

Interactive comment on “Global distribution of sea salt aerosols: new constraints from in situ and remote sensing observations” by L. Jaeglé et al.

Anonymous Referee #1

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This paper uses extensive ship-borne aerosol measurements to evaluate the GEOS-Chem model simulated coarse-mode sea salt aerosols and to develop a modified sea salt emission function. The finding of adding SST-dependence to the commonly used Gong formula is illuminating. The evaluation/testing are carefully conducted, the results are clearly presented, and the paper is well written.

However, there are a few issues that should be addressed in the revision.

(1) The modification and adjustment of sea salt emission are completely based on the performance of a particular model, GEOS-Chem, therefore the application of the new empirical formula to other models may be limited. Also, because of the non-linearity of wind-dependence of sea salt emissions, the emission and the resulting sea salt concentrations and optical depth are unfortunately dependent on model spatial resolutions.

Other factors such as the boundary layer mixing schemes (as the authors pointed out the differences between GEOS-4 and GEOS-5 driven simulations) and dry deposition schemes will also affect the model bias, even though the other processes such as wet deposition and transport can be less important for coarse mode sea salt. Therefore, while the finding of the necessity of including SST in emission is general, the actual parameters are “tuned” to the current GEOS-Chem configuration and performance. The authors should clearly state the limitations here.

(2) Considering SST as a controlling factor of sea salt emission makes a good sense, and inclusion of such a factor seems to resolve the “long-standing” problems of model underestimating AOD in the tropical and subtropical Pacific Ocean, since the MODEL-SST run agrees with MODIS AOD much better than the MODEL-STD. However, one should take into account that MODIS is likely to overestimate the AOD in that region when compared with the AOD measurements from the Maritime Aerosol Network (from many research ship cruises, coordinated by AERONET, see Smirnov et al. GRL 2006). I strongly suggest the authors use the MAN data, which also contain fine mode and coarse mode AODs.

Some detailed comments:

- The term “SSA” is in general reserved for “single scattering albedo”, not “sea salt aerosol”. I suggest not use this acronym here for sea salt aerosols.
- Page 25689, line 21-23, large discrepancies of sea salt aerosols in the AeroCom models have a lot to do with different size ranges in different models.
- Page 25690, line 15-16, “large diameters” – need to be more quantitative. How large is “large”?
- Page 25691, line 18: GEOS-4 has 1.25 deg longitude resolution.
- Page 25691, line 23: Given the high non-linearity of wind-speed dependence of sea salt emission, something should be said here about the effects on degrading spatial

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resolution.

- Page 25694, line 8-11: Are all these wind comparisons at 2x2.5 deg resolution?
- Bottom of page 25694 to top of page 25695, comparing winds: Does GEOS-4 assimilate the 10-m QuickScat winds? The reason of GEOS-4 having higher 10-m winds due to its thicker lowermost layer should be explained better because readers wouldn't necessarily know why the thickness of the lowermost model layer would affect the 10-m wind speed, especially if it is from the reanalysis.
- Page 25695, paragraph starting with "Another difference": This is not really the difference between GEOS-4 and GEOS-5, but the difference in GEOS-Chem's choice of BL mixing schemes. Also, I would think that too much vertical mixing in the BL would lower the surface concentrations, even though the dry deposition could be less efficient. What is the budget from the GEOS-Chem model using two different schemes/met fields?
- Page 25696, line 1-2: It would be more appropriate to sample the model output at the closest time and location of measurements, not every 30 min, in order to have a fair comparison.
- Page 25696, line 5: add "and AOD" after "concentrations".
- Page 25699, 2nd paragraph: Do you sample the model output that matches the MODIS observation time and condition (i.e. cloud free)? Do you use MODIS Terra or Aqua or both?
- Page 25701, line 10-12: If the model error in wet dep cannot explain the poor model performance, how about errors in dry dep and/or settling?
- Page 25701, 2nd paragraph: The winds are not from GEOS-Chem. Therefore it should say GEOS-4 or GEOS-5, not "the model" to avoid confusion.
- Page 25710, line 12-13: This should be tropical/subtropical Pacific Oceans. AOD over

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the tropical Atlantic is dominated by dust with high values.

- Page 25713, line 3: Should be more quantitative than just saying “generally good agreement”, which sounds subjective.

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