

Response to Comments for “Implementing marine organic aerosols into the GEOS-Chem model”

B. Gantt et al.

*Note that the responses are in bold italic typeset.*

Anonymous Referee #1

Gantt et al. have implemented marine organic aerosol (MOA) primary emissions into GEOS-Chem and have used the model to look at MOA concentrations and aging. The article is very well written and clear. This is one of several MOA modeling studies from Gantt and co-authors. I do slightly wonder how much value there is in having this paper in the literature, since Gantt has already implemented MOA emissions into another model (and in GEOS-Chem itself), as have several other groups. However, I think they have presented enough new material, especially the comparisons to recent MOA-specific mass concentration observations and insights into MOA aging, to warrant publication in GMD subject to minor revisions.

Specific comments:

P5968, Line 3-4: Also cite Arnold et al. (2009) here about the SOA/POA contribution to marine organic aerosol?

*This has been added to the updated manuscript.*

P5969, Line 29: So the main model development step here was just bringing the online MOA emissions into the GEOS-Chem standard code? What exactly did this entail? Is it any different than the previous Gantt implementation into GEOS-Chem?

*We appreciate the reviewer’s question, and would like to clarify the differences between this effort and that of Gantt et al. (2012). In Gantt et al. (2012), GEOS-Chem was used as a tool to evaluate several different marine POA emission parameterizations with consistent meteorology and chlorophyll-a concentrations. More than 20 tracers were added to GEOS-Chem in Gantt et al. (2012) to enable the comparison, and model inputs such as chlorophyll-a concentrations were in a format (ASCII table requiring the model to be recompiled for every simulation month) that would be difficult for a typical GEOS-Chem modeler to use. This effort uses the top-down approach from Gantt et al. (2012) (which compared most favorably to the observed weekly and monthly mean values of marine organic aerosol from marine sites at Mace Head, Ireland and Amsterdam Island) and implemented the online POA emissions and two MOA tracers in a way easily adaptable for any GEOS-Chem user. In addition to the MOA-specific mass concentration observational comparison and insights into MOA aging, this effort expands upon Gantt et al. (2012) by employing a nested simulation to illustrate the coastal-to-inland concentration gradients. We don’t feel that this level of detail is needed for most readers, but have edited the following discussion in the updated manuscript to better highlight these differences: “The overall objective of this study was to expand upon Gantt et al. (2012) by implementing an online marine POA emission parameterization into the current version of GEOS-Chem (v9-02) that can be easily used in the default setting with the following characteristics: 1) adds minimal computational expense, 2) capable of being used for all*

*GEOS-Chem model domains/simulation periods, and 3) treated with unique tracers capable of explicit atmospheric aging and tracking. During this study the emission parameterization is tested for the global and nested regional model domains and evaluated with new datasets having advanced MOA chemical characterization and widespread global coverage. Finally, the model is used to predict global surface concentrations, ocean-land concentration gradients, and relative contributions of nascent (freshly emitted) and aged marine organic aerosols.”*

P5973, 1st paragraph, and Fig 1: The concentrations of MOA seem to be larger in the Northern Hemisphere summer (JJA) than the Southern Hemisphere summer (DJF). Of course, this is also the case for the emissions in Fig S1. Why is this exactly? One might expect stronger wind speed in the SH summer months (DJF).

*We agree with the reviewer that the summertime differences between the Northern and Southern Hemisphere are somewhat counter-intuitive because of the differential wind speed (and sea spray emission rates). The marine POA emissions (and resulting concentrations) are a function of the sea spray emission rates and  $OM_{SSA}$ . The sea spray emission rates are a function of the 10 meter wind speed and to a lesser degree sea surface temperatures and are higher over the Southern Hemisphere summer. The  $OM_{SSA}$ , however, is positively related to chlorophyll-a concentrations and negatively related to 10 meter wind speed using a logistic curve for both relationships. The results shown in Figure 1 and S1 suggests that the higher  $OM_{SSA}$  in the Northern Hemisphere summer has a bigger impact on the emissions and surface concentrations than does the higher sea spray emission rates in the Southern Hemisphere summer. The updated manuscript includes the following discussion: “The summertime MOA concentrations and marine POA emissions predicted by GEOS-Chem were higher in the Northern Hemisphere than in the Southern Hemisphere (see Figures 1 and S1) despite having lower SSA emissions; this was related to the higher  $OM_{SSA}$  in the Northern Hemisphere which is positively related to [chl a] and negatively related to  $U_{10}$  using a logistic curve for both relationships.”*

P5975 Line 8: Mention that this is submicron sea salt only.

*This has been added to the updated manuscript.*