

PML

Plymouth Marine
Laboratory

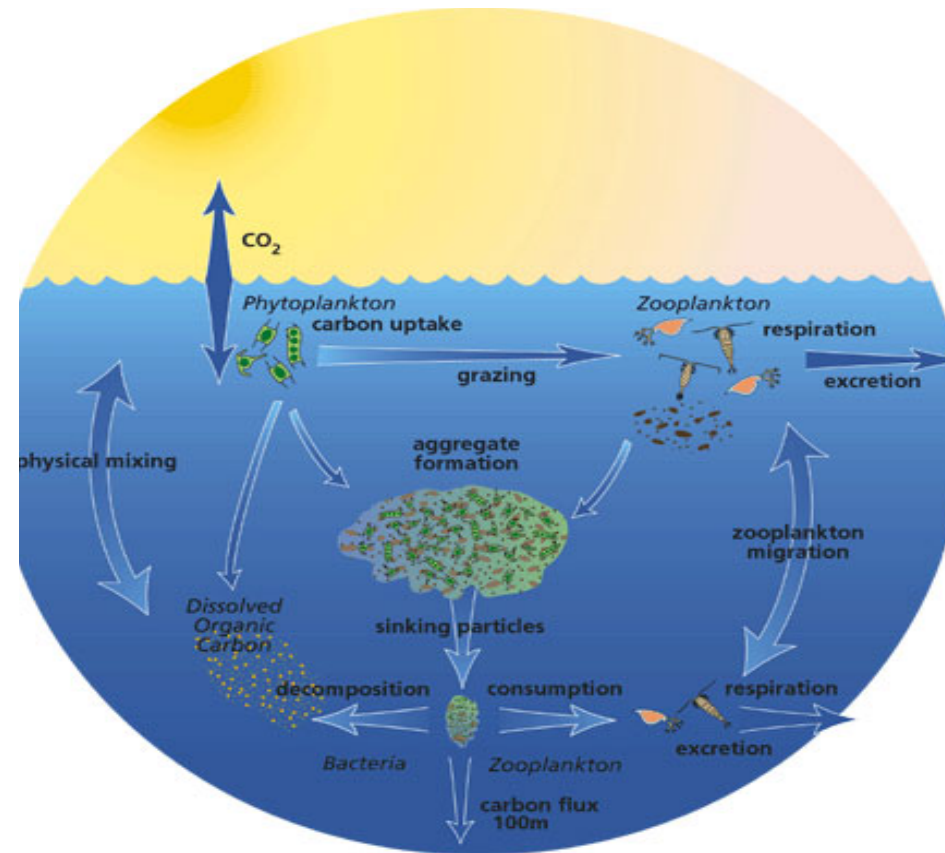
Listen to the ocean

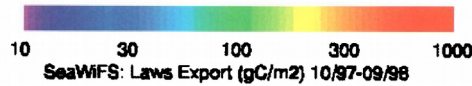
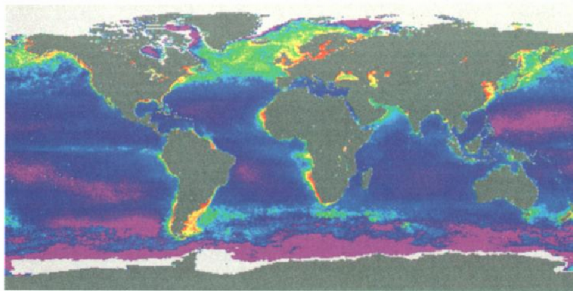
Is the Seasonal Mixed Layer Carbon Pump an Important Component of the Ocean Carbon Cycle?

Giorgio Dall'Olmo and James Dingle

Background

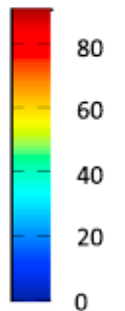
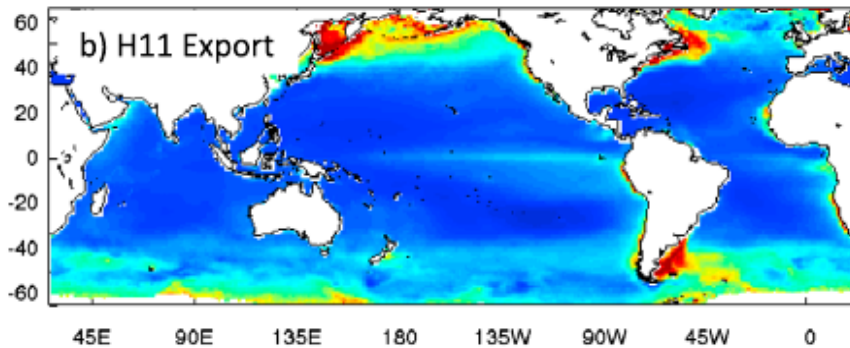
- Uptakes atm CO_2
- Without BCP, atm CO_2 50% higher [Parekh et al., 2006]
=> T of 2070
- Fuels deep-sea ecosystems
=> fisheries





Laws et al (2000)

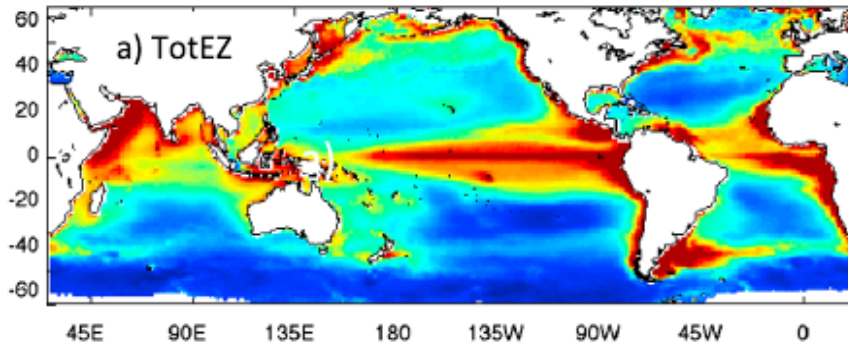
~**12** PgC/yr



mg C m⁻² d⁻¹

Henson et al (2011)

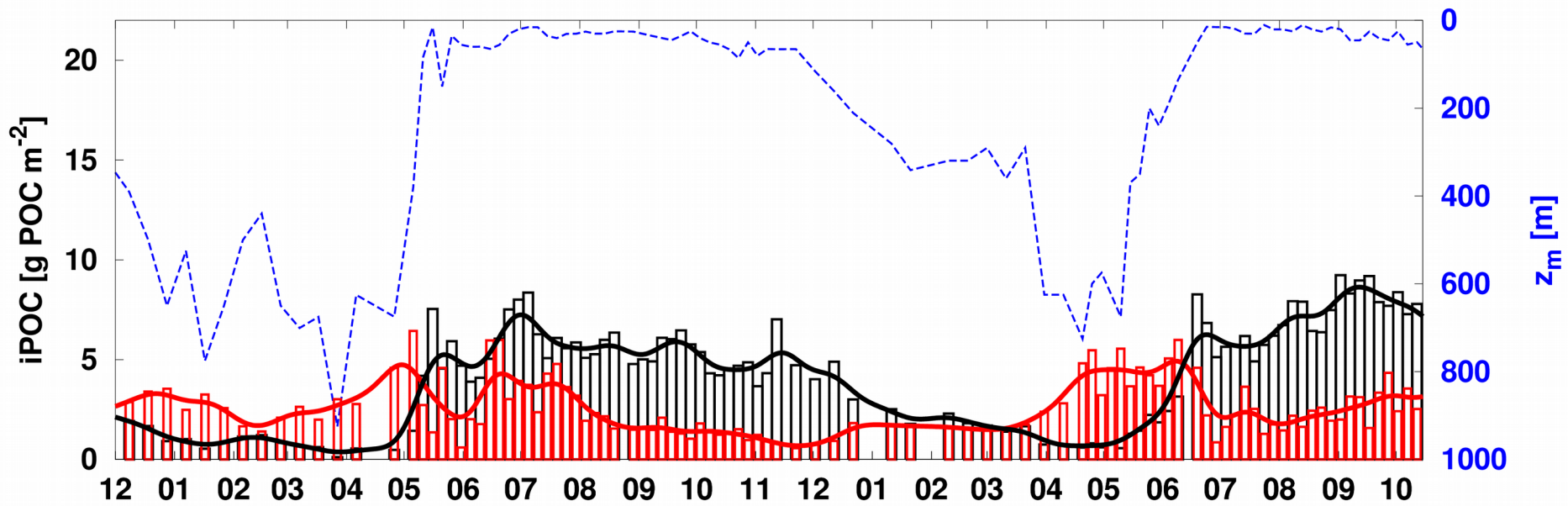
~**4** PgC/yr



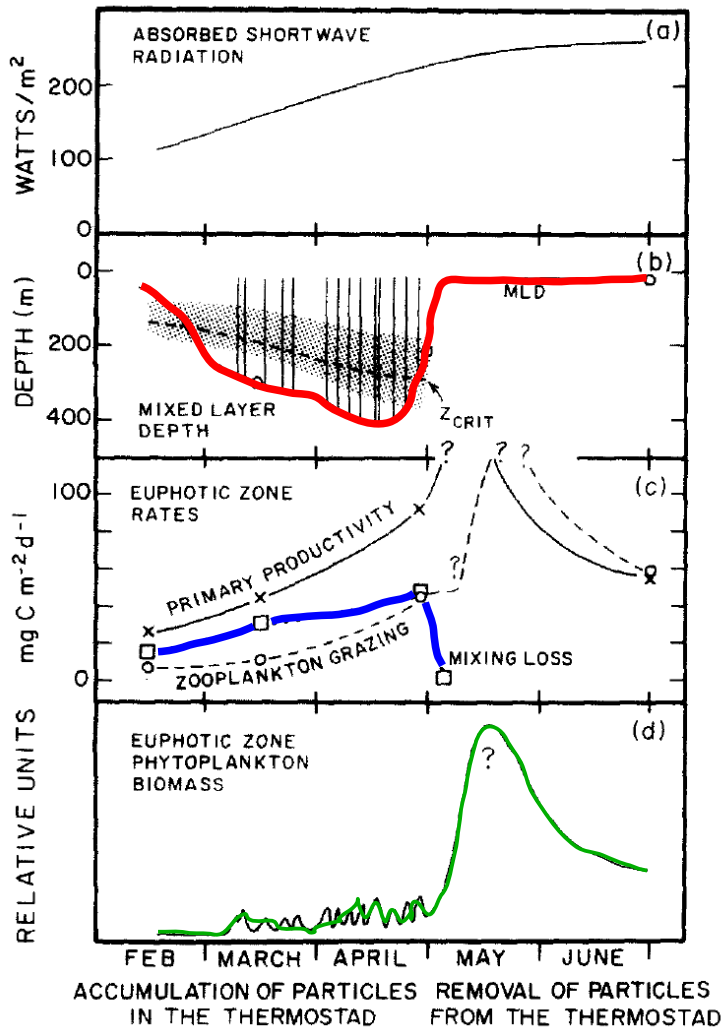
Siegel et al (2014)

~**6** PgC/yr

The seasonal Mixed-Layer Carbon Pump



[Dall'Olmo and Mork, 2014]



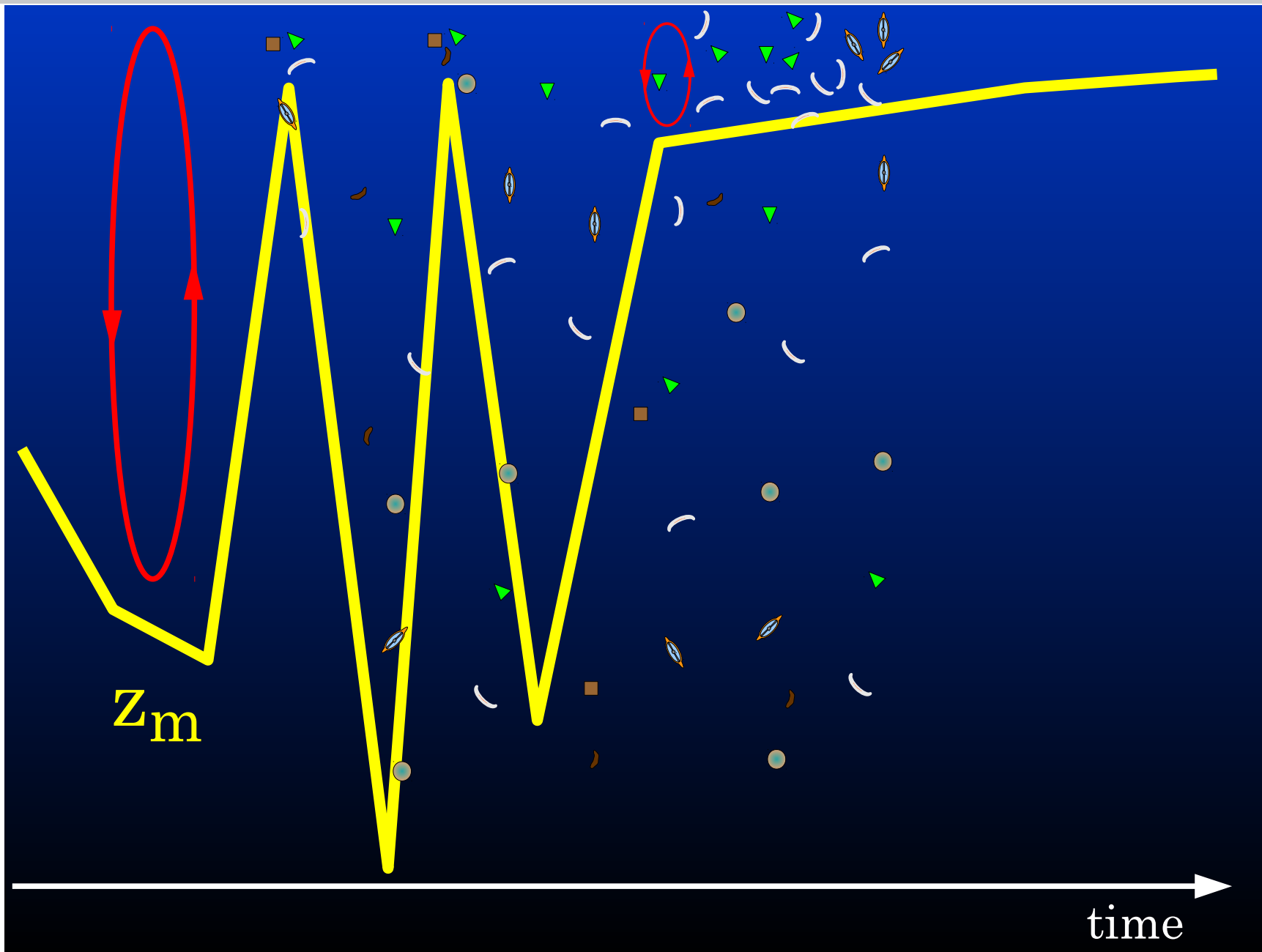
“... the particle concentration remained nearly constant in the euphotic zone, but increased between 50 and 400 m”

Because...

“... mixed layer convection in March and April removed a significant fraction of particles from the euphotic zone into the deep thermocline.”

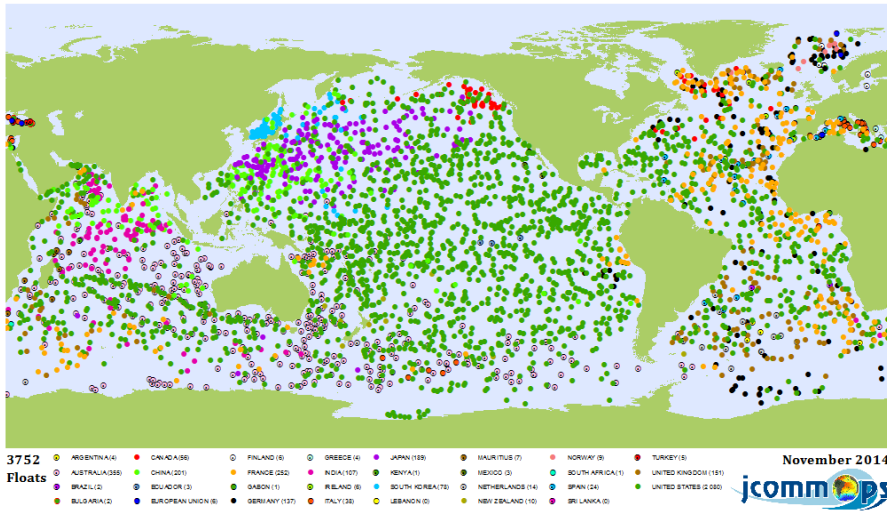
[Bishop et al., 1986]

The Mixed-Layer Carbon Pump

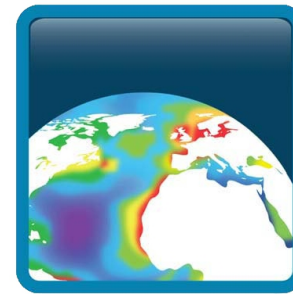
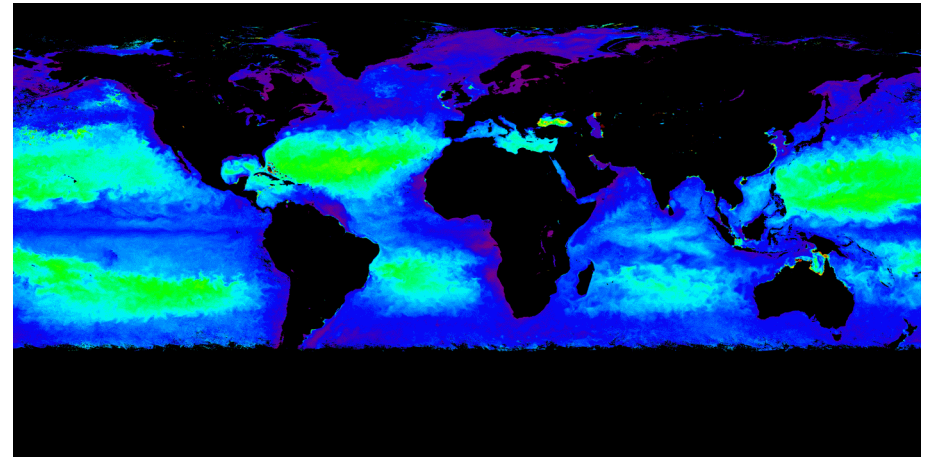


Methods

Mixed Layer Depth



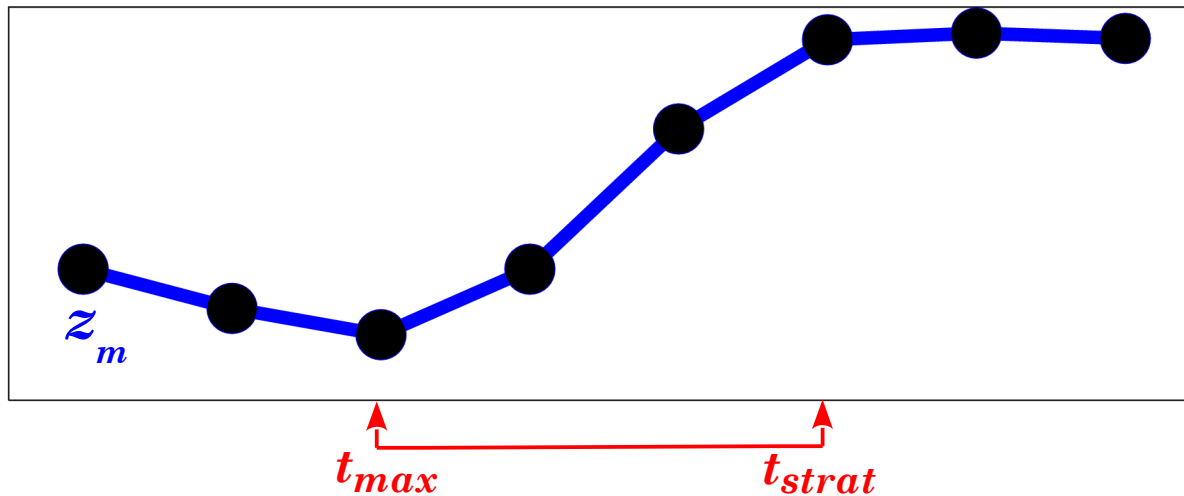
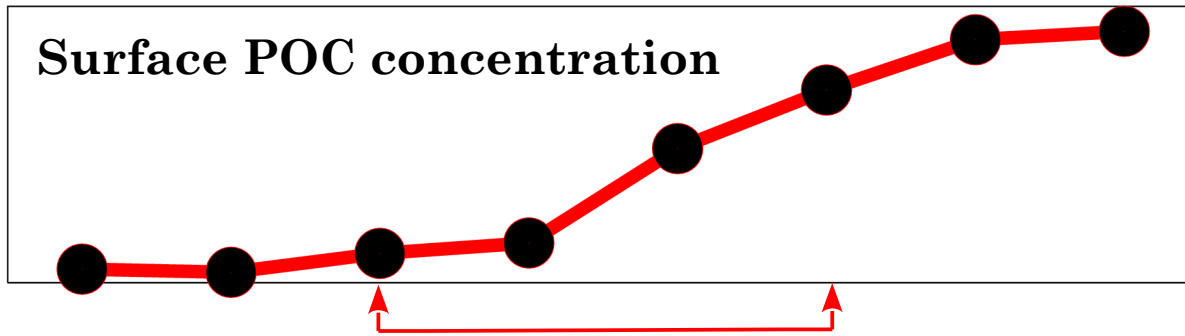
Particulate Organic Carbon



8-day 4 km

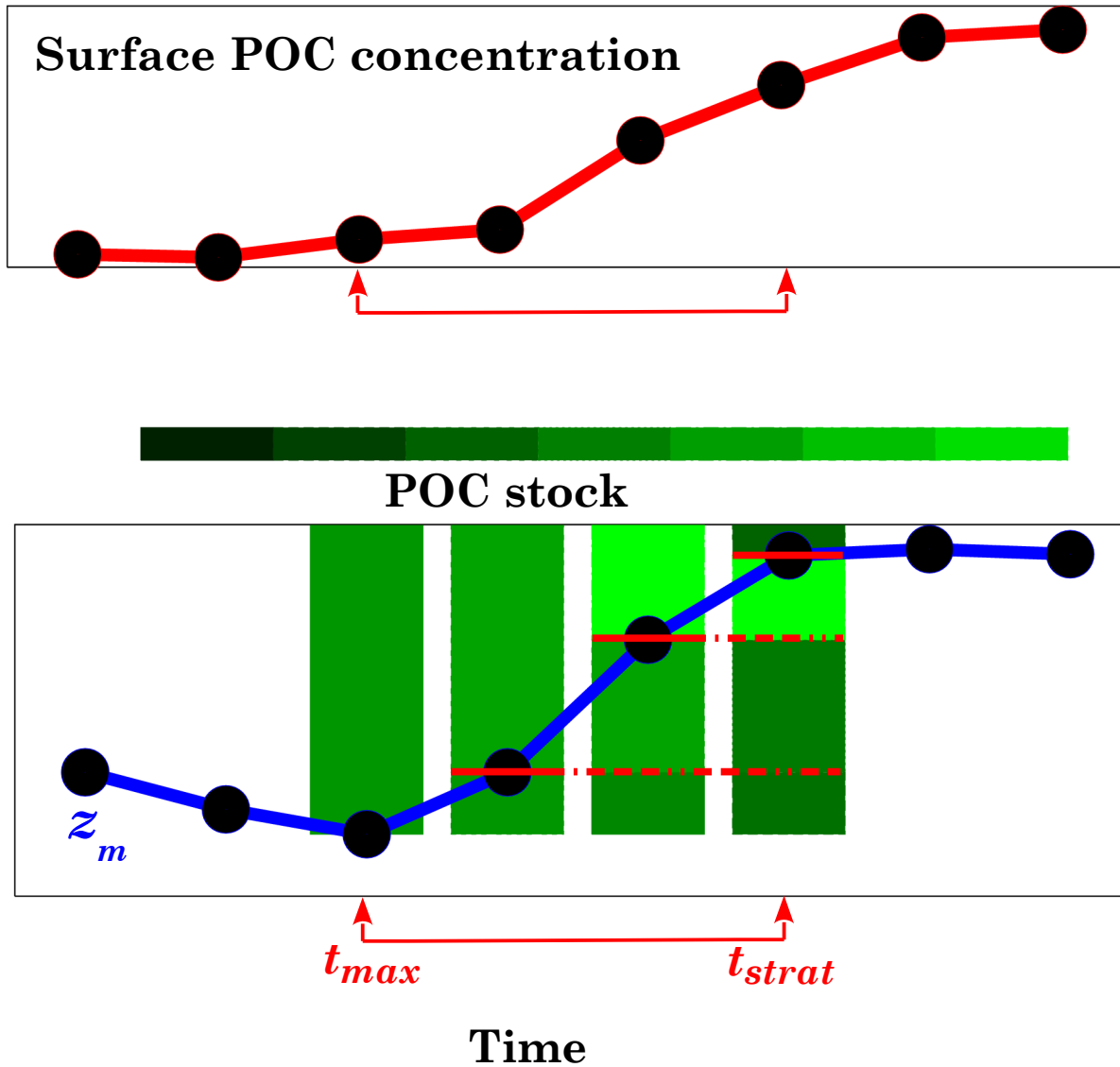
- Compute z_m : density algorithm [*Holte and Talley, 2009*]
- For each year: find z_{max} and t_{max}
- Find shoaling: $\{t: \Delta z_m > 0.5(z_{max} - z_{min})\}$
- Find z_{strat} and t_{strat} : $\{t(30d): \Delta z_m > 0.2z_{max}/10d\}$
- Compute mean POC from 8x8 grid [*Stramski et al. 2008*]
- Compute export only if all POC data between t_{max} and t_{strat} are available

Computing export (2)

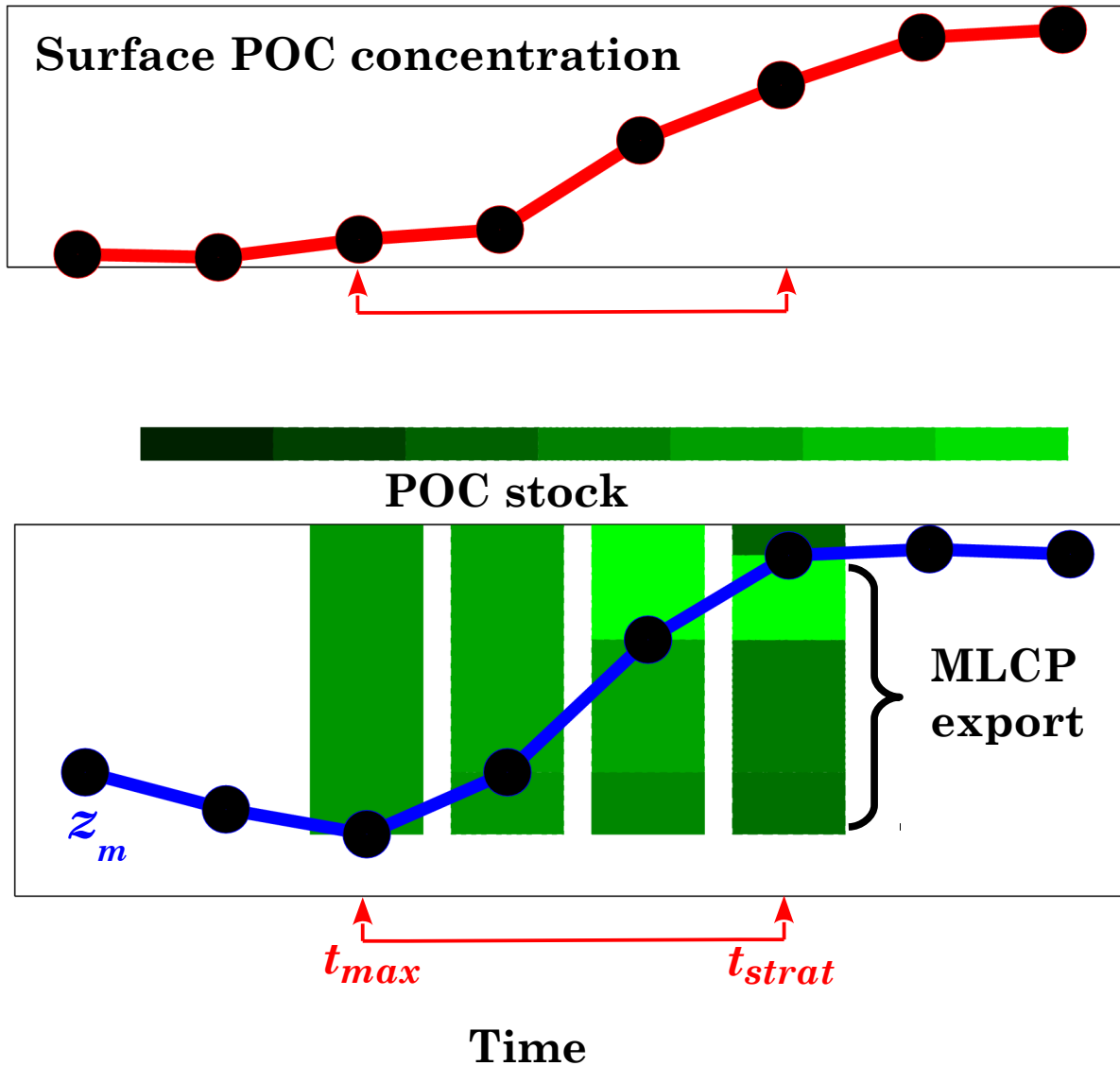


Time

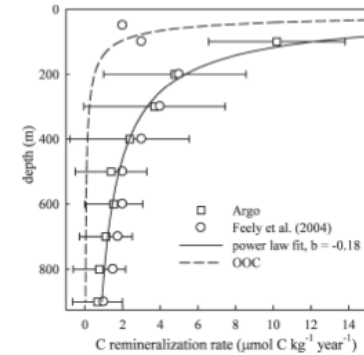
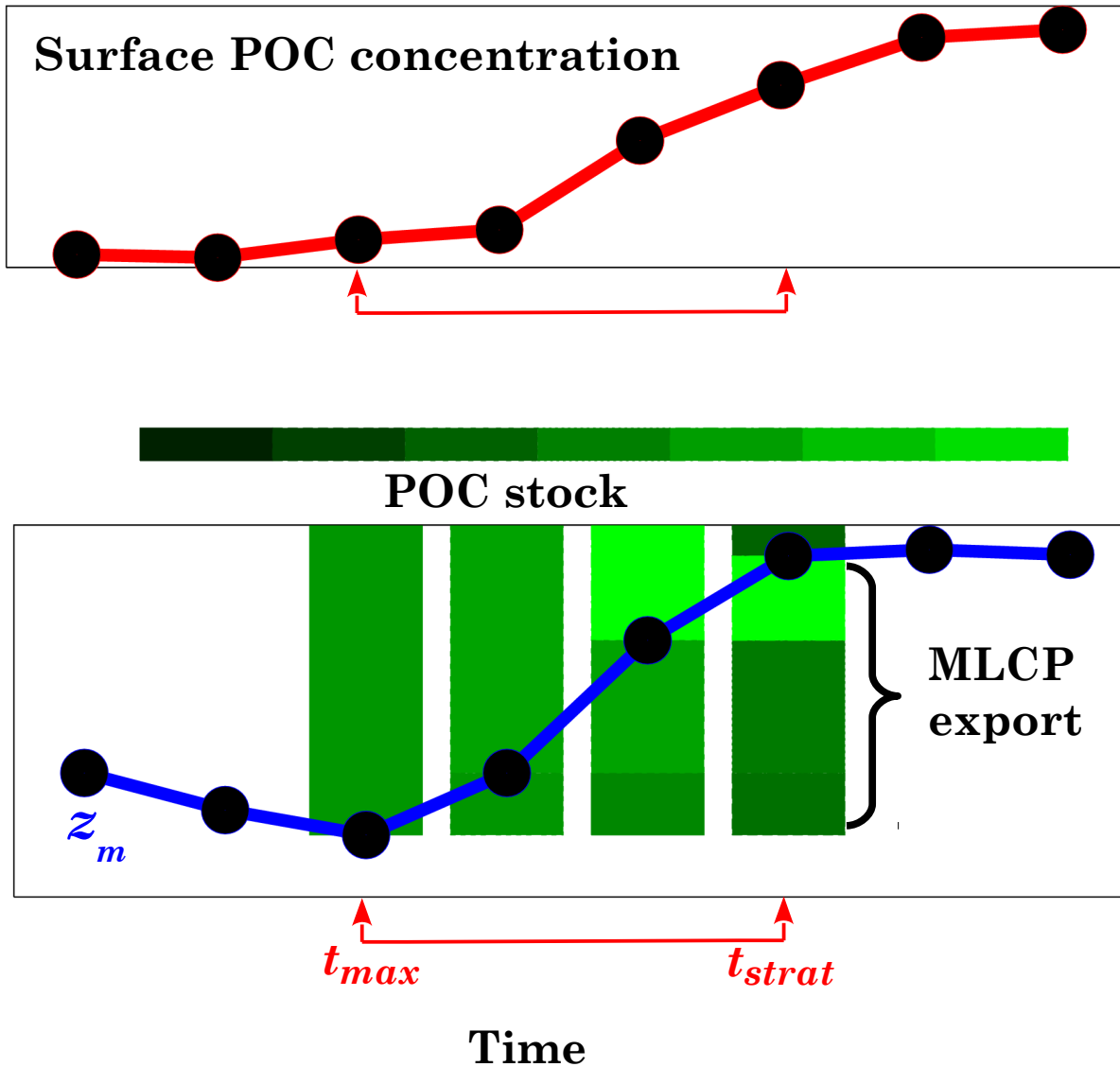
Computing export (2)



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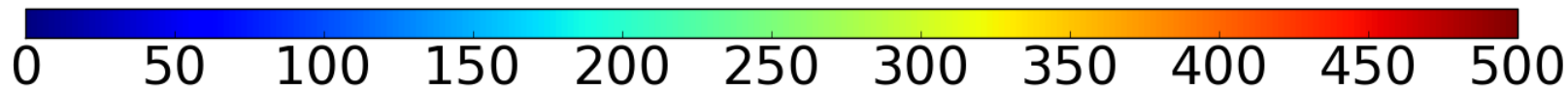
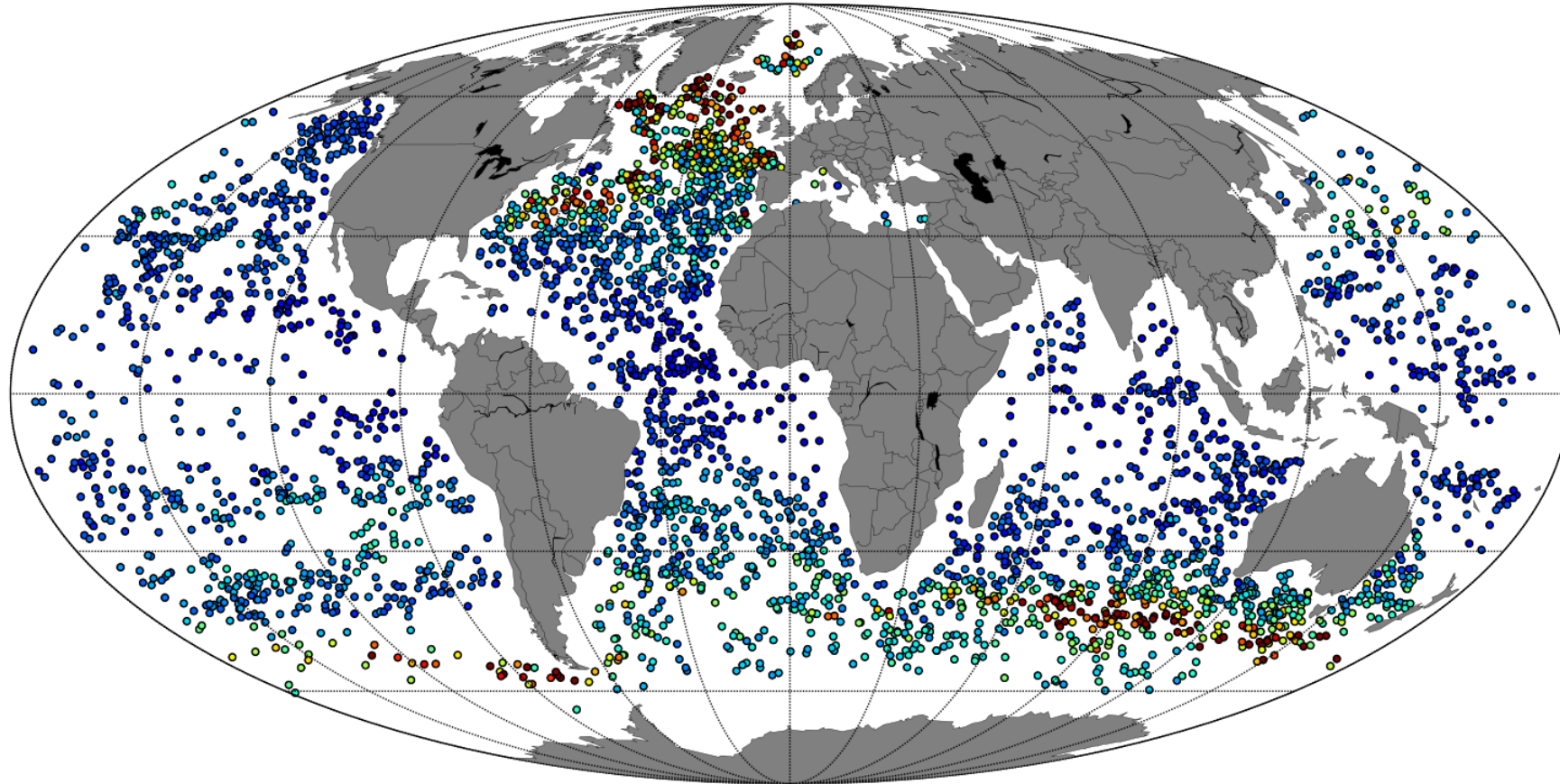
Computing export (2)



[Martz et al., 2008]

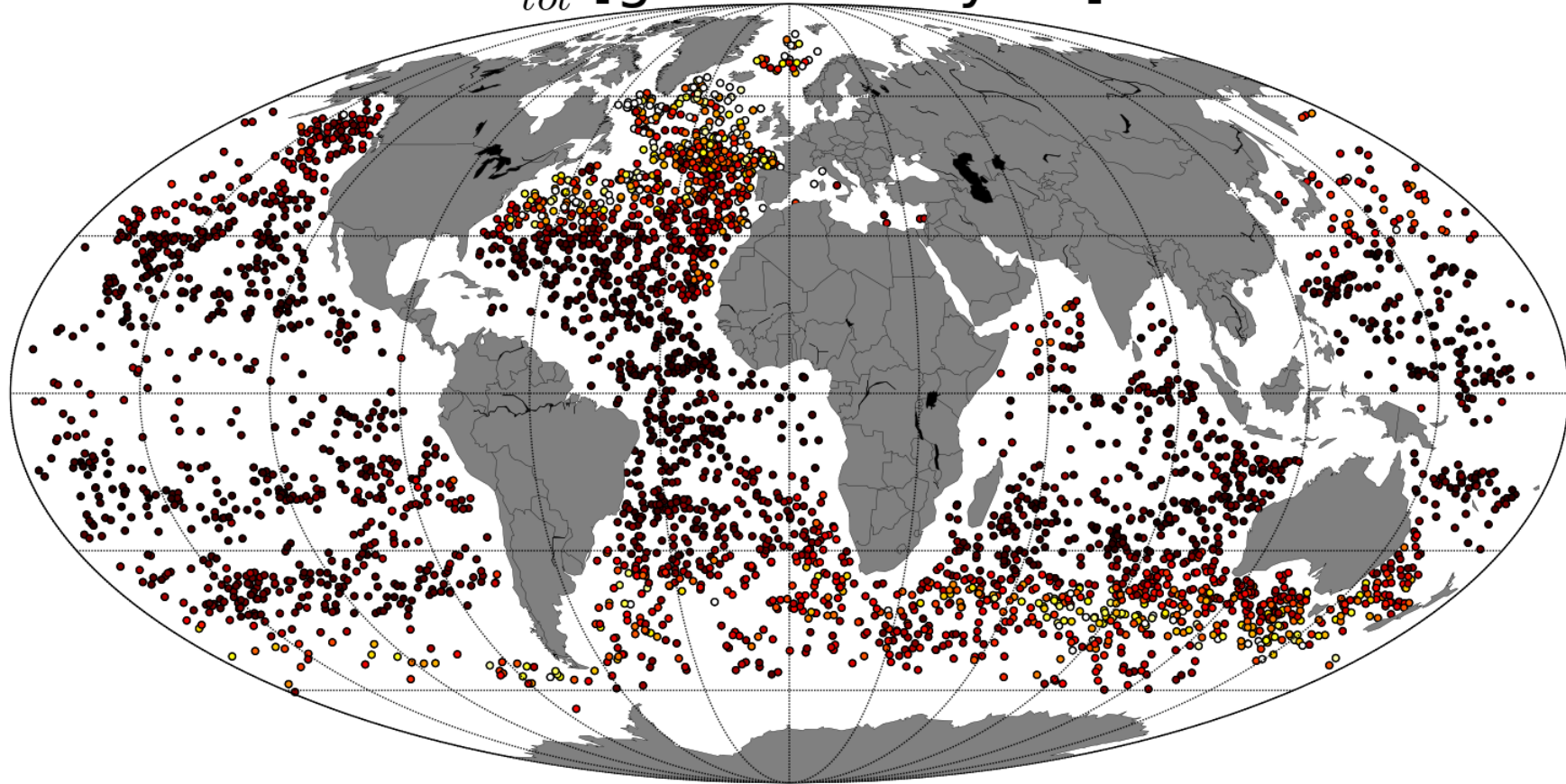
Preliminary Results

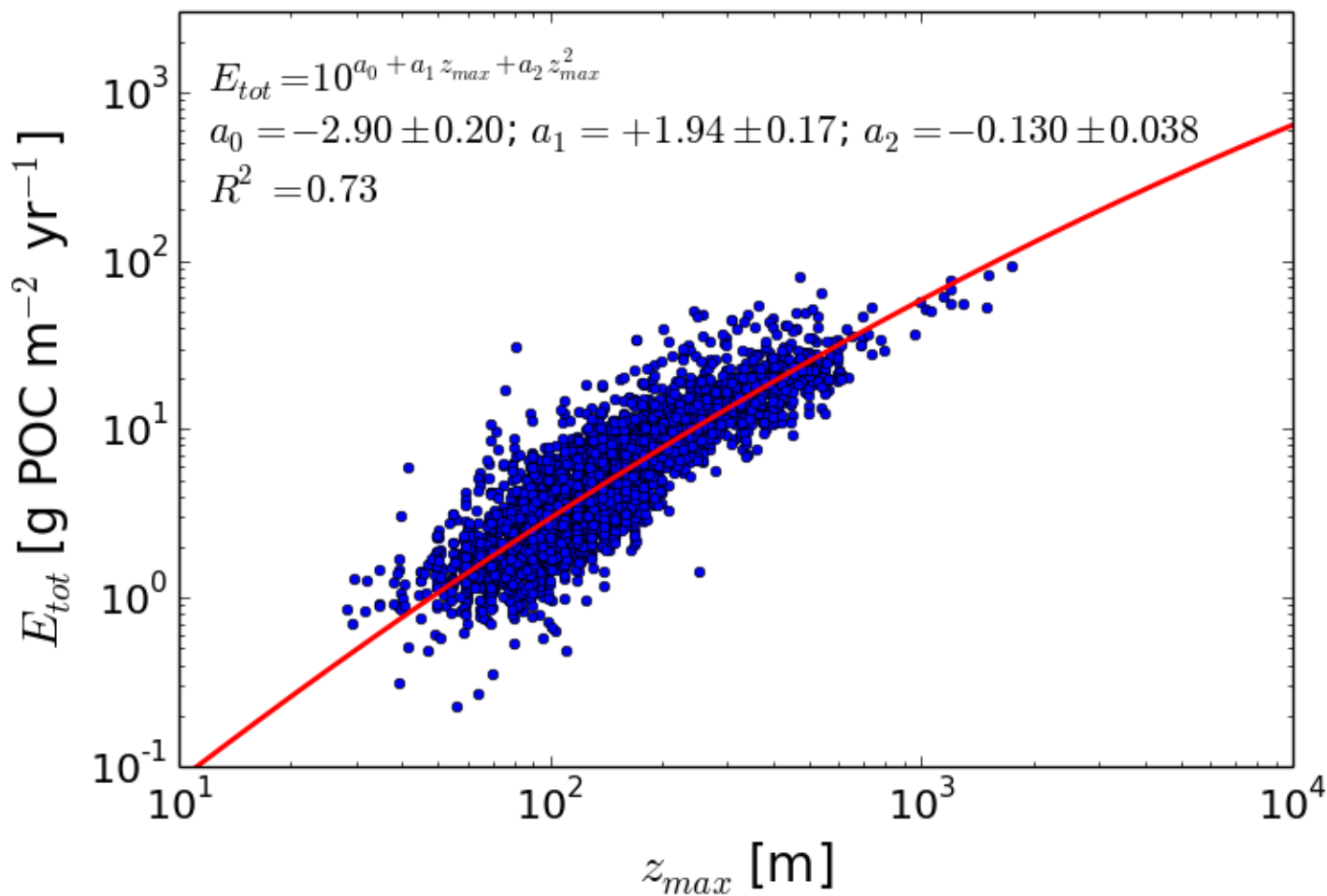
z_{max} [m]



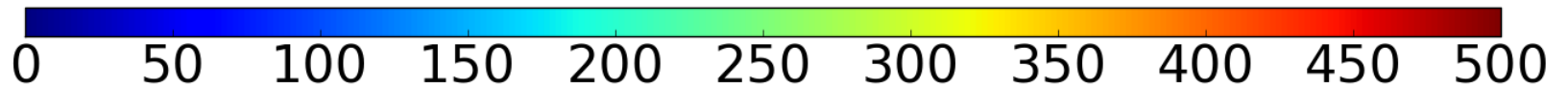
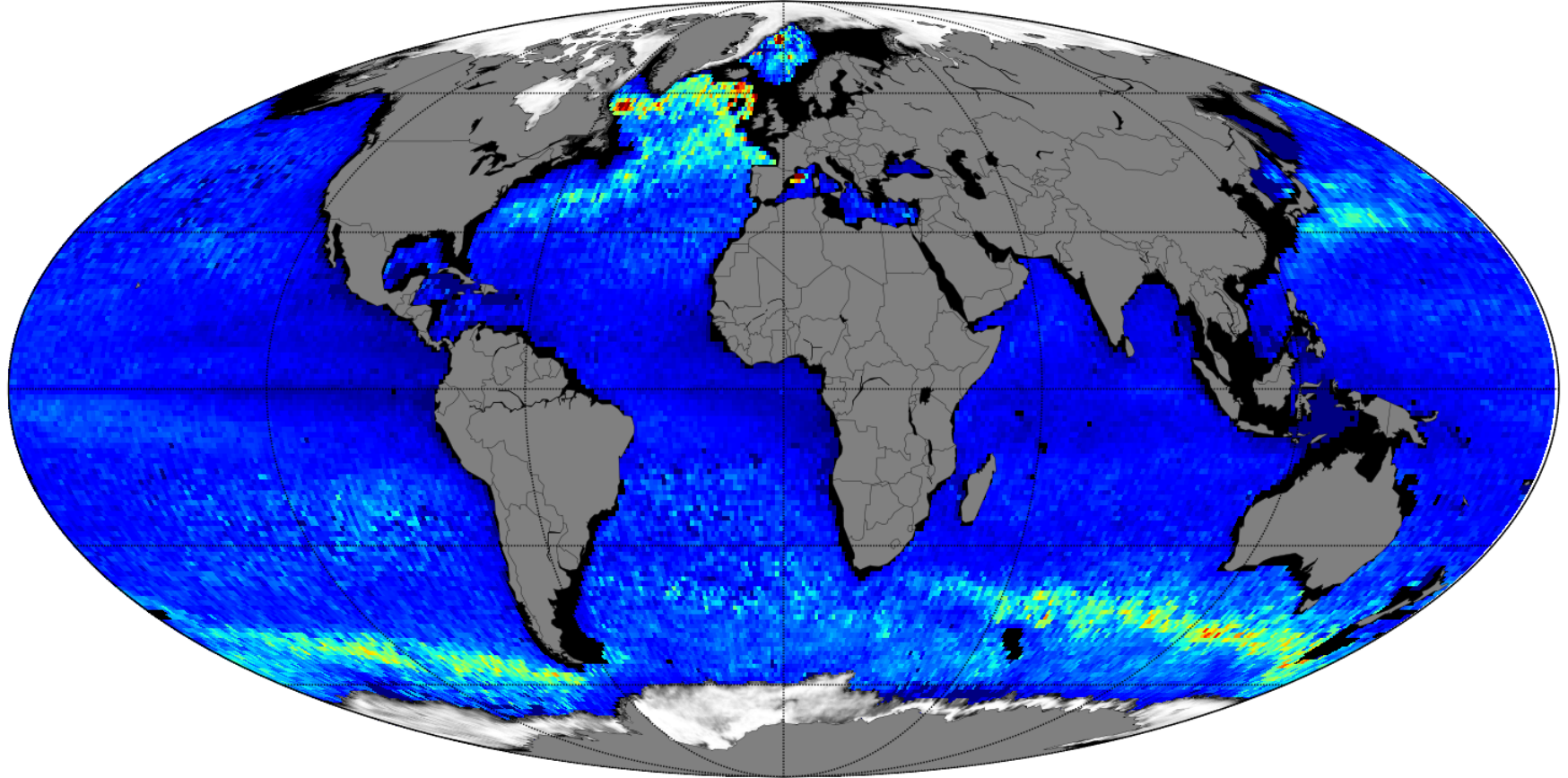
Results: E_{tot}

E_{tot} [g POC m⁻² yr⁻¹]

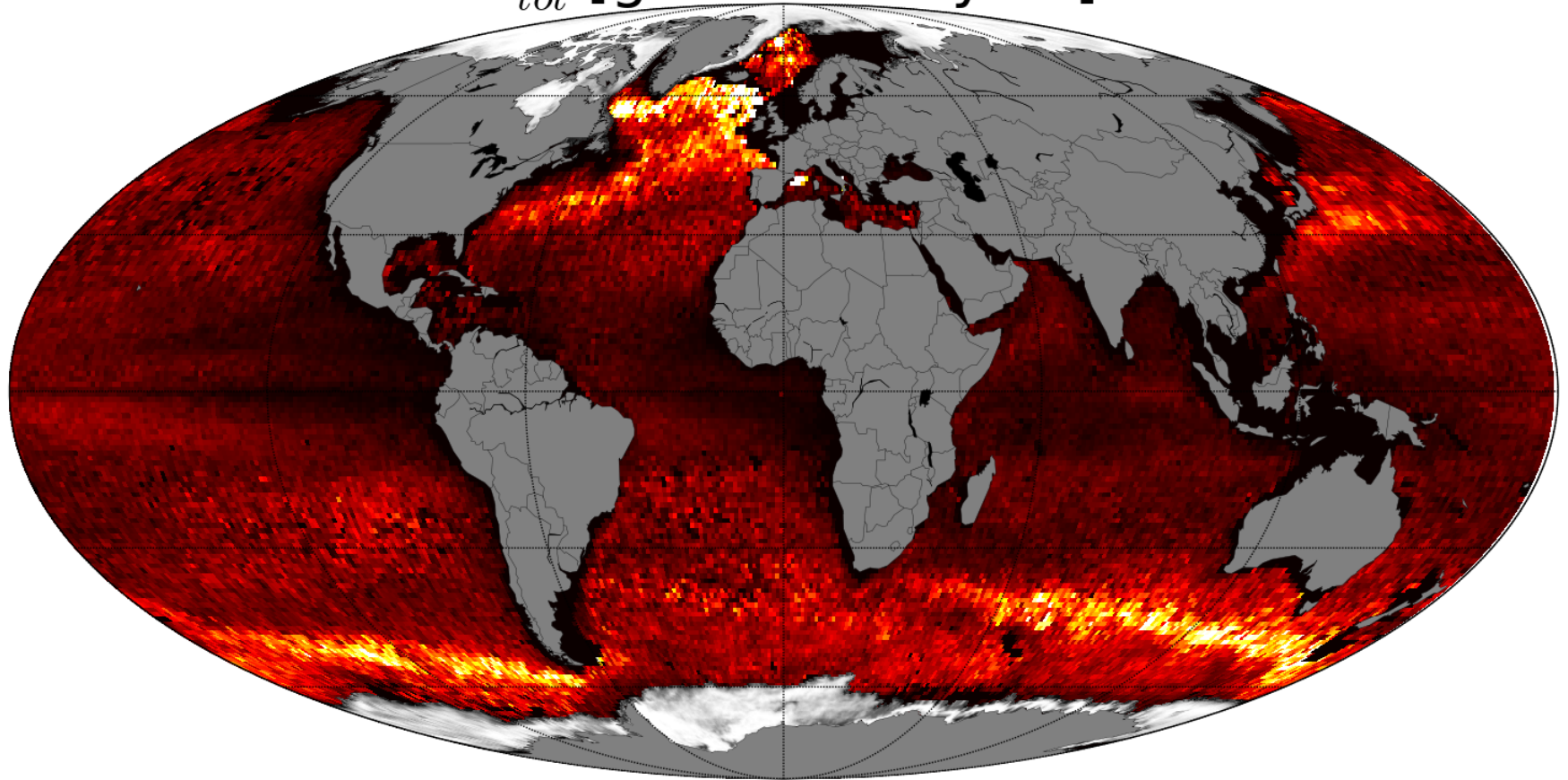


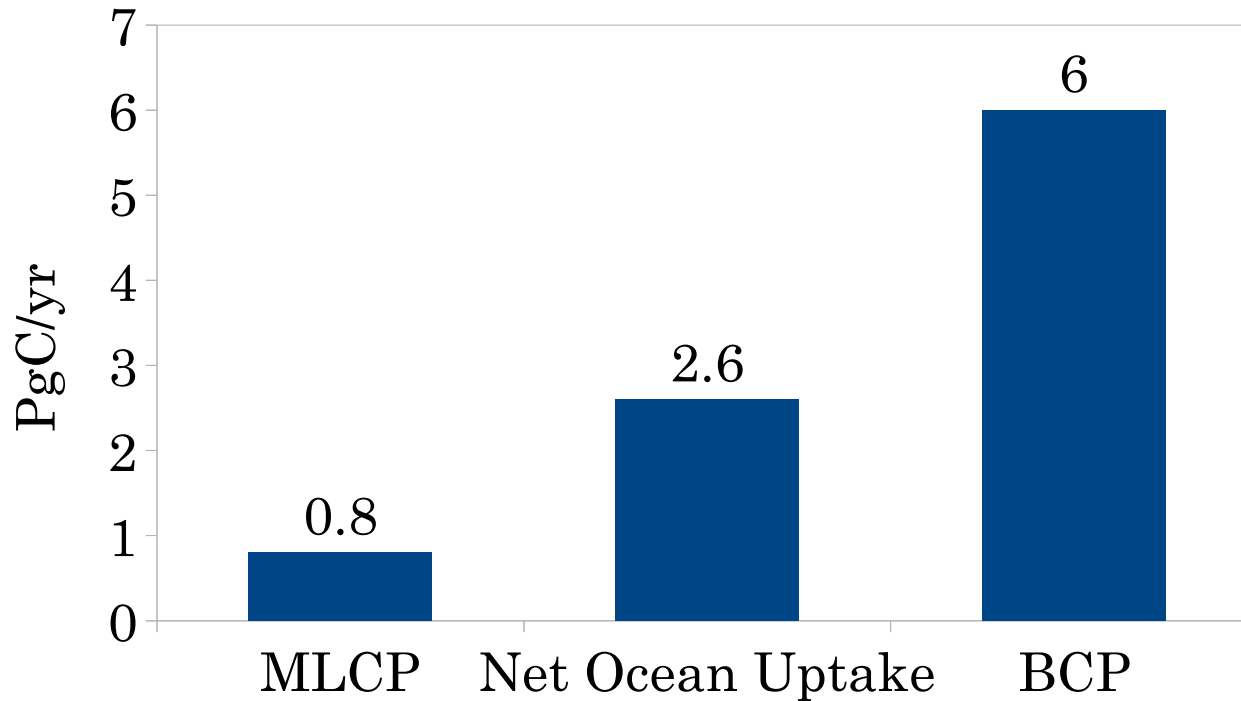


z_{max} [m]



E_{tot} [g POC m⁻² yr⁻¹]





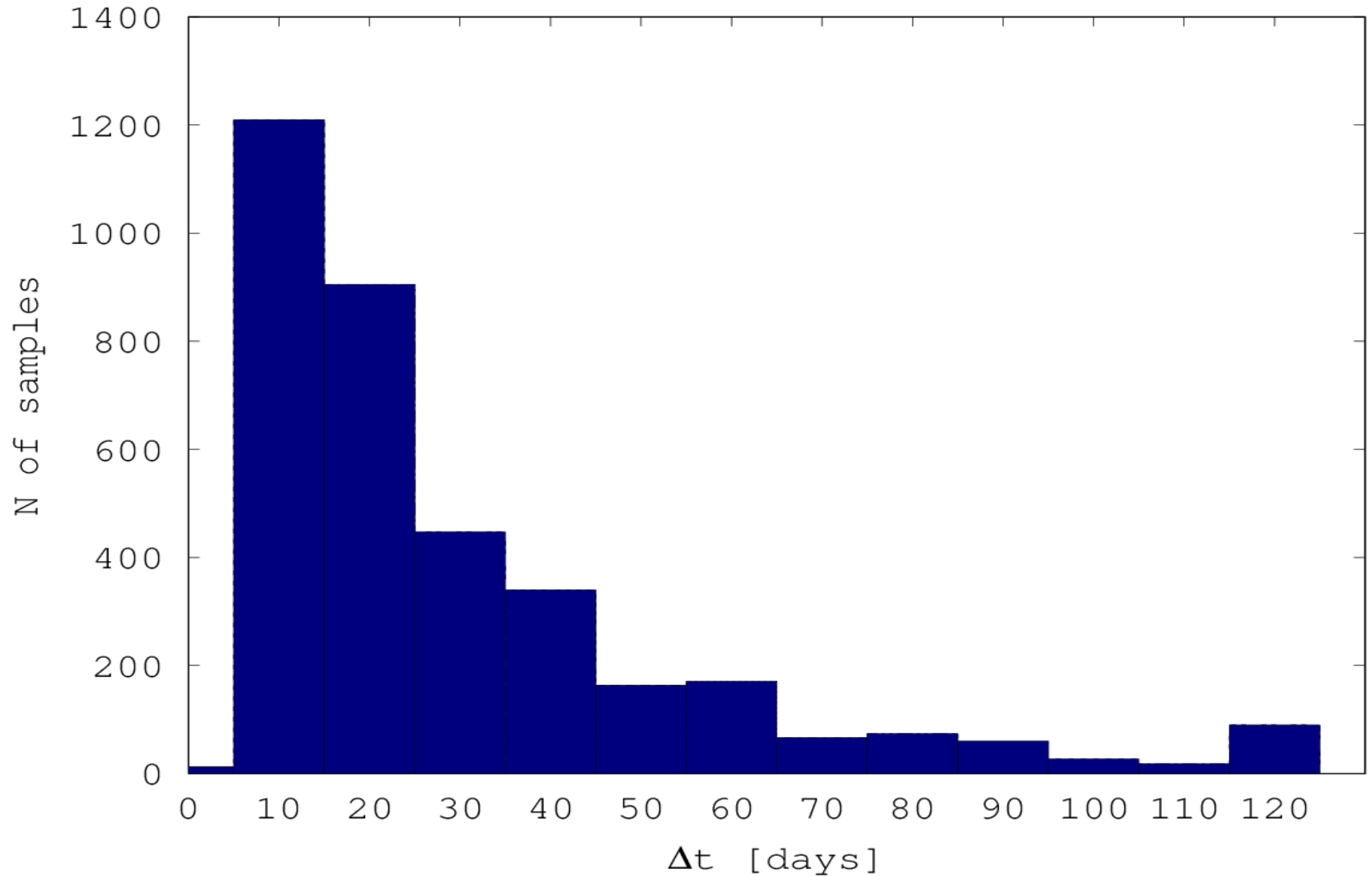
MLCP:BCP = 0.13 [0.06 – 0.20]

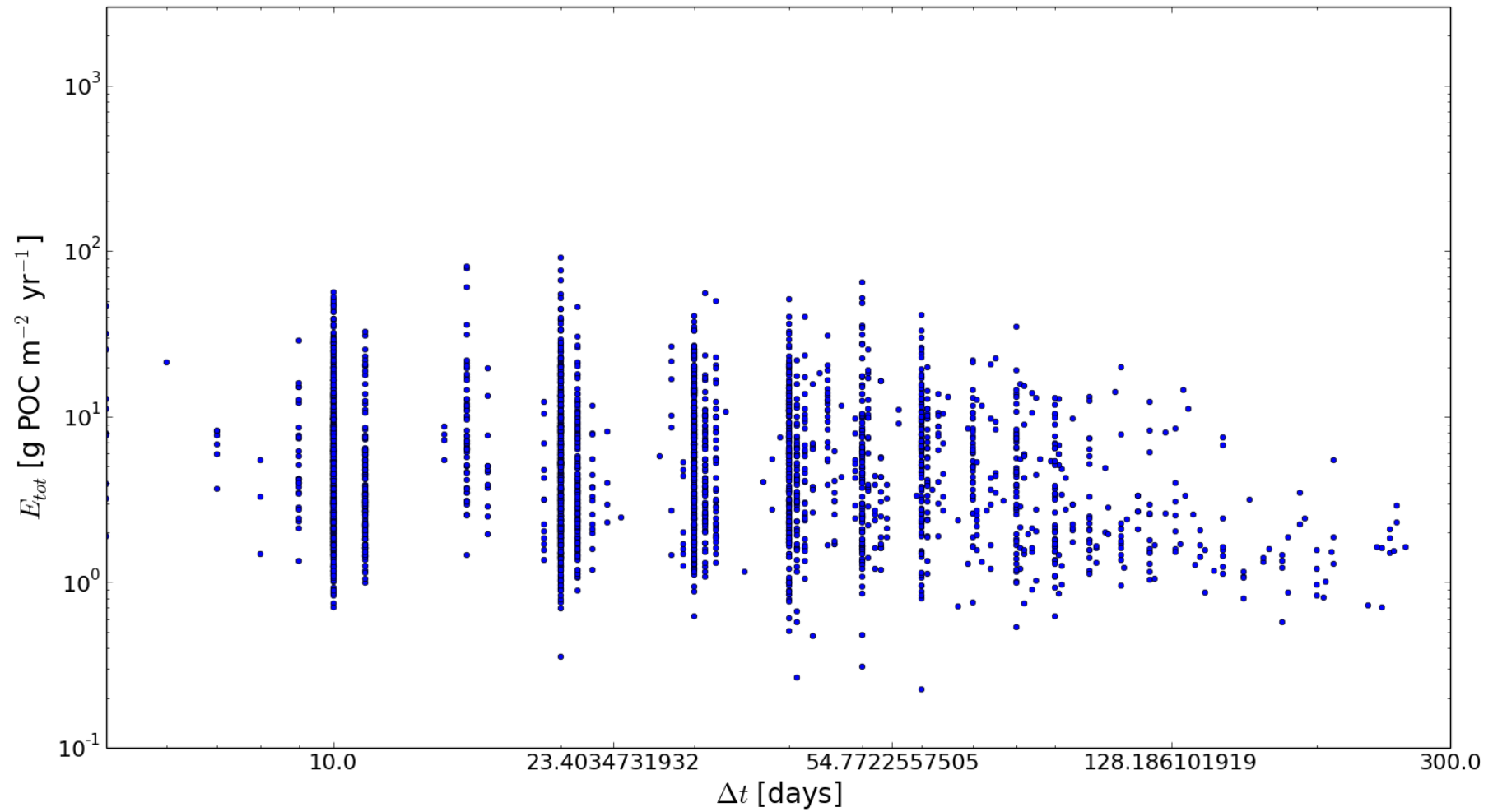
Preliminary Conclusions

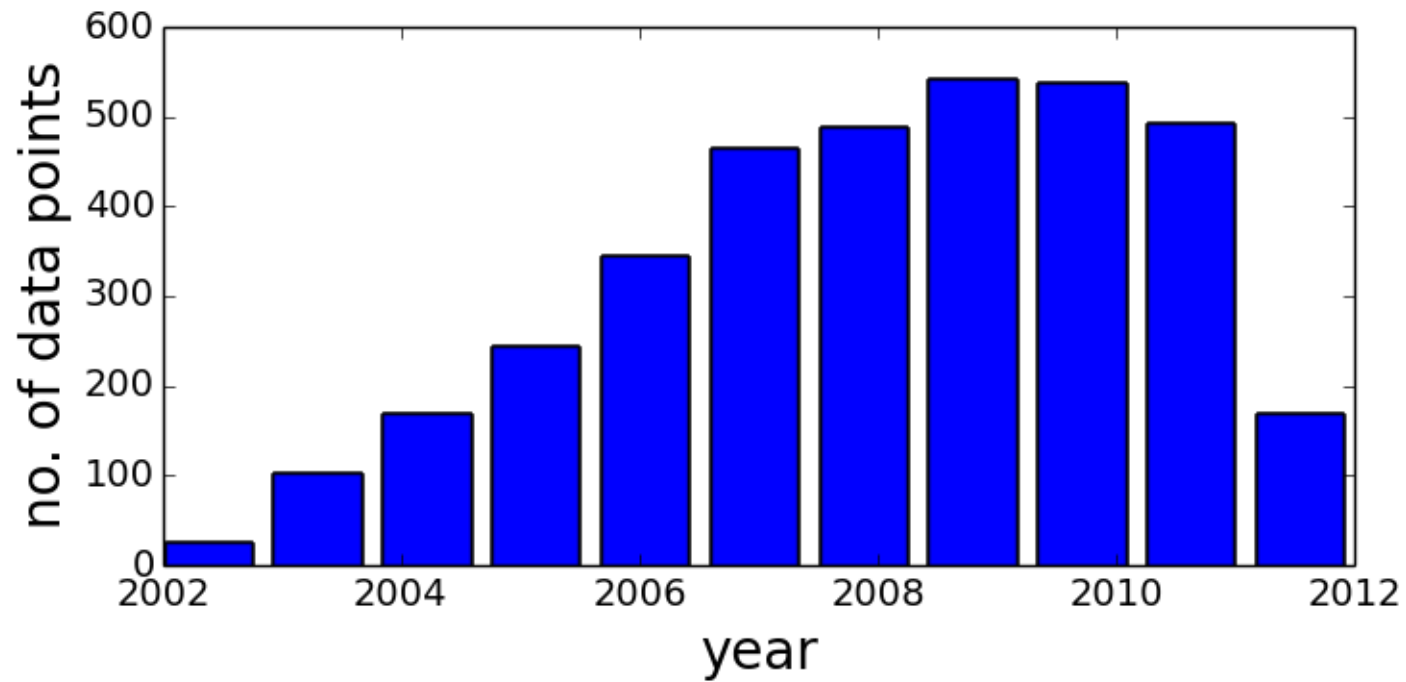
- MLCP is significant: **6-20% of the BCP export**
- This is likely **“in addition to”** the BCP export

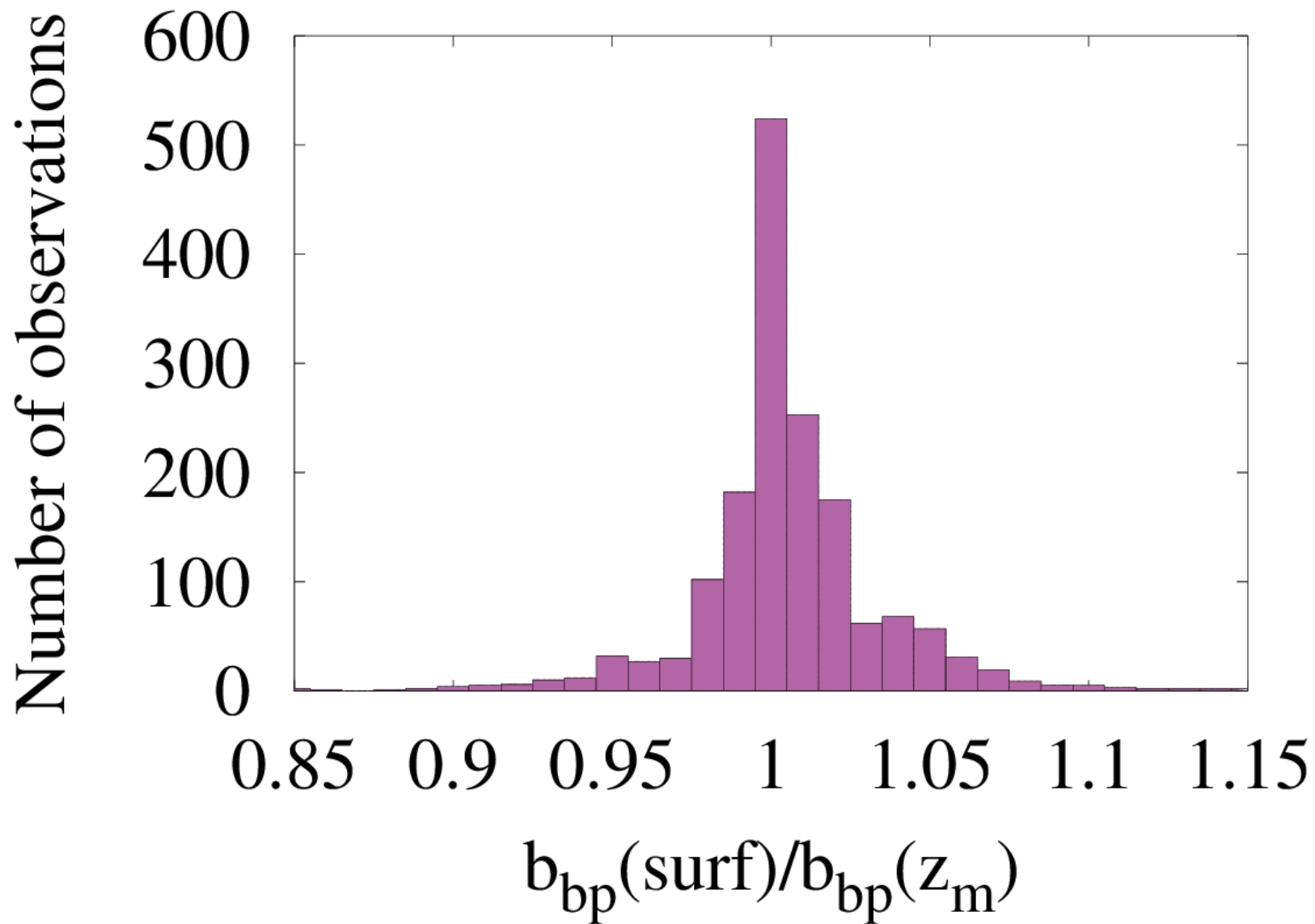
Thank you

- Initial dataset: ~10000 floats
- Data for at least 365 days
- All profiles with coincident T, S, p
- $-10^{\circ}\text{C} < T < +50^{\circ}\text{C}$
- $0 < S < 45$
- Filtered dataset (preliminary): ~2000 floats



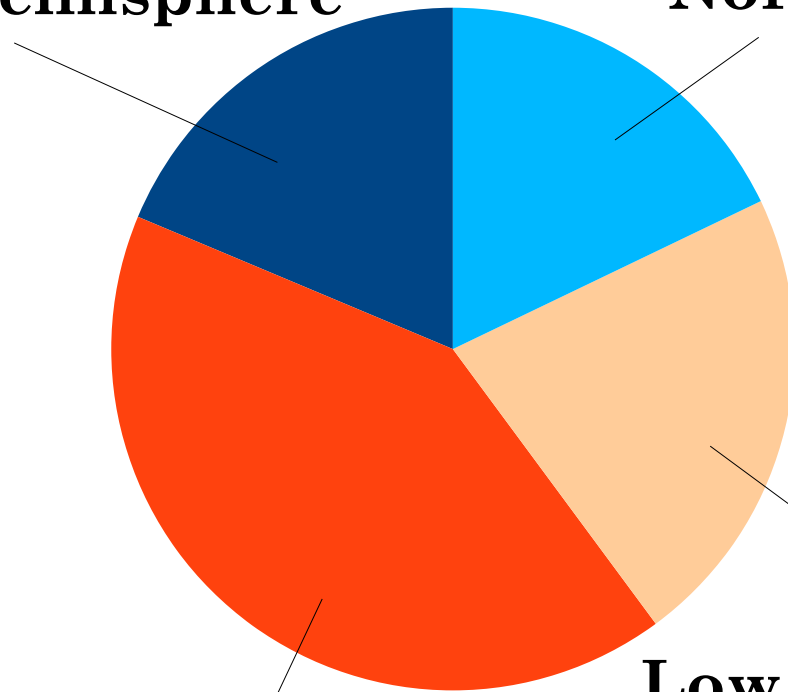






**High latitudes ($>35^\circ$)
Northern hemisphere**

**Low latitudes ($<35^\circ, >0^\circ$)
Northern hemisphere**



**High latitudes ($<-35^\circ$)
Southern hemisphere**

**Low latitudes ($>-35^\circ, <0^\circ$)
Southern hemisphere**

