Observational Needs for Simulating Southern Ocean Aerosol and Ice Nucleating Particles

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NCAR

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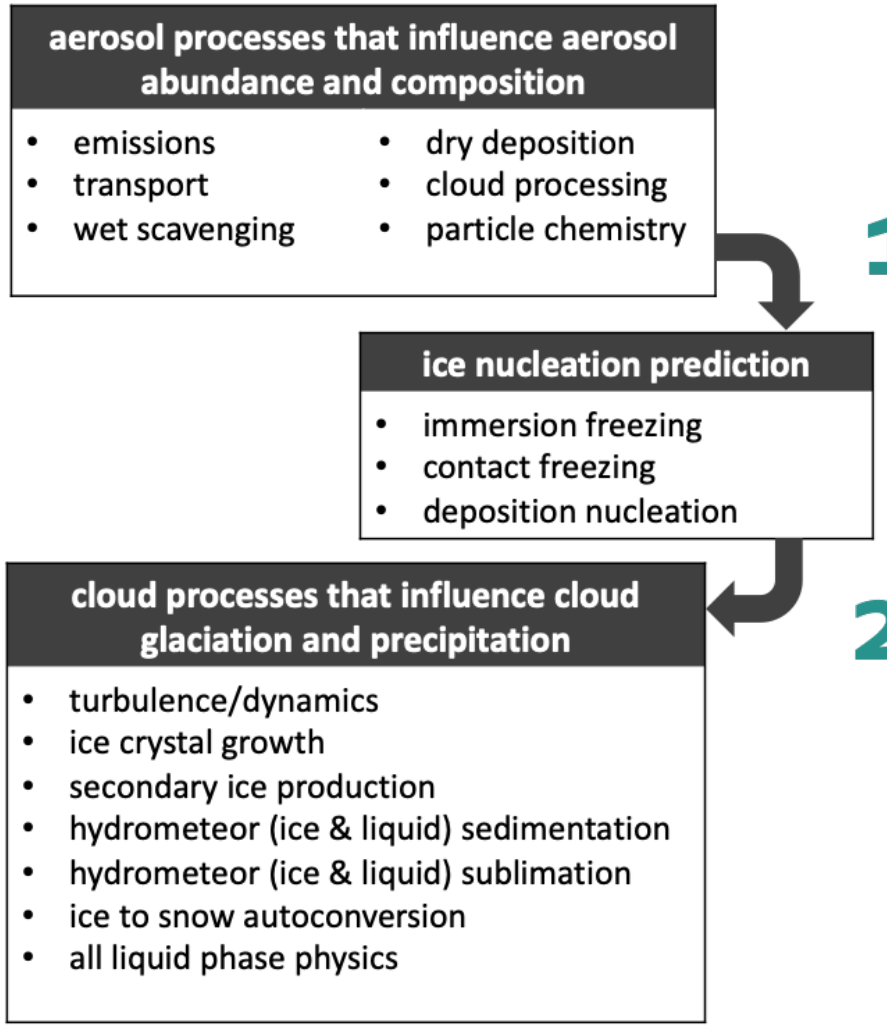


Burrows et al. [2022]

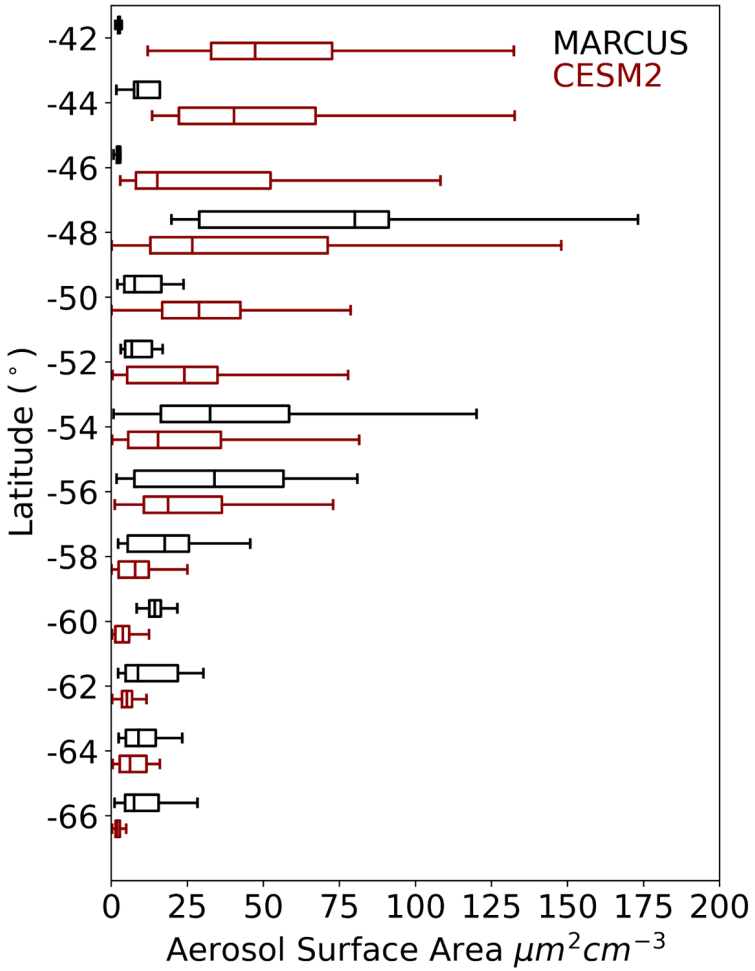
1 Assess **aerosol and ice nucleating particle** concentration prediction skill against observations

2 Assess impact of updated ice nucleation scheme on simulated **cloud processes**

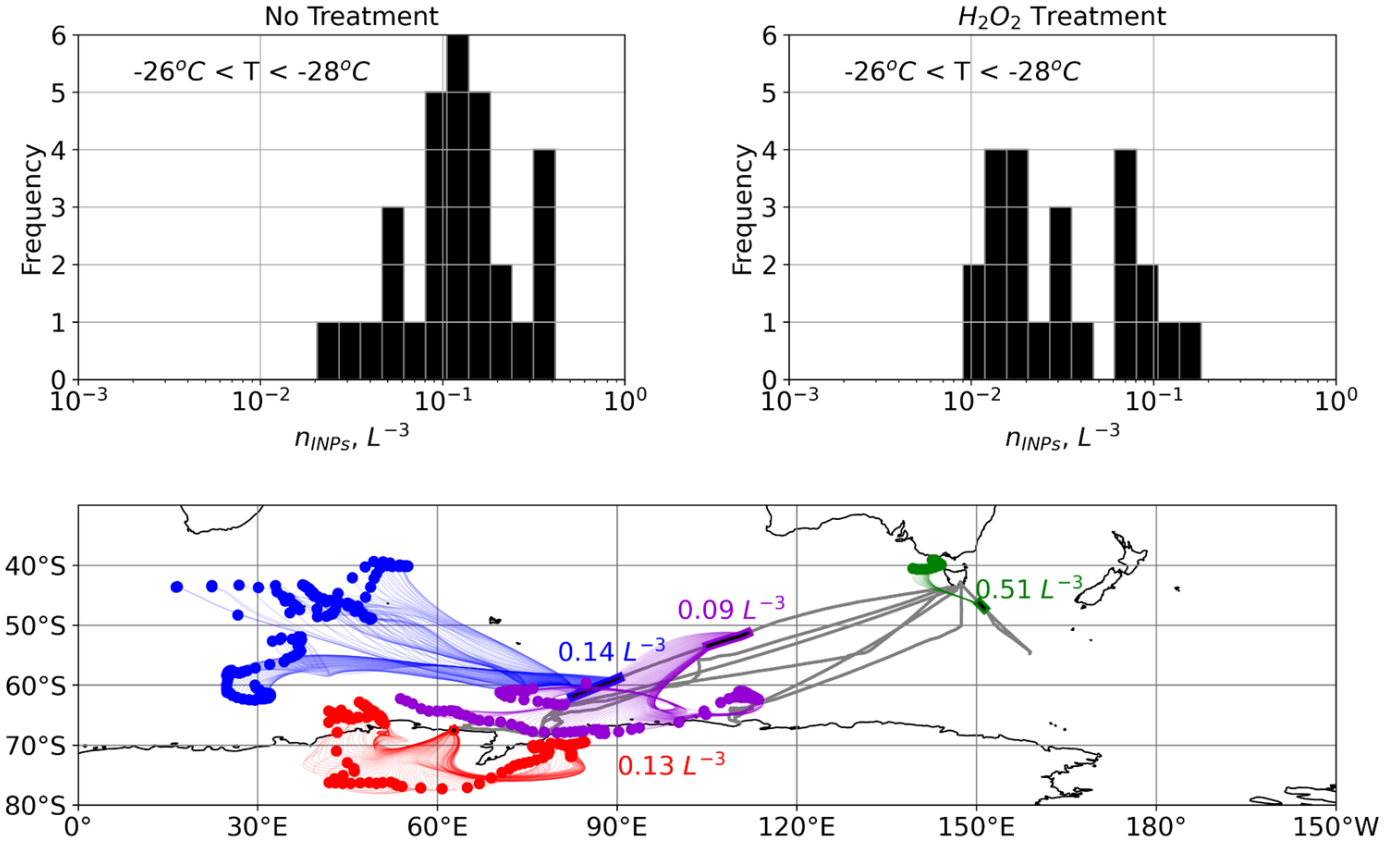
Poster tomorrow!

Aerosol Amount, Composition, and INP populations during MARCUS and SOCRATES

Assessed latitudinal and vertical distributions of simulated aerosol amount



Identified periods of dust influence during MARCUS using offline treatment tests of INPs



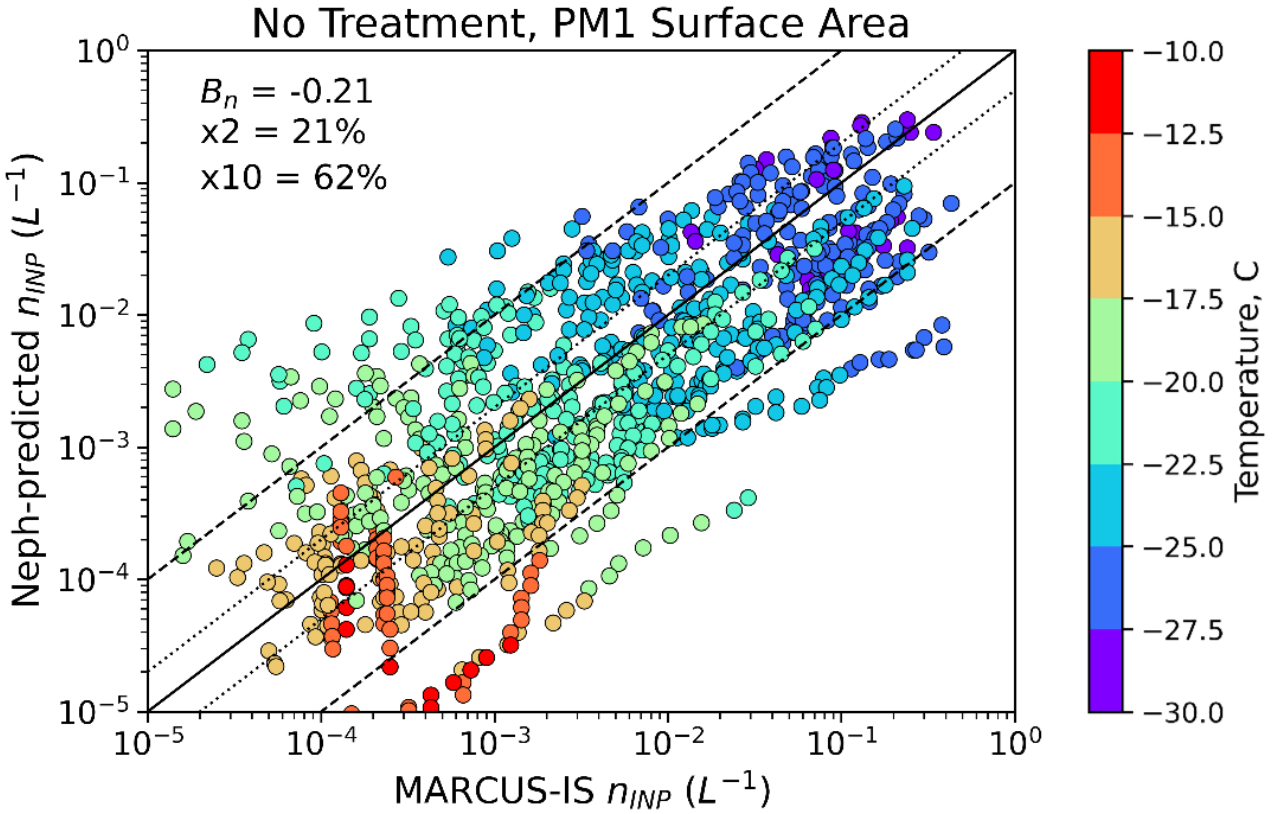
Observational Closure Study: Marine INPs dominate MARCUS INP population

M18 – Marine INPs: *McCluskey et al.*, **JGR** (2018)

M18 only includes marine ice nucleation active molecule type.

$$n_{INPs}(T) = \exp[a(T - 273.15) + b] \times S_{SSA,submicron}$$

Measured aerosol surface area from nephelometer



Southern Ocean Marine Boundary Layer INPs in CAM6

DeMott et al., 2015 (D15) - Mineral Dust INPs:

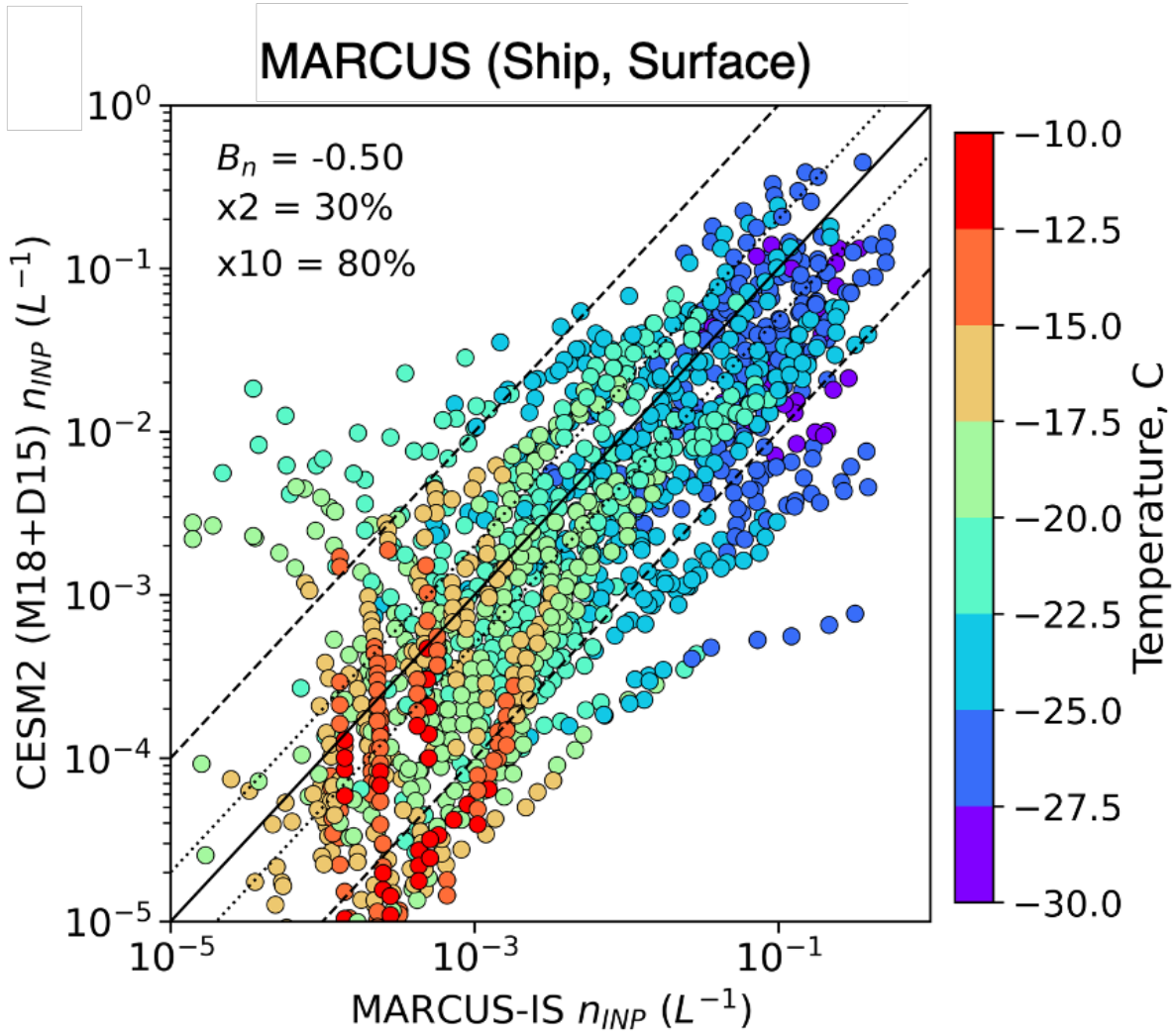
$$n_{INPs}(T) = cf\,(n_{500nm})^{\alpha(273.15-T_k)+\beta}\exp\left(\gamma(273.16-T_k)\right)+\delta\right)$$

McCluskey et al., 2018 (M18) – Marine INPs:

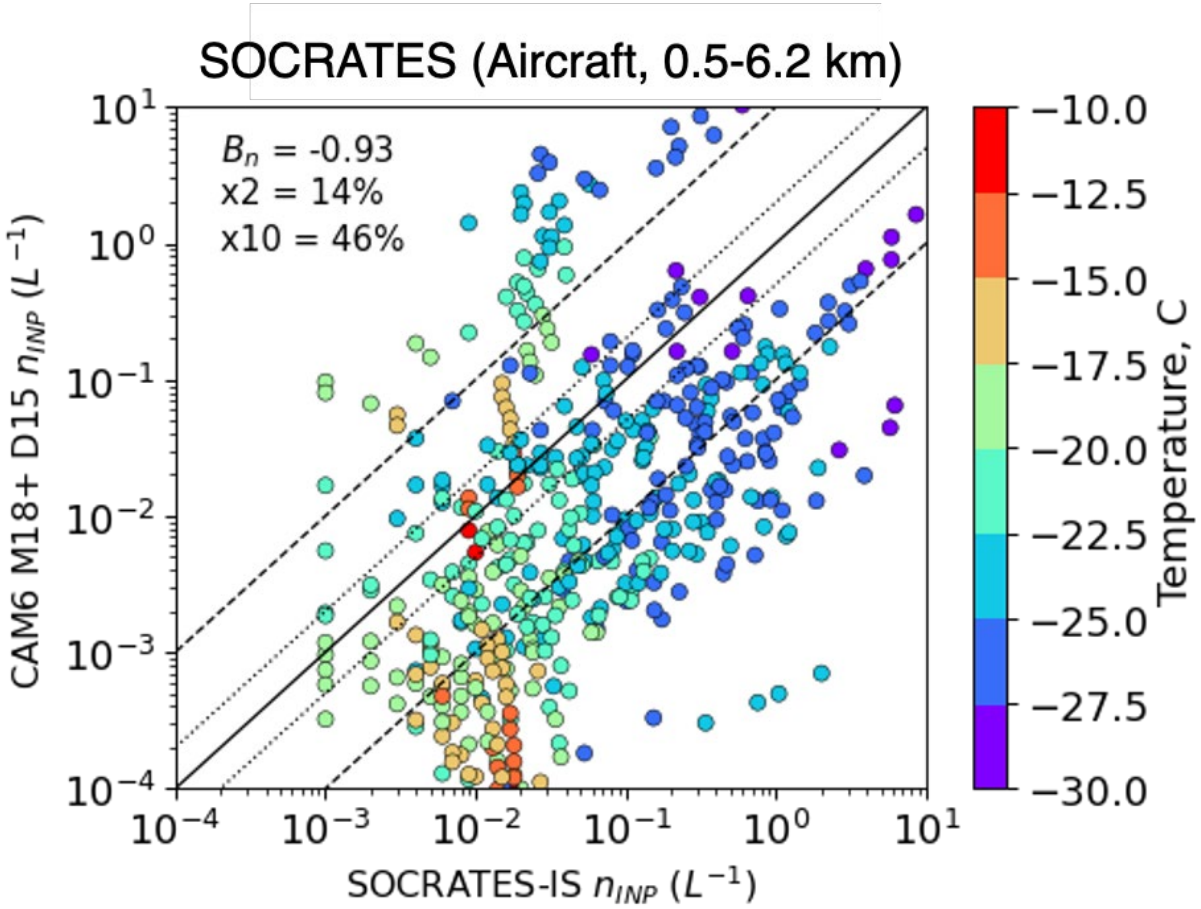
M18 only includes marine ice nucleation active molecule type.

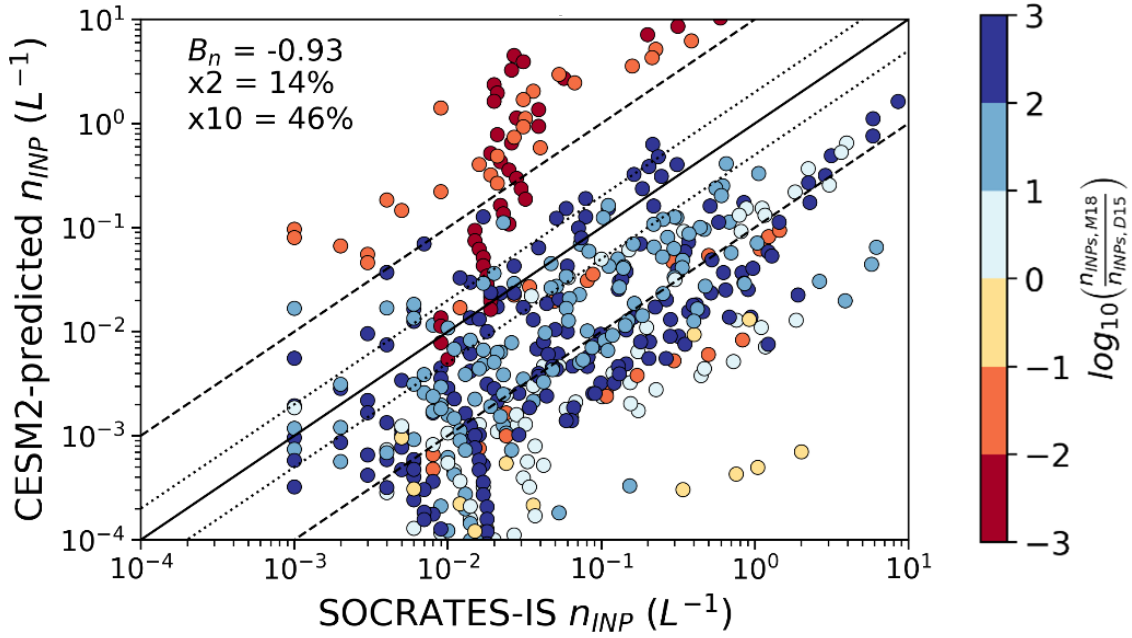
$$n_{INPs}(T) = \exp[a(T-273.15)+b]\times S_{seasalt}$$

Modal Aerosol Model (MAM4)	
Black Carbon	
Dust *dynamic emissions*	n_{500nm}
Particulate Organic Matter	
Sea Salt *dynamic emissions*	$S_{seasalt}$
SO_4	
Secondary organic aerosol	



Predicting INPs in CAM6 above the Marine Boundary Layer





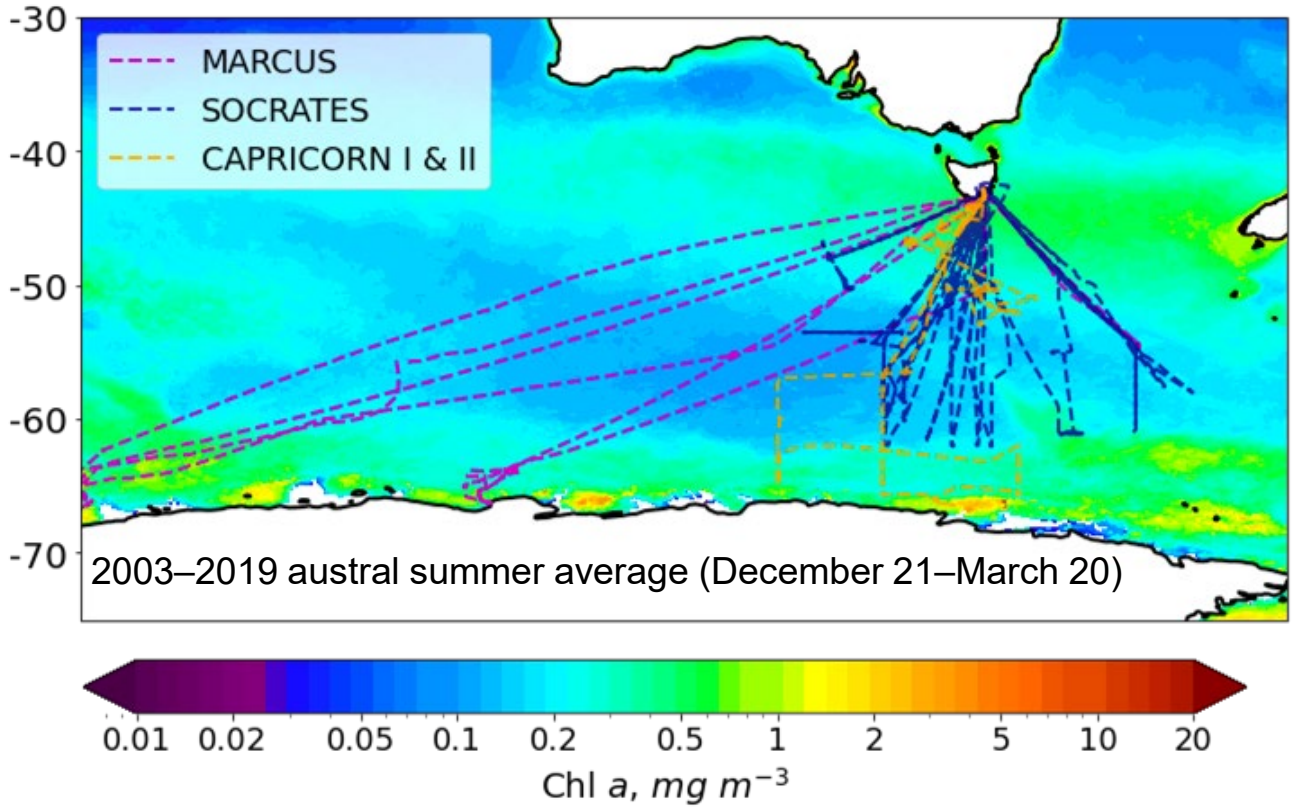
Need: Marine Biological Particle & Mineral Dust influences on aerosol INP populations at High Latitudes and High Altitudes

Measurements

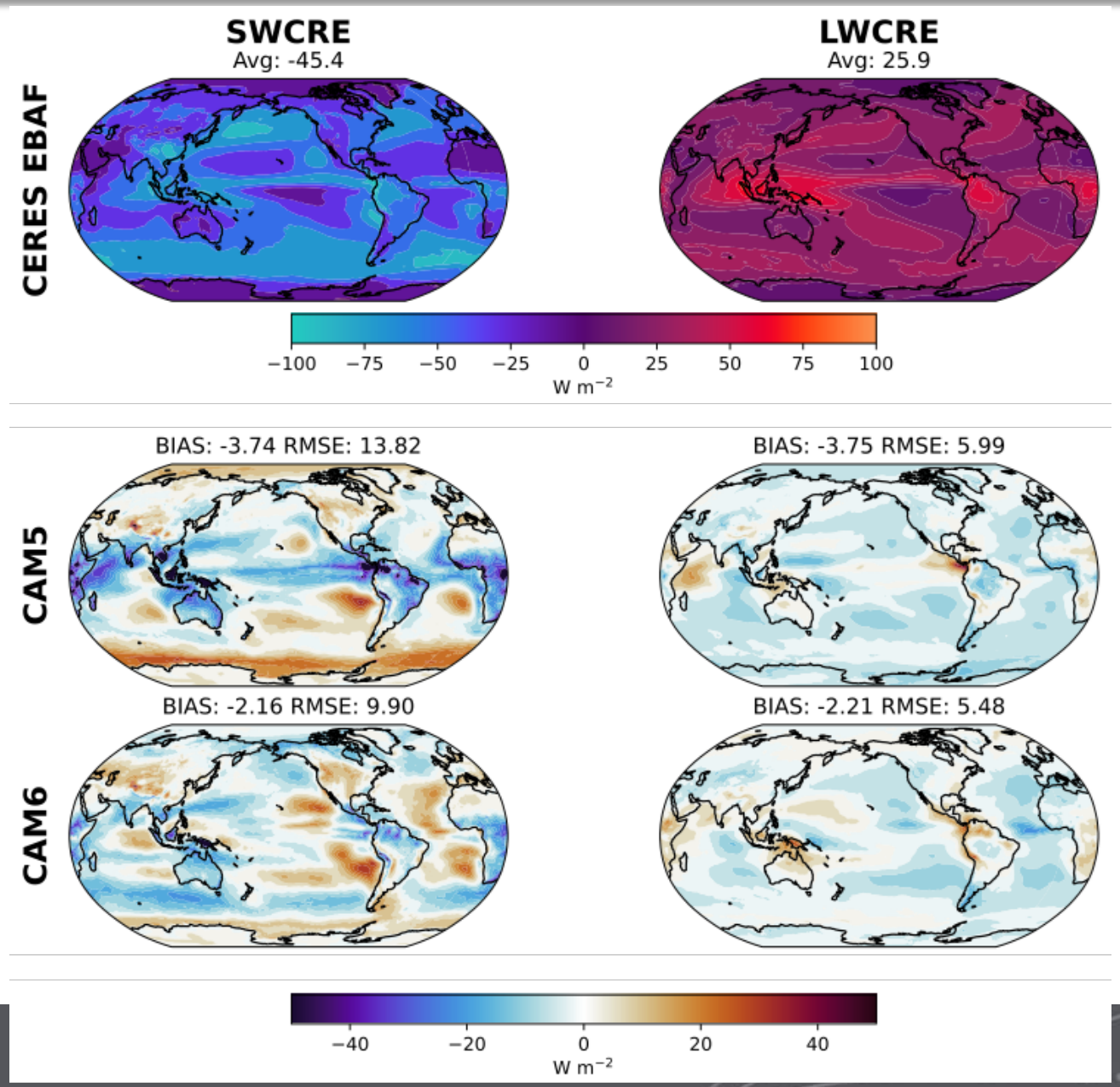
- Aerosol size distributions
- Tracer for identifying terrestrial air masses (i.e., Radon)
- Size resolved particle composition, including microbial particles & mineral dust
- Size resolved INP amount and composition

Where & When:

- High latitudes (>60S)
- From ship and aloft
- Summertime and Wintertime



Earth System Model Uncertainties in Southern Ocean Clouds remain



Medeiros et al., *in prep*

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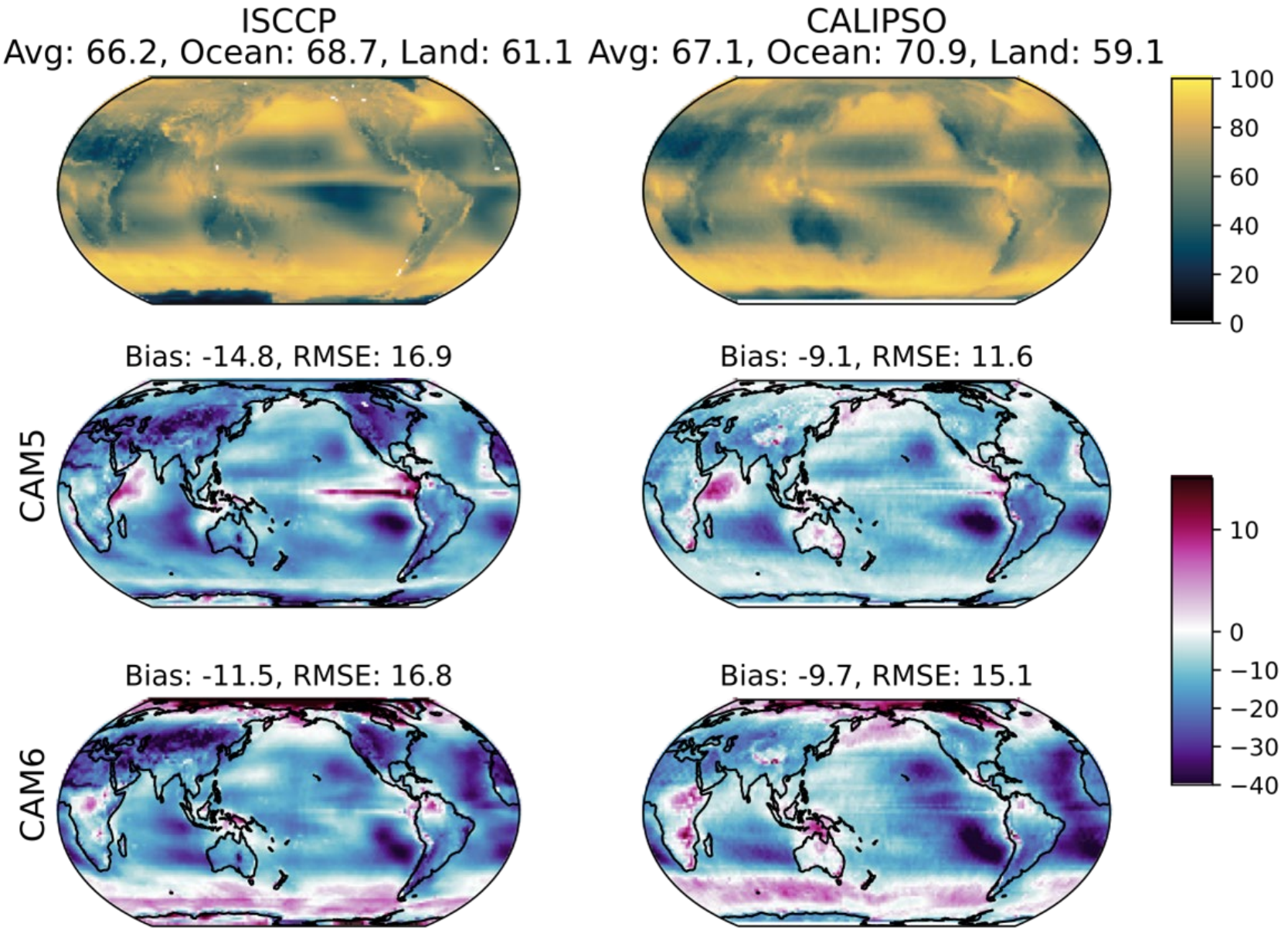

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