

CLAW: Dead or Alive?

Peter Liss

School of Environmental Sciences

University of East Anglia

Norwich, UK

<p.liss@uea.ac.uk>



Bob **C**harlson



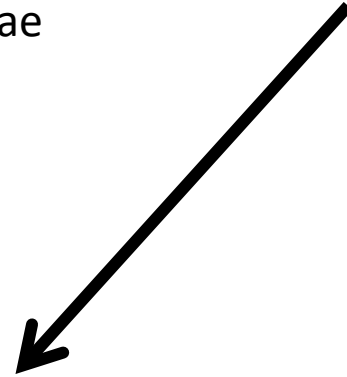
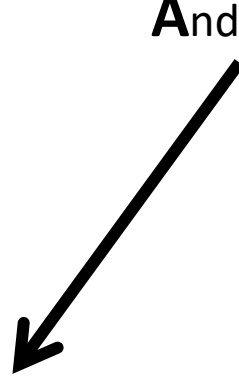
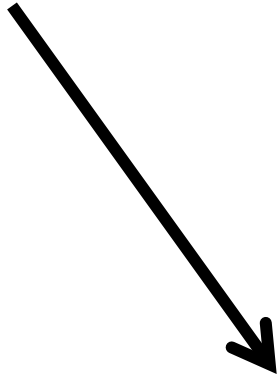
Jim **L**ovelock



Andi
Andreae

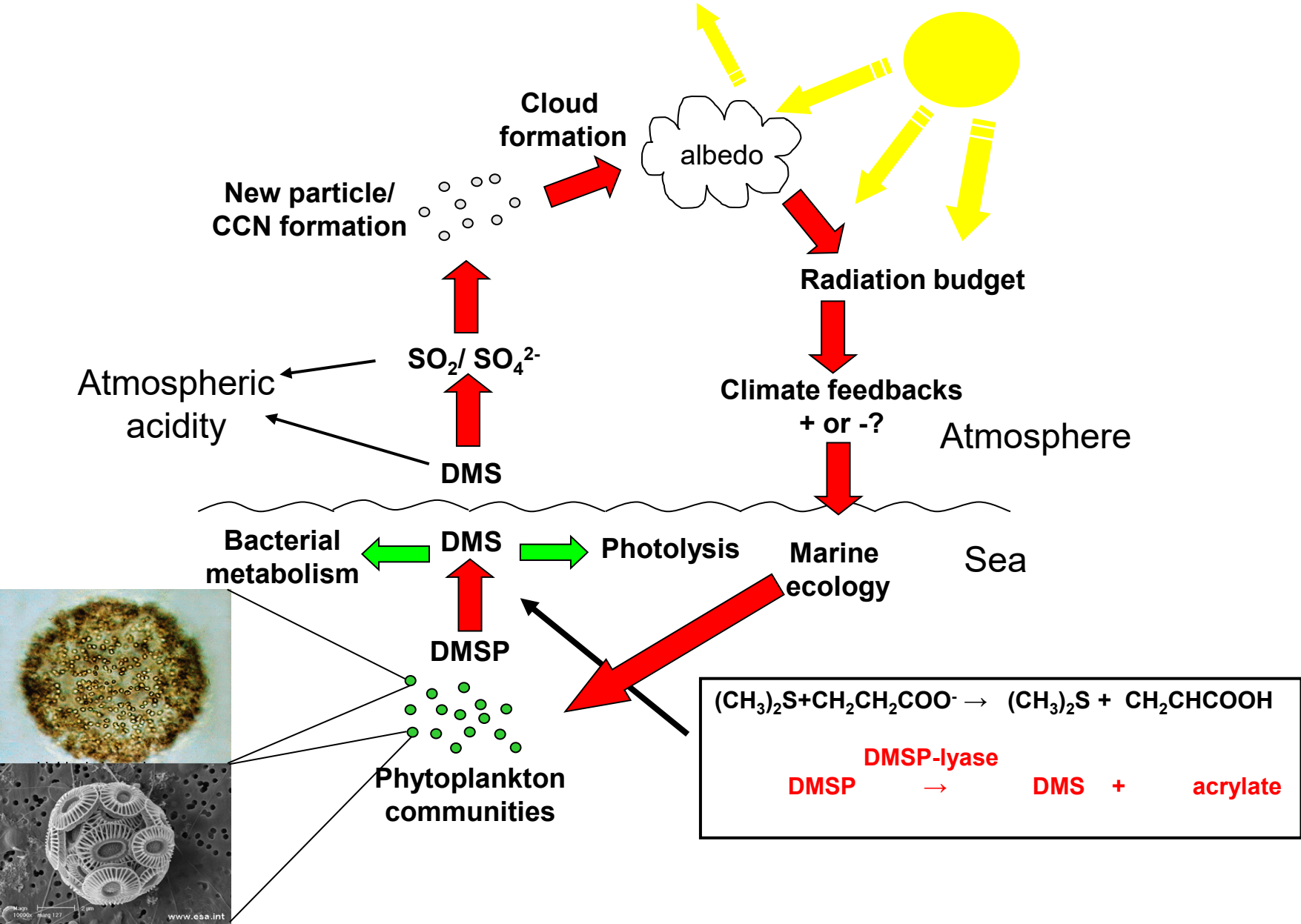


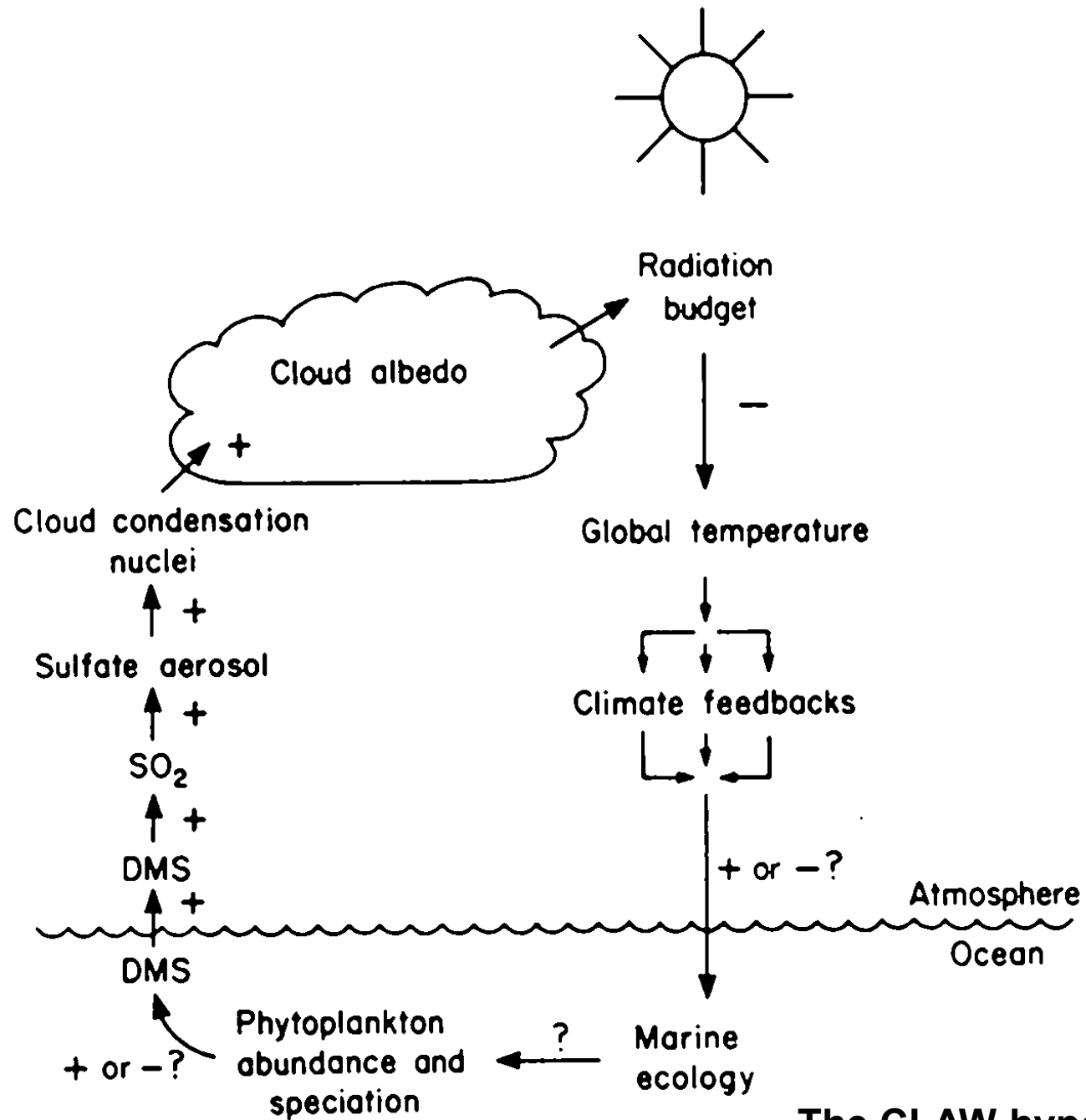
Steve **W**arren



C L A W

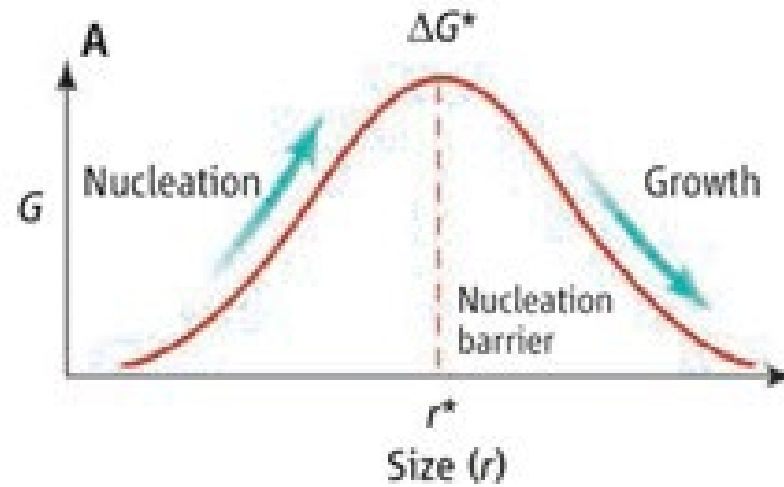
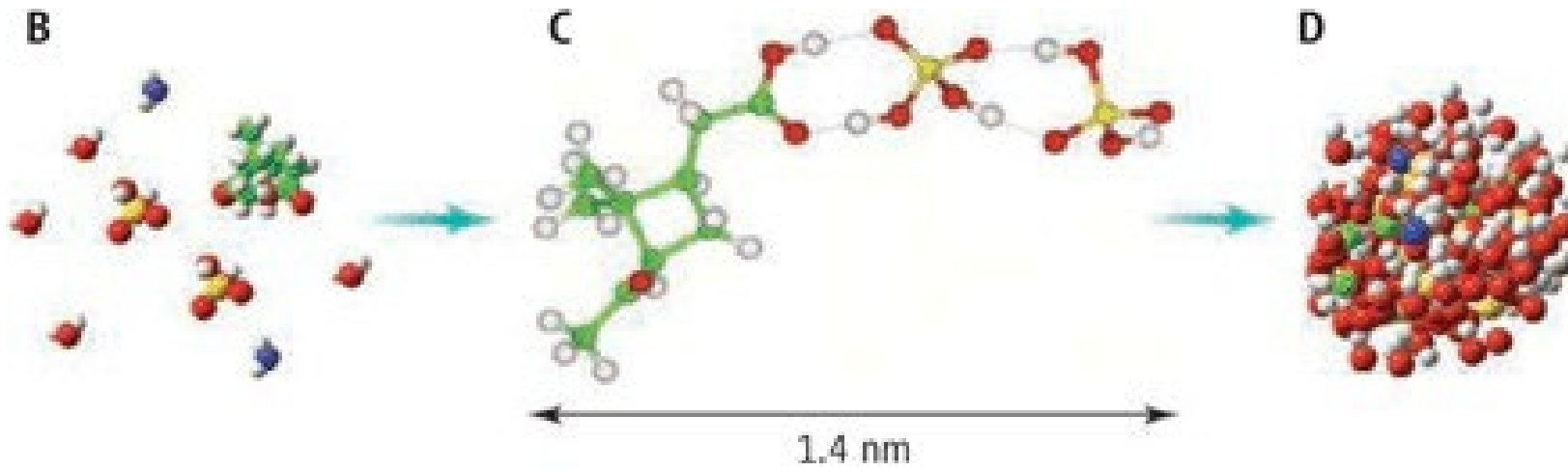
Dimethyl sulphide (DMS)



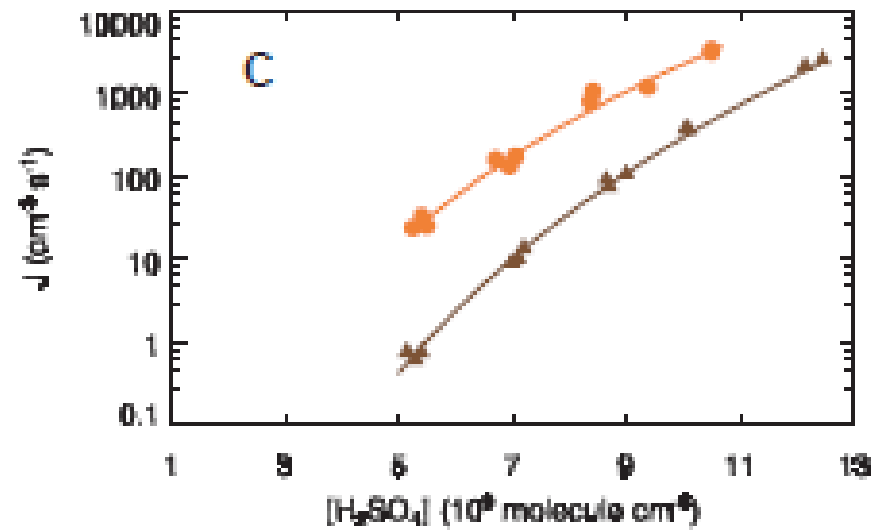
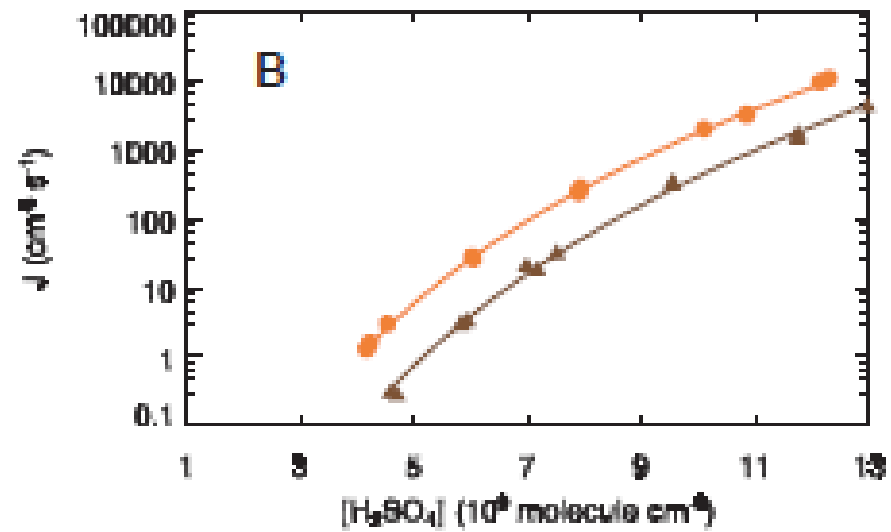
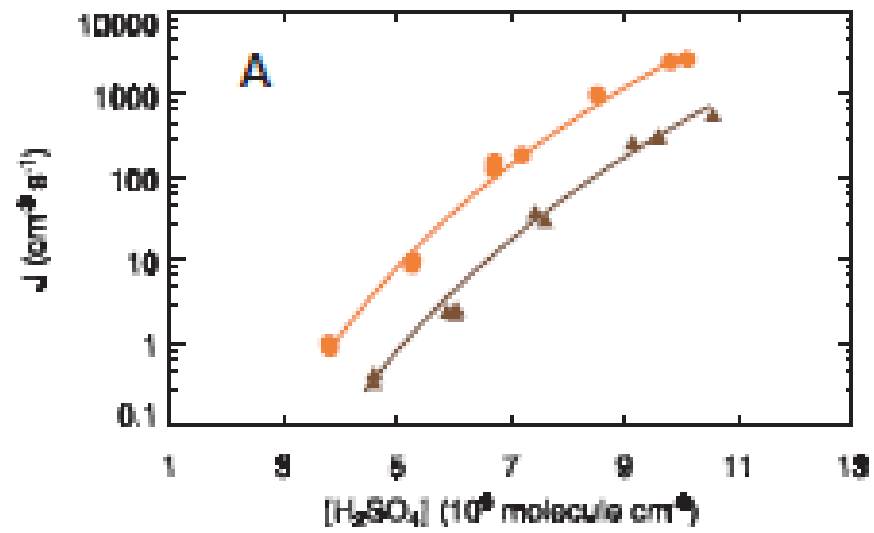


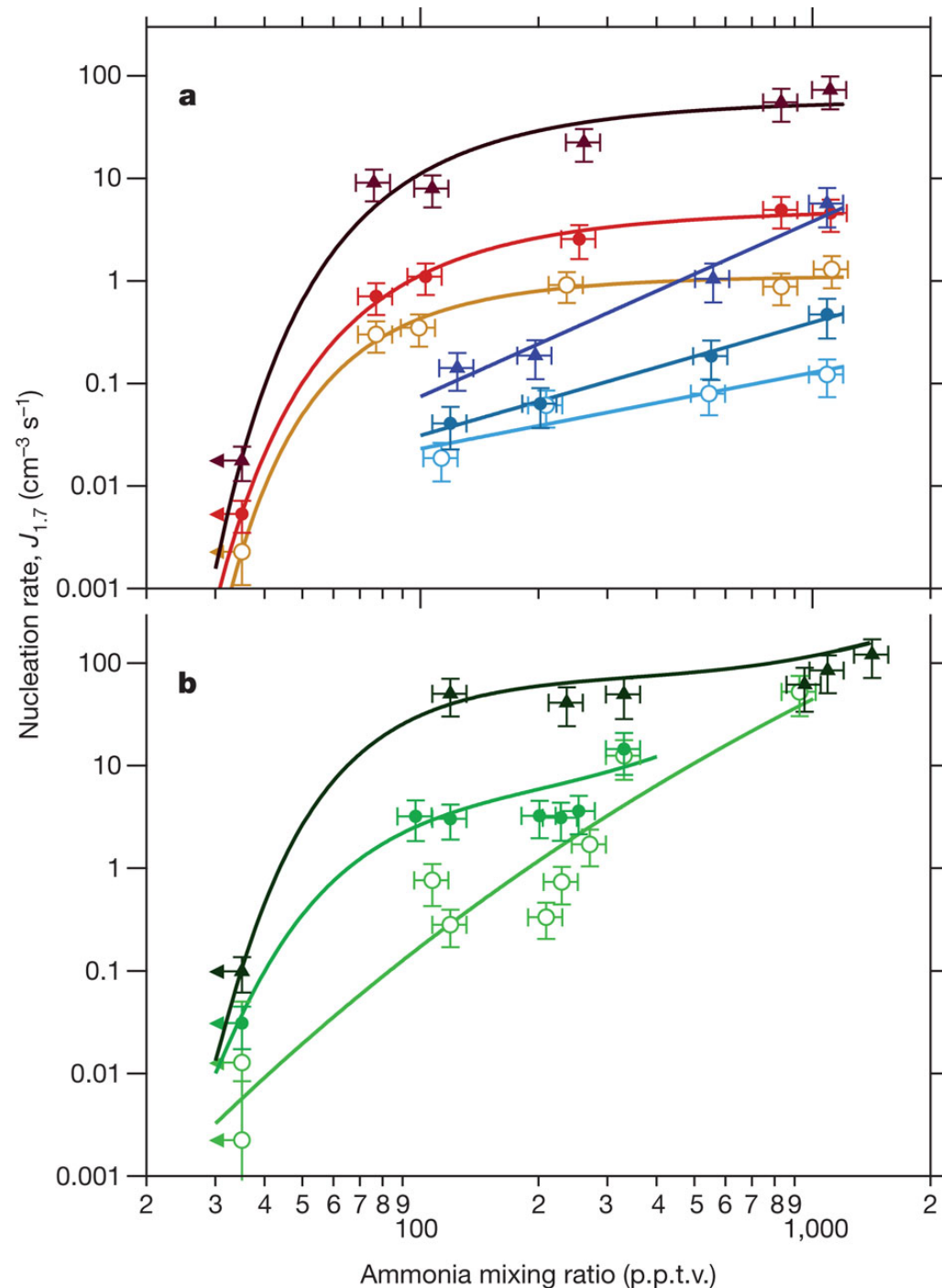
The CLAW hypothesis 1987

Organics-assisted aerosols.



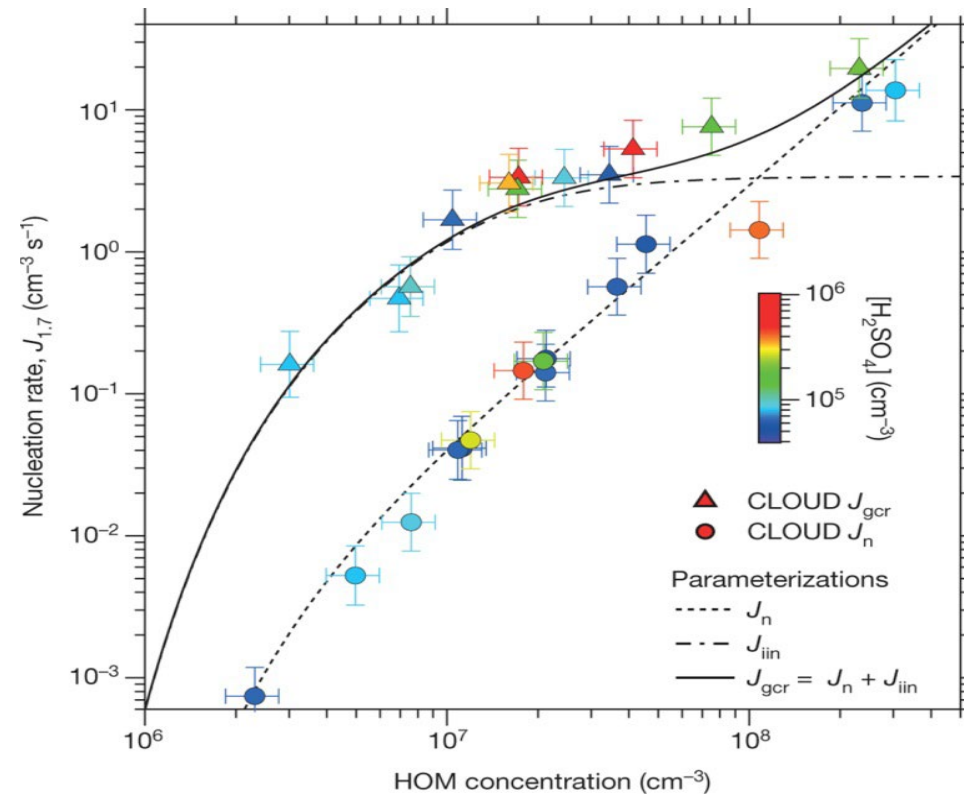
R Zhang Science 2010;328:1366-1367





Kirkby et al. 2011

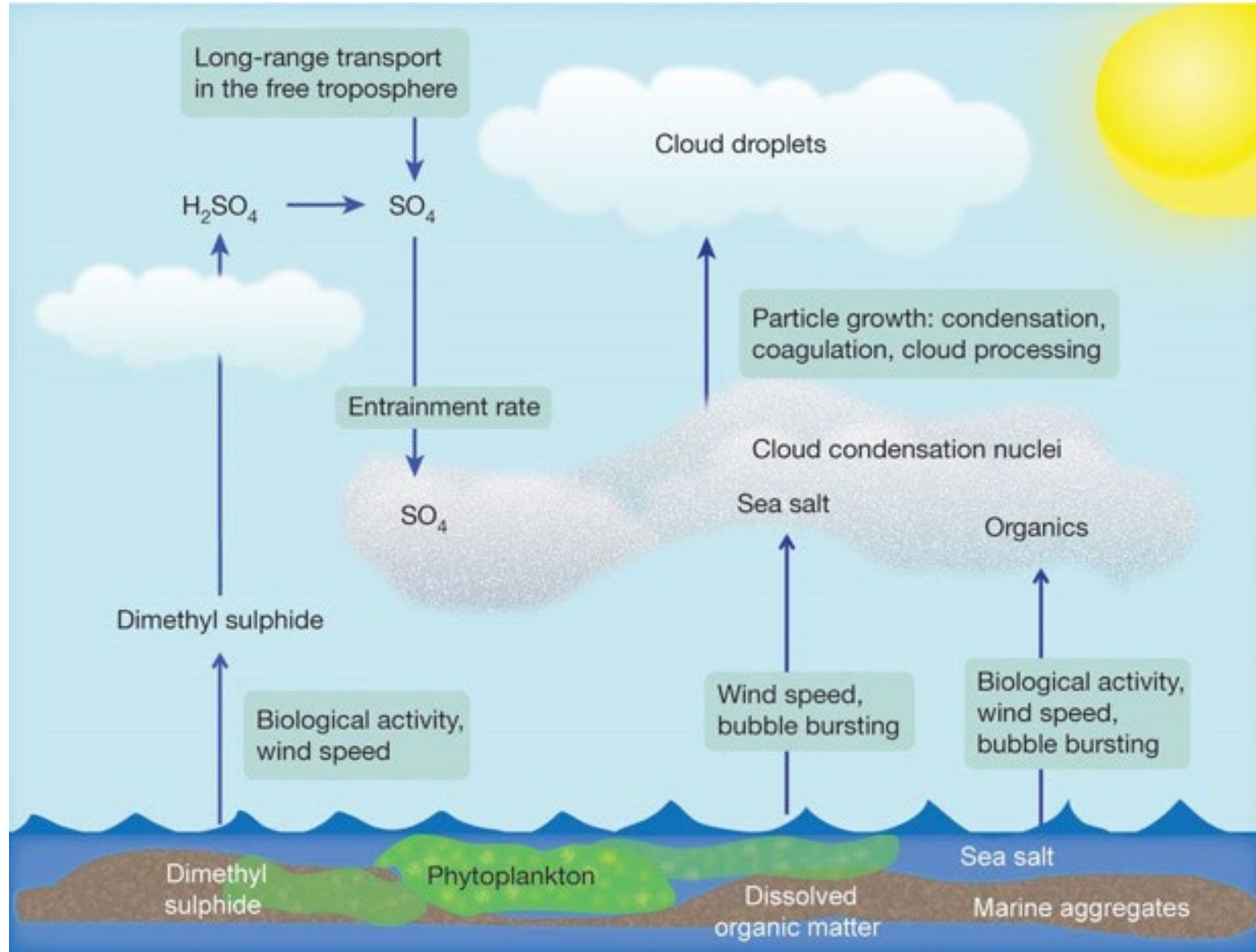
Pure biogenic nucleation rates versus HOM concentration

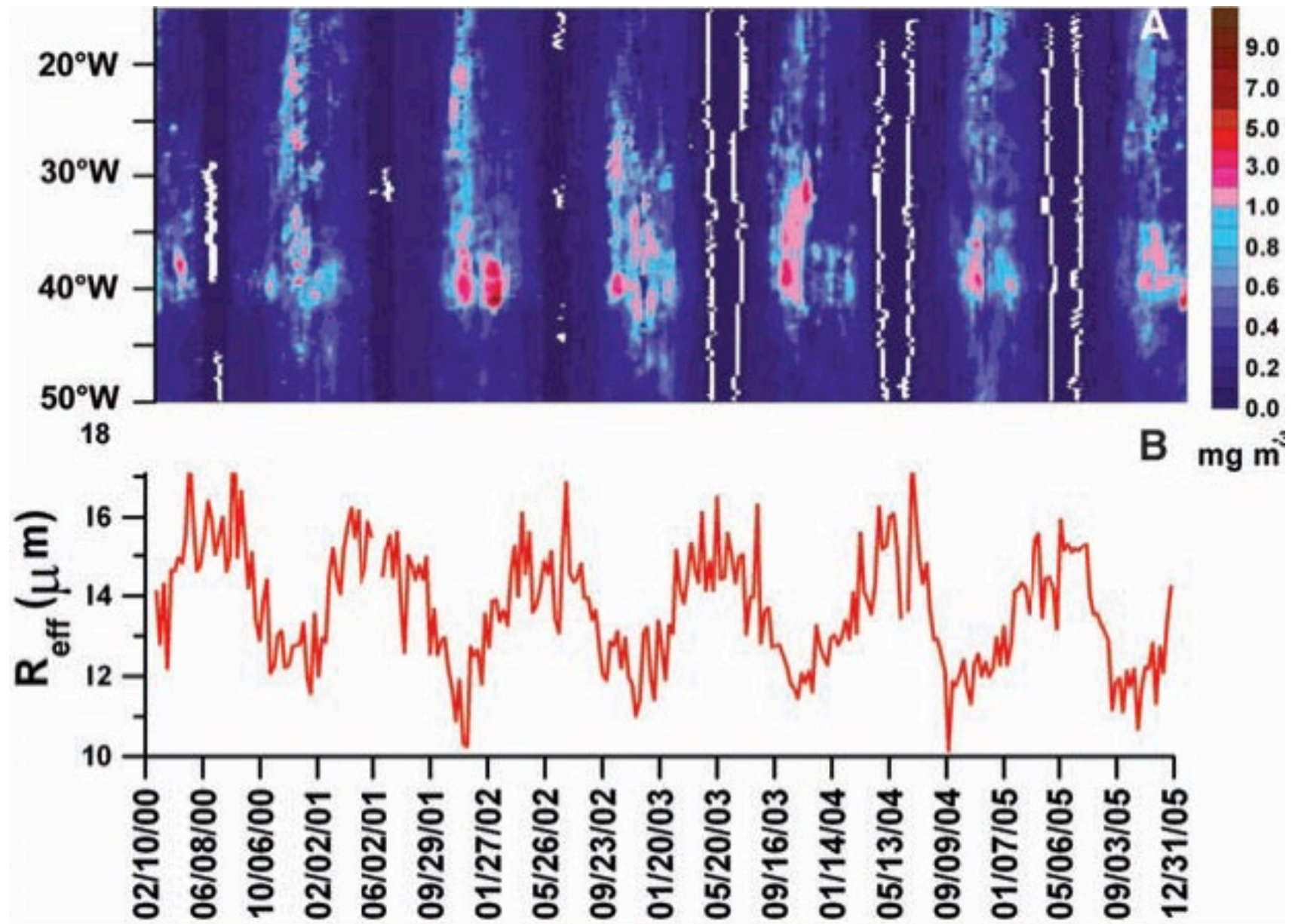


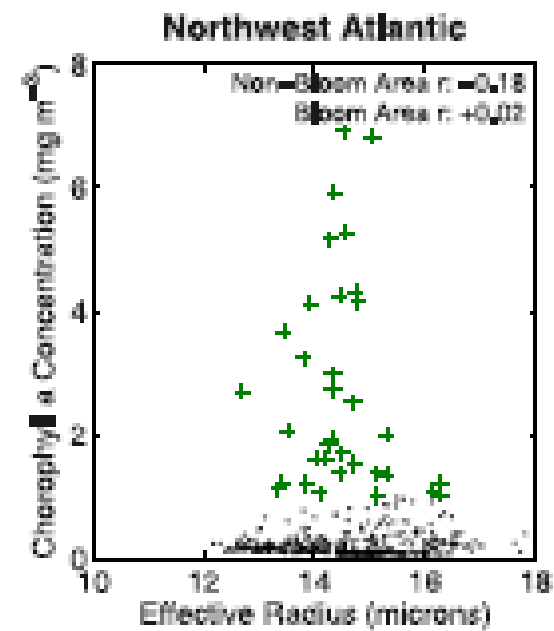
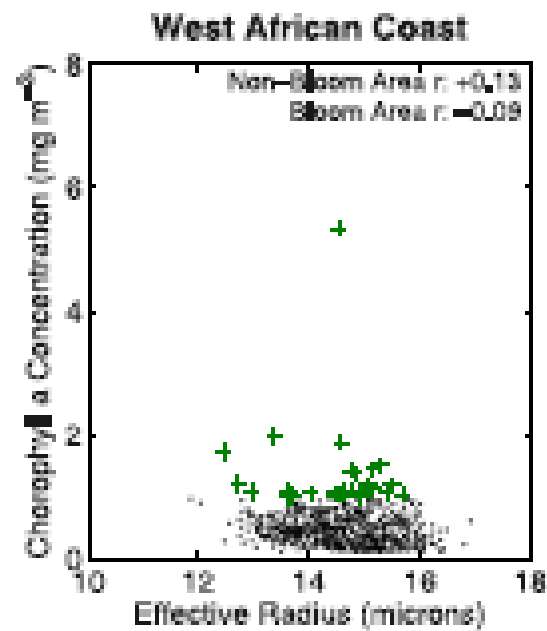
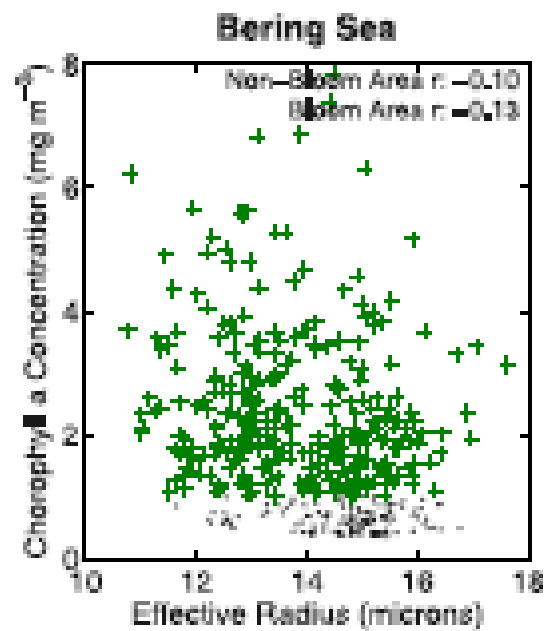
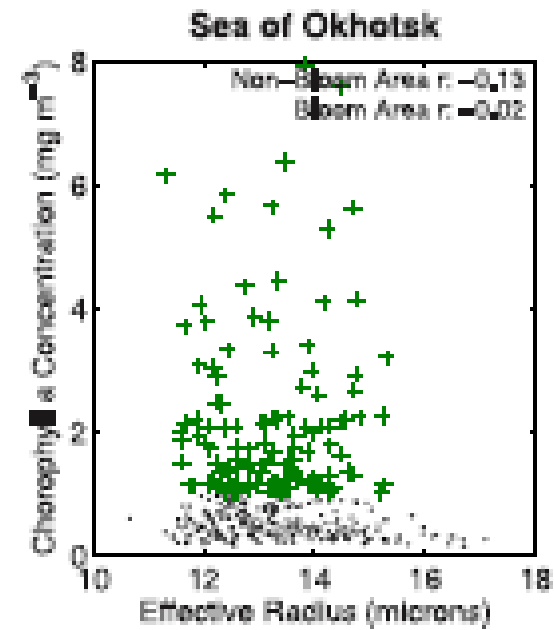
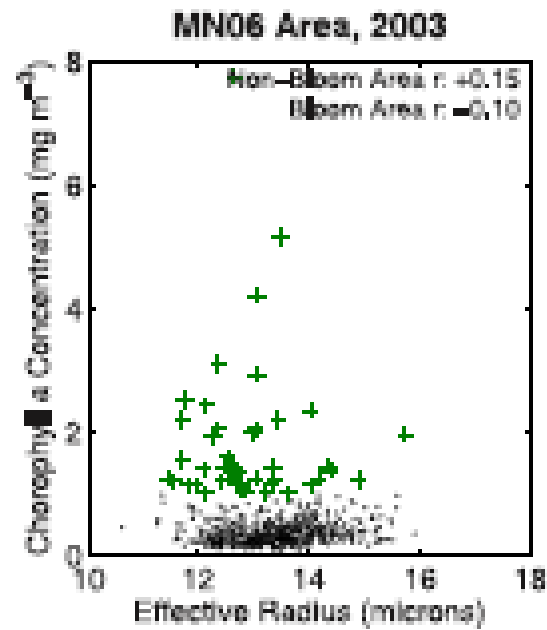
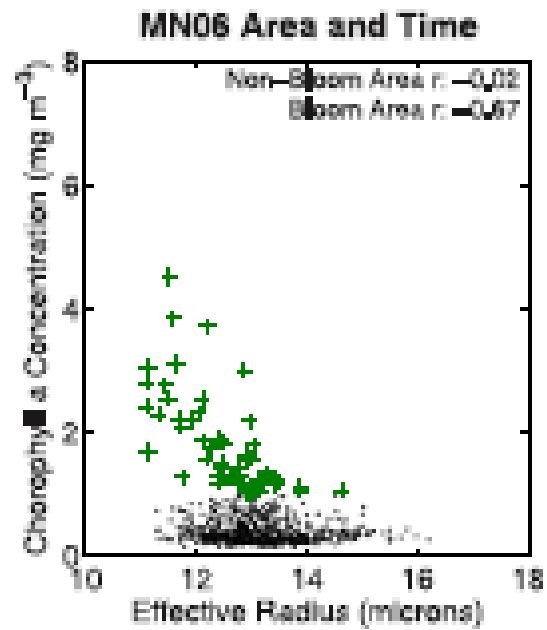
Quinn and Bates

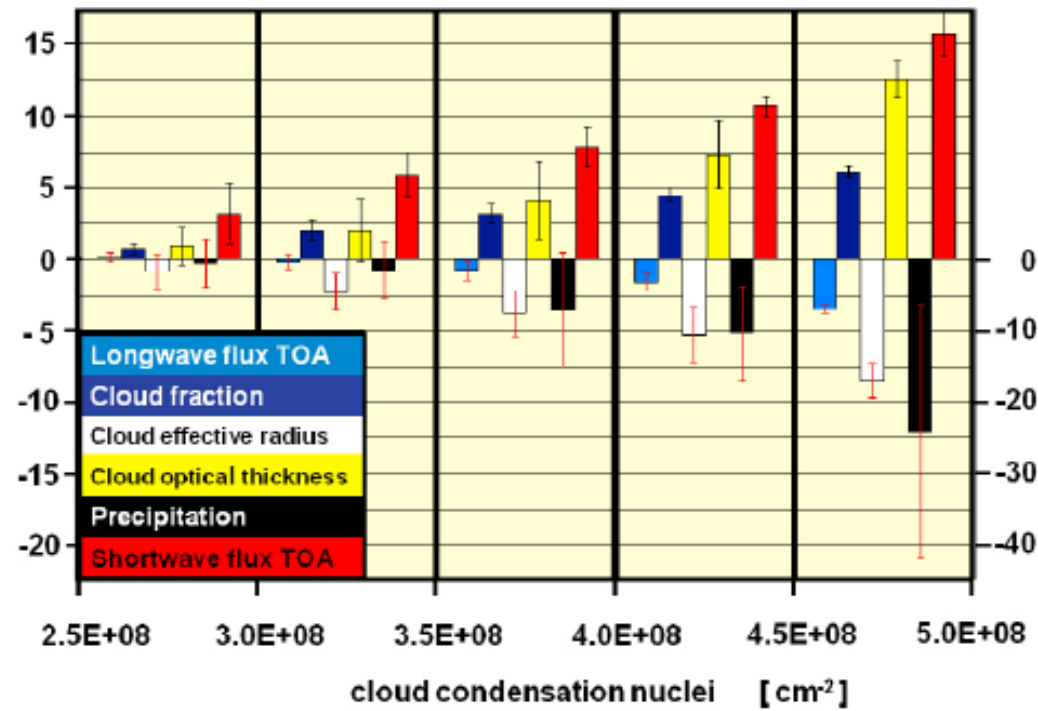
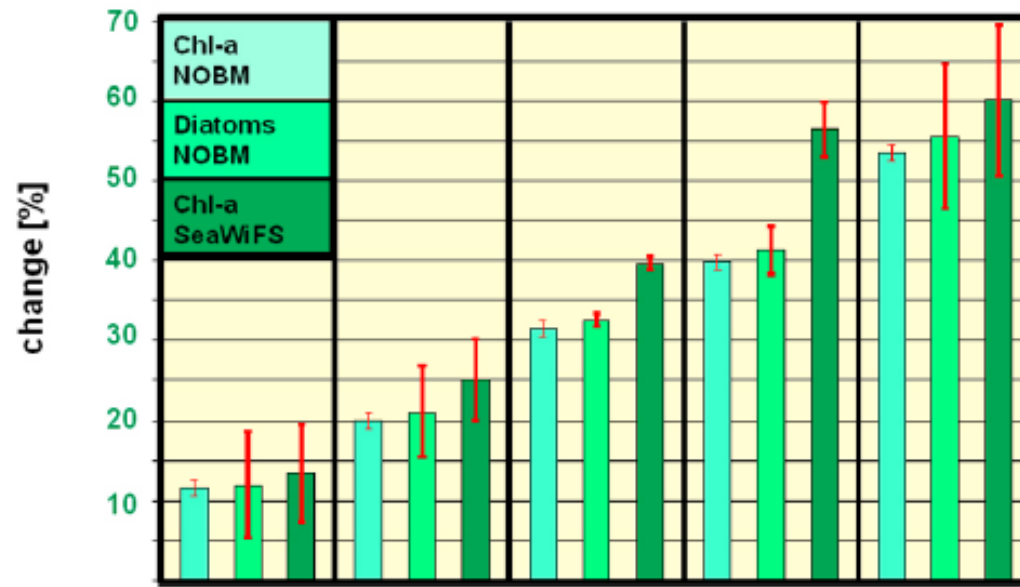
Nature volume 480, pages 51–56 (2011)

- ‘These results indicate that it is time to retire the CLAW hypothesis.’

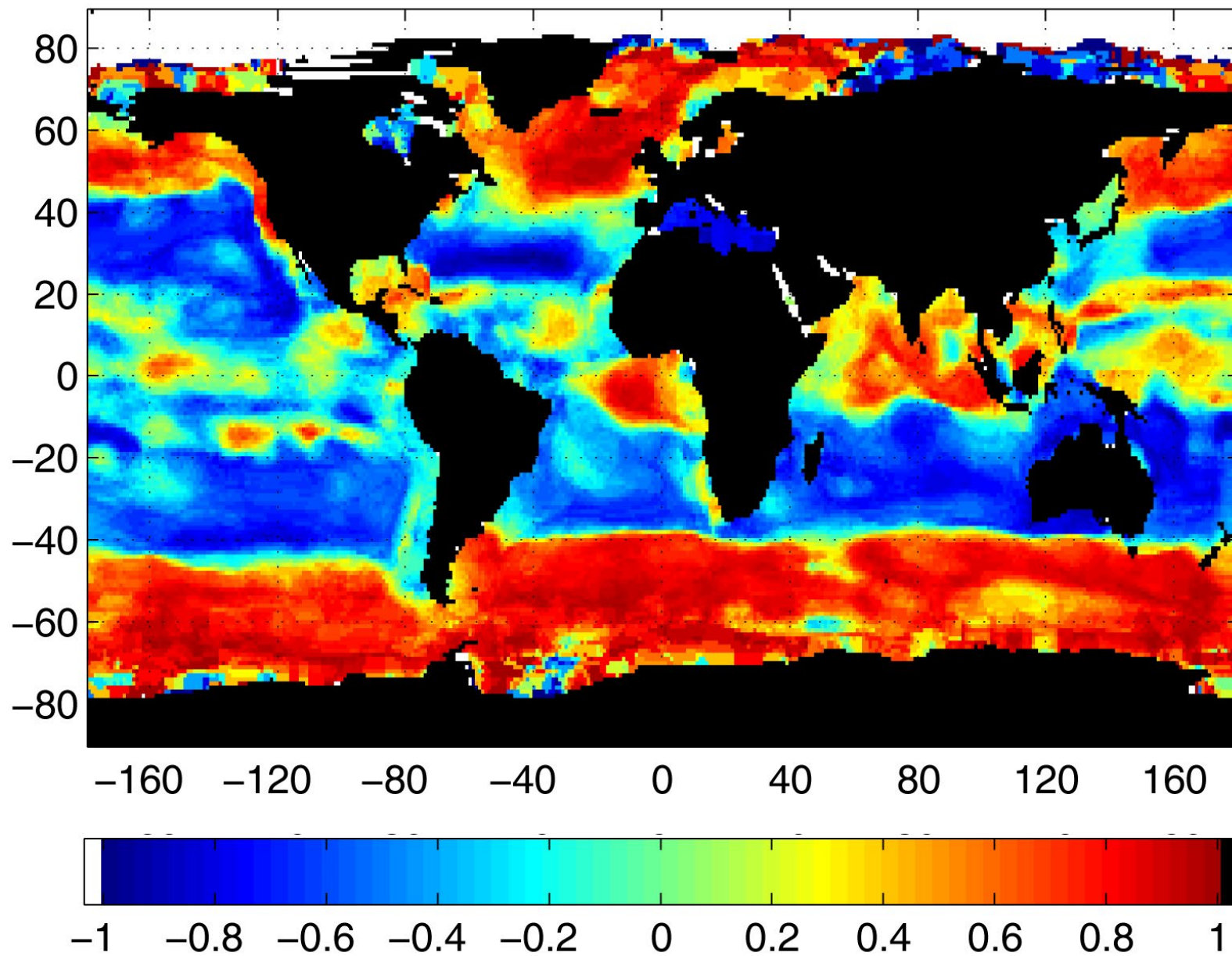






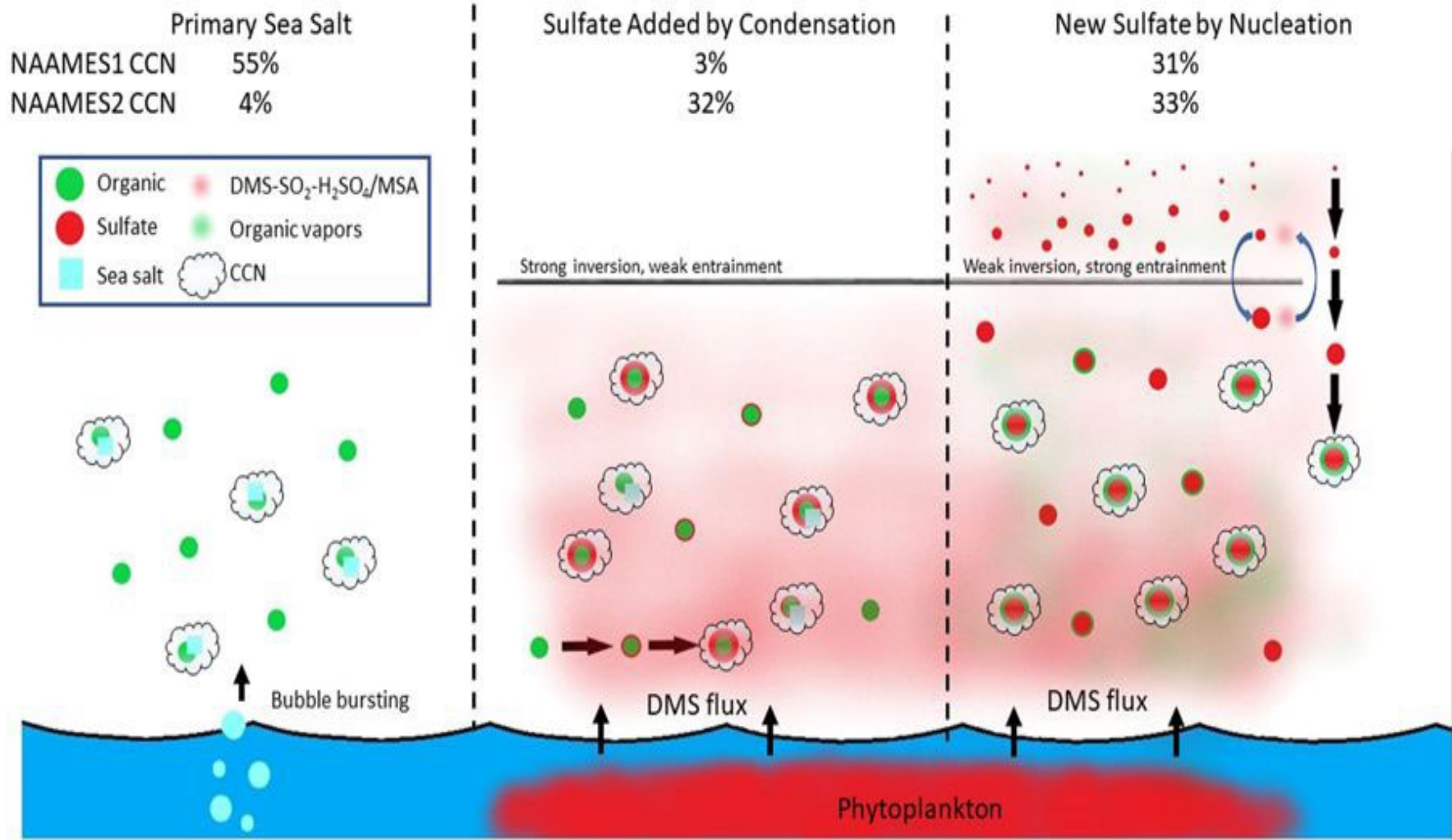


L10 vs CHLA

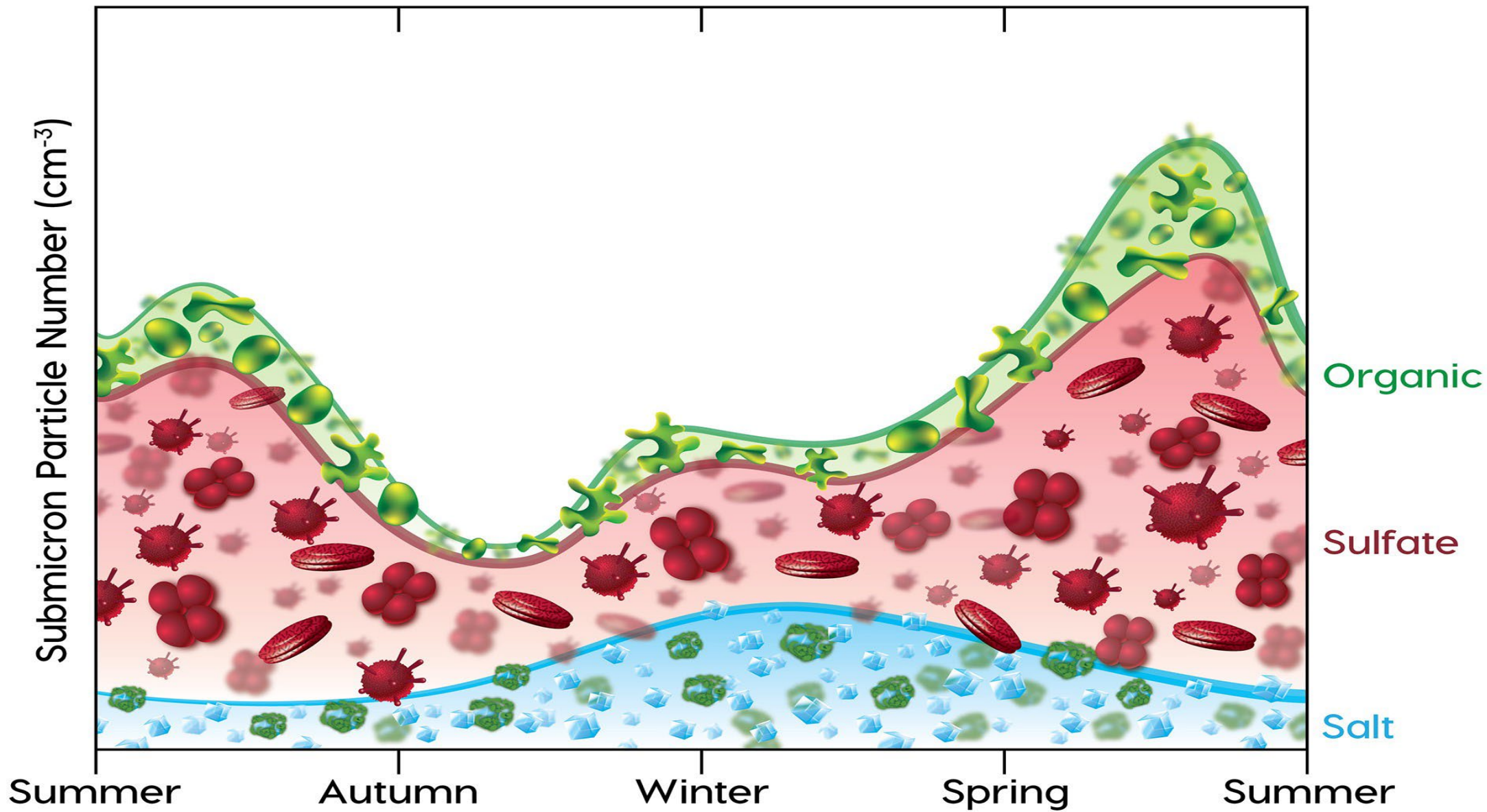


'league table' of production of DMSP (and so DMS) by phytoplankton

- Diatoms <
- *Gyrodinium* <
- *Phaeocystis* <
- *Coccolithophores* (e.g. *Emiliana huxleyi*)
- A factor of order 20 spanning the highest to the lowest



Sanchez et al. 2018



As well as Sulphur:

Halogens (I)

Selenium,

Ammonia, Urea, Amines

Glyoxal

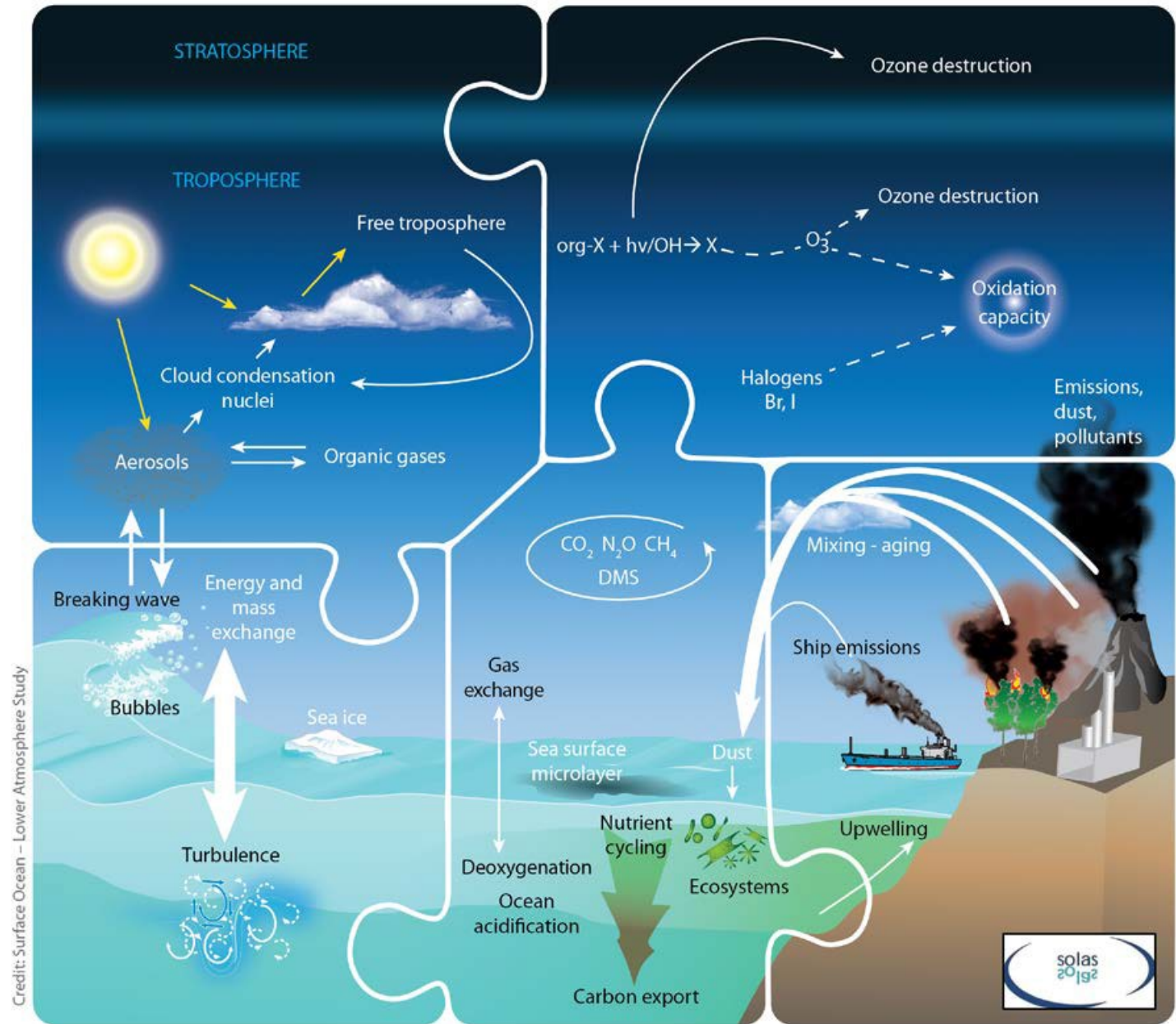
Hydrocarbons

OVOCs

Isoprene

Urea, Amines

CO₂



“Even if CLAW turns out to be utterly irrelevant climatically, it will leave a rich and fundamentally important legacy in our perception of how the world works and the way we need to do our science in order to understand it.”

So, is CLAW Dead?

- Evidence for the formation of biogenic particles has grown stronger.
- Evidence for biological climate control is still very uncertain (+/-/?) due to complexity of the system with many feedbacks but CLAW does not appear to be a strong feedback.
- Importance of biogenic particle formation with impact on new particle formation, cloud albedo, oxidative capacity of the marine atmosphere, global cycling of several elements (S, Se, I).

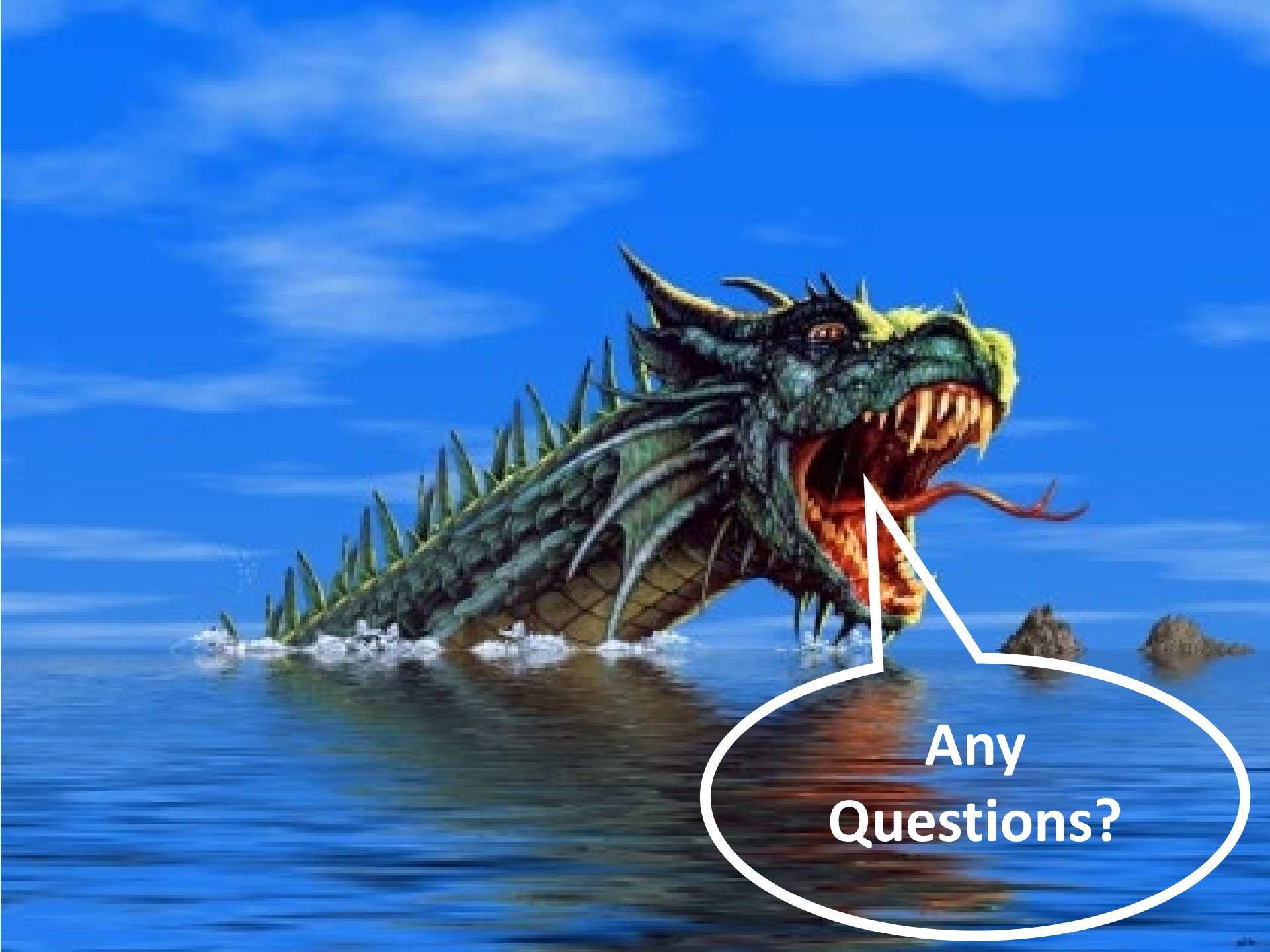
My Plymouth Family!

Phil Nightingale

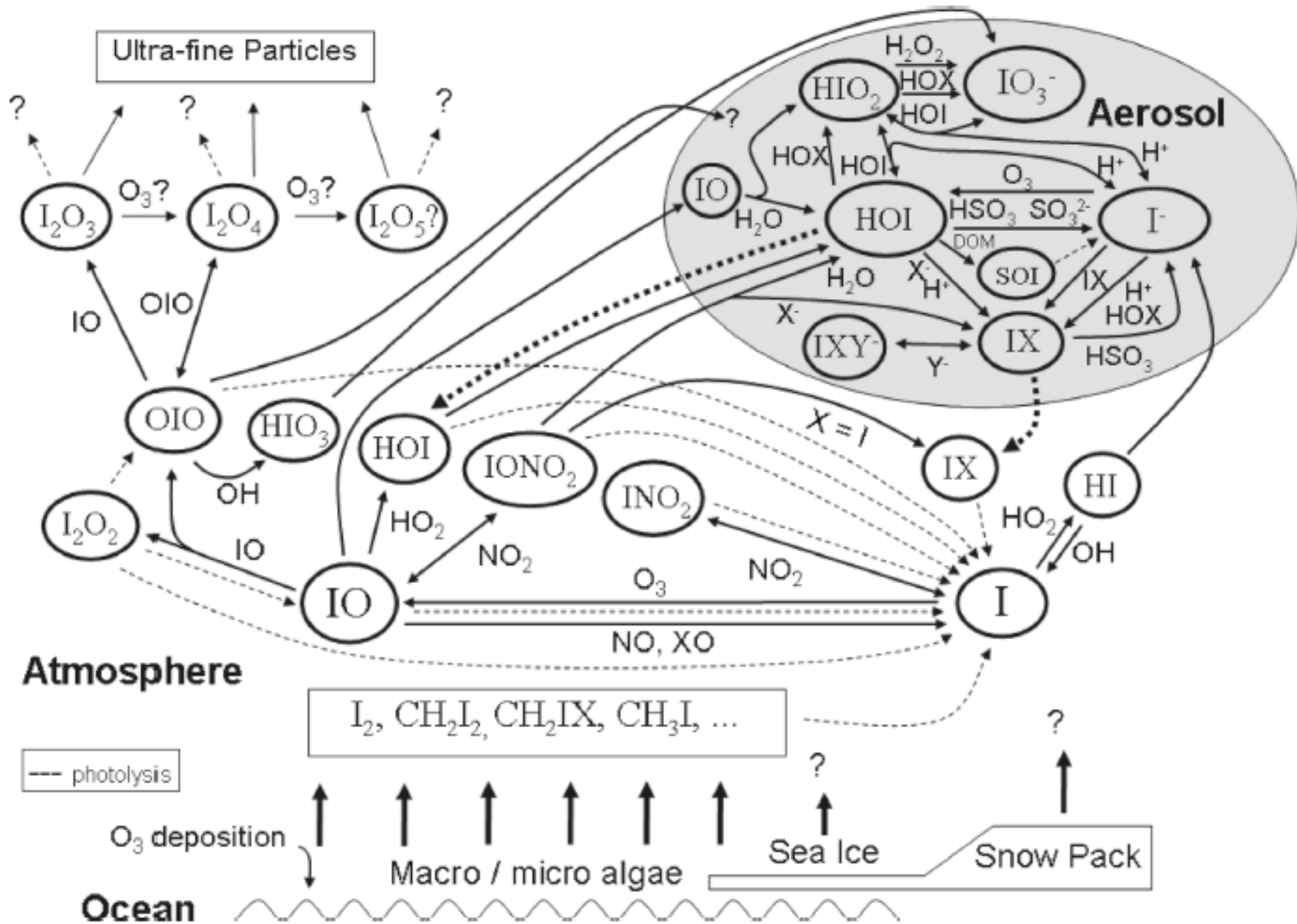
Valia Avgoustidi, Tom Bell, Frankie Hopkins, Rachael Beale

Daniel Phillips, Yuanxu Dong

(Mingxi Yang)



Any
Questions?



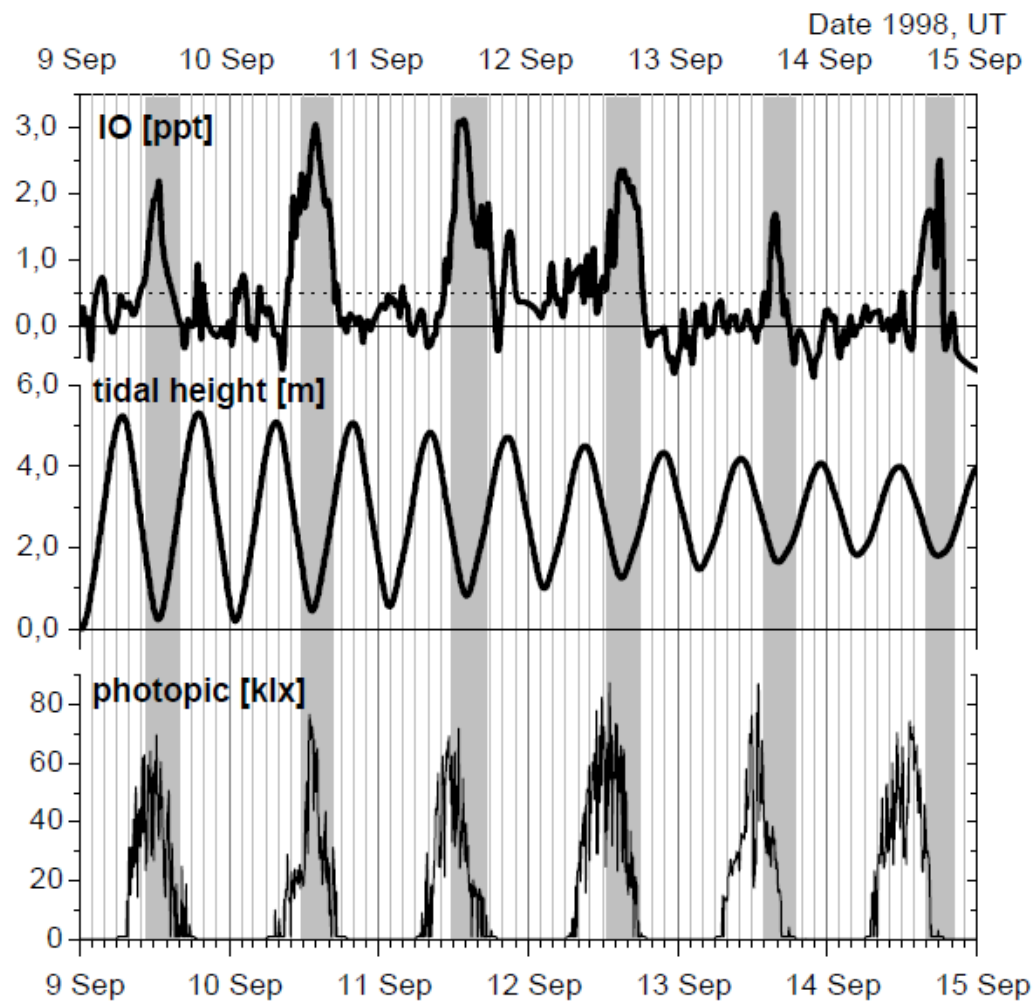
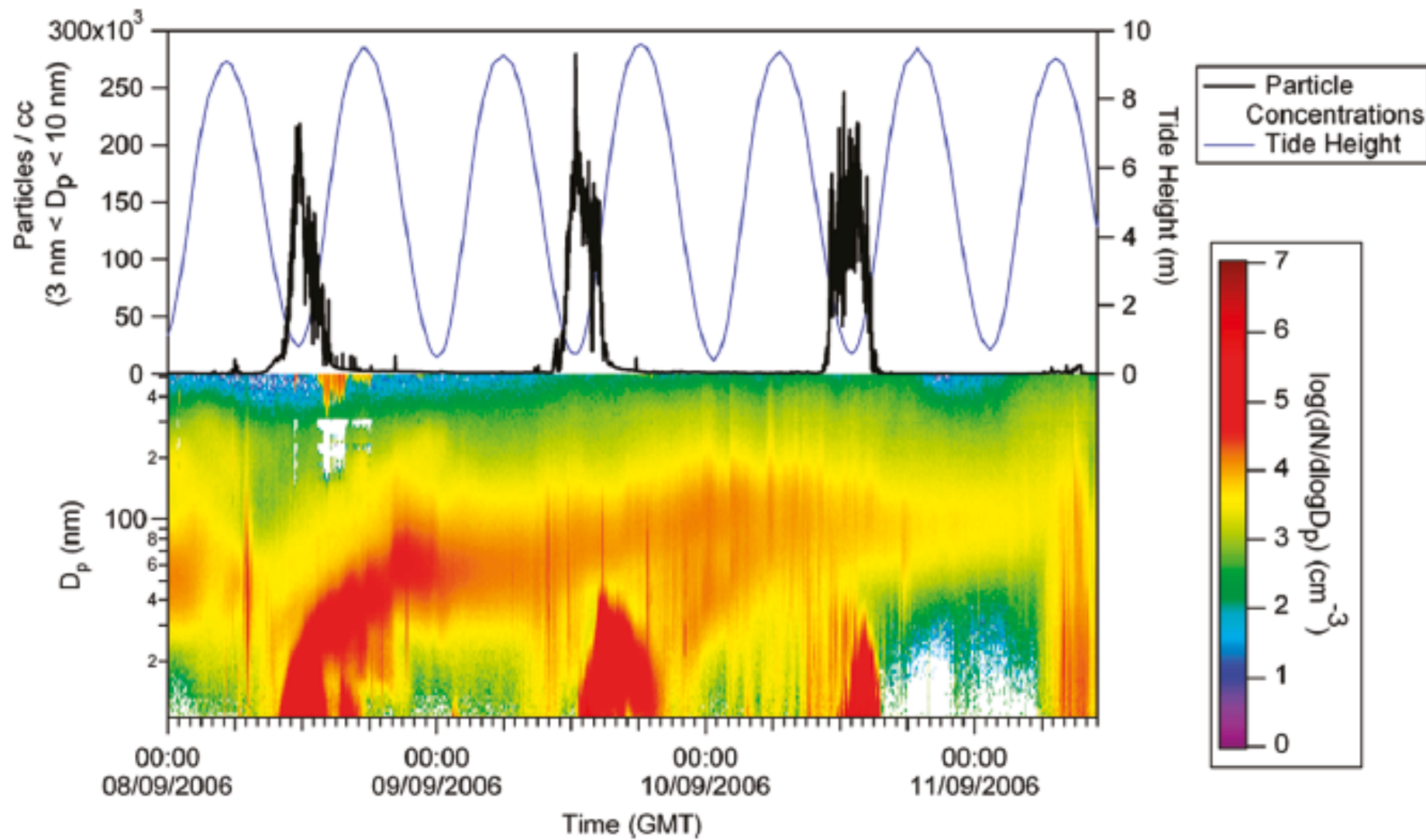
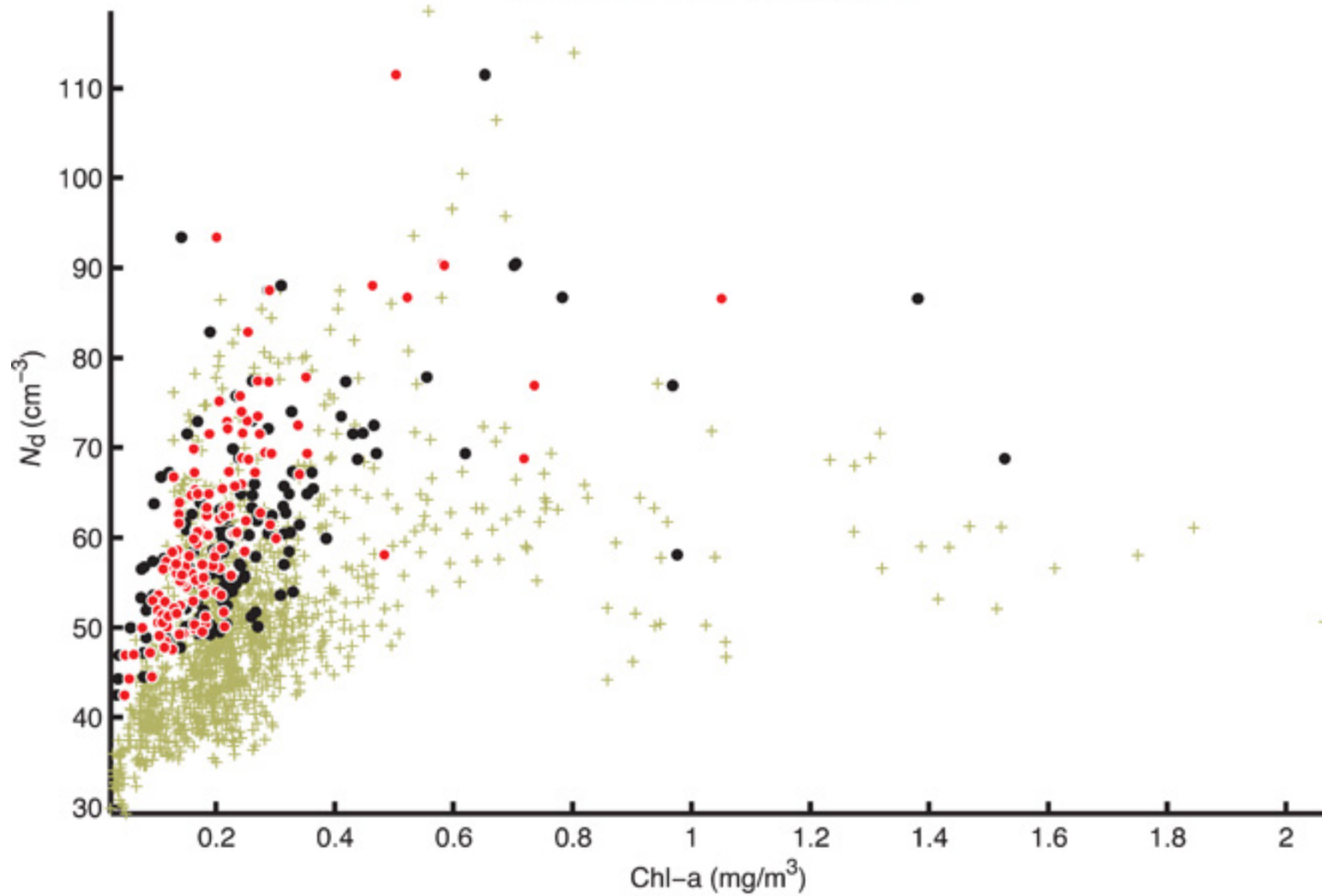


Fig. 1. IO, tidal height and solar radiation during 9–15 September, 1998. The dotted line on the IO graph represents the average detection limit. The grey areas mark the low tide periods.



Sept–April mean N_d versus Chl-a



- N_d (2007)–Chl-a (2007) $\rho = 0.76$
- N_d (2007)–Chl-a (2001–2009) $\rho = 0.63$
- + N_d (2001–2009, all SZA)–Chl-a (2001–2009) $\rho = 0.57 \pm 0.04$