Low Temperature Ice Nucleation of Sea Spray and Secondary Marine Aerosols under Cirrus Cloud Conditions

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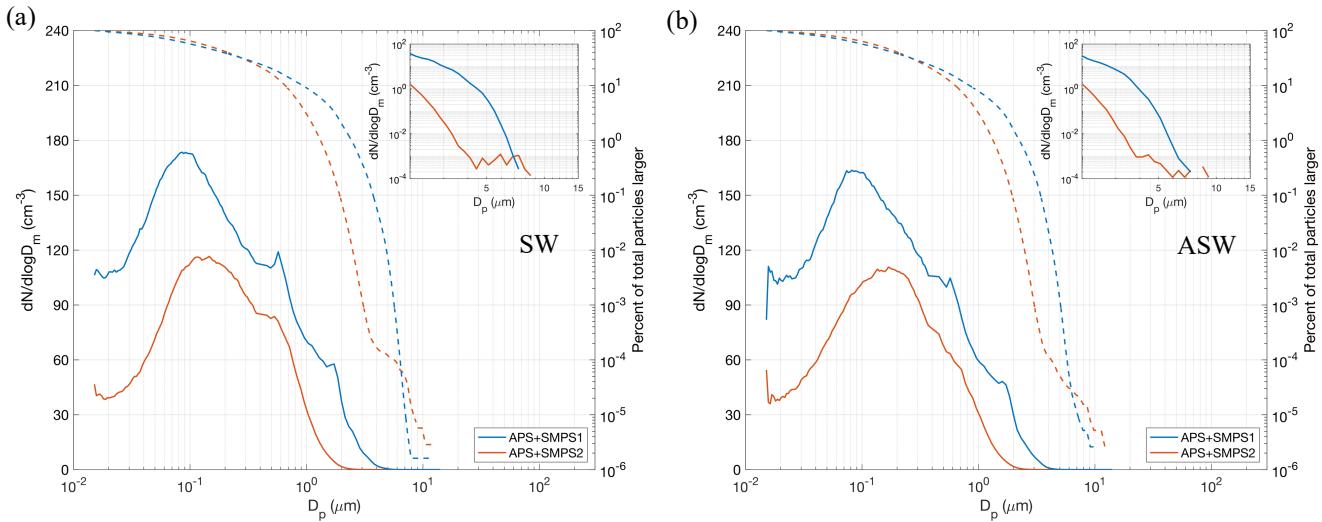


Figure S1 Merged size distributions from the SMPS and APS for the upstream (blue solid line) and downstream (red solid line) set of sizing instruments generated from (a) real and (b) artificial seawater. The dashed lines represent the percent of total particles larger than a given particle diameter and the colors match the size distribution they are referring to. The panels in the upper right of both figures denote the size distributions zoomed in a logarithmic scale for particles > 2 μm.

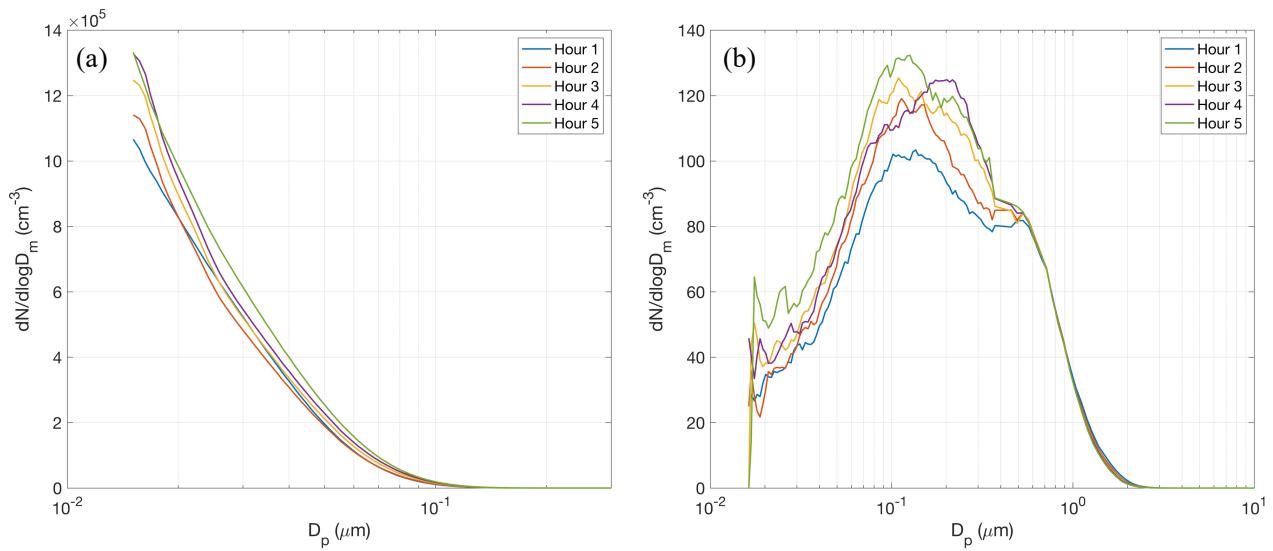
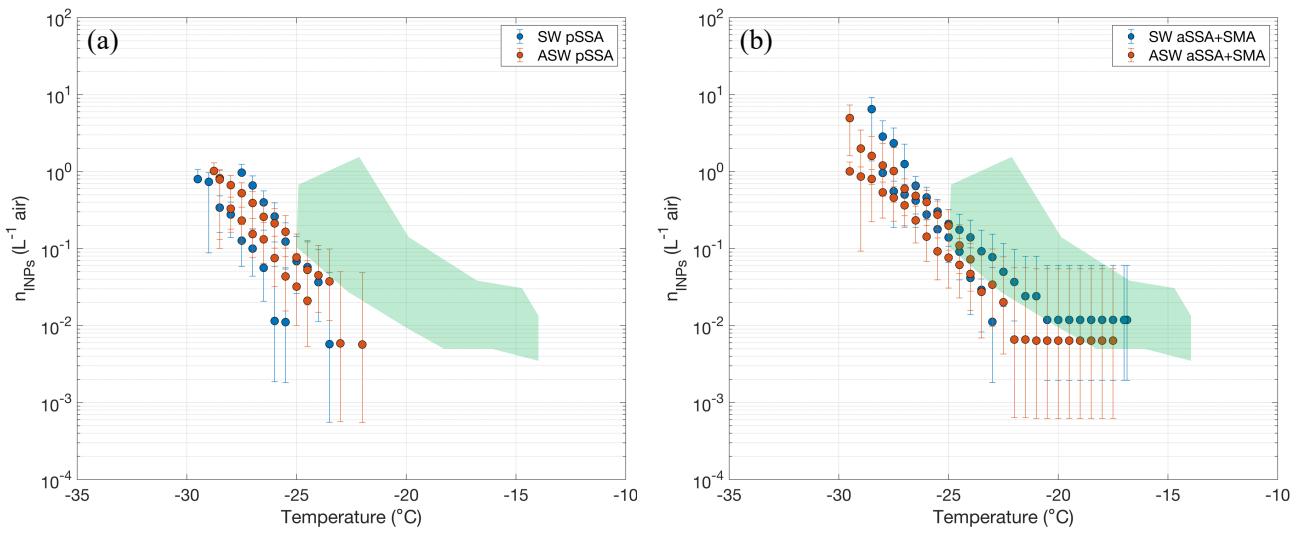



Figure S2. Size distributions of (a) SMA-only and (b) pSSA color-coded by hours of each experiment.

15 **Figure S3.** Number of INPs and uncertainties as a function of temperature processed from the IS filters for (a) pSSA and (b) aSSA+SMA during the MART experiments. The blue and orange markers denote INP numbers from the real and artificial seawater, respectively. The shaded green region represents IS measurements generated from a MART in McCluskey et al., (2017).

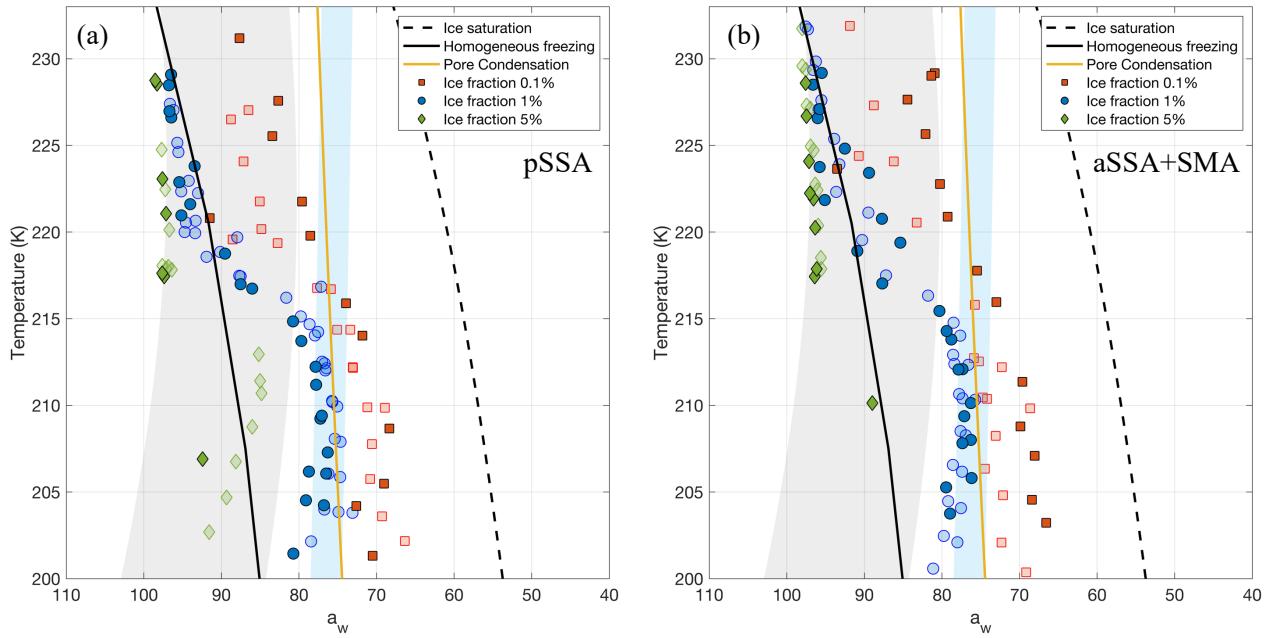



Figure S4. Fraction of frozen particles for (a) pSSA and (b) aSSA+SMA particles. The filled markers denote particles generated from real seawater and the open markers from artificial seawater. The red, blue and green markers indicate 0.1%, 1%, and 5% frozen fractions, respectively. The reference lines indicate ice saturation (black dashed), the parameterized RH_w for pore condensation in an 11 nm pore (Marcolli, 2014) (solid yellow), and the expected threshold for the onset of homogeneous freezing (Koop et al., 2000) (solid black). The blue shaded region represents the range of possible deliquescence RHs for NaCl and SSA, using the parameterization from Tang & Munkelwitz, (1993) for NaCl extrapolated to colder temperatures as the upper bound and shifting it down 4% RH for SSA following Wagner et al., (2018). The gray shaded region represents the range of uncertainty for the aqueous sulfuric acid particle homogeneous freezing parameterization as presented in Schneider et al. (2021b).

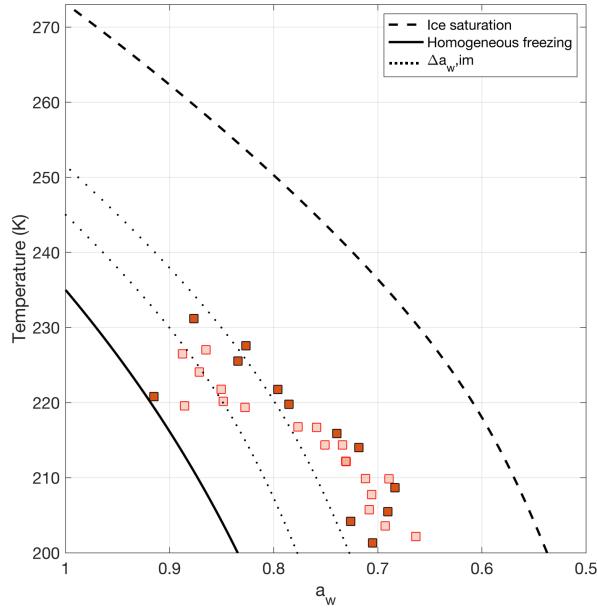



Figure S5. The same 0.1 % frozen fraction shown from Figure S4a, but for a given temperature and water activity (a_w). We assume the larger particles would nucleate ice first difference leading to a negligible difference between the RH_w and a_w. The reference lines indicate ice saturation (black dashed), the expected threshold for the onset of homogeneous freezing (Koop et al., 2000) (solid black), and the dotted lines indicates a constant water activity offset (Δa_w) fitted to the 0.1 % data to resemble immersion freezing.

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