Supplementary information to: Ice nuclei in marine air : biogenic particles or dust?

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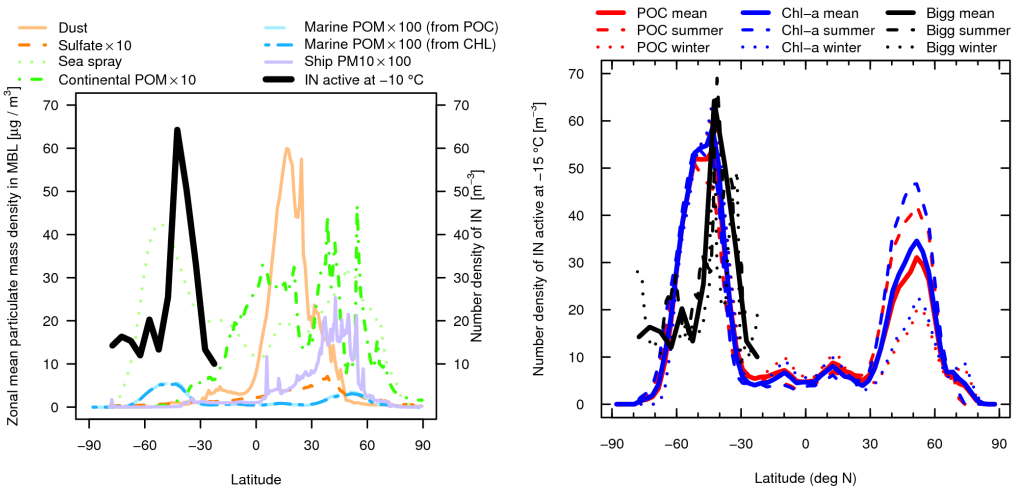
Zonal mean of emissions

Using the distribution of chlorophyll rather than POC to drive the emissions results in a closer match to the zonal mean distribution. Among the possible explanations are that ice nuclei concentrations in water might be more closely associated with phytoplankton than with organic debris, or that the distribution of ice nuclei might be latitudinally dependent.

Interestingly, the peak in the B73 data appears to be more closely matched in shape by the simulated emissions than by the simulated concentrations S-1, and the magnitude of the peak can be approximated by multiplying with a residence time of 2.3 days and dividing by a boundary layer height of 600 m, and an enrichment factor of 200, all other factors as in Table 1 of the main paper.

We can only speculate about whether this apparent better correspondence is spurious or real. We do note that a better correspondence with the emissions would be expected if the IN decayed close to their source in a way that deactivated them as IN, perhaps due to photochemical processing upon exposure to the atmosphere. For example, it has been proposed that a large part of the marine organic aerosol is made up of exopolymer secretions (EPS) of marine microorganisms. EPS compounds are known to form gels that may disintegrate upon exposure to ultraviolet light or acidification [*Leck and Bigg*, 2005].

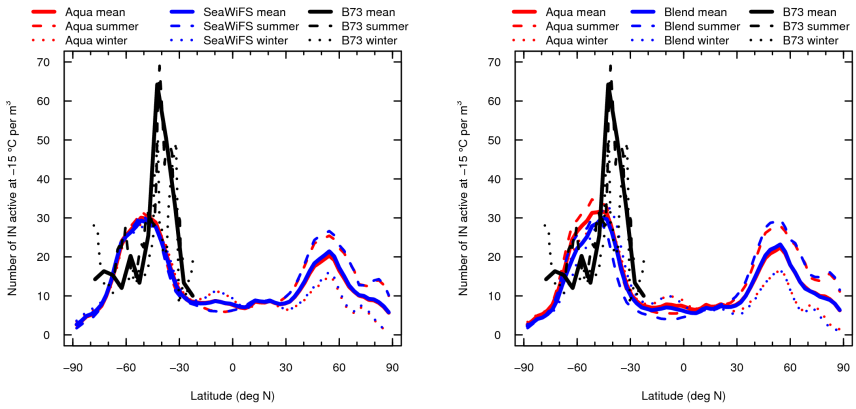


(a) Aerosol type comparison

(b) MODIS-Aqua POC and CHL emissions

Figure S-1: Longitudinal dependence of marine IN number densities from simulated emissions and longitudinally averaged number densities over the Southern Ocean [*Bigg*, 1973]. Number densities from emissions are derived assuming a residence time of 2.3 days, a boundary layer height of 600 m, and all relevant scaling factors are as listed in Table 1 of the main paper, except an enrichment factor of 200 is used (rather than 500). Simulations using ocean climatologies of POC and chlorophyll from MODIS-Aqua (July 2002 – June 2010, [*Esaias et al.*, 2002]). Northern hemisphere summer and winter averages are shown. Seasonal averages from *Bigg* [1973] are normalized such that the mean concentrations for the summer, winter and annual mean zonal distributions are equal. (a): Comparison to AEROCOM zonal mean MBL aerosol mass densities and ship particulate emissions, in analogy to Figure 4 of main paper. (b): Comparison of emissions driven by MODIS-Aqua POC and CHL, in analogy to Figure 7 of main paper, and Figure S-2.

Comparison of simulations with alternative ocean satellite data



(a) POC-based simulation

(b) CHL-a-based simulation

Figure S-2: Zonal mean simulated marine IN number densities vs. zonal mean observed number densities over the Southern Ocean [*Bigg*, 1973]. (a): Simulations using ocean POC seasonal climatologies from MODIS-Aqua (July 2002 – June 2010, [*Esaias et al.*, 2002]) and SeaWIFS [*Hooker and McClain*, 2000; *Stramski et al.*, 2008]. Northern hemisphere summer and winter averages are shown. Seasonal averages from *Bigg* [1973] are normalized such that the mean concentrations for the summer, winter and annual mean zonal distributions are equal. (b): Simulations using ocean chlorophyll seasonal climatologies from MODIS-Aqua (July 2002 – June 2010), and a blended climatology (labelled "blend") constructed from Coastal Zone Color Scanner (CZCS) satellite data and *in situ* data (1978 – 1986 [*Gregg and Conkright*, 2001]).

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