Supplementary material for "Global distribution of sea salt aerosols: new constraints from in situ and remote sensing observations" by L. Jaeglé, P. K. Quinn, T. Bates, B. Alexander, and J.-T. Lin

Our paper used the Gong (2003) sea salt source function in the GEOS-Chem global chemical transport model. Based on a comparison between the GEOS-Chem simulation and PMEL cruise observations of coarse mode sea salt mass concentrations, we empirically derived a sea surface temperature (SST) correction so as to reduce the bias between model and observations.

Many other source functions have been published, and we examine here how three of these source functions compare to the PMEL coarse and accumulation mode SS mass concentrations: Monahan et al. (1986), Clarke et al. (2006), and Mårtensson et al. (2003). Figure S1 shows how these source functions compare at 9 m/s as a function of dry diameter, D_p. Gong (2003) is based on the Monahan et al. (1986) parameterization and the two formulations are thus quite close for D_p>0.2 µm. Below that size, Gong (2003) changed the shape of the source function to reduce emissions of small particles in order to match observations. Clarke et al. (2006) is higher than Gong (2003) by a factor of 2-8 at D_p>0.2 and 10-100 at smaller sizes. The Mårtensson et al. (2003) source function, which depends on SST, agrees with Clarke et al. (2006) at 28°C and is closer to Gong (2003) at 2°C.

Figure S2 shows how these source functions compare to the coarse mode sea salt mass concentrations observed during the PMEL cruises. As expected, Monahan et al. (1986) and Gong (2003) yield very similar results and are within 10-20% of each other, with a mean model bias of 50-64%. Clarke et al. (2006) consistently overpredicts the observations by a factor of 6 (+500% bias). For the accumulation mode sea salt mass concentrations (Figure S3), Monahan et al. (1986) is lower than Gong (2003) by 10-15% and across all 6 cruises both show little bias compared to observations: +7% for Gong (2003) and -3% for Monahan et al. (1986). Clarke et al. (2006) is too high by a factor of ~2 (+95% bias), this is particularly clear for ACE1, AEROINDO99, ACEASIA, and VOCALS. Mårtensson et al. (2006) yields results similar to Clarke et al. (2006), with a bias of +80%.

Based on this comparison, we find that the Gong (2003) parameterization yields the smallest initial bias with respect to in situ observations. We have thus used this parameterization to examine the remaining bias as a function of windspeed and SST.

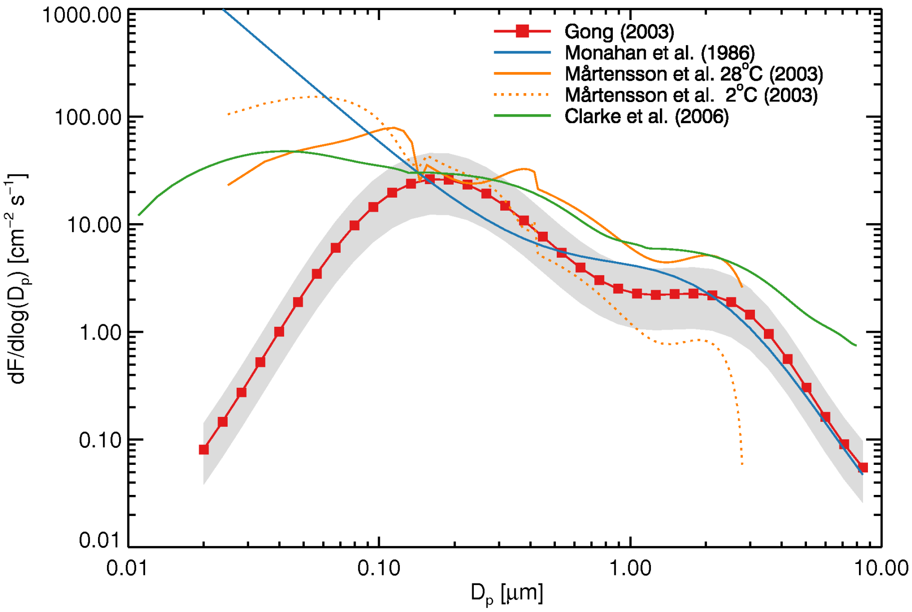

Figure S1. Sea salt source functions comparison. All flux estimates have been scaled to oceanic conditions under u_{10m}=9 m/s and converted to dry diameter, D_p: Gong (2003), Monahan et al. (1986), Mårtensson et al. (2003) (calculated at 2°C and 28°C); Clarke et al. (2006). The gray shaded area shows the bounds of our empirically derived SST dependent source function (MODEL-SST, Eq. 4 in main text) at 2°C and 28°C.

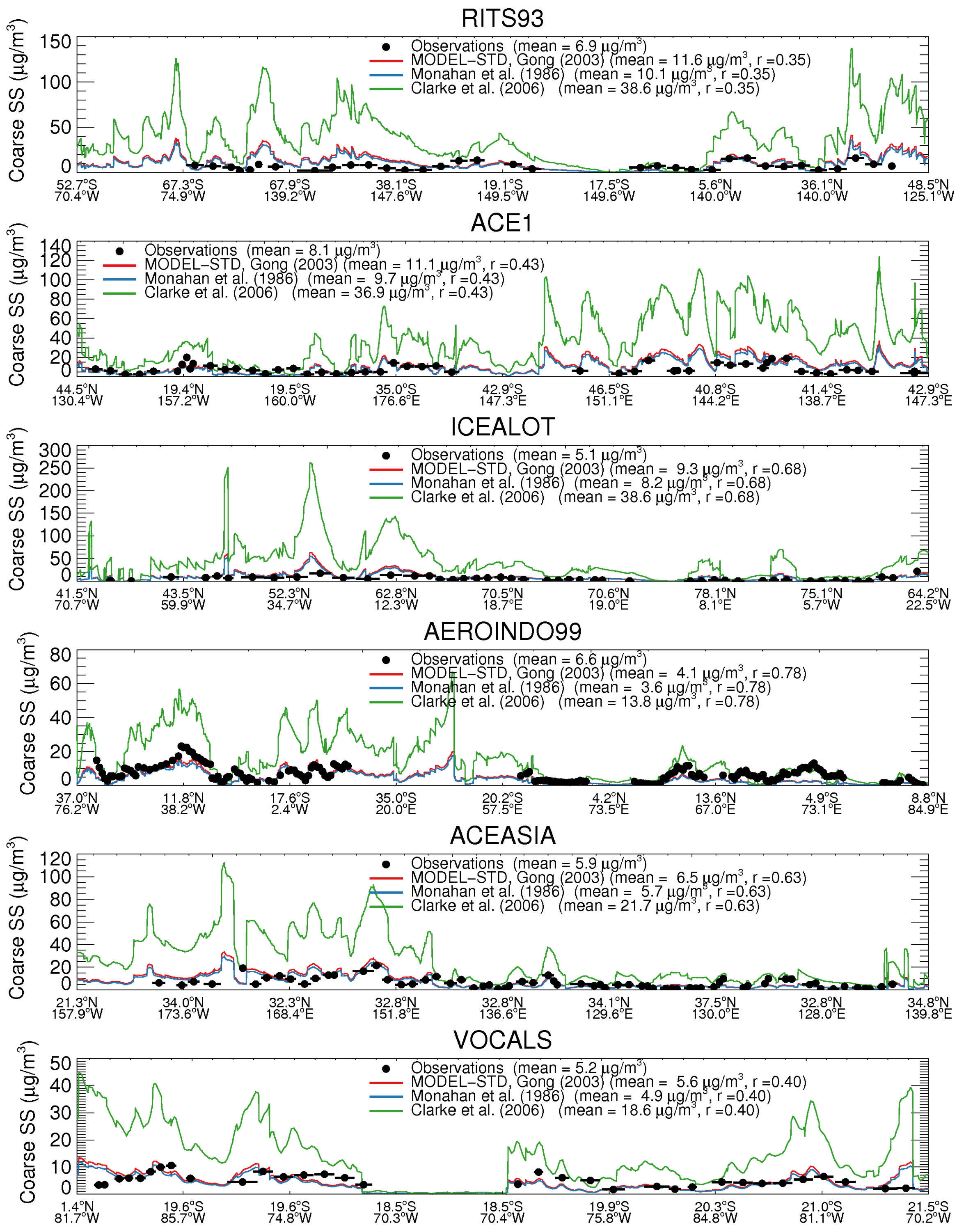

Figure S2. Timeseries of coarse mode sea salt mass concentration during the RITS93, ACE1, ICEALOT, AEROINDO99, ACEASIA, and VOCALS PMEL cruises. Sea salt concentrations are shown with black circles. The horizontal bar corresponds to the instrumental averaging period. The three lines are the three different sea salt source functions: Gong (2003) (MODEL-STD, red), Monahan et al. (1986) (blue), and Clarke et al. (2006) (green). For observed 10m wind speed and sea surface temperature, please refer to Figures 3a and 3b in the main text.

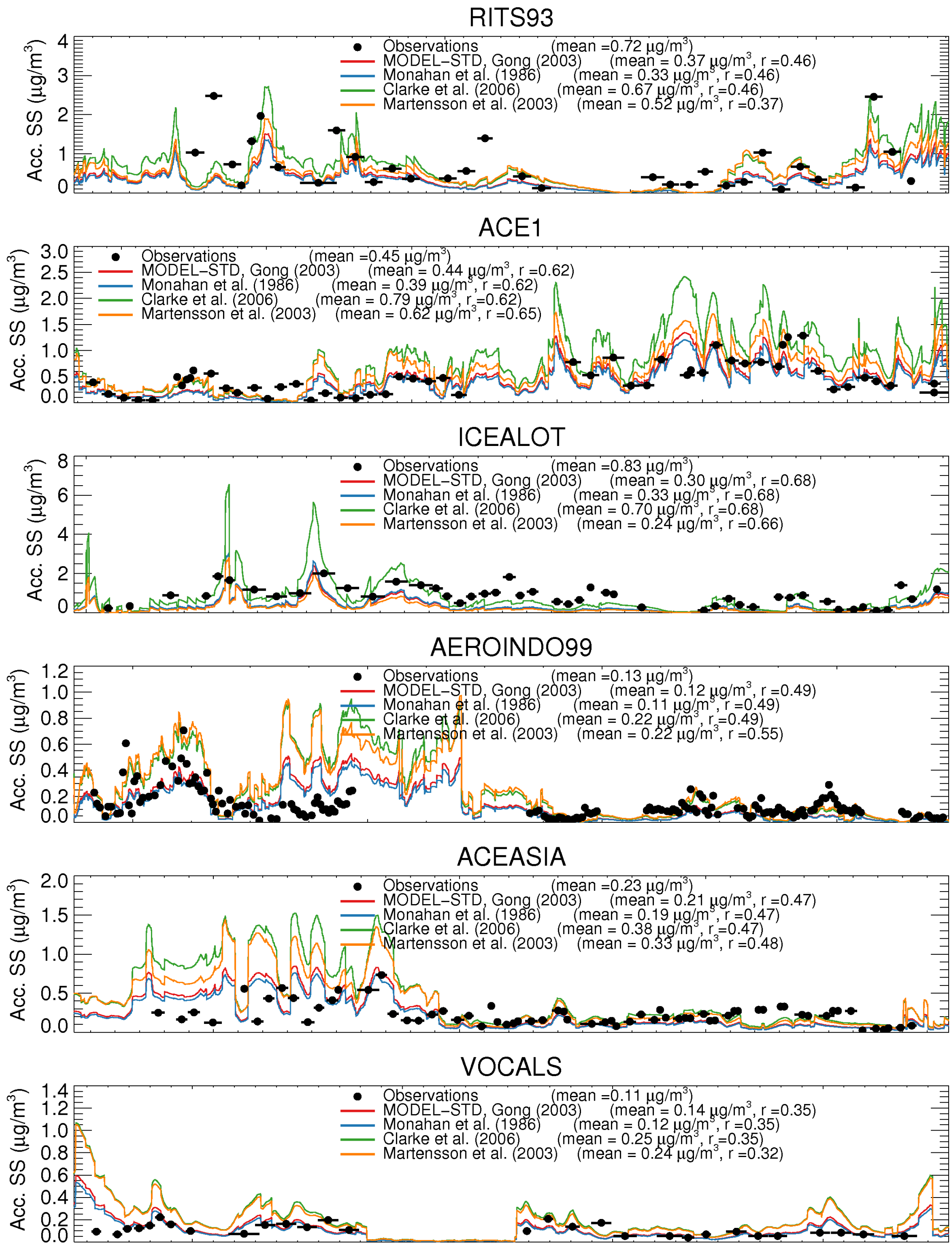

Figure S3. Same as Figure S1, but for accumulation mode sea salt mass concentrations observed during the 6 PMEL cruises. In addition to the three sea salt source functions described in Figure S1, we all show the source function of Mårtensson et al. (2003) (orange).