

**Ice and Supercooled Liquid Water Distributions over the Southern Ocean based on  
In Situ Observations and Climate Model Simulations**

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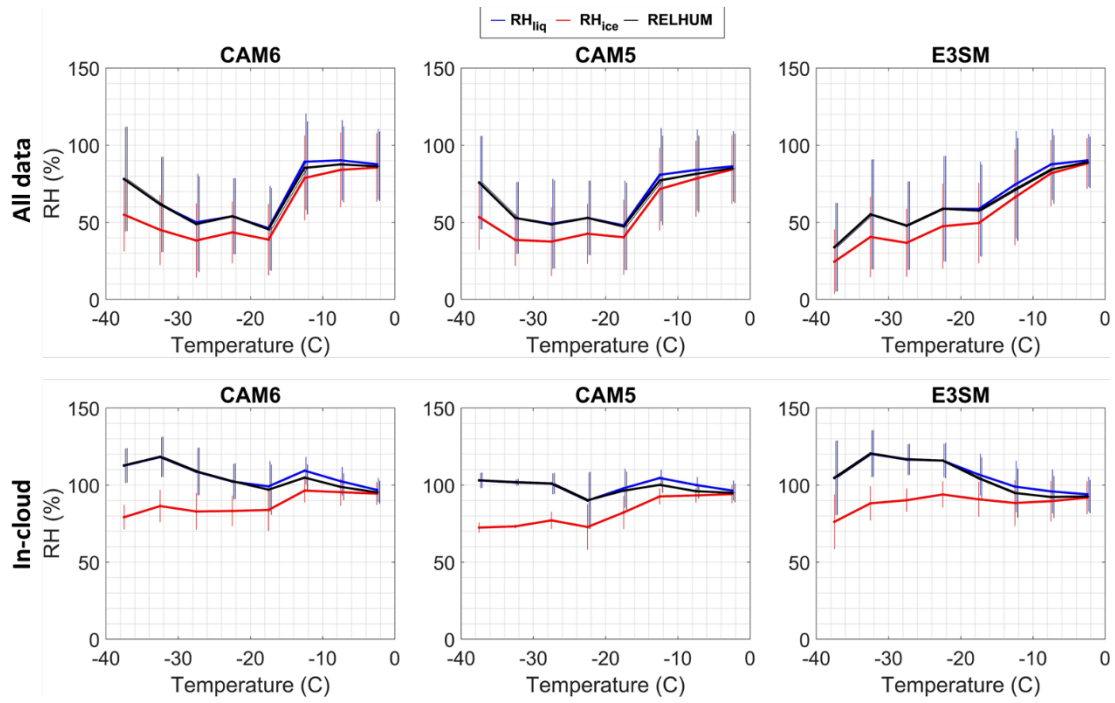
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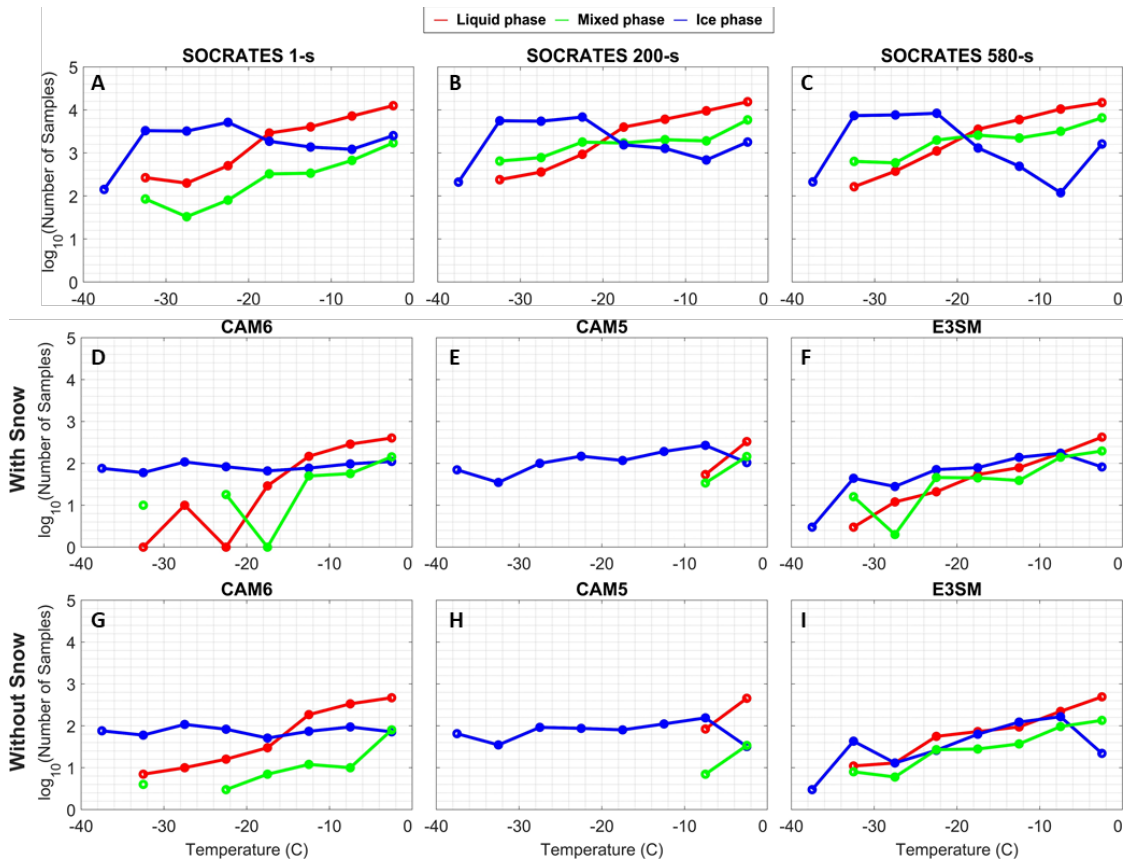
Figures S1 to S11  
Tables S1

**Introduction**

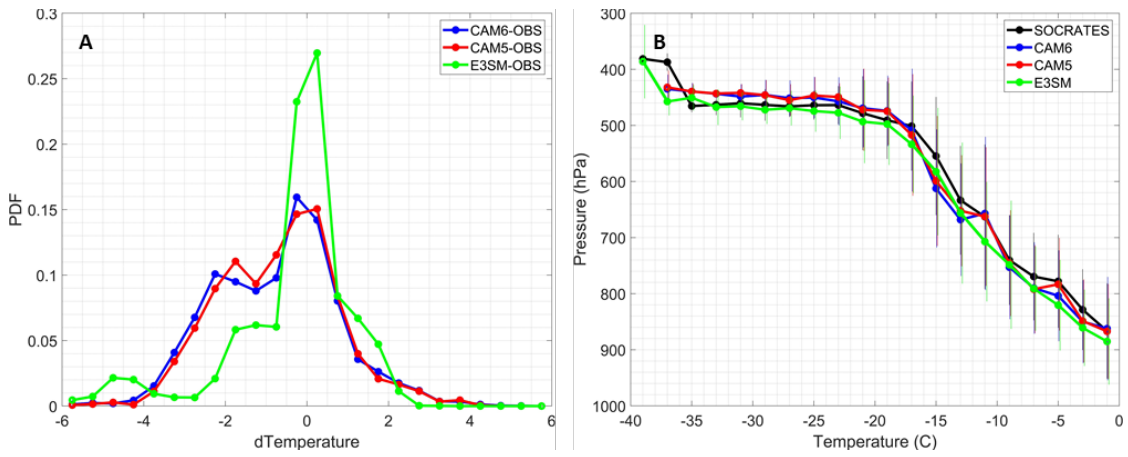
This document includes the figures and a table that provide the supporting information such as number of samples and sensitive tests for the main figures in this paper. The availability of the data collected and used to create these figures and tables is described in the Instruments and Simulations section and the Acknowledgements section of the main text.



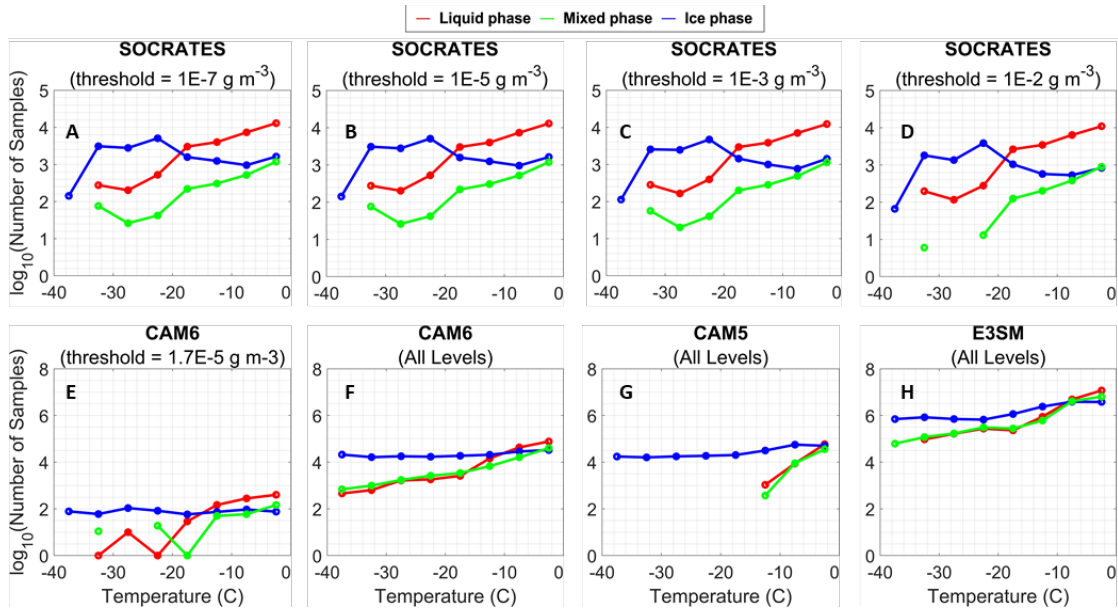
**Figure S1.** Comparisons among direct model output named “RELHUM” (relative humidity, RH) and the calculated  $RH_{liq}$  and  $RH_{ice}$  for simulations based on the saturation vapor pressure equations from Murphy and Koop (2005).



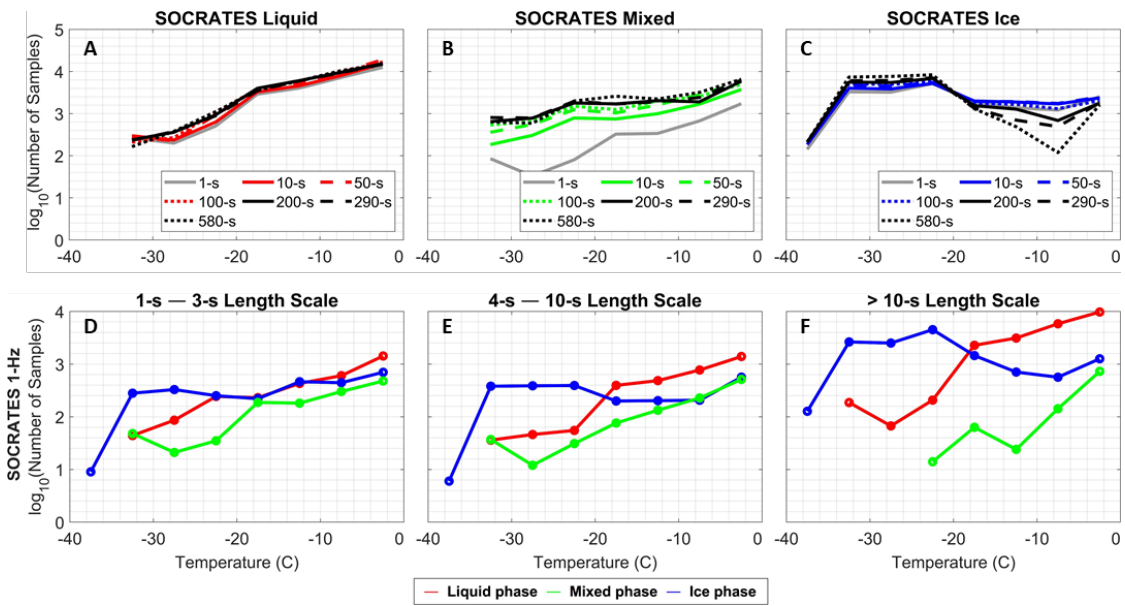
**Figure S2.** Logarithmic scale of number of samples for Figure 3.



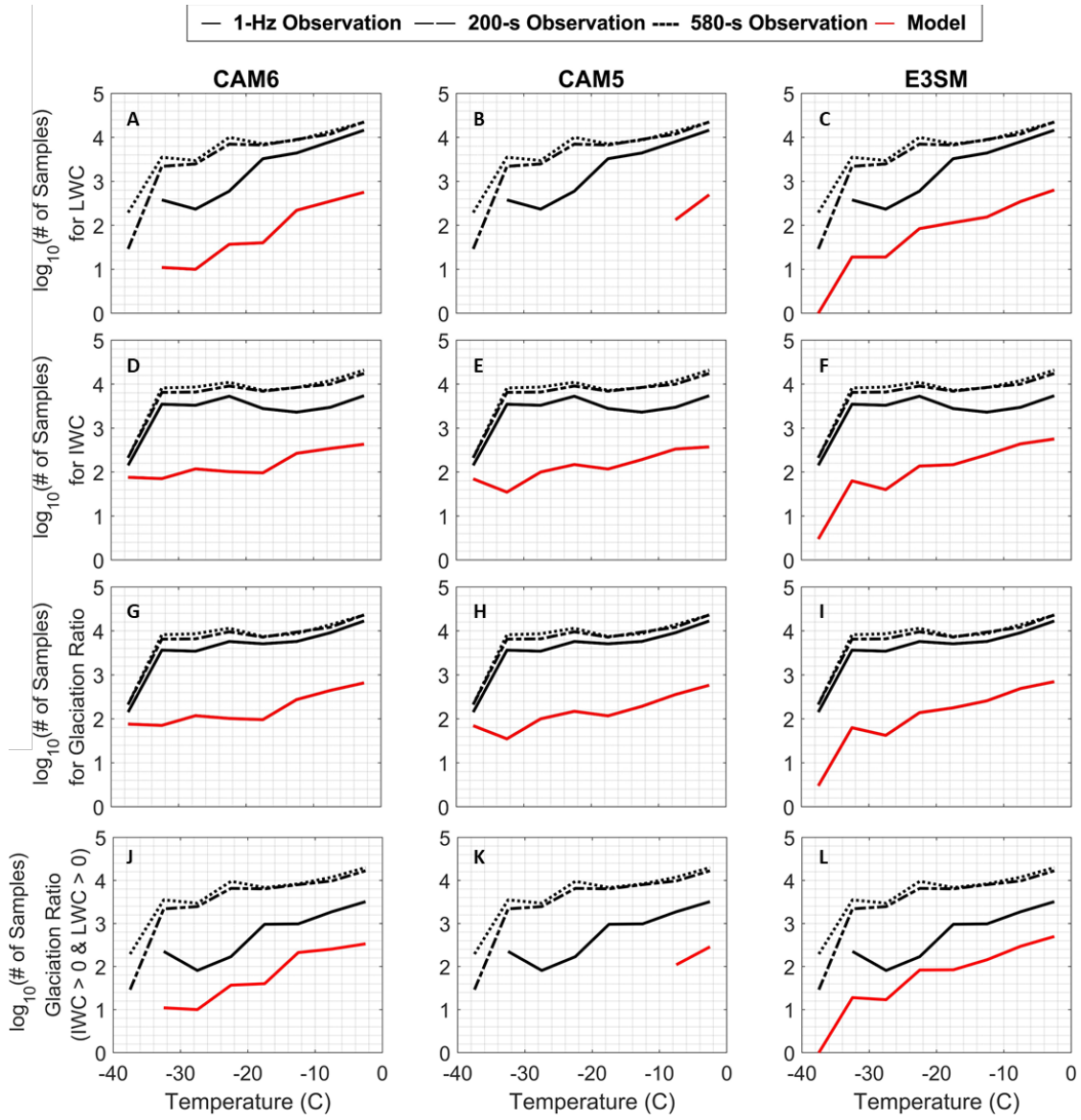
**Figure S3.** (a) The distributions of temperature differences (in °C) between the model simulations and observations. (b) The average pressure values for each 2°C temperature bin.



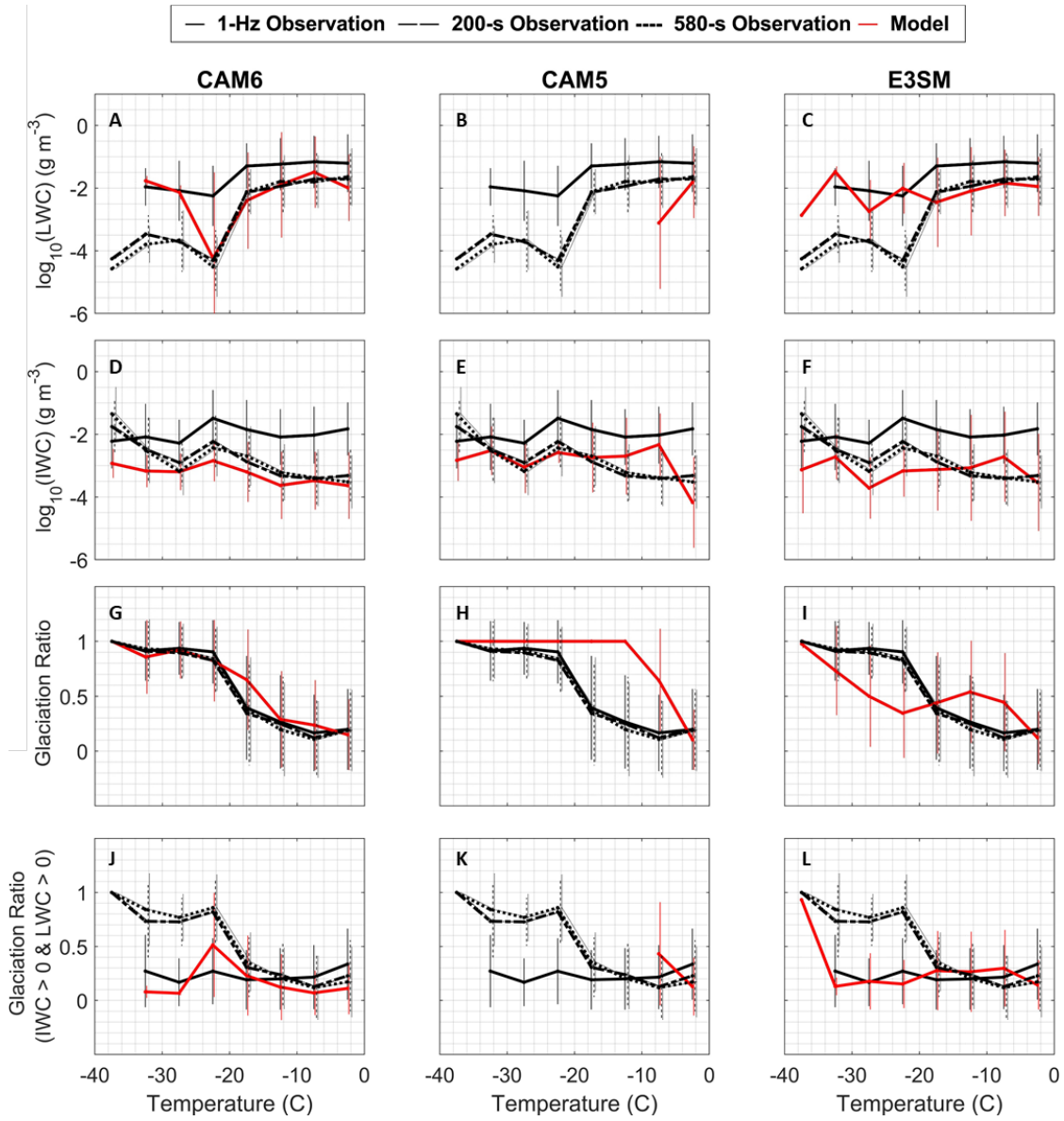
**Figure S4.** Logarithmic scale of number of samples for Figure 4.



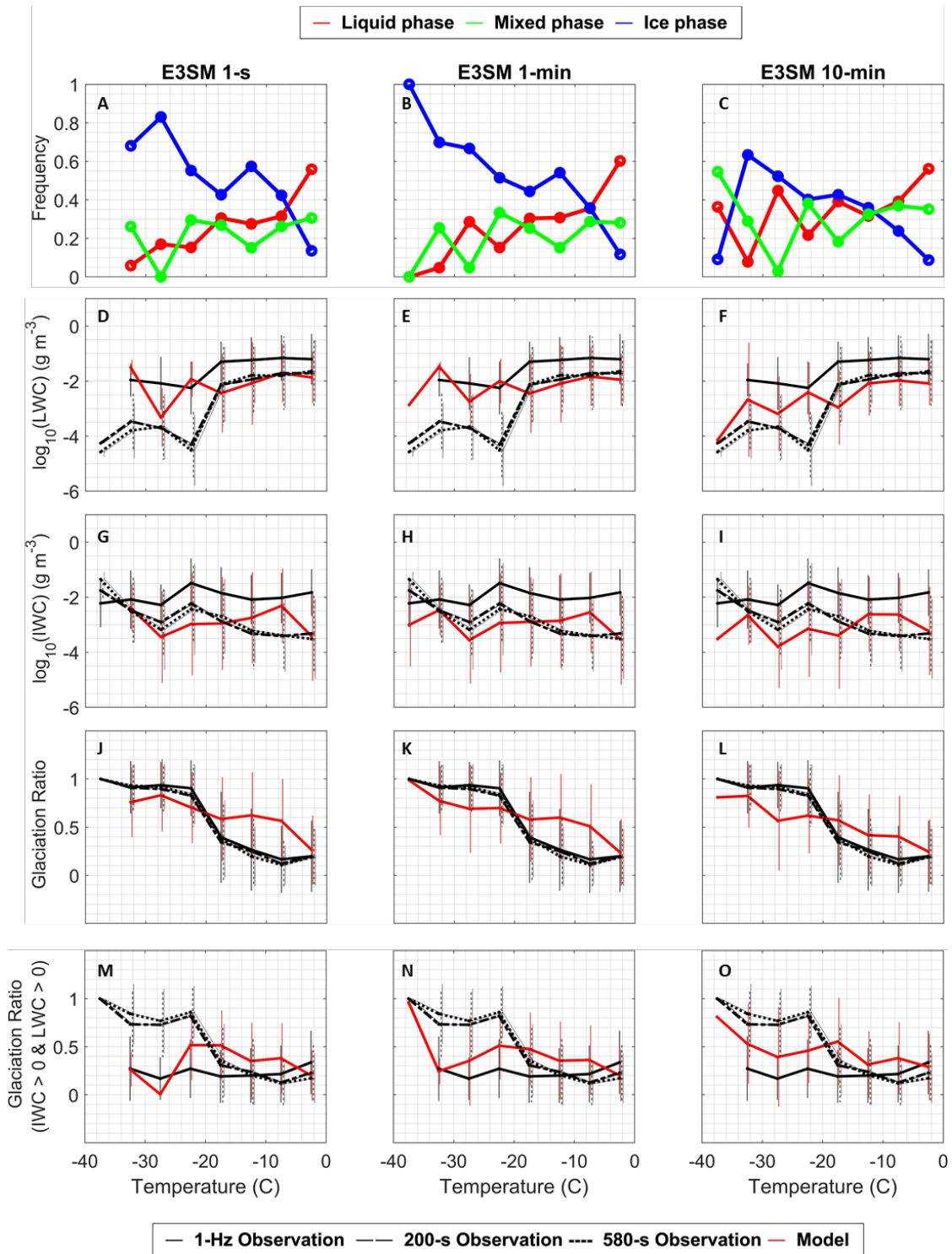
**Figure S5.** Logarithmic scale of number of samples for Figure 5.



**Figure S6.** Logarithmic scale of number of samples for Figure 6.

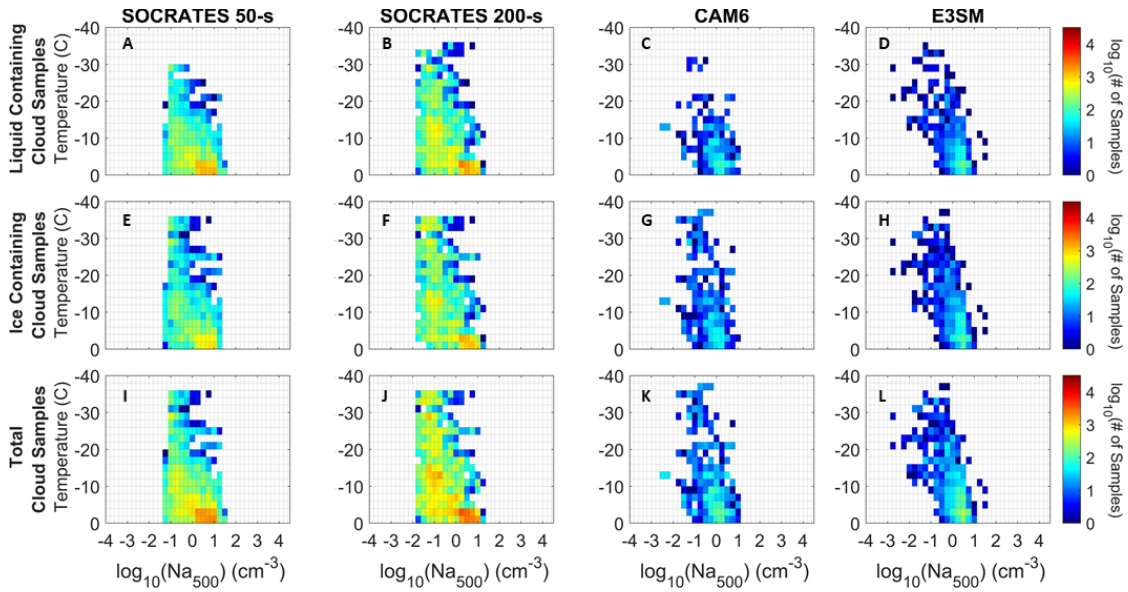


**Figure S7.** Similar to Figure 6, but without adding snow to total IWC for the simulations.

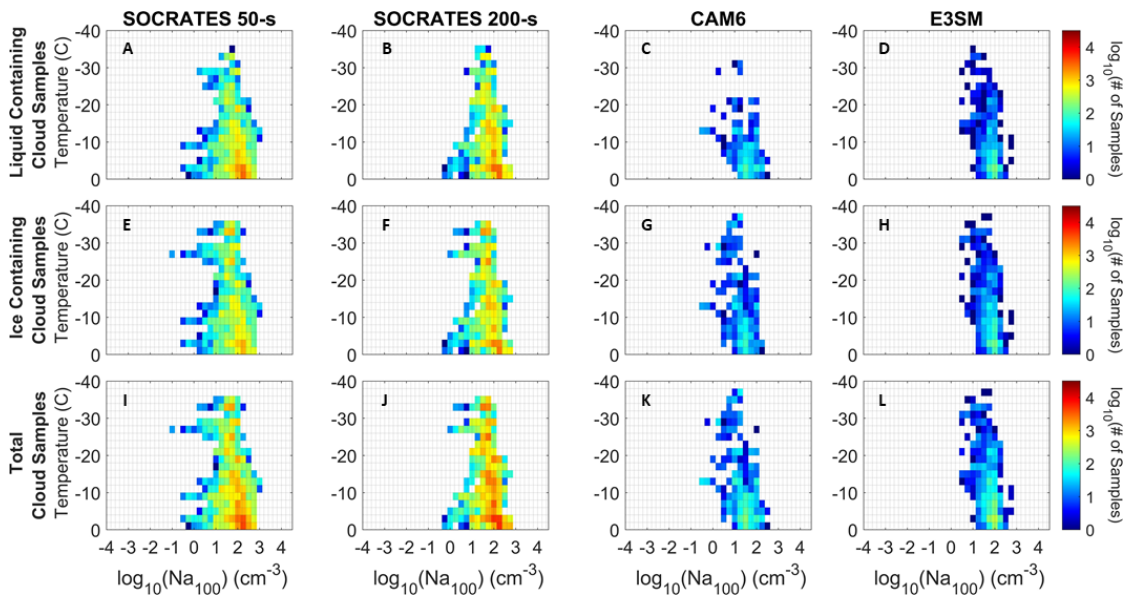


**Figure S8.** Sensitivity tests using E3SM simulations with 1-s, 1-min, and 10-min data output frequencies for (a – c) cloud phase occurrence frequencies (d – f) log-scale LWC, (g – i) log-scale IWC, (j – l) glaciation ratio (i.e., linear averages of IWC/TWC), and (m – o) glaciation ratio only when ice particles and supercooled liquid water coexist.

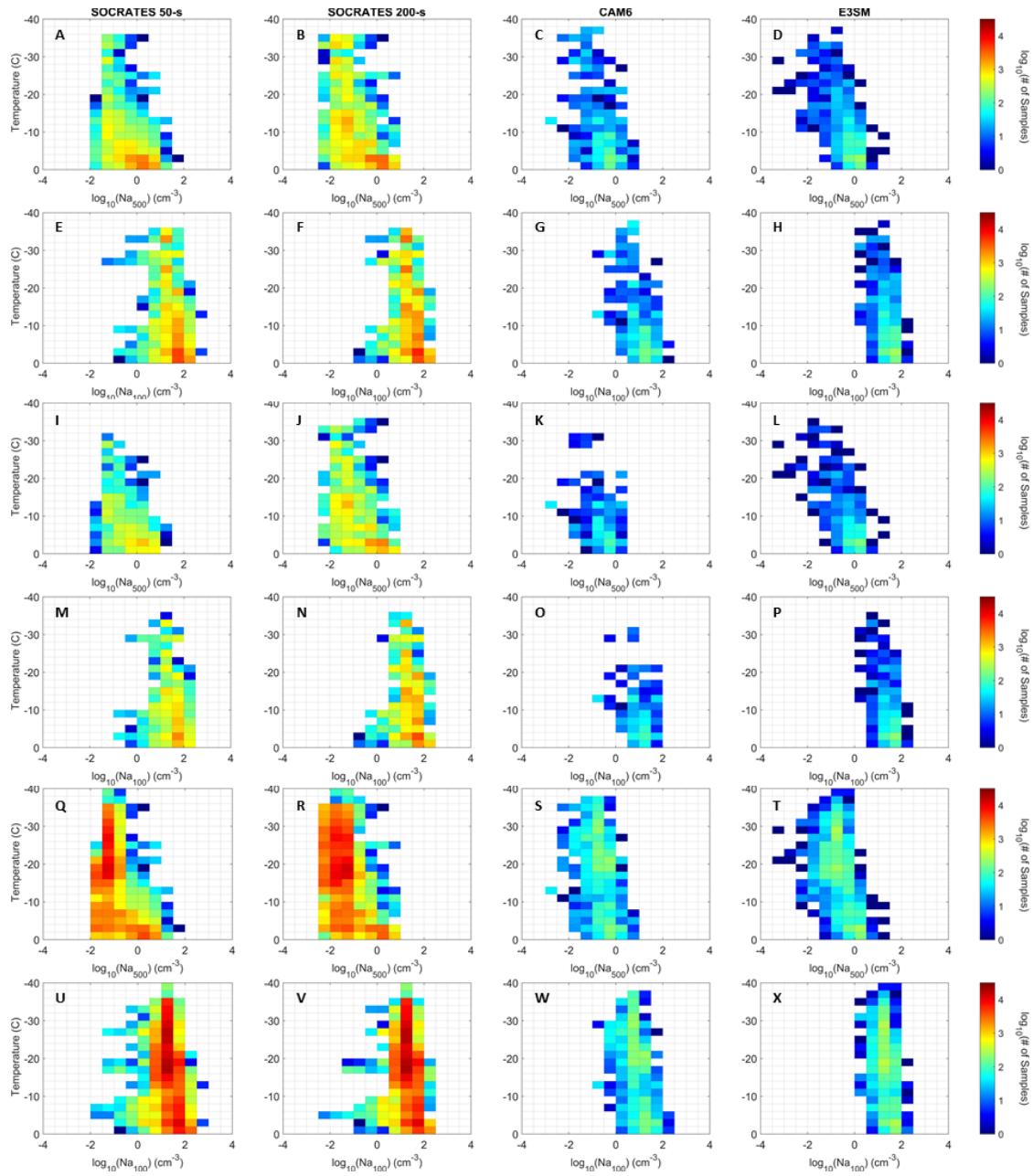




**Figure S9.** Number of in-cloud samples in relation to various temperature and  $\log_{10}(\text{Na}_{500})$  bins for (a – d) liquid containing clouds, (e – h) ice containing clouds, and (i – l) all clouds, colored by  $\log_{10}(\text{number of samples})$ .



**Figure S10.** Similar to Figure S9 but in relation to  $\log_{10}(\text{Na}_{100})$ .



**Figure S11.** Logarithmic scale of number of samples for Figure 12.

<b>Contribution of Partial Mass Concentration (%)</b>								
(unit: $\mu\text{m}$ )		5000–Inf	3200–Inf	62.5–Inf	50–Inf	40–Inf	2–Inf	0–Inf
<b>CAM6</b>	Ice	2.19	2.21	99.3	99.7	99.9	100	100
	Snow	7.23	16.2	100	100	100	100	100
<b>CAM5</b>	Ice	16.6	16.8	98.8	99.4	99.7	100	100
	Snow	1.93	5.21	100	100	100	100	100
<b>E3SM</b>	Ice	3.47	3.48	94.9	97.3	98.6	100	100
	Snow	1.44	3.58	100	100	100	100	100

**Table S1.** The contributions of ice and snow mass concentrations between size ranges of 5000  $\mu\text{m}$  – inf, 3200  $\mu\text{m}$  – inf, 62.5  $\mu\text{m}$  – inf, 50  $\mu\text{m}$  – inf, 40  $\mu\text{m}$  – inf, 2  $\mu\text{m}$  – inf, and 0 – inf for CAM6, CAM5, and E3SM. Each percentage is calculated as the mass concentration in each size range divided by the mass concentration in the total size range from 0 to infinity.