

Update on BGCWG Activities

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- BGC features in CCSM4/CESM1
- CMIP5 Runs with BGC
- Developments in Progress

What is in the CESM1 release

- POP Ecosystem model (first release)
 - Default: Off
 - Online User's Guide
 - Scientific Reference in prep
- CLM features (in CCSM4 release)
 - Carbon-Nitrogen Model, Default: On
 - Land Cover & Land Use Change (LCLUC)
 - Dynamic Global Vegetation Model (DGVM)
 - Crops (CESM 1.0.3)
- CAM CO₂ features (first release)
 - Default: Off
 - CO₂ constituents that use LND & OCN CO₂ fluxes as surface boundary condition
 - Pass CO₂ to driver for LND & OCN flux computations
 - Couple CO₂ constituents to radiation computations

What is in the CESM1 release

- New BGC compsets (i.e. works out of the box)
 - Spun-up Initial Conditions
- Diagnostics from 30 year segment of 1850 controls
 - no ATM CO₂ or Ocean BGC yet
- Model Output from 30 year segment of 1850 controls

New BGC Compsets

- Model configurations that work out of the box
- Coupled
 - BGC & Radiation uses prognostic (predicted) CO₂
 - BGC & Radiation uses diagnostic (prescribed) CO₂
 - 1850 Pre-industrial & 20th Century configurations
- Ocean Alone w/ BGC

New BGC Compsets

- Terminology
 - BGC CO₂: used by BGC in surface components
 - RAD CO₂: used by ATM radiative code

 - Prognostic CO₂: predicted ATM concentrations
 - Diagnostic CO₂: prescribed ATM concentrations

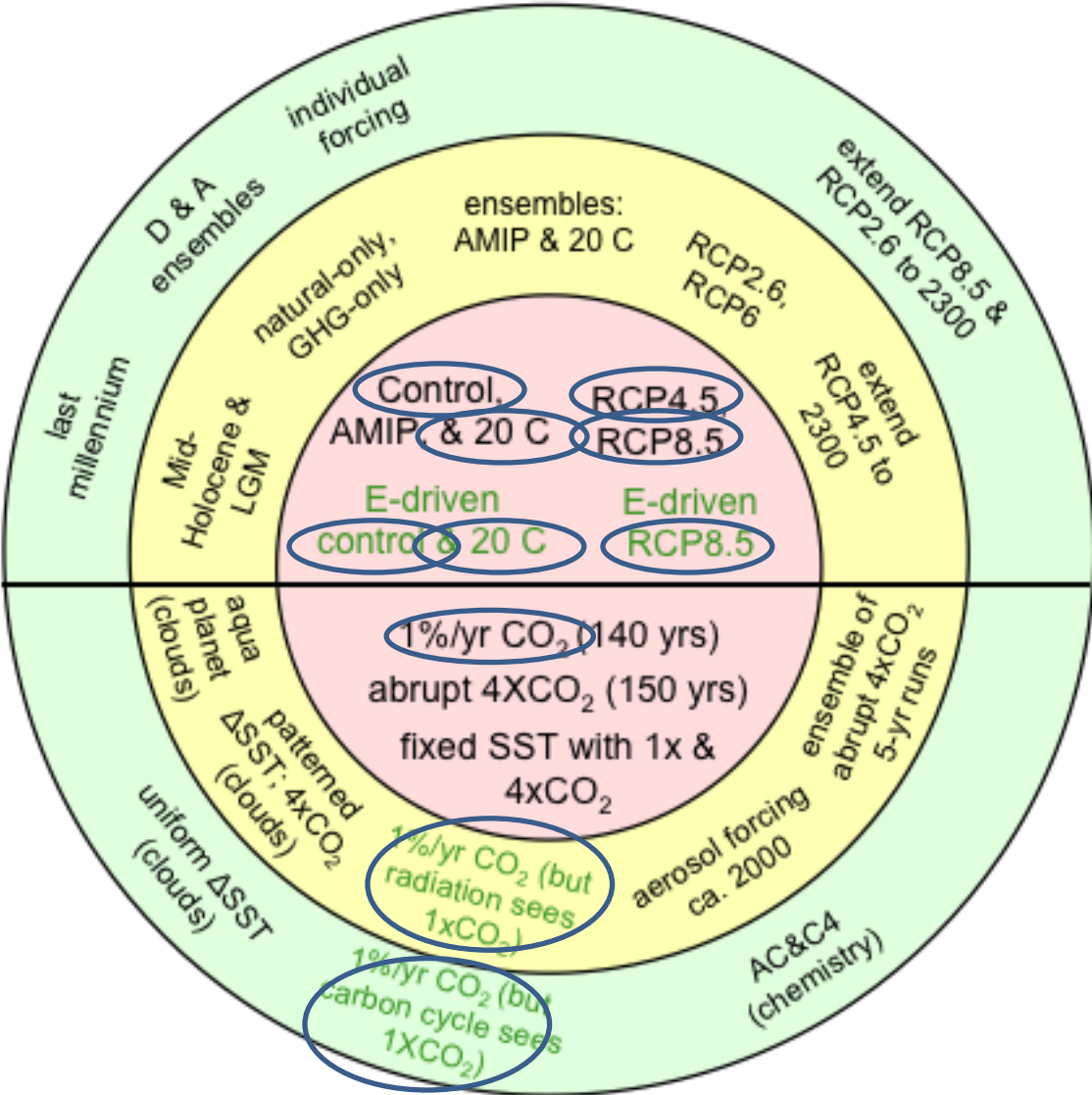
- B_1850_BGC-BPRP
 - BGC CO₂ = Prognostic, RAD CO₂ = Prognostic
- B_1850-2000_BGC-BPRP
- B_1850_BGC-BDRD
- B_1850-2000_BGC-BDRD

- C_NORMAL_YEAR_ECOSYS

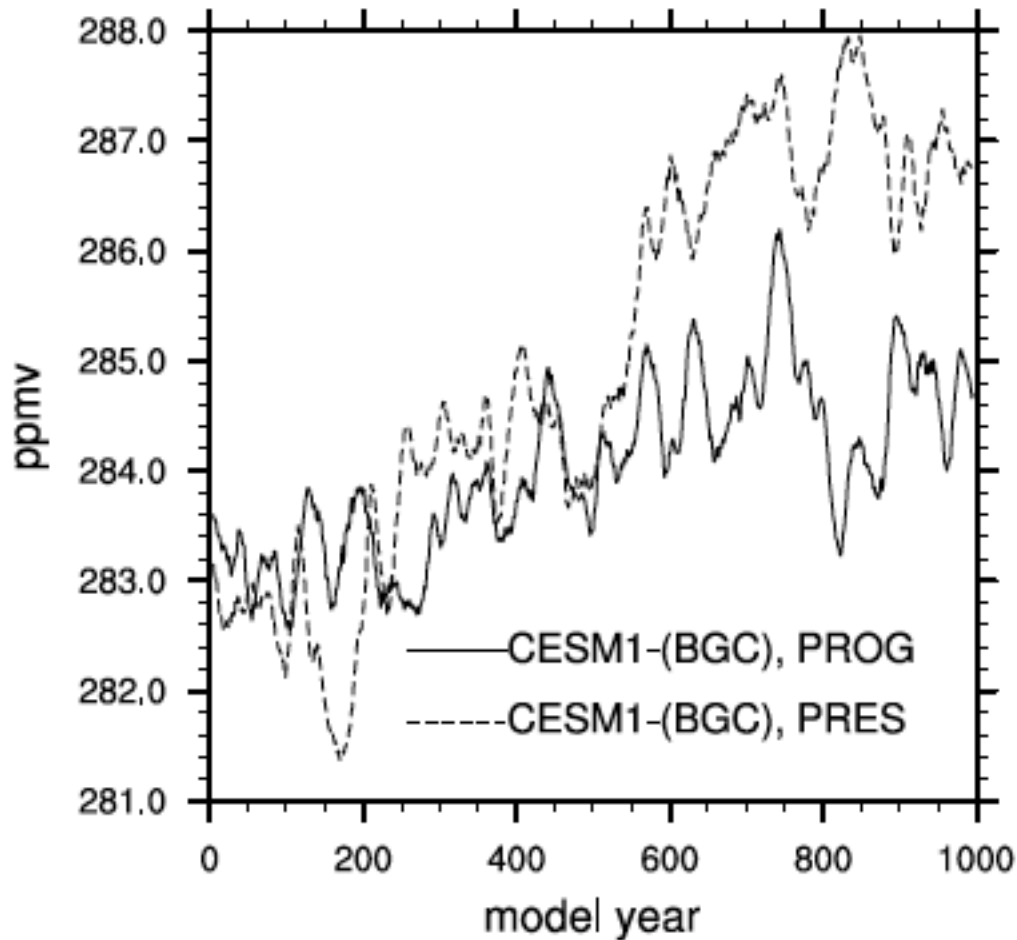
Spun-up Initial Conditions

- IC's are provided for coupled compsets
 - Uses physics of CAM4
- Resolution
 - ATM/LND: 0.9x1.25
 - OCN/ICE: gx1v6
- Ocean Alone IC are provided for gx1v6, gx3v7, but are not spun-up

CMIP5 Long-Term Experiments

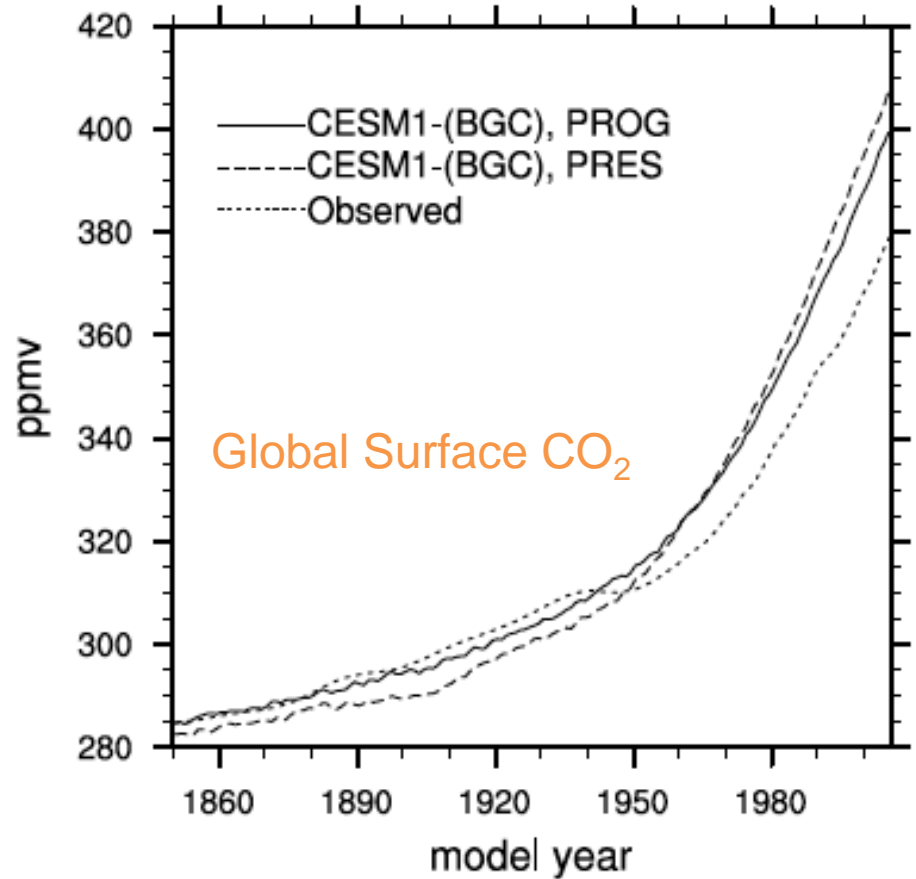
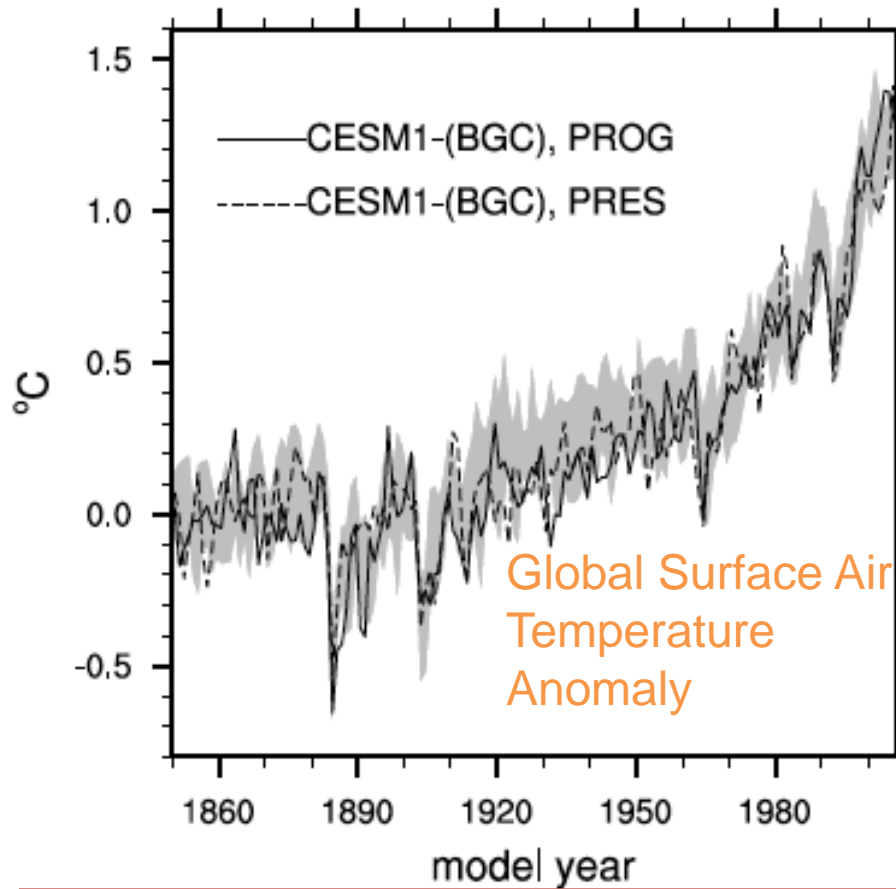


Preindustrial Control Simulations



- Sequential spin-up procedure for land & ocean components
- Stable preindustrial controls
 - atmosphere within either +2 or +4 ppmv over 1000 yrs
- Some small drift with ocean outgassing & land uptake (15-20 Pg C or ~7-10 ppmv CO₂)

CESM1 20th Century Transient Simulations

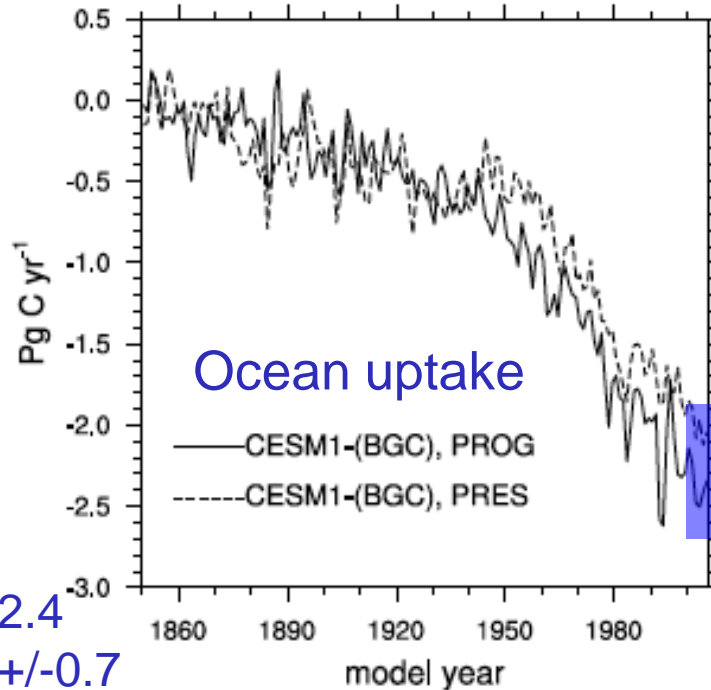
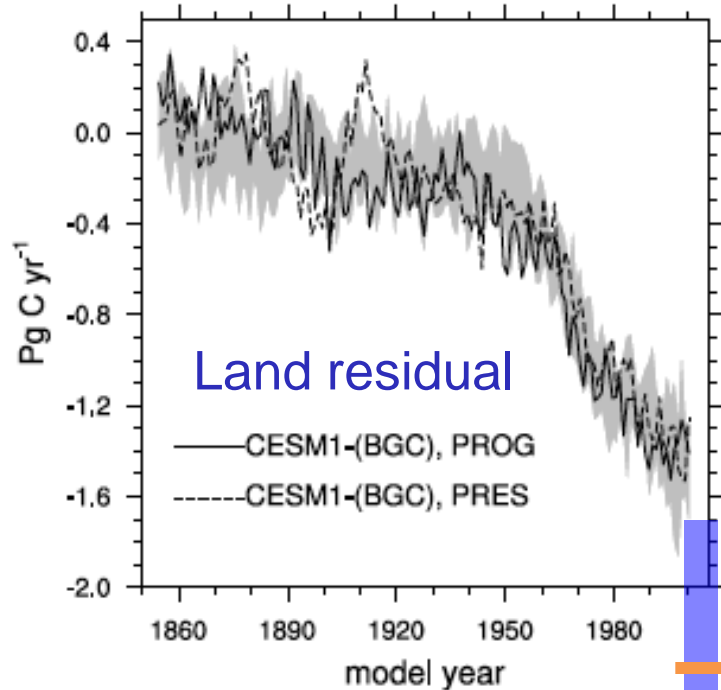
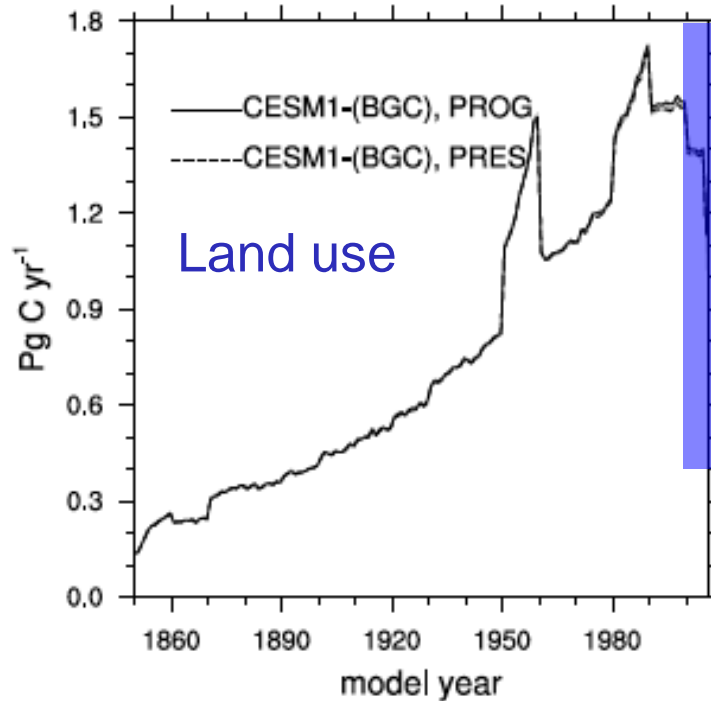
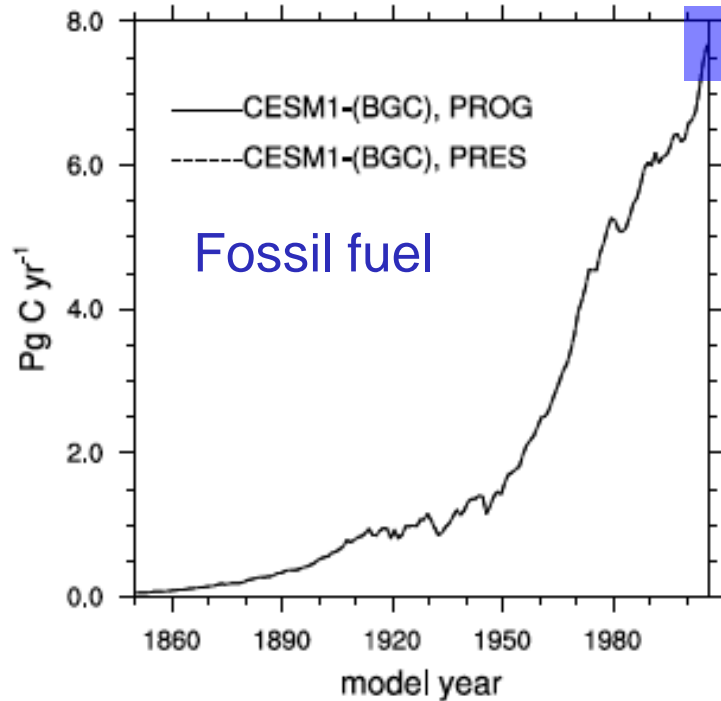


- Run with CO₂ emissions (prognostic CO₂) or prescribed CO₂
- CESM1 positive atmospheric CO₂ bias (+20 ppmv) for both Prognostic & Prescribed CO₂
- no significant temperature impact from CO₂ bias

20th Cent. Carbon Fluxes

Global Carbon
Project
estimates
(2000-2009)
w/ 1σ error

Le Quere et
al., Nat.
Geosci. 2009
Friedlingstein
et al. Nat.
Geosci. 2010



Land Developments

- Unstructured Grids
- Revised GPP and multi-layer canopy
- Cold region hydrology
- 2-way CLM-RTM interactions
- Process based methane emissions
- Vertically resolved C & N dynamics
- Revised lake model
- Faster C cycle spinup procedure
- Riverine transport of BGC quantities

Ocean BGC Developments

- Functioning Diagnostics Package
- Fe/C stoichiometry, growth and grazing updates
- River Inputs of Nutrients
- Improved DOM cycling
- Coupling to a simple sediment model
- NH_3 , N_2O surface emissions
- Ocean Acidification Feedbacks
- Enhancement of Calcifying Functional Groups
- Treatment of Sea-Ice Heterogeneity
 - PAR yes, sinking particles maybe
- Isotopes (C, O_2 , N)
- Couple to Sea-Ice Algae
- Methane
- Get Newton-Krylov fast spinup working at x1