U.S. DEPARTMENT OF ENERGY

Office of Science

Marine Aerosol Sources: This Week in Boulder

Scott Elliott (LANL) for:
S. Burrows (PNNL), P. Cameron-Smith (LLNL),
C. Deal (IARC), M. Jin (IARC), X. Liu (PNNL),
N. Meskhidze (NCSU), K. Tsigaridis (GISS),
A. Kirkevag (NorESM)… and many others

Selected Sponsorship: DOE SciDAC, SFA, EPSCoR and external

OUTLINE

BACKGROUND –Global ocean DMS, organics

DIRECTION –Dynamic/biogenic, secondary/primary

HIGHLIGHTS –Chemistry/Climate WG sessions

Cameron-Smith, Deal, Tsigaridis, Meskhidze, Elliott

VISION –Offline, intercomparison, interaction

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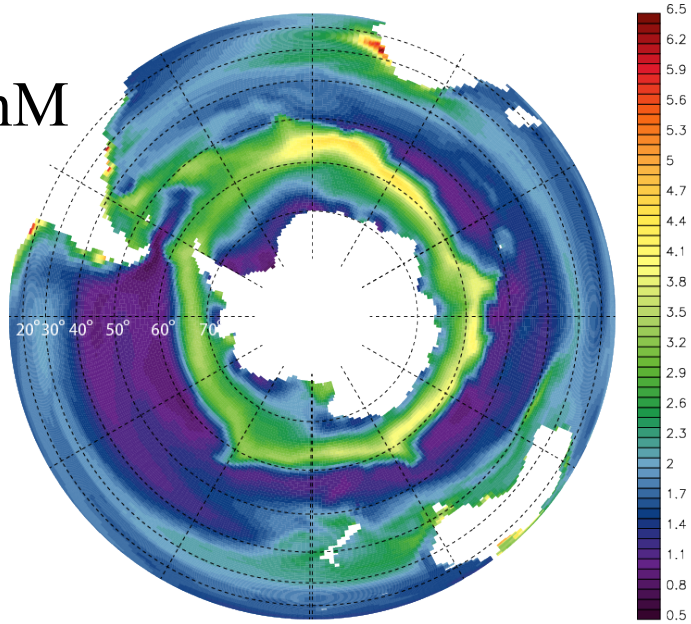
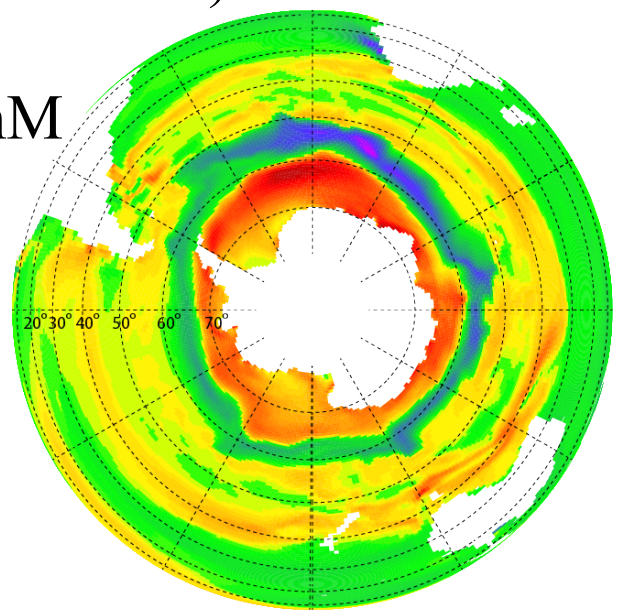
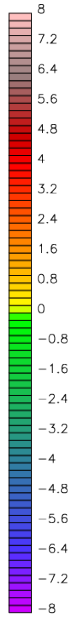
Once and future DMS (*LLNL and LANL in CESM*)

2000 nM

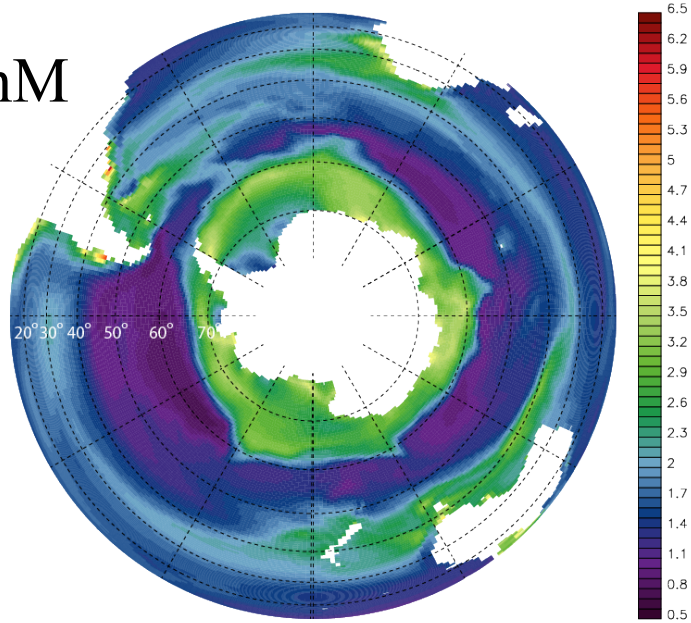


ΔnM

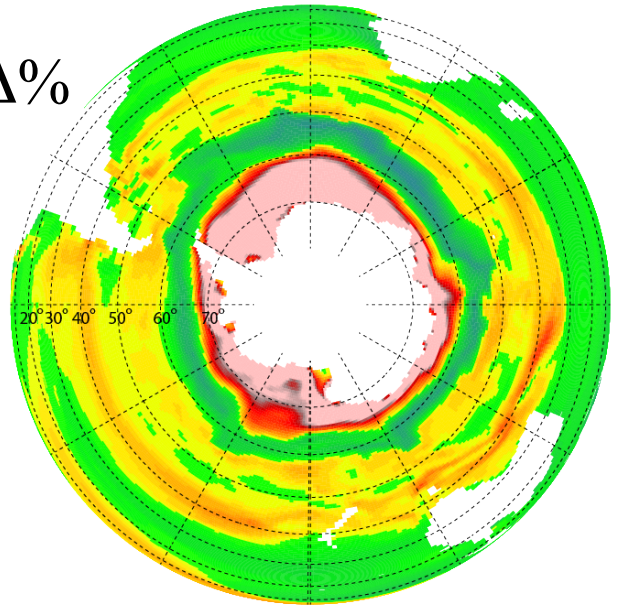


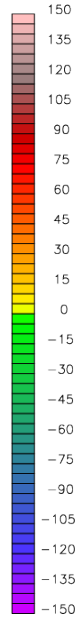


2100 nM



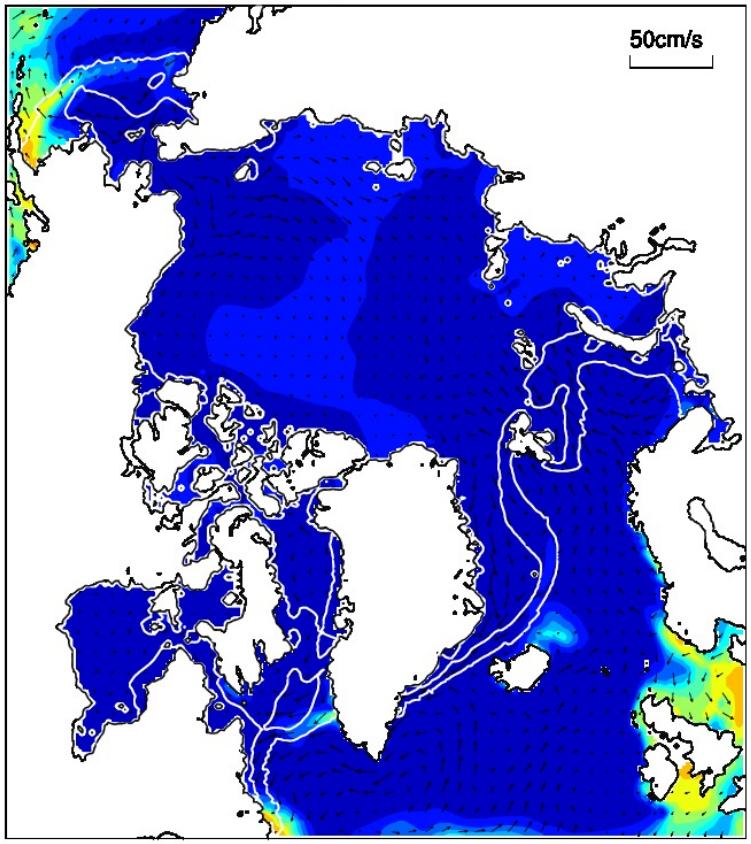
Δ%





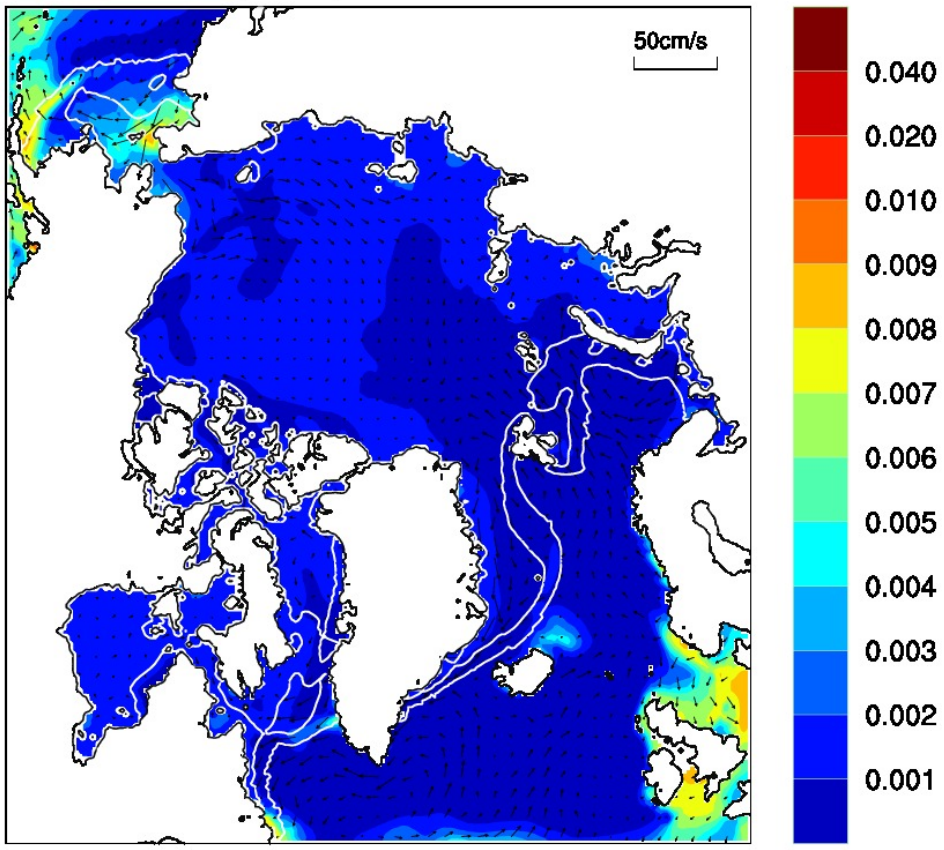
S-ice OFF

DMS (mmol S/m 3) 1992 04 01



S-ice ON

DMS (mmol S/m 3) 1992 04 01



In Prep

IARC Coupled Sulfur Cycle:
Early POP/CICE results subdued
Stay calm and carry on…

International Arctic Research Center
IARC
University of Alaska Fairbanks

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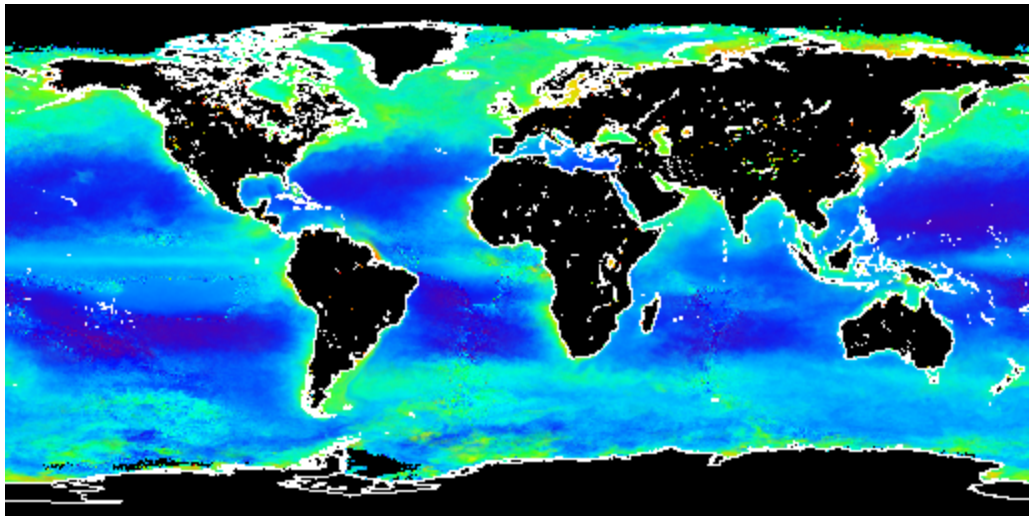
Sea-spray organic enrichment

SeaWiFS, 2000



O'Dowd et al., 2008

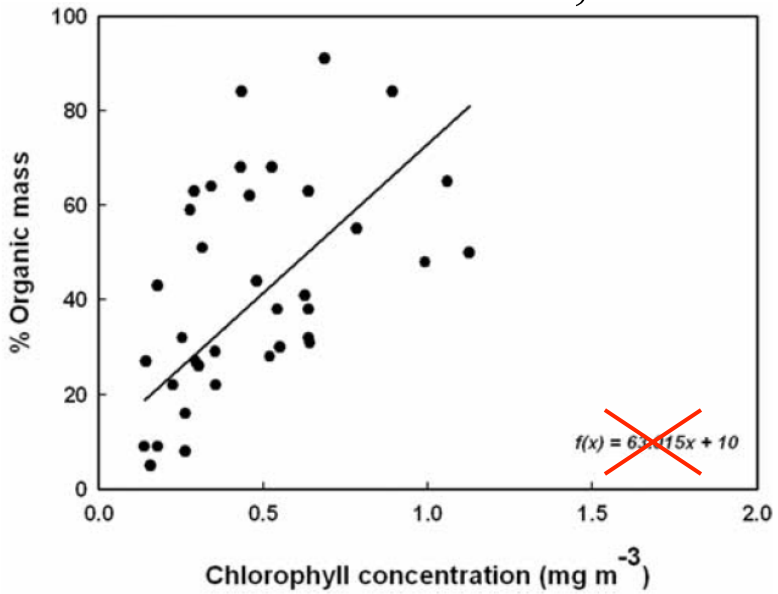
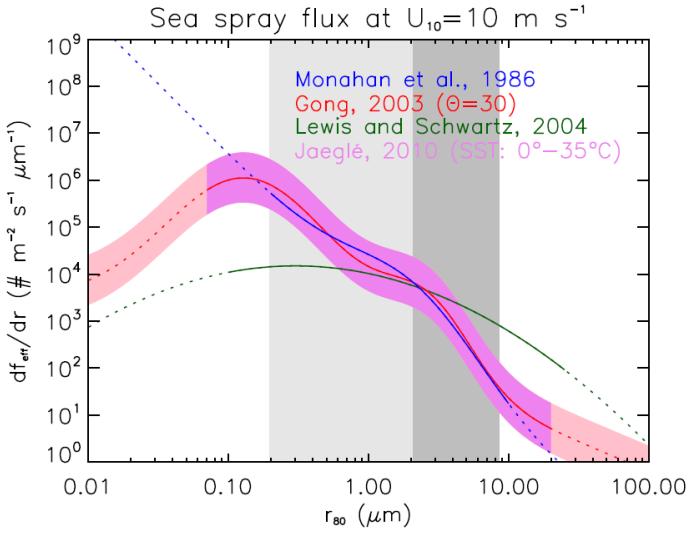


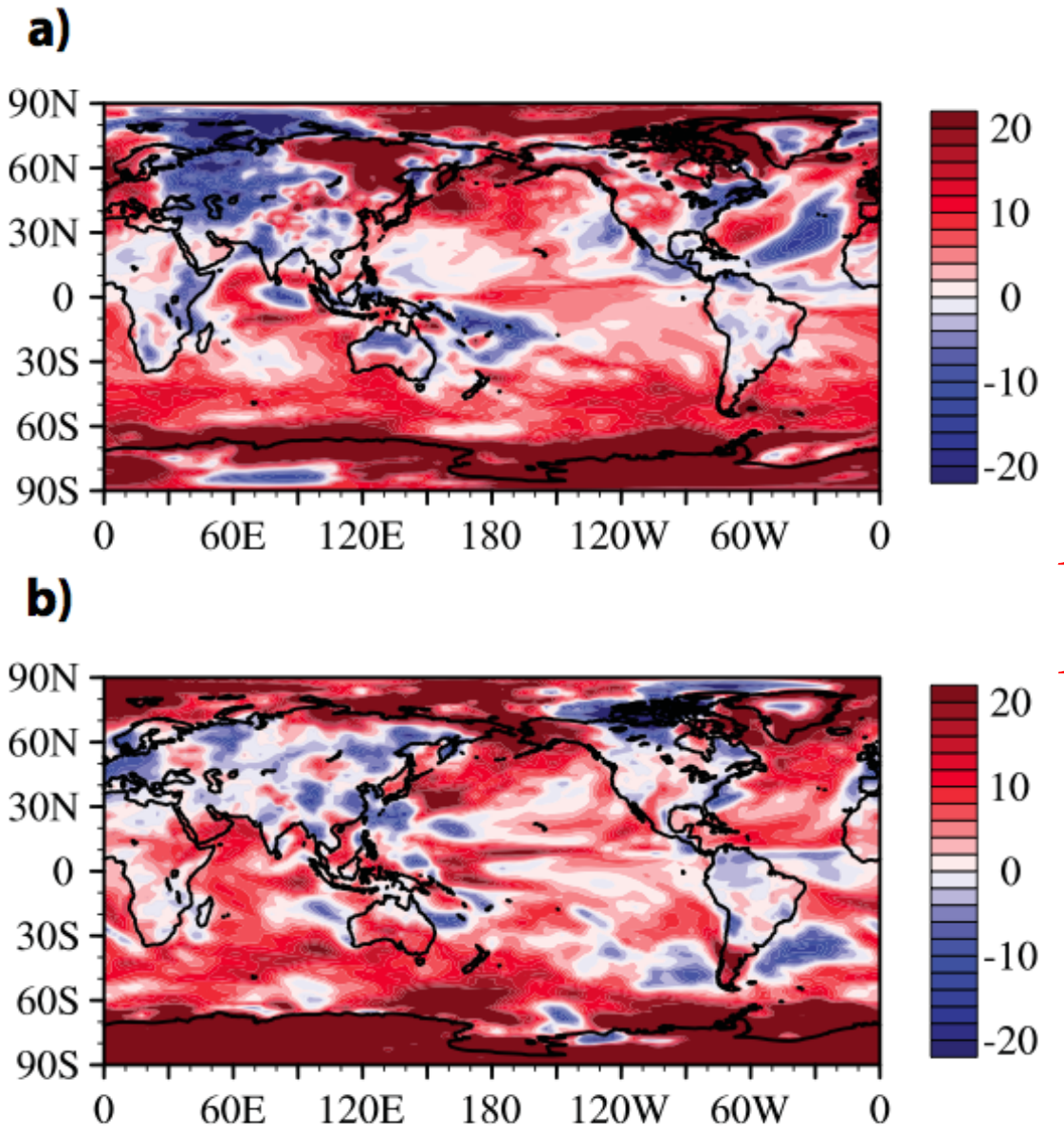
Figure 2. Correlation between fractional WIOC component of sea-spray as a function of grid-average chlorophyll-a concentration.



Vignati et al., 2010

$$\%\ \text{organic mass} = 43.5 * \text{Chl}\ [\text{mg m}^{-3}] + 13.805, \quad \text{Chl} < 1.43\ \mu\text{g m}^{-3}$$

Tsigaridis -GISS

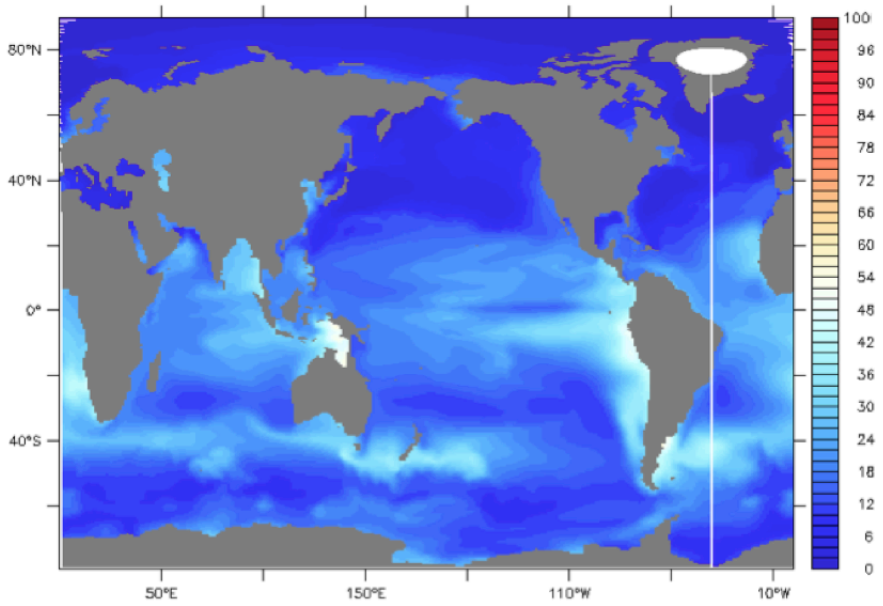


NCSU, PNNL

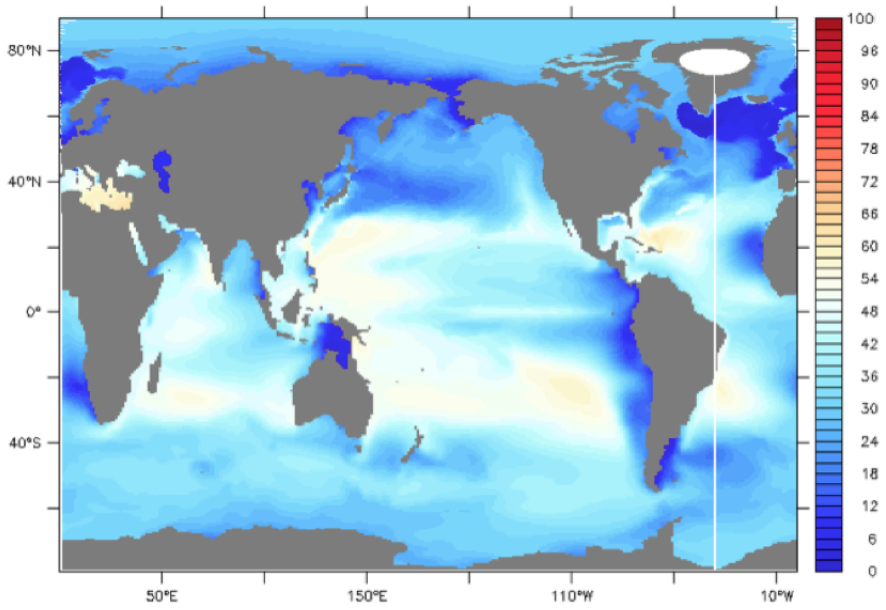
Fig. 6. Average percentage change in surface CCN (0.2 %) concentration between the Default and G11 for **(a)** December–February and **(b)** June–August.

Concentrations (top, μM), Diameters (below, microns) *SH summer*

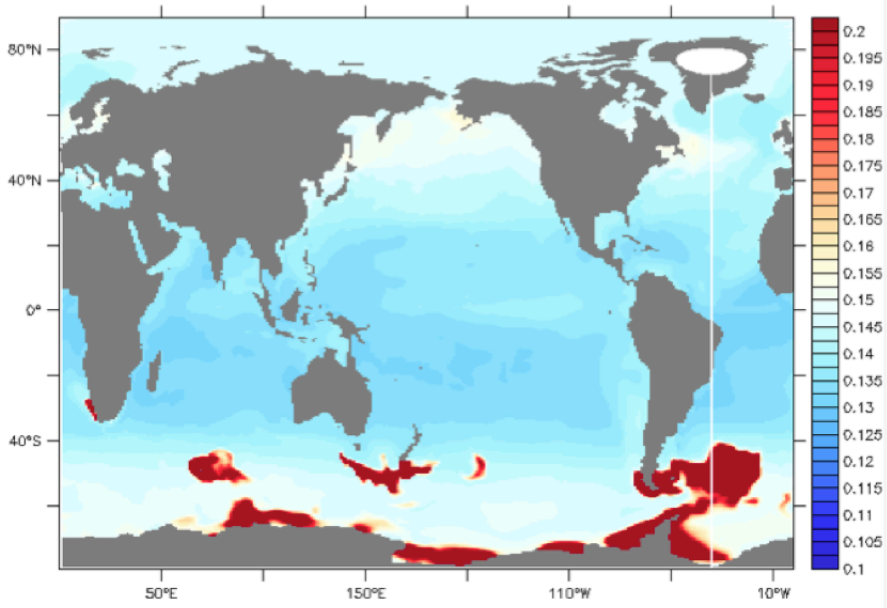
Polysaccharides



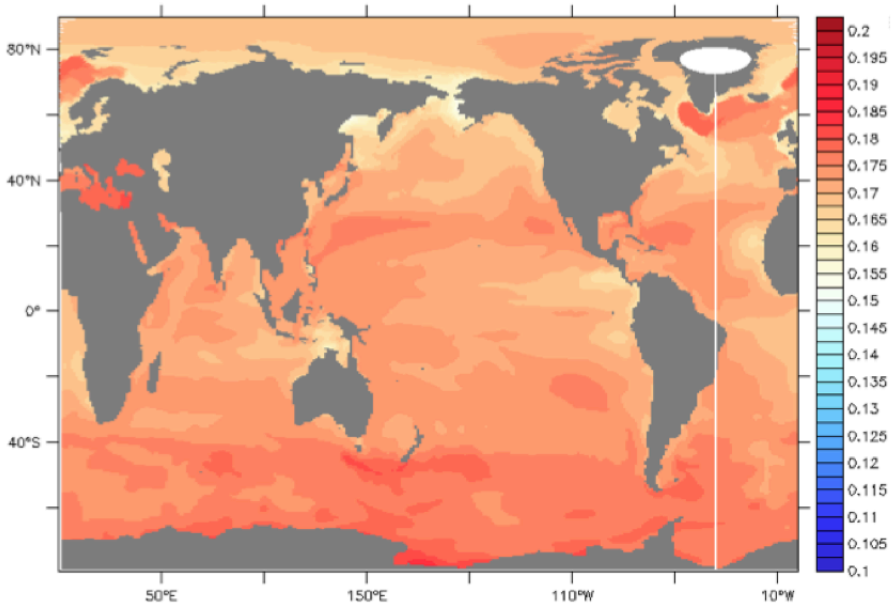
Unidentified Intermediates



Chlorophyll Proxy Diameter



Surfactants x3 Hi Hi



CAM Modal Aerosol

PNNL, LANL

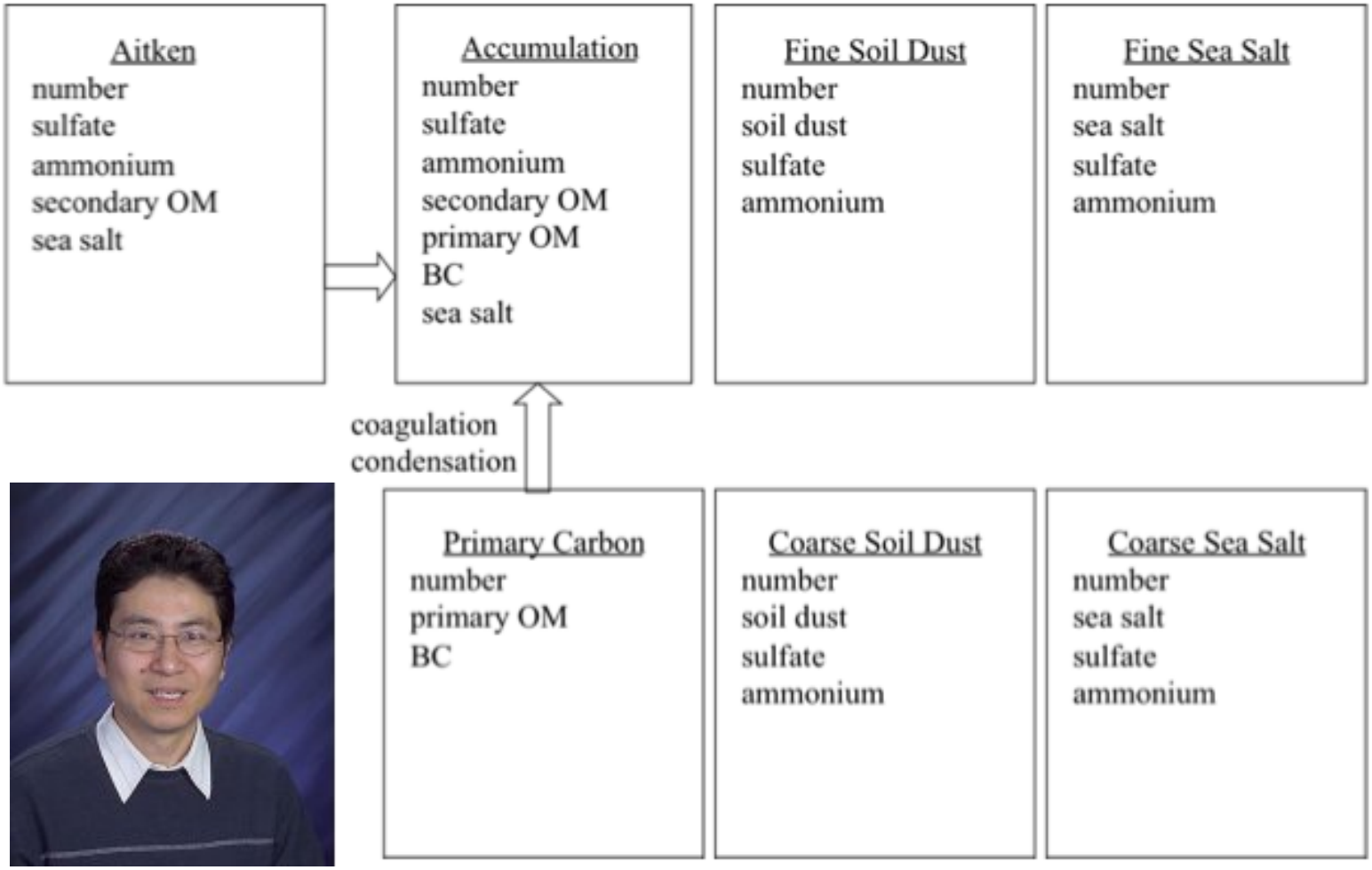


Fig. 1. Predicted species for interstitial and cloud-borne component of each aerosol mode in MAM7. Standard deviation for each mode is 1.6 (Aitken), 1.8 (accumulation), 1.6 (primary carbon), 1.8 (fine and coarse soil dust), and 2.0 (fine and coarse sea salt).

CODiM intercomparison as sample

Table 2. Technical Characteristics of DMS(P) Cycle Modeling in the 3D Models Evaluated During This Study[a]

Model Name	POP	PISCES	HAMOCC	PlankTOM
S(DMSP): C quota	Variable as function of nutrient and light stress, temperature and Chl *a* in each specific group (6)	- Fixed for diatoms; - Variable as function of nutrient and light stress for nanophytoplankton	Species-dependent constant	Variable as function of nutrient and light stress and temperature in each specific group (3)
Bacterial DMSPd consumption	Function of implicit bacterial biomass and DMSPd concentration	n/a	Function of temperature and DMSPd concentration (Michaelis-Menten uptake)	Function of temperature, implicit bacterial biomass and activity and DMSPd concentration (Michaelis-Menten uptake)
DMSP to DMS transformation yield	Fixed yield	Variable as function of bacterial nutrient stress	Fixed yield	Fixed yield
Other DMS production source	n/a	n/a	Fixed rate from phytoplankton degradation; Estimated direct *Phaeocystis* production from temperature and iron	- Additional fixed enzymatic DMSPd cleavage; Direct - DMS exudation
Bacterial DMS consumption	Function of implicit bacterial biomass and DMS concentration	Function of implicit bacterial biomass and activity and DMS concentration (Michaelis-Menten uptake)	Function of temperature and DMS concentration (Michaelis-Menten uptake)	Function of implicit bacterial biomass and activity and - DMS concentration (Michaelis-Menten uptake)
DMS photo-degradation	Function of PAR(z)	Function of PAR(z)	Function of PAR(z)	Function of PAR(z)
DMS surface ventilation	*Wanninkhof* [1992]	*Wanninkhof* [1992]	*Wanninkhof* [1992]	*Wanninkhof* [1992]

[a]DOC is for Dissolved Organic Carbon, and PAR is for Photosynthetically Active Radiation.

LATE LAST NIGHT

HETEROGENEOUS REACTIONS –do surfaces matter?

EUROPEAN ANALOGS –Nor-ESM as example

SECONDARIES –Swept under rug for the moment

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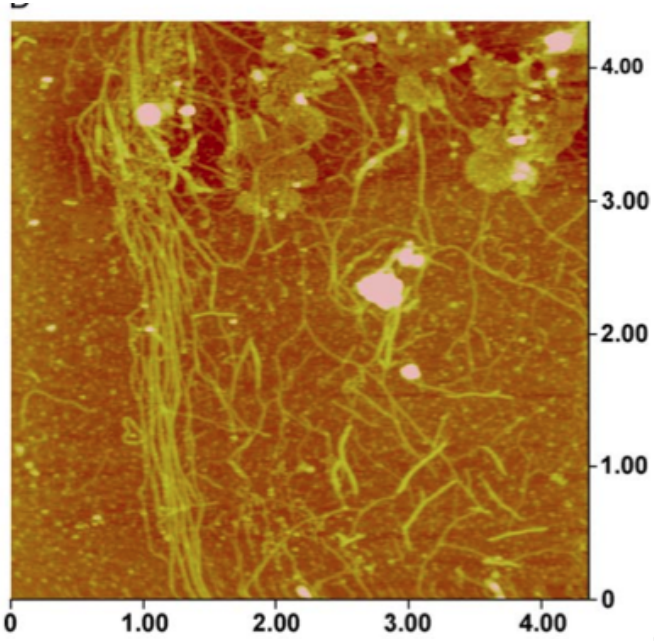

Polysaccharides,
Proteins,
Lipids,
Humic acids,
(and geopolymers…