# Incorporating Ocean Dynamics into a Global Coupled Climate-Carbon Cycle Model

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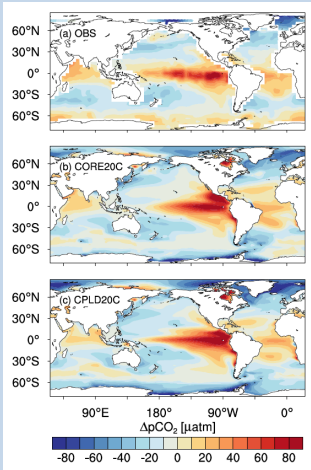
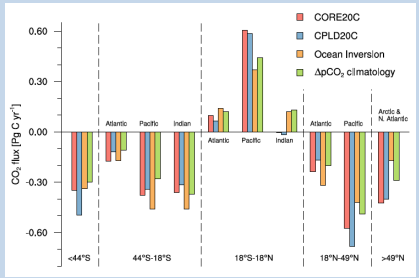
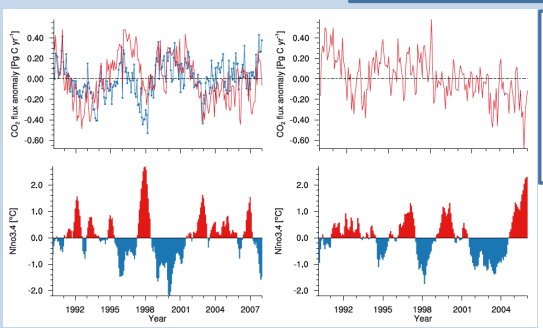
**Abstract:** Marine biogeochemistry have been incorporated into the most recent version of the Community Earth System Model (CESM-1). A major objective is to constrain ocean carbon dioxide uptake and storage under historical, current and future conditions and to assess potential feedback mechanisms on atmospheric carbon dioxide and climate. Model results contemporary conditions will be presented and model skill evaluated against ocean field data.



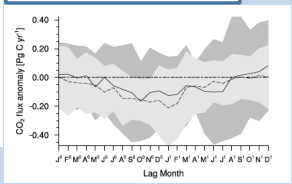

Annual mean sea-air $pCO_2$ gradient from: (a) Takahashi et al. (2009), (b) the ocean-ice hindcast (CORE20C), and (c) the fully coupled 20th Century integration (CPLD20C).



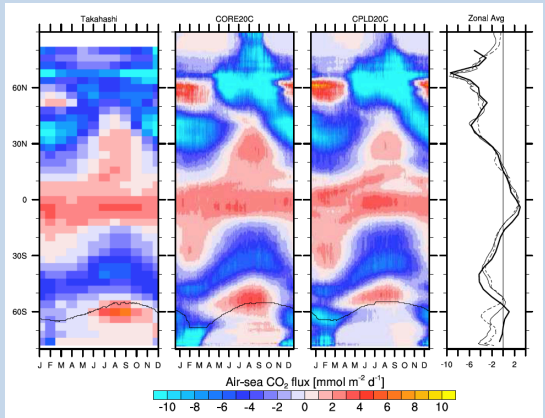

Zonally integrated contemporary sea-air $CO_2$ fluxes by basin (<0 = ocean uptake) with inversion estimates from Gruber et al. [2009] & $pCO_2$-based estimates from Takahashi et al. [2009].



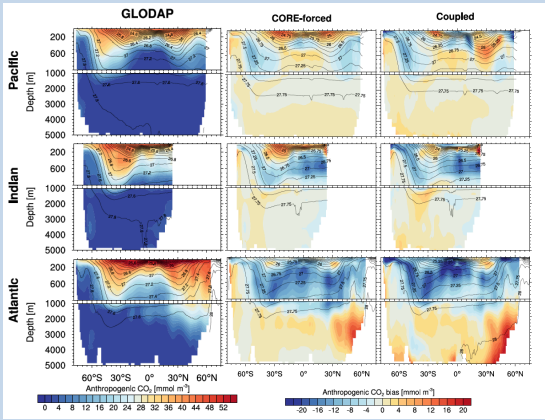

(a) Global monthly $CO_2$ flux anomalies from Park et al. [2010] (blue line, dots) and CORE20C (red line); (b) $CO_2$ flux anomalies from CPLD20C. ENSO3.4 index computed from SST fields



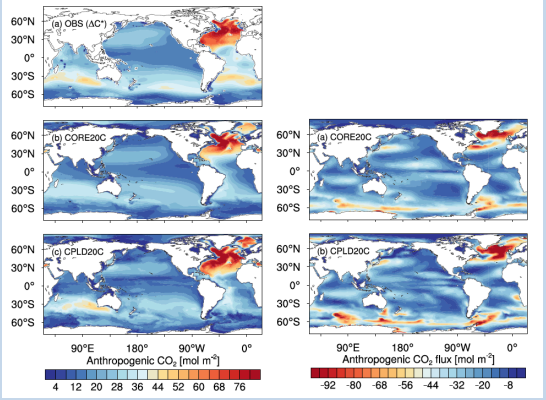

Global sea-air flux anomaly for El Nino events in CORE1850 (solid line) and CPLD1850 (dashed line). Shading shows range of variability (1σ) for all events (CORE: 8 events; dark gray) & (coupled: 33 events; light gray).



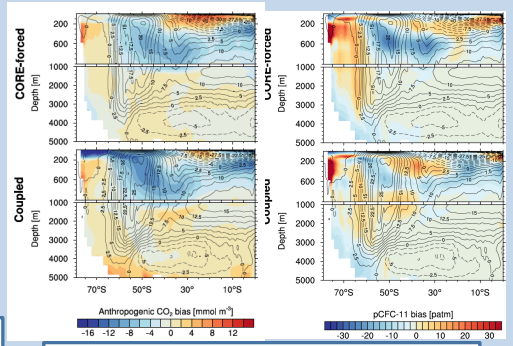

Air-sea CO2 flux from the monthly climatology of Takahashi et al. (2009), CORE20C, and CPLD20C. Black lines show maximum meridional extent of fractional ice coverage greater than 50%. Far right panel shows the annual zonal mean flux from observations (thick solid), CORE20C (thin solid) and CPLD20C (dashed).




Zonal mean anthropogenic $CO_2$ by ocean basin from GLODAP (left), and bias relative to GLODAP inCORE20c (middle), and CPLD20C (right).




Column inventory of anthropogenic $CO_2$ in (a) GLODAP (b) CORE20C, and (c) CPLD20C. Flux of anthropogenic $CO_2$ integrated over the 20th Century in (d) CORE20C and (e) CPLD20C.




Zonal mean anthropogenic $CO_2$ bias (left, color) and pCFC-11 bias (right, colors). Contours show the zonal mean meridional overturning circulation.