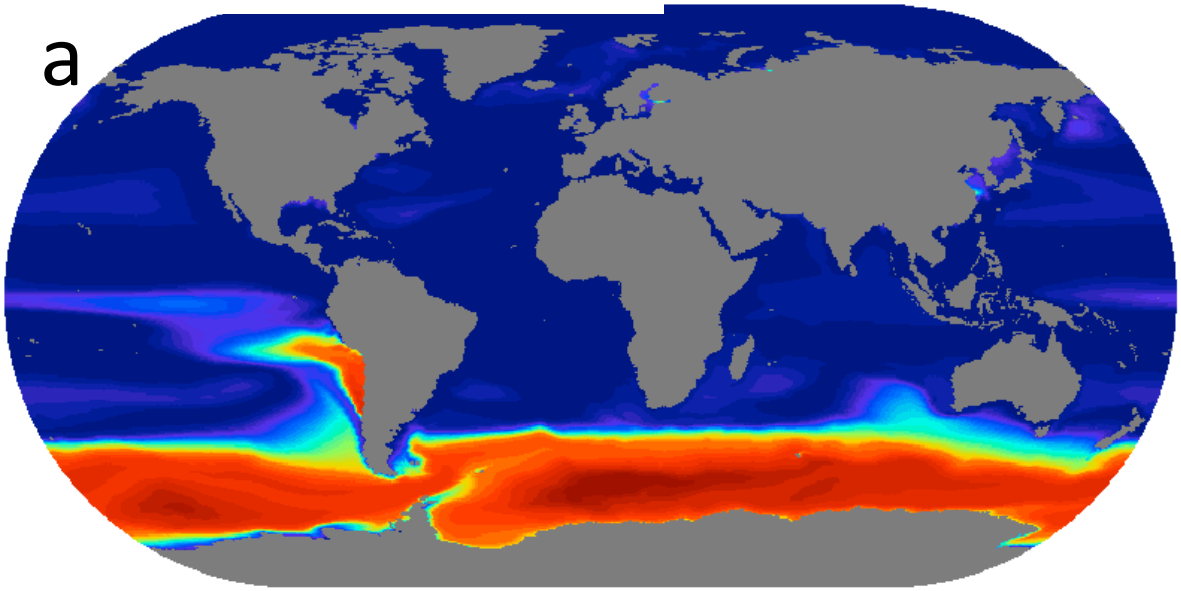
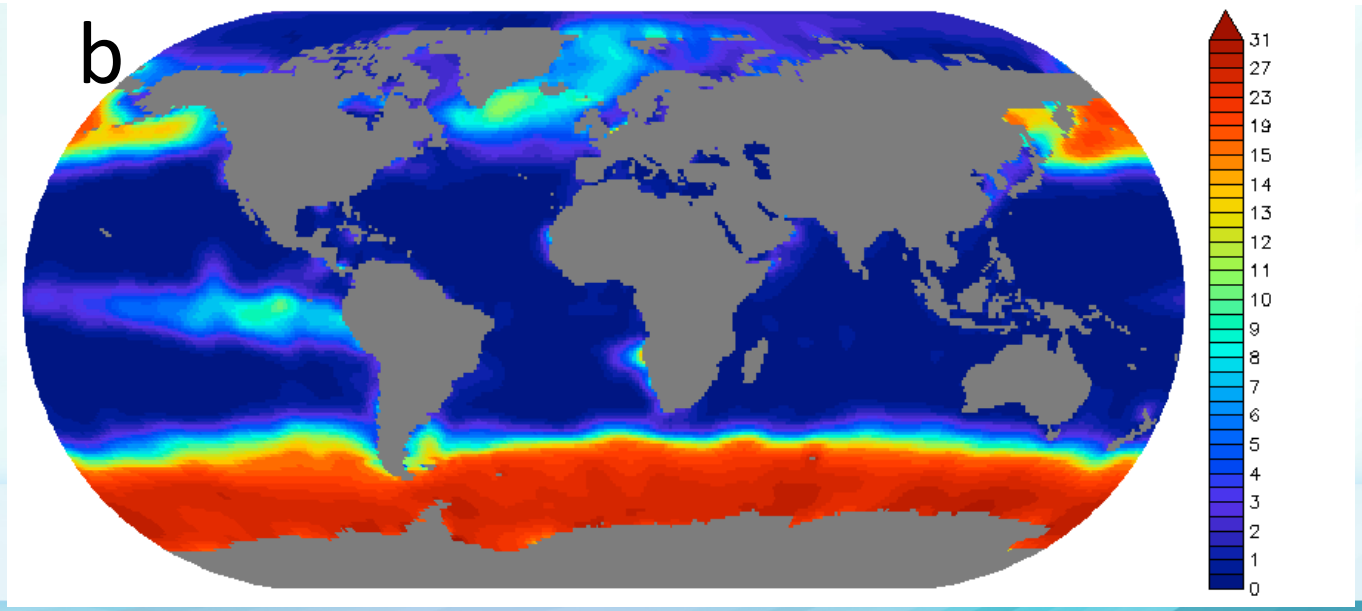
E3SM.v1.1 CBGC Marine BGC Biases

Low Surface Nutrient Biases

Modelled Ocean Surface Nitrate



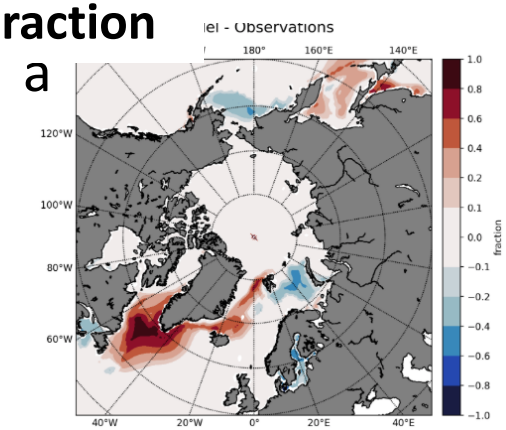
World Ocean Atlas



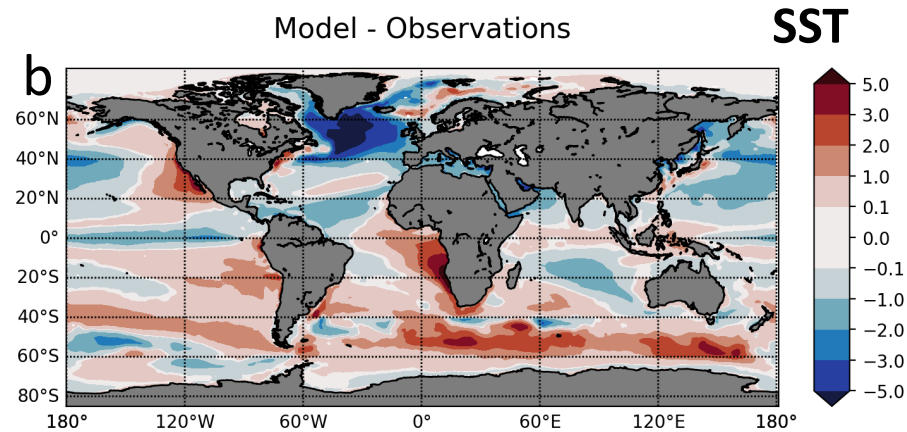
E3SM Energy Exascale Earth System Model

Extensive Arctic sea ice, MLD biases, contribute to low surface nutrients

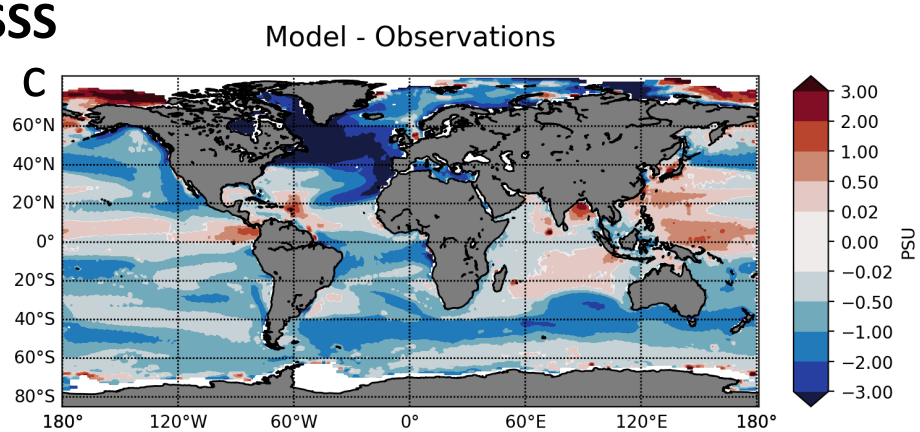
Sea Ice Fraction



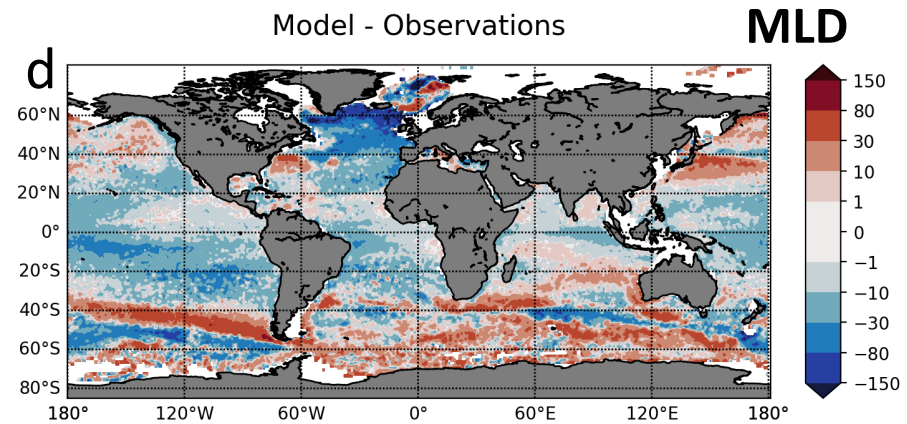
SST



SSS

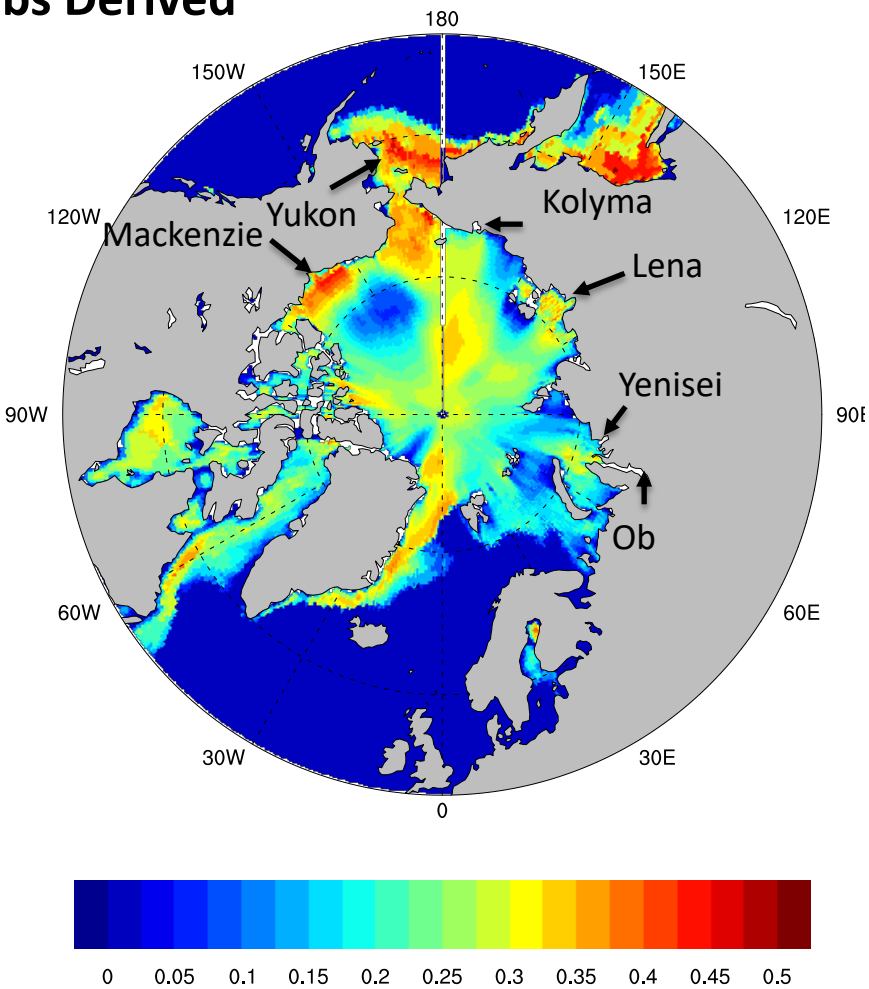


MLD

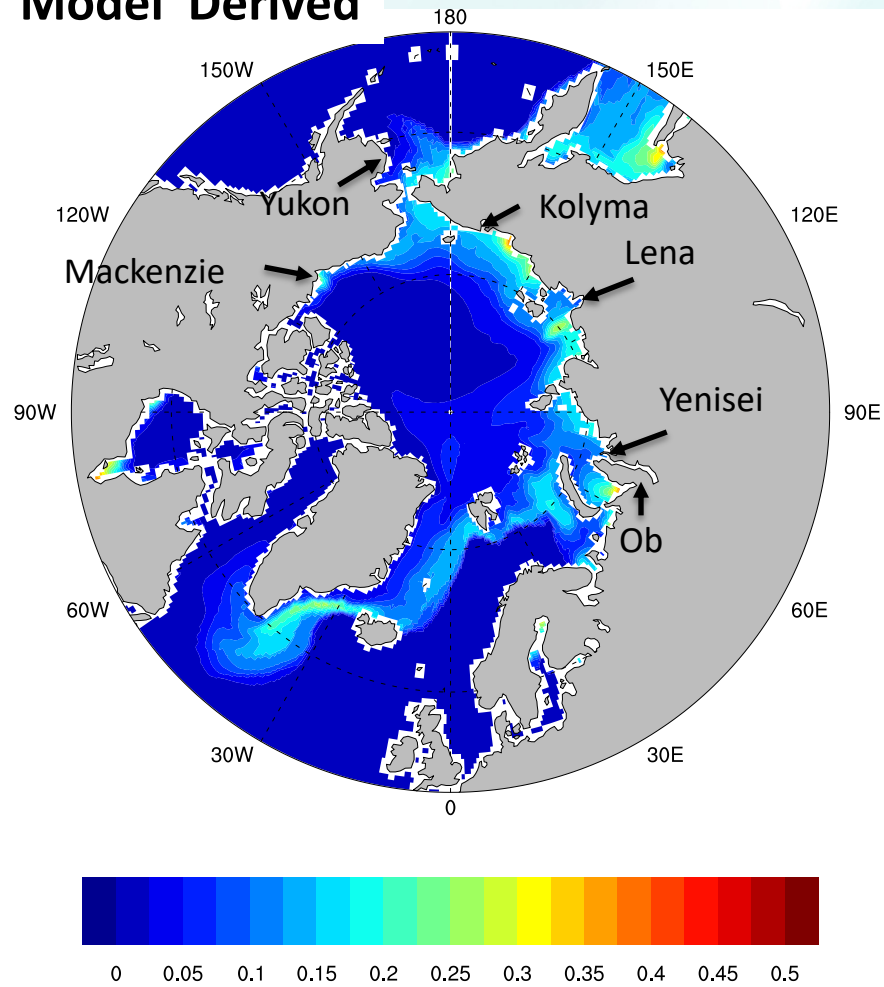


Inconsistencies in riverine fluxes of fresh water and nutrients and in path/strength of Pacific water

Obs Derived



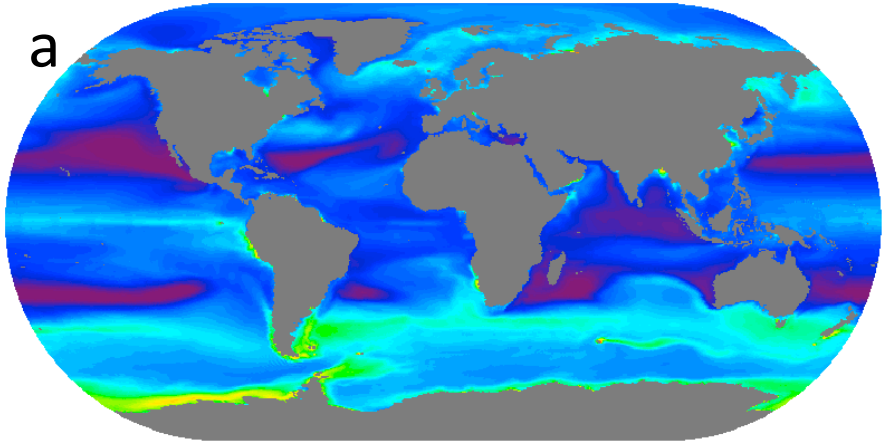
Model Derived



Log(ocean surface chl-a)

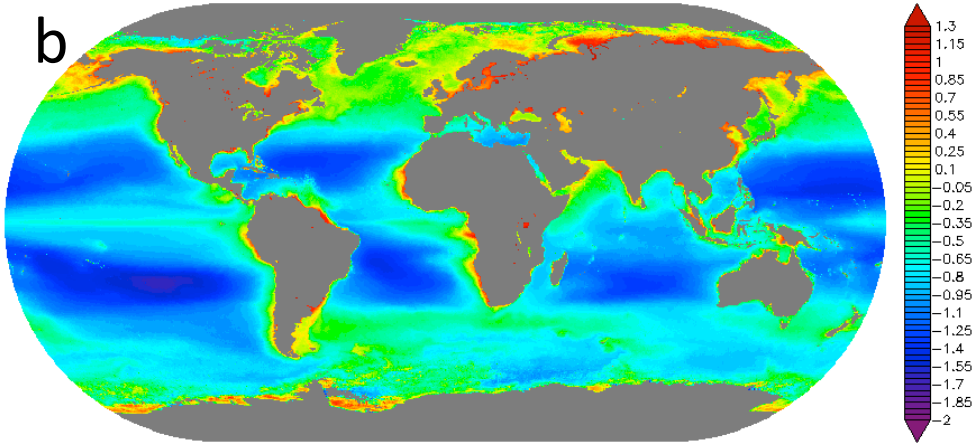
Model (BDRD)

a

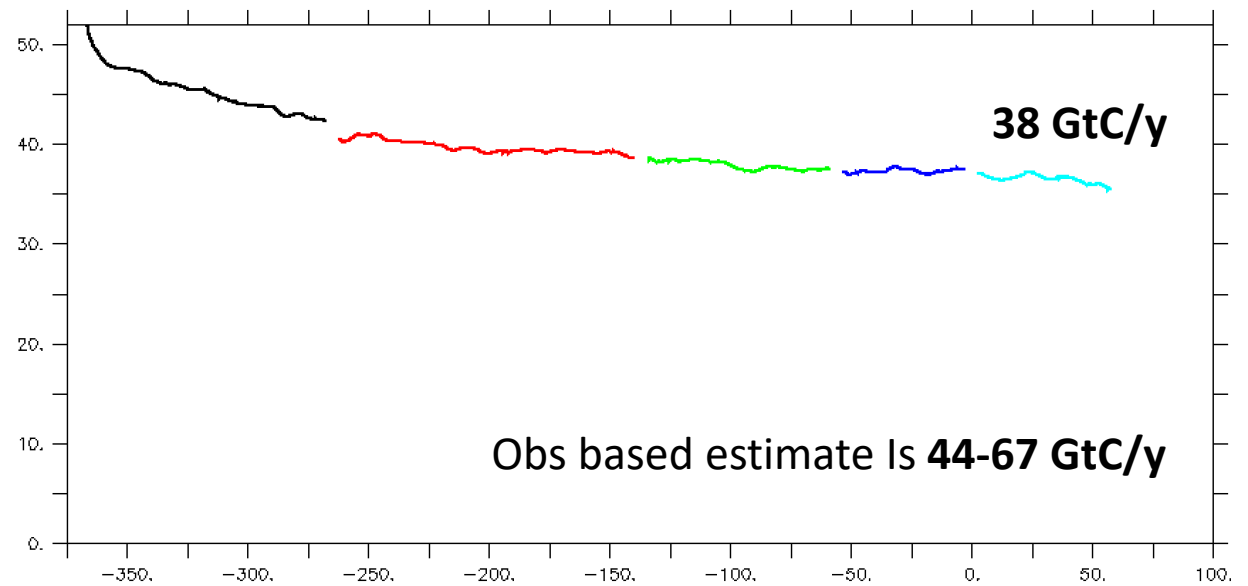


SeaWiFS satellite observations

b



Globally integrated primary production (Gt-C/year)

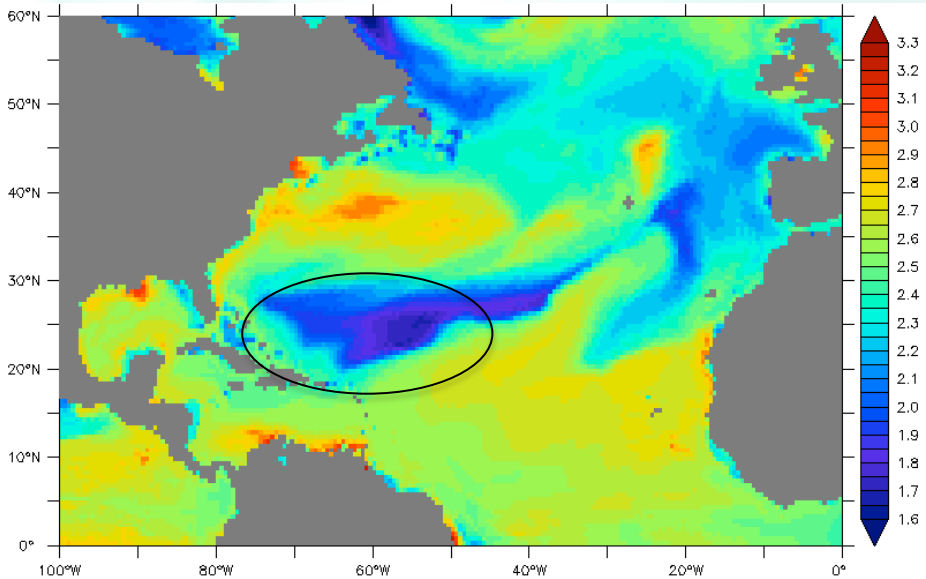


Model year (relative to start of production)

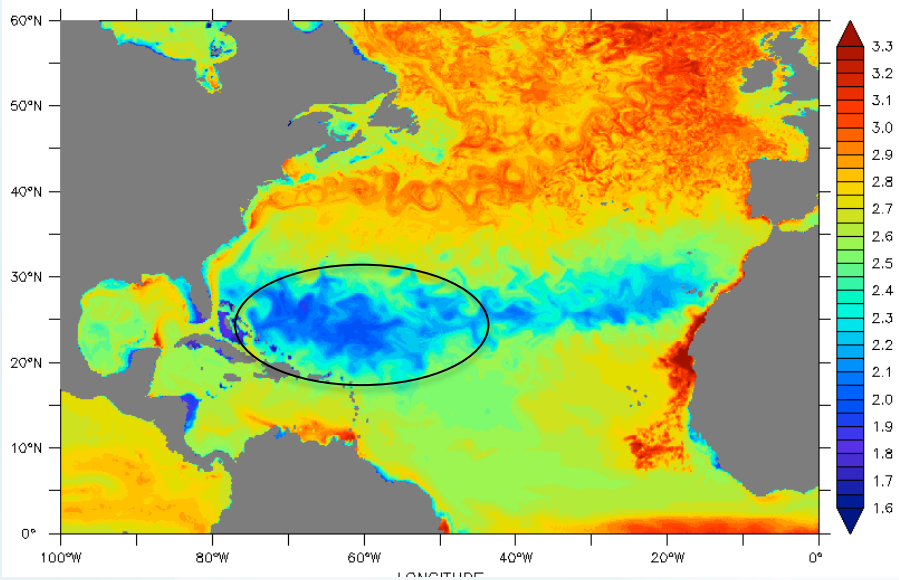
$\log_{10}$(primary production)

(mg-C/m^2/day)

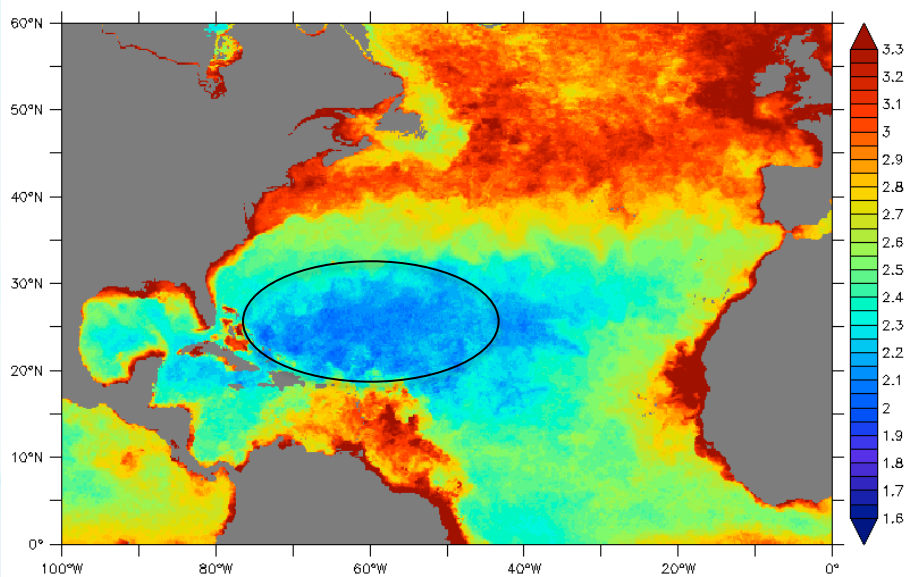
low resolution



high resolution

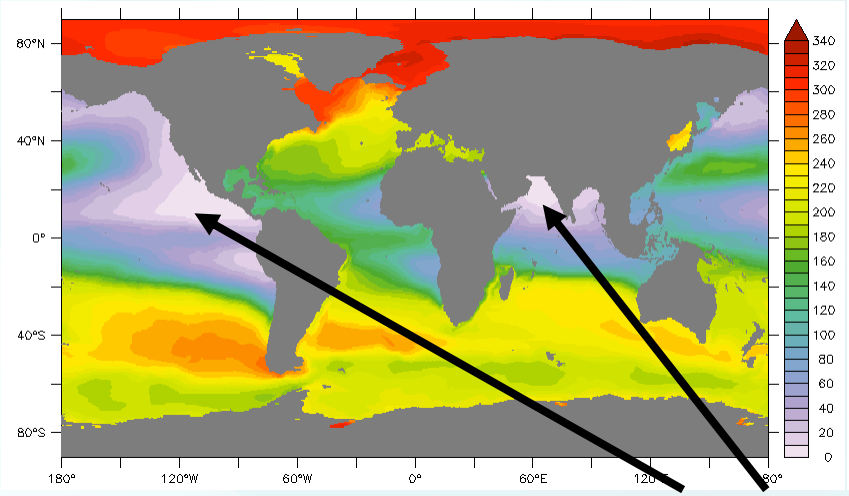


observational estimate

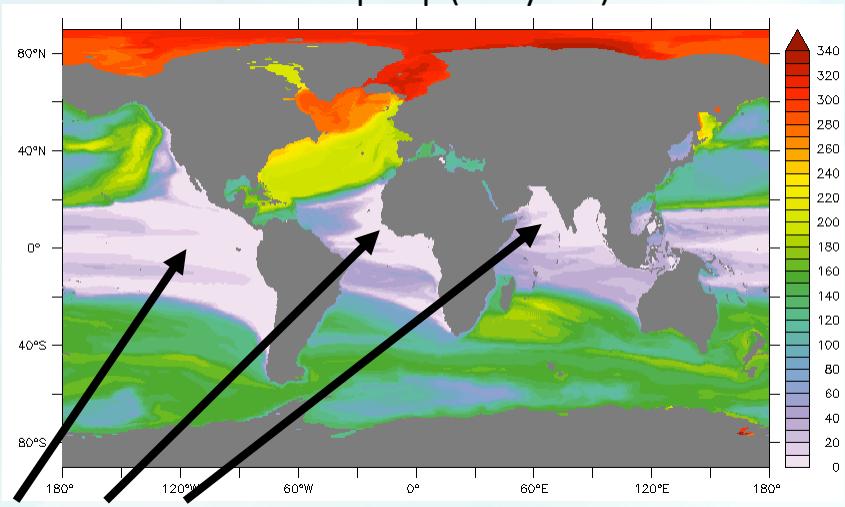


Dissolved Oxygen at 640m (mmol/m³)

Initial condition (World Ocean Atlas)



End of spinup (370 years)



Oxygen minimum zones

- Too extensive Oxygen Minimum Zones (OMZs)
  - Atlantic should not be anoxic
  - Partly due to poor representation of Antarctic Intermediate Water (AAIW)
  - Affects denitrification and remineralization
- Southern ocean deficit due to unrealistically shallow mixed layers

Approaches to mitigate biases

- Regionally Refined North American Grid
- Redi Mixing (unresolved isopycnal mixing of tracers)
- 3d GM
- River nutrient climatology consistent with MOSART River fluxes
- Tweak the benthic nutrient flux in coastal zones?
- DON as a source of nitrogen for sea ice PP.
- Kat Smith (Dec, 2019) and Yohei Takano (Feb, 2019)