BGC Results from CESM 1.5 Experiments

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Background

• Carbon Cycle included in development runs of coupled model
  – we’ve been asking for this
• Carbon Cycle is not spun-up
• Model predicted atmospheric CO$_2$ is NOT coupled to LW/SW or BGC computations
  – atm CO$_2$ is purely diagnostic in these runs
Carbon Cycle is not spun-up
drift is large in 1850 control

b.e15.B1850G.f09_g16.pi_control.28

SURF CO2, glo

ppmv
Ocean & Land are both taking up CO$_2$ at substantial rates.
Global 20th Century Surface CO₂
(from previous model versions)

CESM1(BGC)

(b)
- PROG
- PRES
- Observed

ppmv
1860 1890 1920 1950 1980
model year

CESM1.2+(BGC)

(b)
- PROG
- PRES
- Observed

ppmv
1860 1890 1920 1950 1980
model year
Global 20\textsuperscript{th} Century Land (non-LULCC) Uptake of CO\textsubscript{2} (from previous model versions)

**CESM1(BGC)**

**CESM1.2+(BGC)**

Dark shading denotes estimates from Canadell et al. 2007
Seasonal Cycle of CO$_2$ at Point Barrow, Alaska

- CESM1(BGC)
- CESM1.2+(BGC)
- CESM1.5
Total Net Primary Production (NPP) and the spatial patterns look reasonable in general. One exception is the high NPP associated with equatorial upwelling extend too far west in the Pacific.
Equatorial upwelling extends too far to the west in the Pacific. Eastern Boundary Current and Arabian Sea coastal upwelling zones look better than in CESM1.
Surface nutrients look as good or better than CESM1. But note eastward extension of the high-nutrient equatorial tongue in Pacific.
Summary

• Drift in carbon cycle precludes some analysis
  – Should spin-up be done in the development cycle?
• My fingers are crossed that improvements in CESM1.2 will carry over to CESM1.5 & 2.0.
• Seasonal cycle of atmospheric CO₂ looking OK.
• Ocean BGC has improvements
  – Western Equatorial Pacific productivity is worrisome, more investigation is needed to understand it.
• Other aspects of the carbon cycle (e.g. interannual variability) remain unexplored.