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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.

Anonymous Referee #2

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In this study, Partanen et al. implemented a wave state-based sea spray aerosol source flux into a global climate model with advanced aerosol treatment. This enabled the evaluation of the sea spray source function in terms of size and chemically-resolved mass concentrations, aerosol optical depth, and direct/indirect radiative forcing. Compared to the existing sea spray source function based on a combination of Gong, Monahan, and Andreas, the wave state function decreased the sea spray concentrations, aerosol optical depth, and radiative forcing and led to improved comparison to observations especially for coarse mode mass concentrations. This study is well-designed using state of the science modeling tools, and I recommend publication after minor

revisions listed below.

1) (p. 4546): Please note whether any aerosol size dependence of the organic mass fraction of PMOM was included, or if all four size sections had the same fraction.

2) PMOM CCN activity (p. 4546): I have some concerns about this treatment because the high CCN activity during periods of high organic fraction coincided with high average aerosol diameter in the Ovadnevaite et al. (2011) study. Due to a lack of understanding of this topic, I don't recommend changing this formulation but to give more information about the hygroscopicity of PMOM and total sea spray aerosol with organics in the form of kappa values (Petters and Kreidenweis, 2007, ACP) or another metric more familiar to other modelers.

3) SSA emissions (p. 4554): Please note that the Gantt et al. (2012) global sea salt emissions of 73.6 Tg/yr represented the submicron emissions and that the total sea salt emissions were not listed but were probably consistent with the 4200 Tg/yr reported in Jaegle et al. (2011).

4) Comparison to concentration observations (p. 4557): While this section focuses on biases of the simulations, correlations and seasonal comparisons should also be reported for both sea-salt and organic matter. Also, please discuss how the temperature dependence and different wind speed-sea spray relationship in the new sea spray source function affect the predicted correlations and seasonal cycles.

5) (p. 4558): Please note that the organic aerosol underprediction at Mace Head may have also been affected by the selection of an adjacent "sea" grid cell.

6) Conclusions (p. 4566). Please include additional discussion about the low values of global sea spray emissions from wave state-based parameterization relative to other parameterizations. Also, please explain how the optimized emissions in this study can be an order of magnitude lower than optimized emissions from a recently published sea spray comparison study (Grythe et al., 2014 ACP)

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7) Tables: Please add a table summarizing the statistical evaluation of the model compared to in-situ/satellite-derived observations.

8) Figures: Please include a trendline with the correlation and equation to Figures 9 and 12.

9) Figures: Please add a figure (possibly in the supplemental information) giving the size-resolved number flux at a given wind speed and the mass flux as a function of wind speed for the new and existing source functions.

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