incorporate a new sea-spray emissions scheme into the ECHAM-HAMMOZ GCM. They test the old sea-spray scheme, the new scheme as well as several sensitivity studies regarding organic emissions, total flux and cloud scavenging. They evaluate these simulations using in-situ mass and size distribution measurements, and ground-based and satellite-based optical depths. They show how the radiative effects of sea spray depend on these assumptions. They find the interesting result that the indirect radiative effect of sea spray is positive due to supersaturation and nucleation suppression.

The paper is sound and is a necessary document of updating and evaluating a major aerosol component in their model. I do have several comments that I would like the authors to address, but otherwise I recommend publication.

P4544 L9: Please explain what "significant height" is.

P4545 L32: What wavelengths (or what wavelength range) do you use? This is important for knowing if using a single ref index is reasonable.

P4546 L15-22: So the PMOM is more hygroscopic that sea salt? (at least this is what it seems like). This is weird enough that you probably should discuss this a bit more (I realize you do say that it is to match observations), but it's probably worth pointing out just how hygroscopic the PMOM is.

Equation 5: Is there a physical or observational basis for this dependence of the chlorophyll dropping off with latitude with this dependence? There is no citation given.

Section 2.4.2: Is the model AOD taken as an average over clear-sky conditions only? Since POLDER and AEROSOL will only retrieve AOD values under these conditions, it is important to also sample the model this way (because aerosols may be different between clear sky and cloudy conditions).

Section 2.4.2: Why are you correcting the AOD of the measurements for the wavelength that you use in the model (550 nm)? Since in the model you have the aerosol size distribution, you should be able to calculate the AOD at any wavelength you want. Probably no need to change at this point, but you might want to think of this in the future so that you don't need to use monthly mean angstrom exponents to fudge the observations.

P4552 L17-22: Are you multiplying just the submicron part of the emissions by 0.4 and 1.6 or the entire distribution (the first sentence of the paragraph talks about uncertainties in the submicron part).

Figure 9: How different did these comparisons look when using the default param?

Can you compare some metrics (e.g. bias and correlation)?

The discussion of Figure 10: In “Jaeglé, L., P.K. Quinn, T. Bates, B. Alexander, and J.-T. Lin (2011), Global distribution of sea salt aerosols: New constraints from in situ and remote sensing observations, Atmos. Chem. Phys., 11, 3137-3157, doi:10.5194/acp-11-3137-2011.” the authors corrected a similar bias in marine AOD in in their model against AOD obs where the model had too much AOD in midlatitudes by making a temperature dependence of sea-spay emissions. In your manuscript you do this by switching to a new source parameterization that includes wave height. It might be worth some discussion of how these two techniques might be related. E.g. is there a physical linking between temperature and wave height (at a fixed wind speed)?

Figure 11 and P4562 L17: Can you quantify the correlation coefficient so that you have a metric of how well the model is capturing the variability?

Figure 12: How did the default model do? Can you compare some metrics (e.g. bias and correlation)?

P4564-4565, the discussion of reduced CDNC due to sea salt. Can you add a plot showing (1) the mean aerosol number size distributions over the southern ocean with and without sea-spray and (2) the mean minimum activating diameters over the same region w/ and w/o sea spray. This would allow us to see how the distribution changed due to sea spray and nucleation/growth feedbacks as well as see how much the sea spray suppressed activation of smaller particles.

Interactive comment on Atmos. Chem. Phys. Discuss., 14, 4537, 2014.