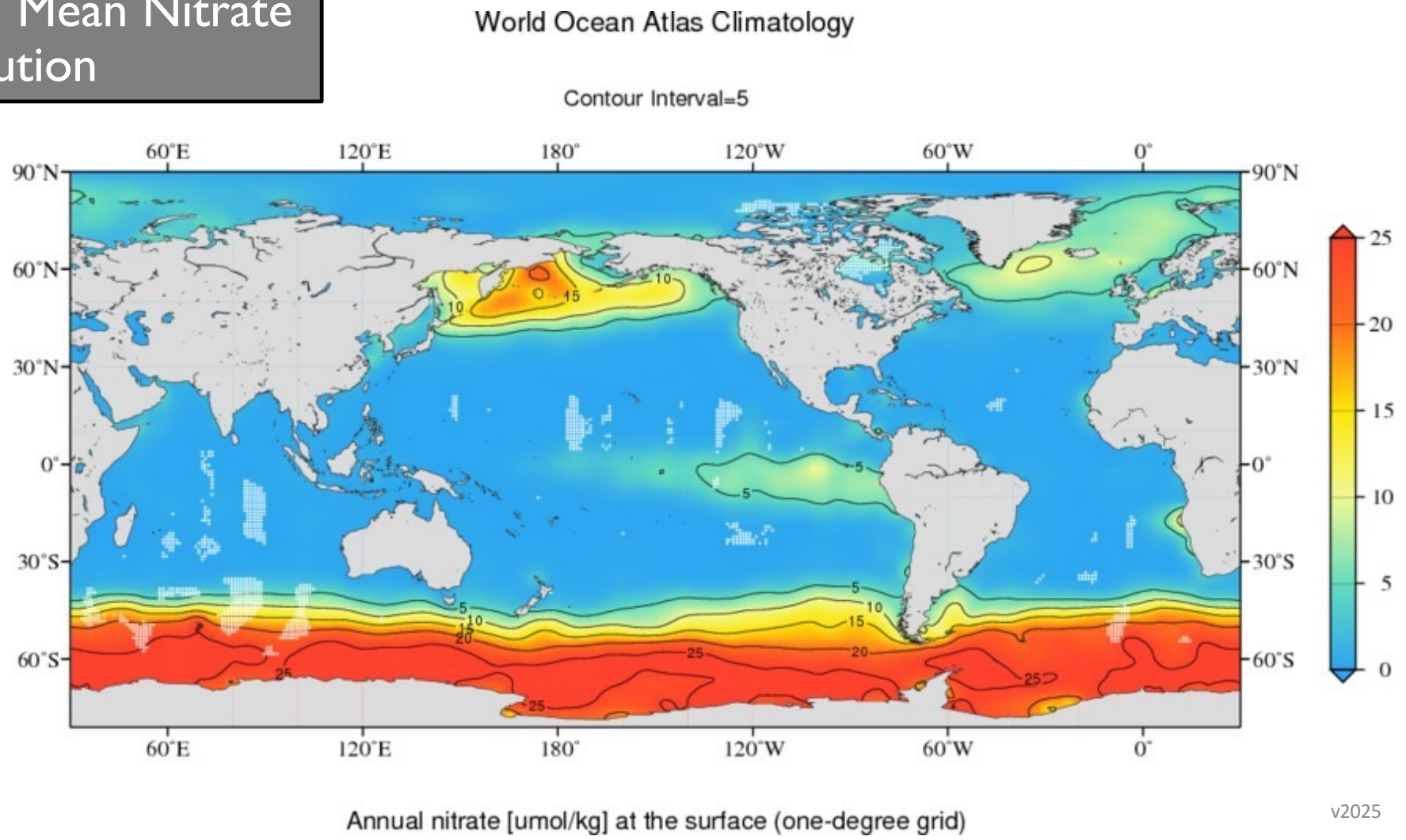
Biology and nutrients

- Spatial and temporal patterns of biological production, respiration, and associated tracers
- Stoichiometric ratios for biological processes
- Fluxes of organic matter in the upper ocean

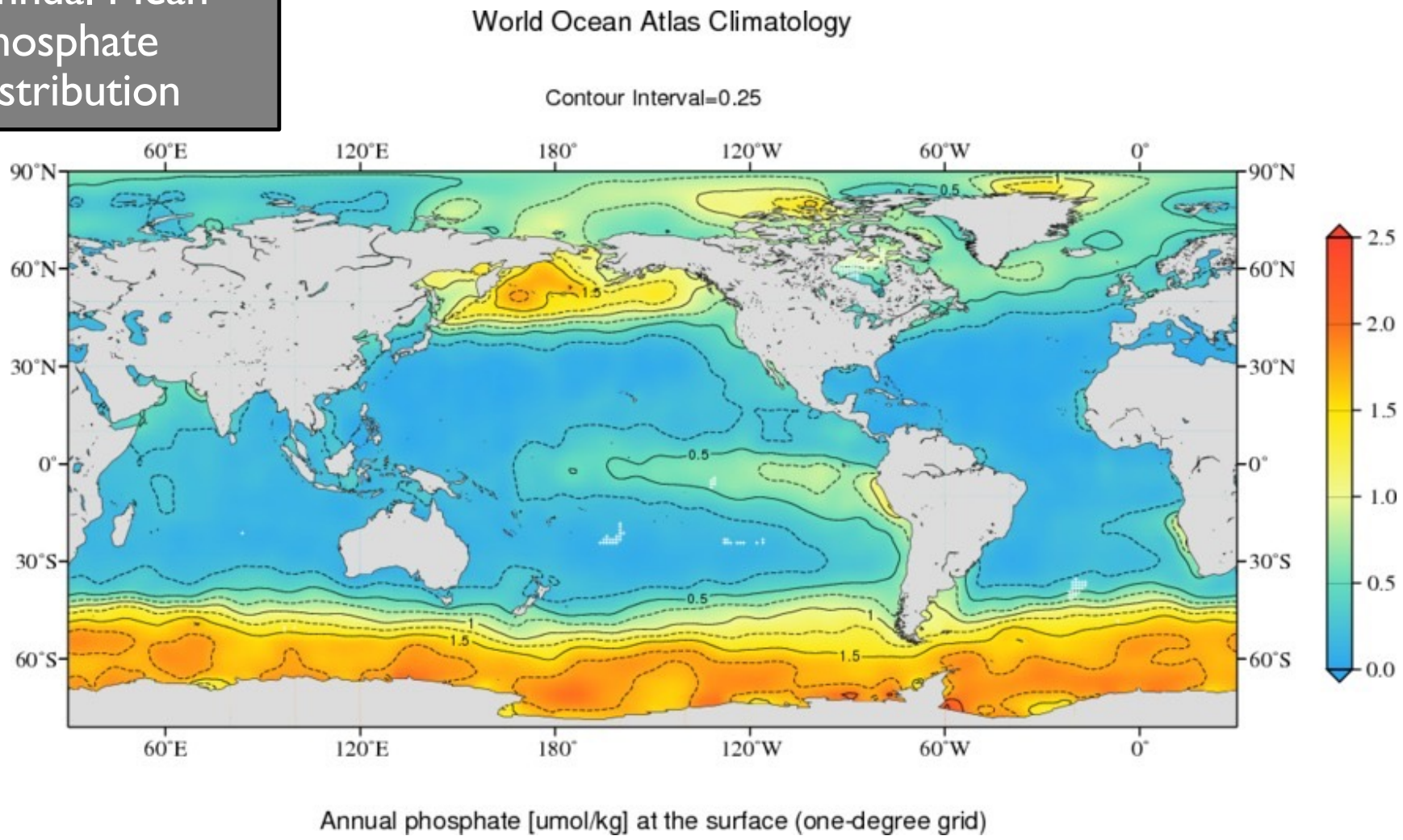
Annual Mean Nitrate distribution



Annual nitrate [umol/kg] at the surface (one-degree grid)

v2025

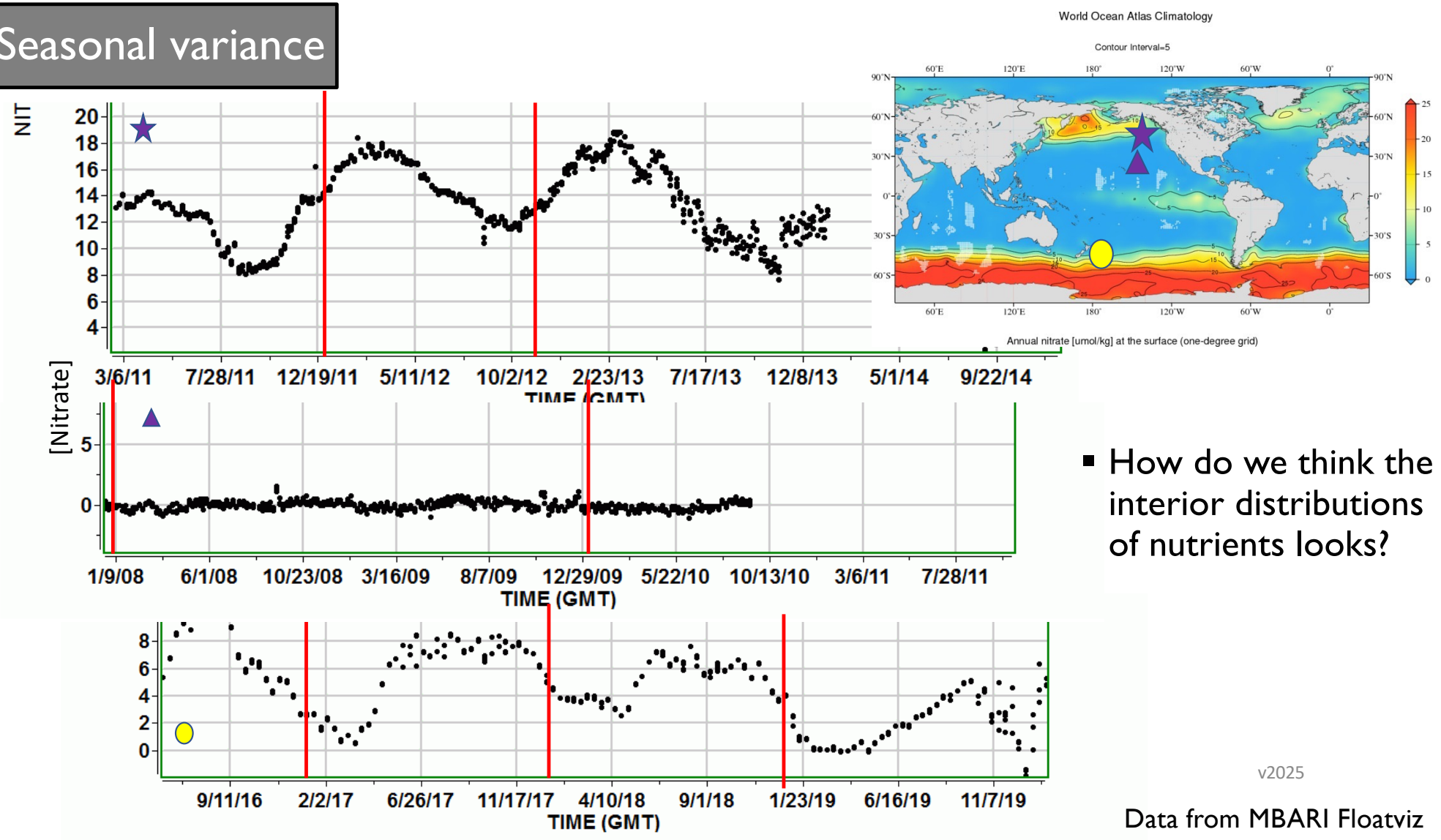
Annual Mean Phosphate distribution



Annual phosphate [umol/kg] at the surface (one-degree grid)

v2025

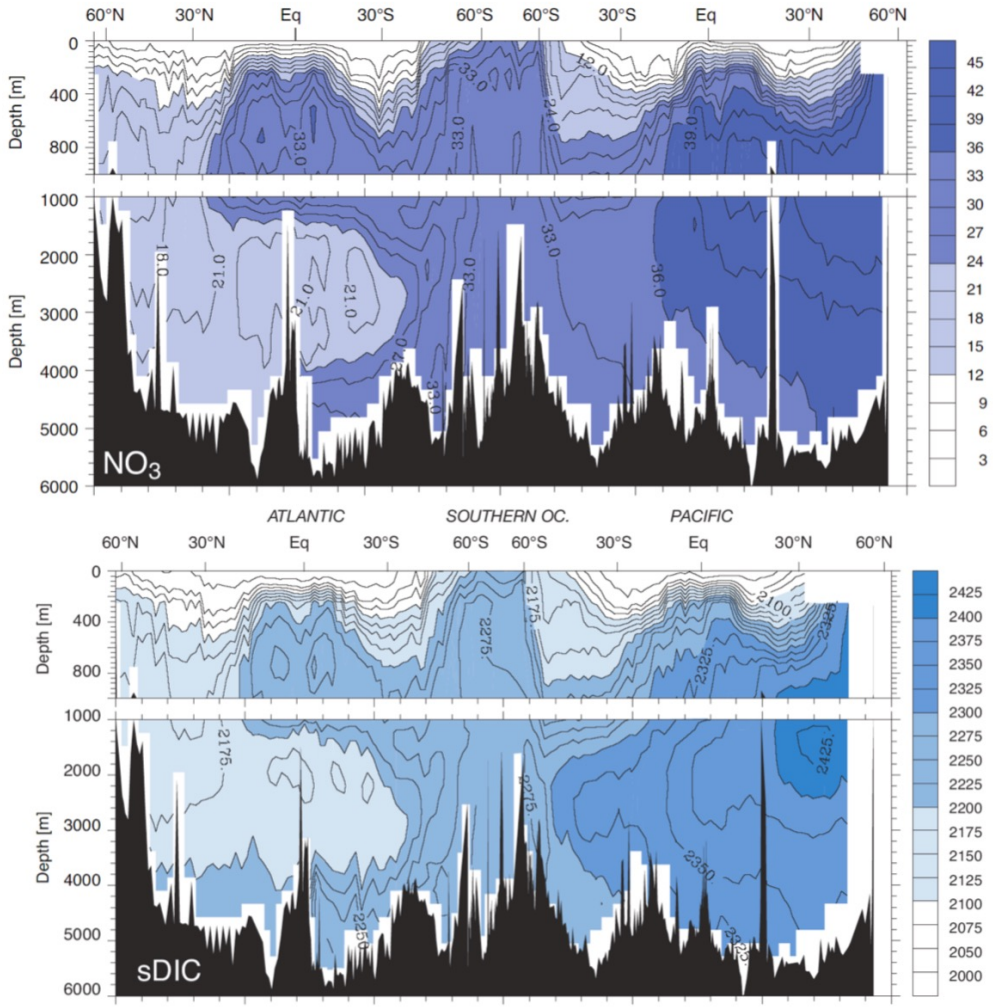
Seasonal variance



- How do we think the interior distributions of nutrients looks?

v2025

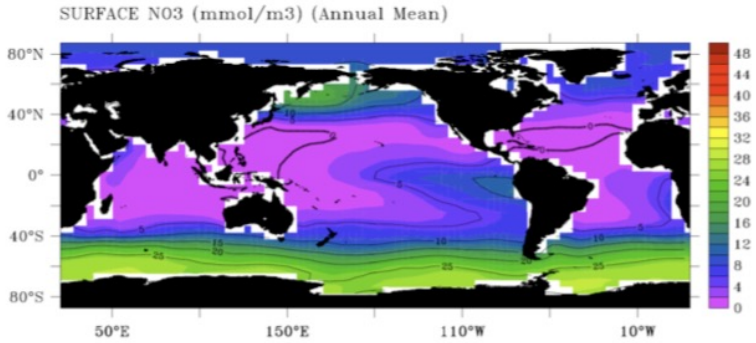
Data from MBARI Floatviz



Oceanic distributions of nutrients and carbon are linked!

How do physics and biology combine to yield these cross sections?

Sarmiento and Gruber (2006)

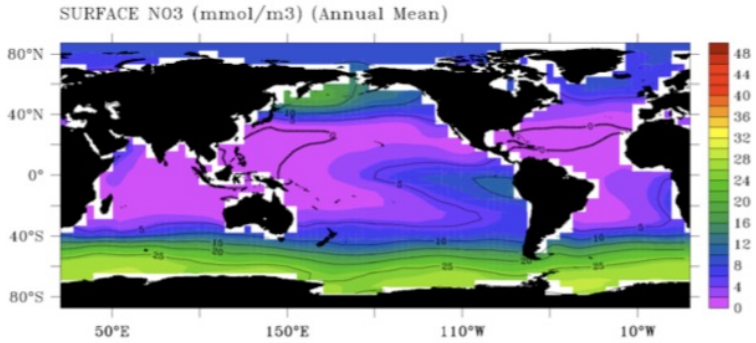


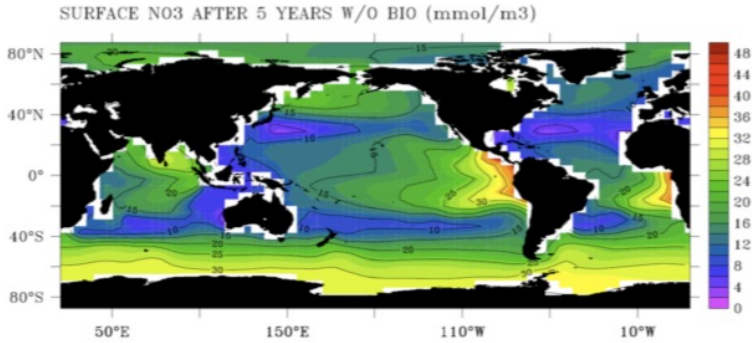
What would happen if we turned off biology?

In 5 years?

At equilibrium?

Sarmiento and Gruber (2006)





What would happen if we turned off biology?

In 5 years?

At equilibrium?

Sarmiento and Gruber (2006)

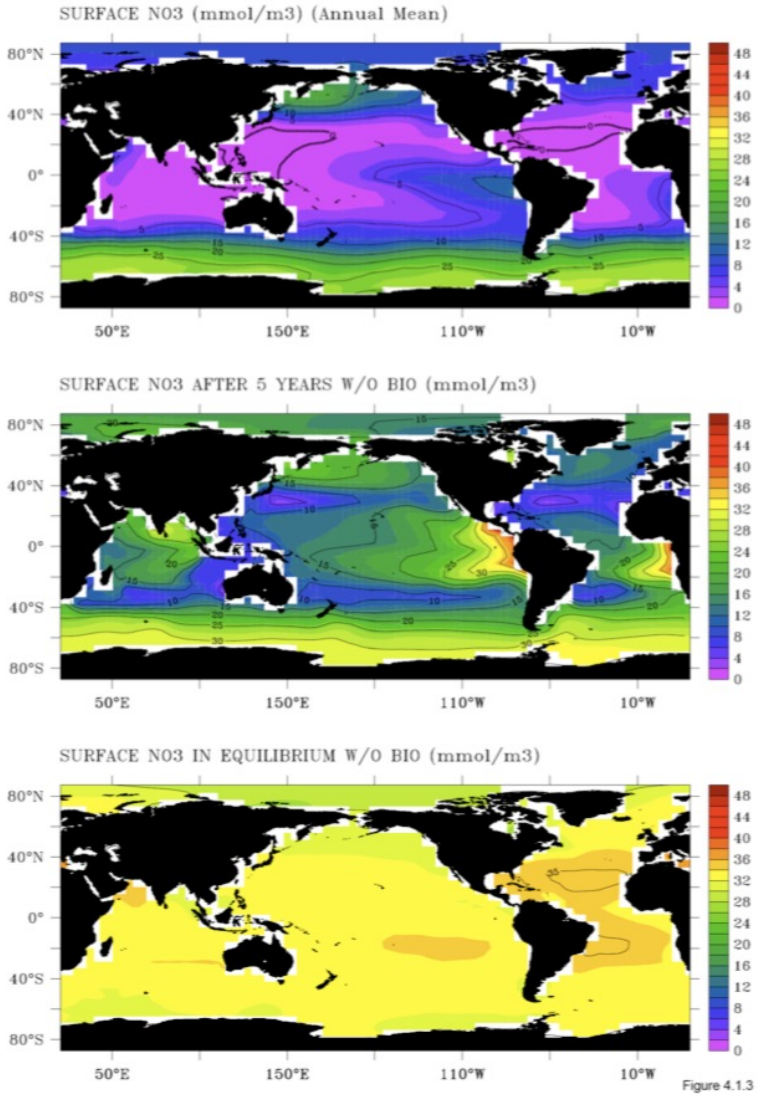


Figure 4.1.3

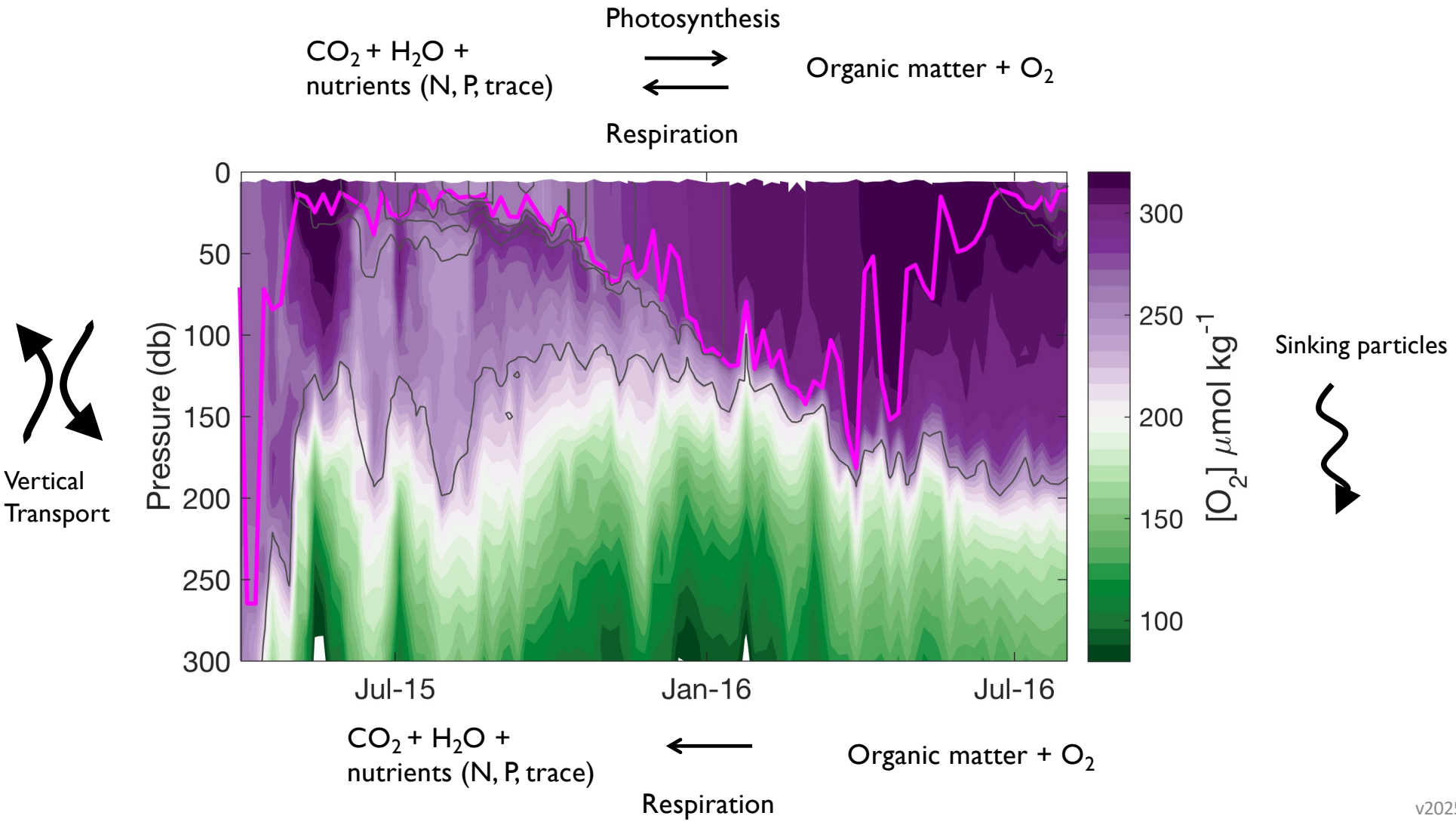
What would happen if we turned off biology?

In 5 years?

At equilibrium?

Global mean NO_3^- is ~31 µmol kg^{-1}

Sarmiento and Gruber (2006)


Photosynthesis
$CO_2 + H_2O +$ nutrients (N, P, trace)
Organic matter + O_2
Respiration
Vertical Transport
Pressure (db)
0
50
100
150
200
250
300
Jul-15
Jan-16
Jul-16
300
250
200
150
100
$[O_2]$ μmol kg^{-1}
Sinking particles
$CO_2 + H_2O +$ nutrients (N, P, trace)
Organic matter + O_2
Respiration

v2025

$CO_2 + H_2O +$ nutrients (N, P, trace)

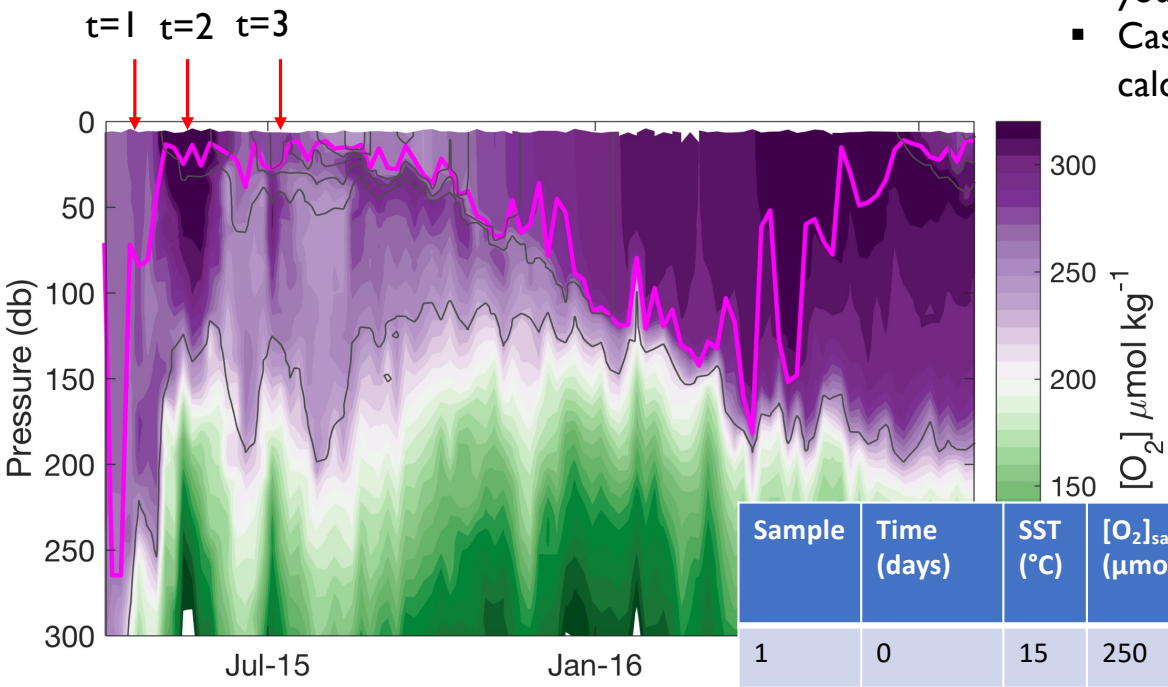
Photosynthesis ⟶ ⟵ Respiration

Organic matter + O_2

Given:

- G = 4 m d^{-1}
- ρ = 1000 kg m^{-3}

- Case 1: No Biological production, what do you expect the $[O2]_{ML}$ to be?
- Case 2: Using observed [O2], what do you calculate for a biological production rate?



Sample	Time (days)	SST (°C)	$[O_2]_{sat}$ (µmol kg^{-1})	MLD (m)	Case 1 - $[O_2]_{ML}$ (µmol kg^{-1})	Case 2 – $[O2]_{ML}$ (µmol kg^{-1})	F_{bio} (mmol m^{-2} O_2 d^{-1})
1	0	15	250	70	250	250	----------
2	10	21	220	20	?	320	?
3	20	27	200	20	?	240	?