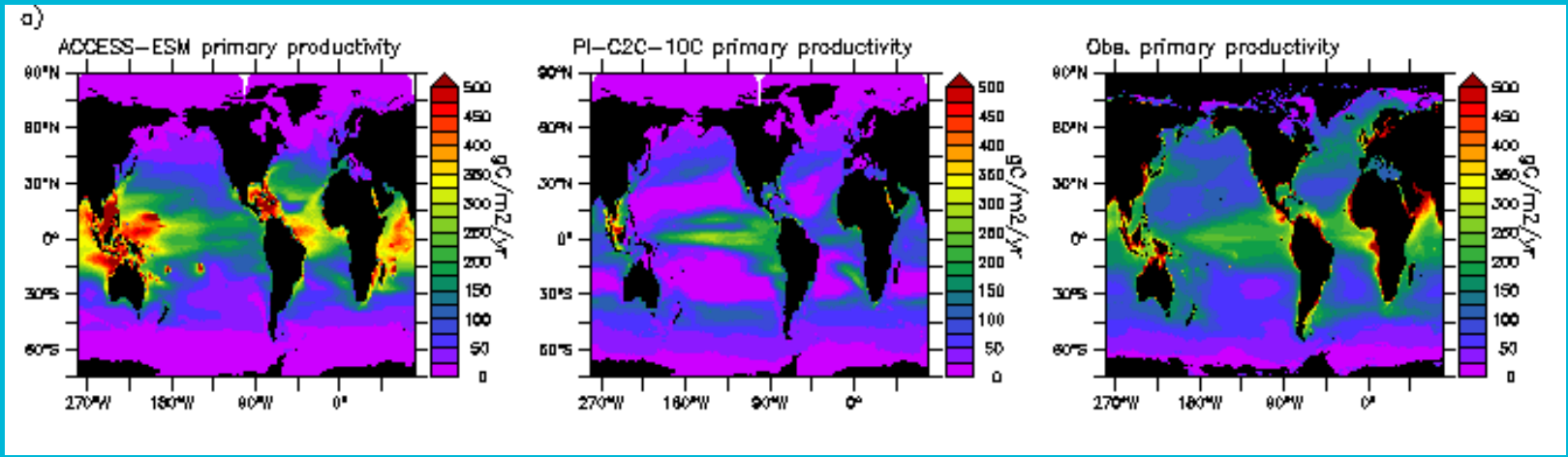

Ocean-BGC in ACCESS-ESM1.5

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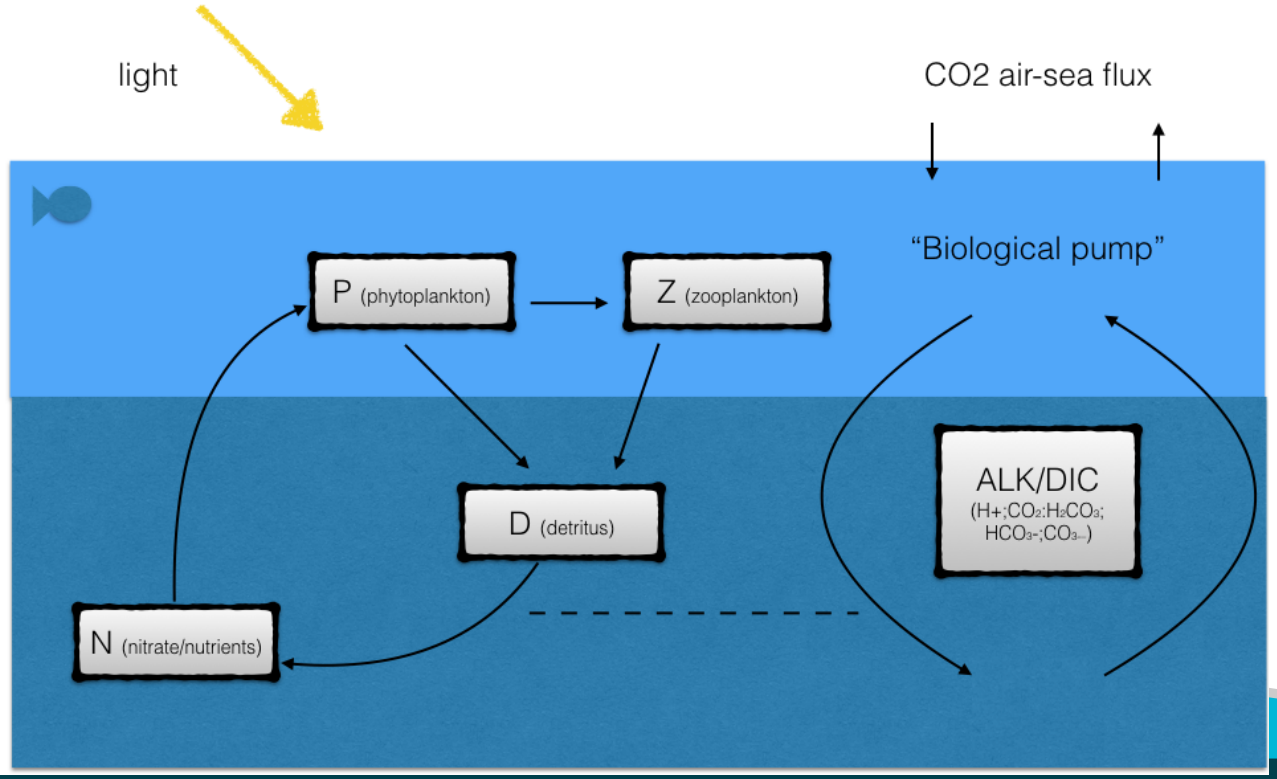
Matt Chamberlain, Andrew Lenton – 2018

Ocean-BGC introduction

- Productivity determined by NPZD model.
- Carbon linked to N-cycle

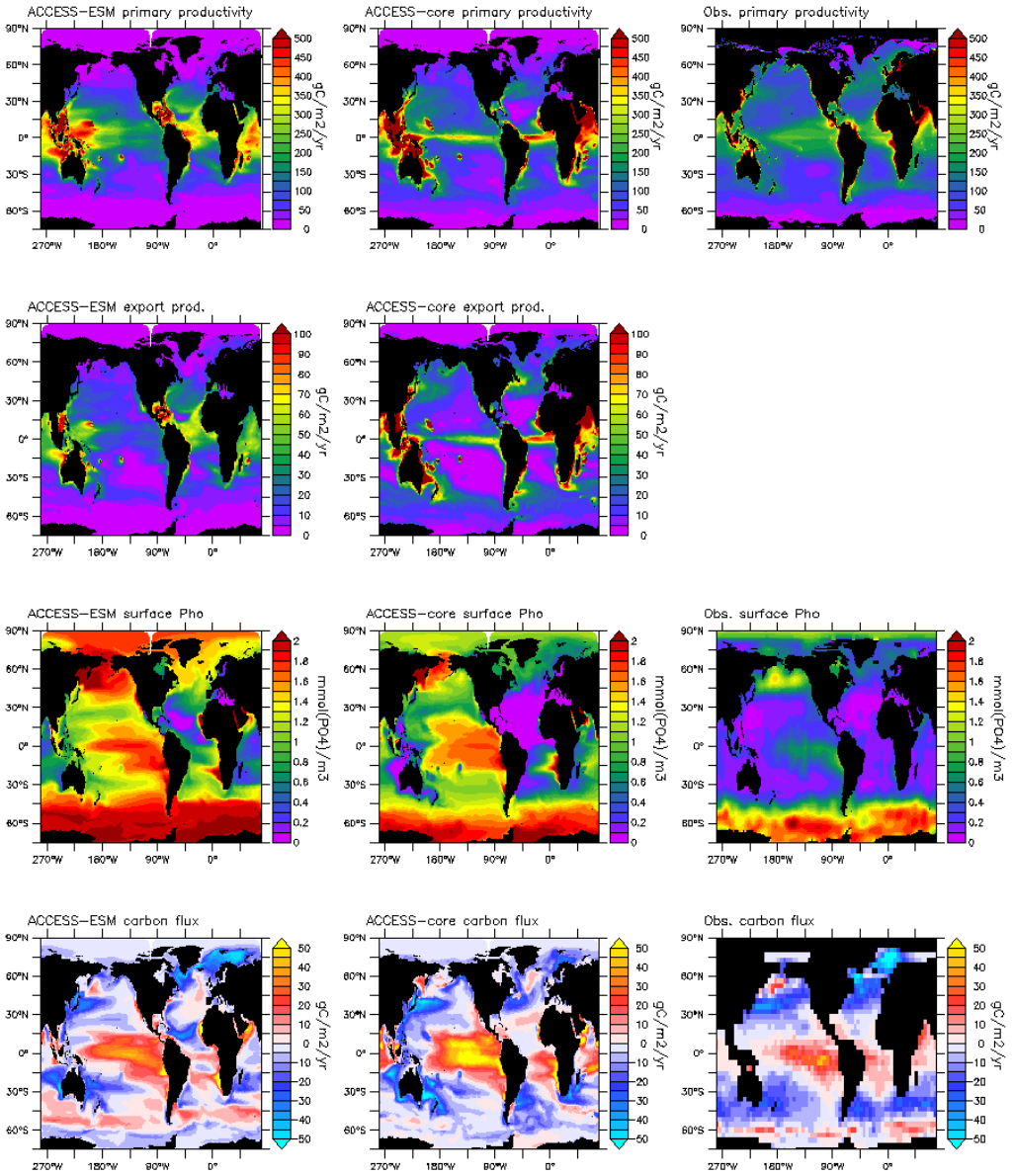


ACCESS-ESM1.0

- Construction: ACCESS-CM1.4 with carbon cycle for land (CABLE) and oceans (WOMBAT).
- Results summarised in two GMD papers
  - Law et al. 2017. The carbon cycle in the Australian Community Climate and Earth System Simulator (ACCESS-ESM1) – Part 1: Model description and pre-industrial simulation. GMD, 10.
  - Ziehn et al. 2017. The carbon cycle in the Australian Community Climateand Earth System Simulator (ACCESS-ESM1) –Part 2: Historical simulations. GMD, 10.
- Completed various experiments, including piControl, historical, RCP's, emissions.

ACCESS-ESM1.0

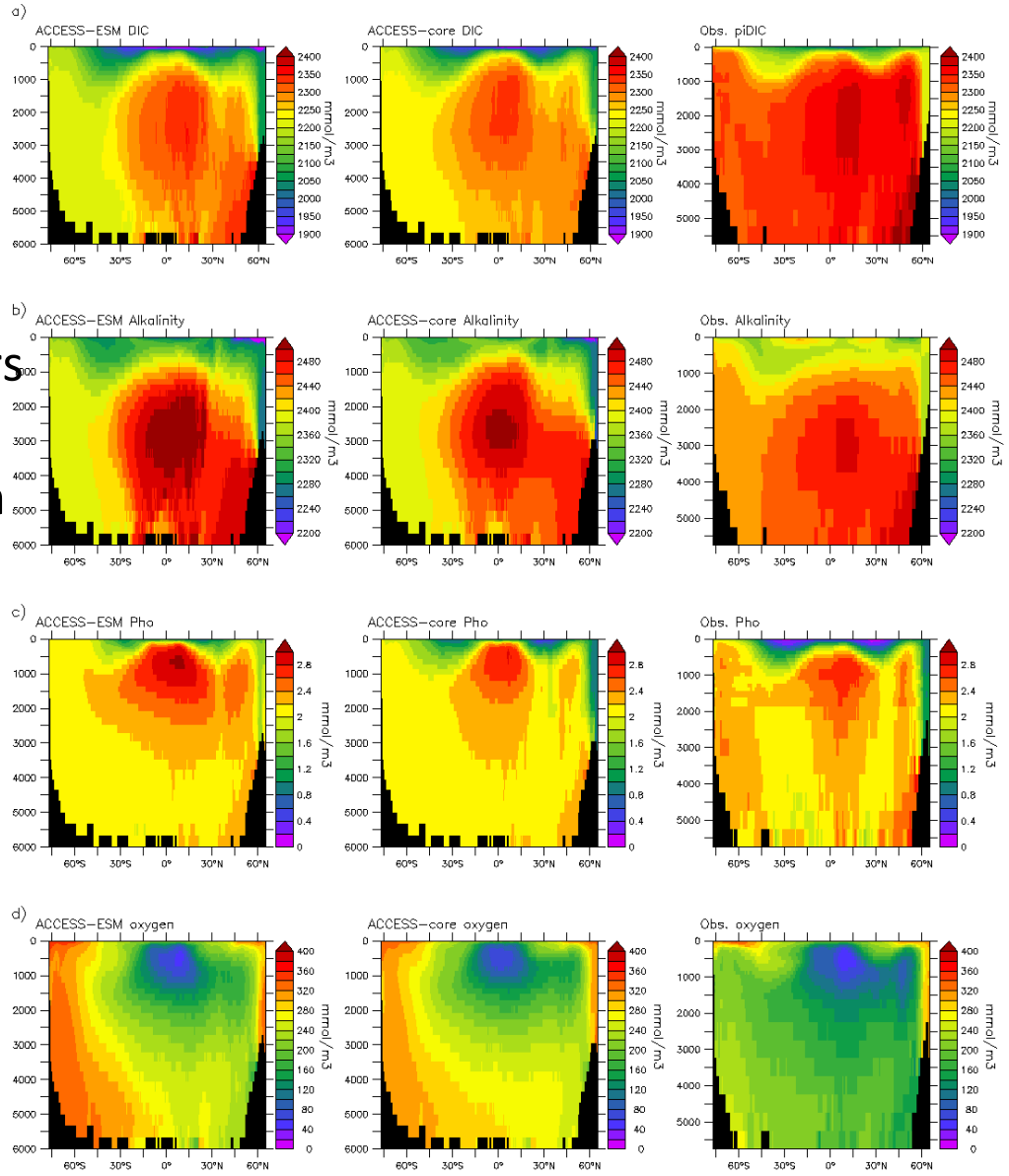
- Compare surface BGC field/ fluxes (which adjust rapidly to surface forcing).
- ESM1 productivity extensive across tropics, including “warm pool.”
- Extensive surface nutrients.
- Carbon flux reasonable.



Surface fields and fluxes of OBGC tracers (Law et al. 2017)

ACCESS-ESM1.0

- Longer time scales for deep tracers to stabilise.
- Alkalinity depleted in upper ocean driving CO2 outgassing.
- Nutrients reasonable
- Oxygen high in Southern Ocean.

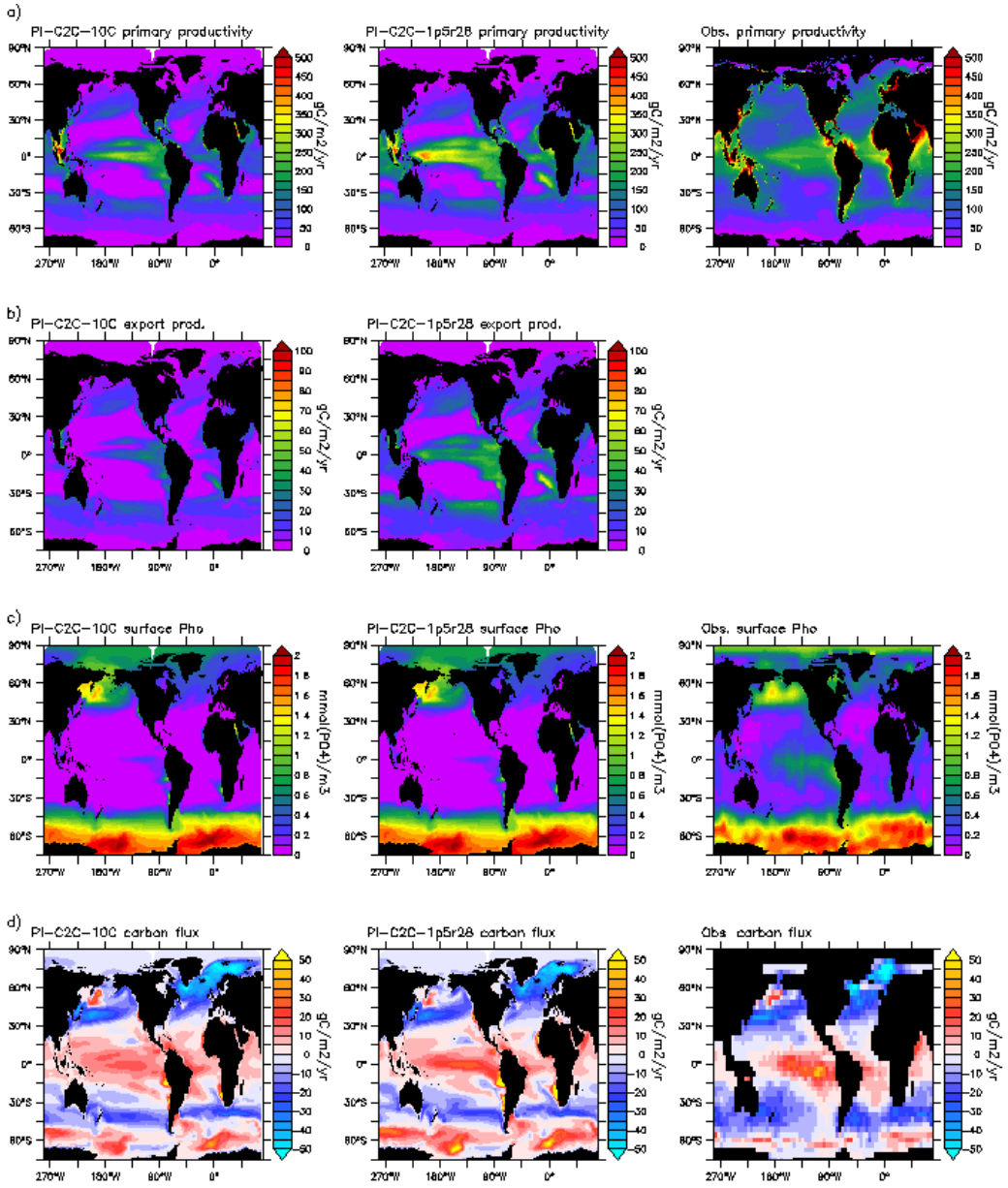


Sections of OBGC tracers, (Law et al. 2017).

Progress since ESM1

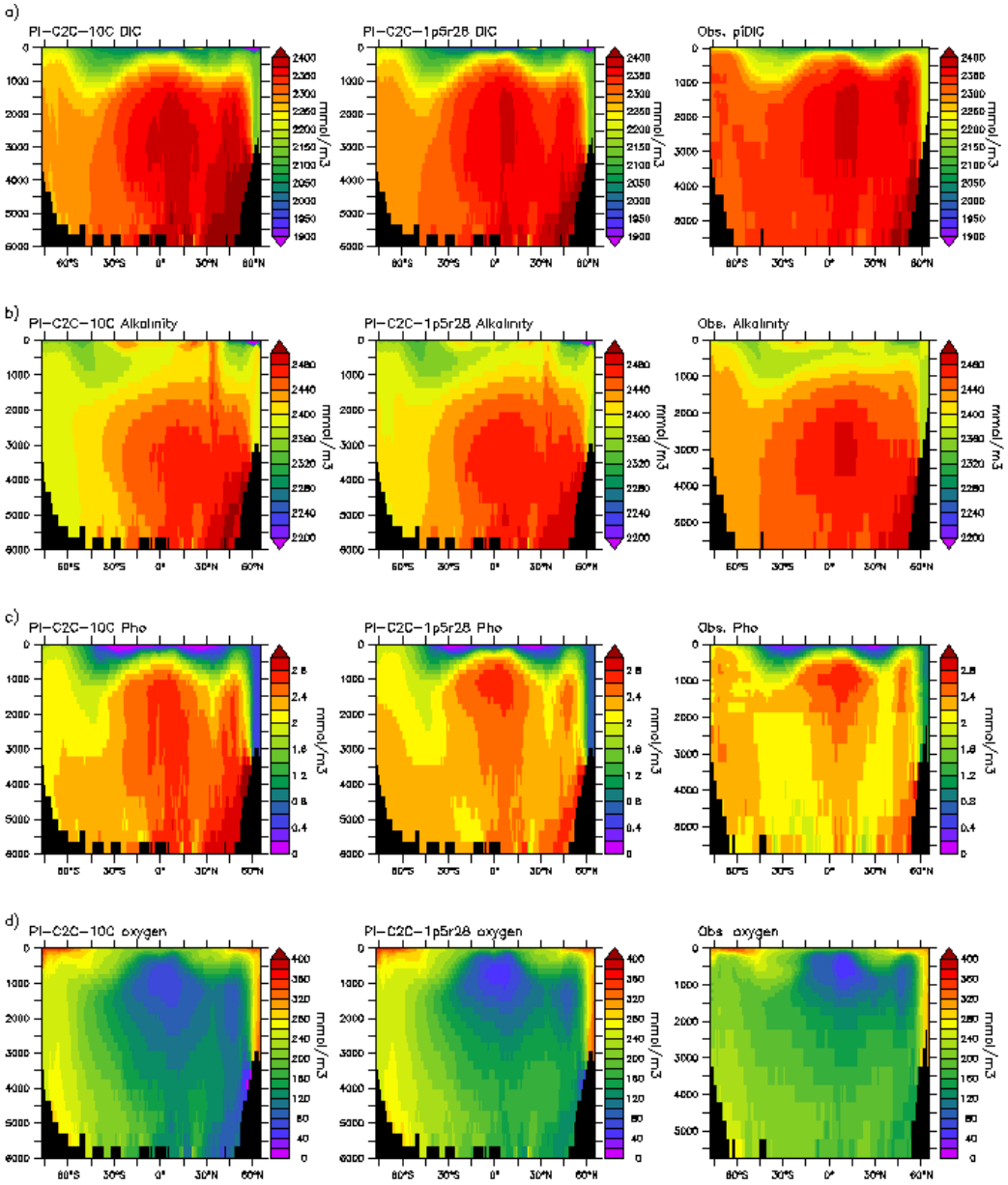
- Experiment PI-C2C-10C
  - tuning of BGC parameters.
  - run for several centuries.
- Experiment PI-C2C-1p5r28
  - using MOM5; without iceberg scheme, etc., from CM2.
  - further reduction in DET sinking velocity.
  - run for ~100 years.

- Productivity field closer to observed.
- Surface nutrients drawn down (like nitrate).



Progress since ESM1

- Alkalinity reasonable in upper ocean, no longer losing CO2 (DIC)
- Oxygen closer to observed in SthOcn.

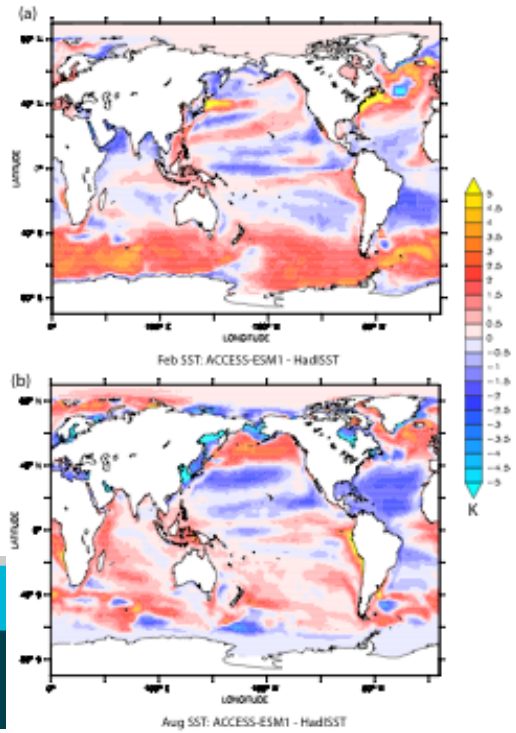


	ESM1	10C	1p5r28	"Obs"
Prod.	51	25	32	45-55
CO2-flx	-0.6	0.0	-.25	0.0

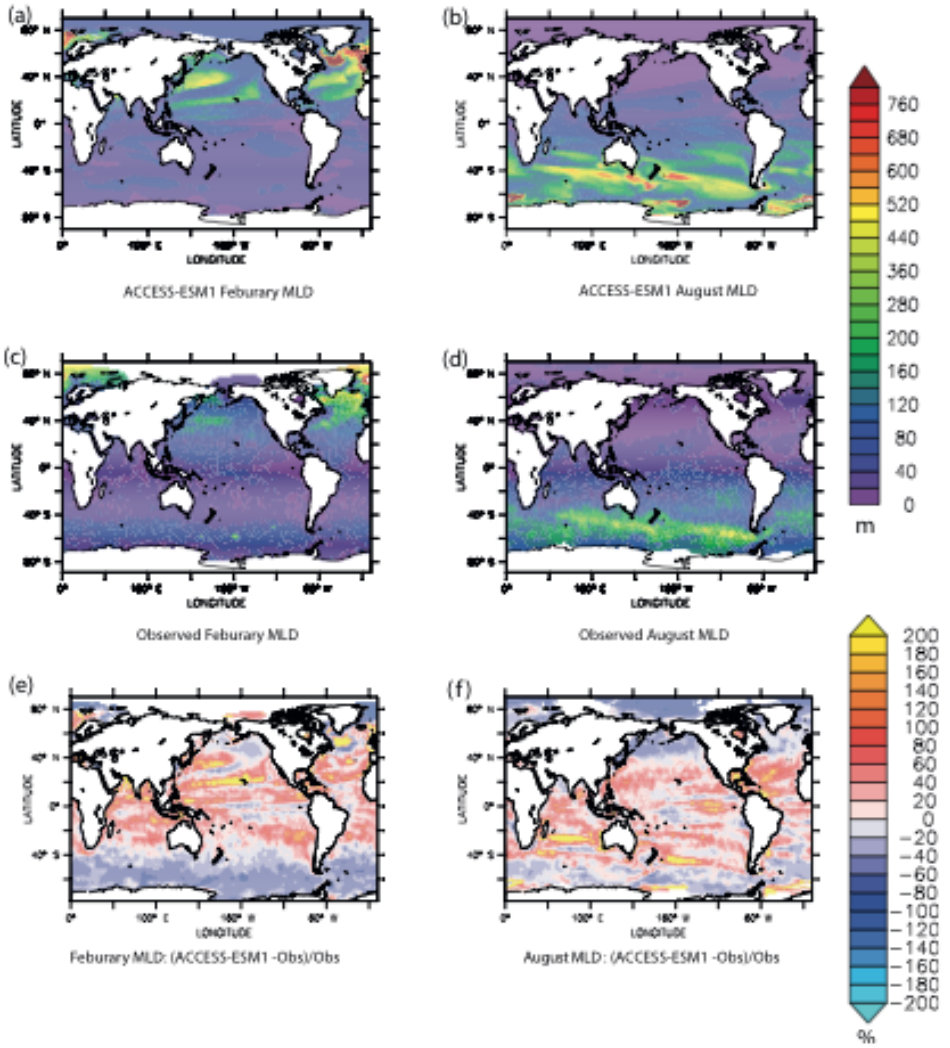
BGC global fluxes (PgC/y)

Southern Ocean Bias and impact on OBGC

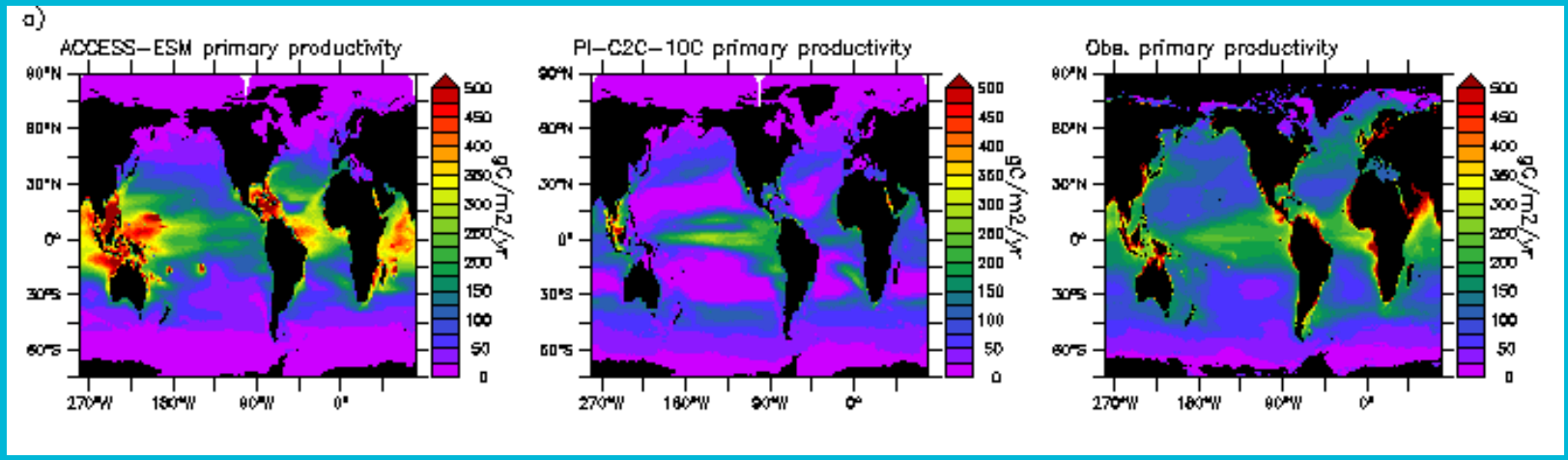
- Long standing BGC bias in SthOcn is lack of CO2 uptake in summer (when productivity is high); bias related to high SST, shallow MLD, low nutrient supply.
- Documented tendency of climate models to underestimate winter MLD (Sallee et al. 2013, JGR)



SST bias in Feb and Aug., Ziehn et al. 2017.



Differences in the MLD in different seasons, Ziehn et al. 2017.


a)
ACCESS–ESM primary productivity
PI–C2C–10C primary productivity
Obs. primary productivity
90°N
60°N
30°N
0°
30°S
60°S
270°W
180°W
90°W
0°
500
450
400
350
300
250
200
150
100
50
0
gC/m2/yr

Thank you