Review of A sea spray aerosol flux parameterization encapsulating wave state by Ovadnevaite et al.

This paper describes a new sea spray source function (SSSF) derived using two in-situ sea spray measurements: at the Mace Head coastal station and an open-ocean eddy correlation flux measurements from the Eastern Atlantic (SEASAW cruise). The new SSSF function is spanning the dry diameter range from 15nm to 6 μm and is expressed in terms of the Reynolds number which involves significant wave height, drag coefficient, and kinematic viscosity of seawater. The use of a Reynolds number, in theory, allows a self-consistent treatment of the different environmental processes controlling sea-spray emissions. The sea spray production is parameterized in terms of 5 log-normal modes. The new SSSF is then used for an estimate of the global production flux. The effect of sea surface temperature (SST) on sea-spray particle flux is discussed. The topic is suitable for ACP, and of interest to the atmospheric chemistry/physics and climate communities.

The paper is well written with clear conclusions. However, due to some concerns with regards to the methodology and lack of details on the evaluation, I recommend major revisions before the manuscript is accepted for publication. The discussion should also be more balanced and critical in terms of the reliability and significance of the parameterization.

Major comments

1) It is stated that $u^{*} = C_d^{1/2} U_{10}$. Please see Foreman and Emeis (2010) for definition of the drag coefficient in the marine atmospheric boundary layer. The definition given in text is strictly valid for neutral drag coefficient. Moreover, due to strong nonlinearity for higher velocities, a Charnock constant needs to be applied for friction velocities greater than 0.27 m s^{-1} and wind speeds greater than 8 m s^{-1} (Foreman and Emeis, 2010).
2) It is true, that the advantages of using Reynolds number (in addition to wind speed and wave energy) is that it includes temperature and salinity effects through the water viscosity. However, since constant salinity of 35 psu is used in this work, please clearly state that no salinity effects are included in the current approach.
3) Please improve Fig.1a (which is already included in Ovadnevaite et al. (2012)) by overlaying 3-hr back trajectories. This will also strengthen the application of the "filling time" concept under variable wind speed conditions.
4) The OSSA-SSSF evaluation by comparing the resulting sea spray mass with independent AMS measurements shows excellent agreement for wind speeds <15 ms^{-1} (that cover the majority of the conditions over the ocean). However, I am not sure how even small (say 1-2 ng) difference in mass can be translated into a number. Since particle number distribution within a size range Dp = 0.03–0.58 μm is known, I think it would be more helpful for the comparison if AMS derived mass is converted to number and plotted on the y-axis on Fig. 6.
5) Looking at Fig. 7 and the supplementary Fig. S2 it is not obvious to me that there is such a strong temperature gradient, "warm waters on both sides of the equator," to explain the

enhanced particle production. Although particle number flux changes more than a factor of 4, variability in temperature can only account for less than 10% changes in seawater kinematic viscosity. It looks to me that the wind speed is also higher along the equator (particularly over the Pacific and Indian Oceans), yet particle number flux is very low. I believe Fig. 7 warrants more detailed discussion.

6) The discussion regarding the effect of temperature on sea-spray number flux needs to be revised. Comparison of sea-spray fluxes of instantaneous global data with Jaeglé et al. (2011) is somewhat misleading. Jeagle et al. derived their Eq (4) using AOD that is a poor proxy for the sea spray source function. 1) Atmospheric turbidity over the remote ocean is controlled by sea-spray particle sources as well as sinks, different meteorological parameters (e.g., relative humidity), etc., and 2) According to the size distribution given in the paper mass scattering efficiencies will be controlled by a small number of particles with Dp_{dry} >0.3 µm. Comparison of sea-spray number particle fluxes with AOD may not lead to a straightforward conclusions.

7) Three lab measurements referenced in the paper (Mårtensson et al., 2003; Sellegri et al., 2006; and Zábori et al., 2012) do not show "contradictory" results. With increasing temperature all lab measurements show decrease in small particle number concentration and an increase for larger particles (with different thresholds). Therefore, lab measurements show decrease in total number of particles with increasing temperature, the result that seems to contradict the outcome of the current study. Please explain.

8) Explanation for the temperature dependency for SSSF as "bubbles in warmer waters will rise more quickly to the surface than in colder waters which would increase the number of smaller bubbles reaching the surface, and thus increase the production of SSA particles" is oversimplification of large number of complex processes involved in the sea-spray production. For completeness, please include some back-of-the-envelope calculation that shows how bubble spectra change in the ocean with changes in temperature and how such a change will influence sea-spray production flux.

Specific comments

Pg. 23144 Ln 9. Please define CLASP.

Pg. 23148, Ln. 8. "SMSP" should be "SMPS"

Pg. 23149, Ln 21. Please specify what is meant for "given wave height and sea surface temperature (SST) conditions."

Pg. 23151. Please explain how can the "largest discrepancy between the SSA mass fluxes obtained with the OSSA-SSSF and measured with the AMS" be caused by supermicron aerosol distributions. It is stated in the manuscript that AMS measurements ranged Dp = 0.03–0.58 µm.

Pg. 23152, Ln. 11. Please explain what is meant "In addition, the wave state contributes to Re_{Hw} modulating the impact of wind speed alone and thus bringing an extra dimension to the interpretation."

Pg. 23154, Ln. 2. "as regards" should be "in regards".

References:

Foreman, R., and Emeis, S.: Revisiting the Definition of the Drag Coefficient in the Marine Atmospheric Boundary Layer, J. Physical Oceanography, 40, DOI: 10.1175/2010JPO4420.1, 2010.