Results from CESM 1.2+ Coupled Carbon Cycle Experiments

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CESM 1.2+ Coupled Carbon Cycle Experiment Objectives

- Determine impact of updated model on biases from CESM1(BGC)
- ~~Identify remaining/new biases in time to address for CESM2(BGC)~~
- Do science that is not possible with CESM1(BGC)
- Practice run for BGC coupling before CESM 2

Model Updates in CESM 1.2+ Runs

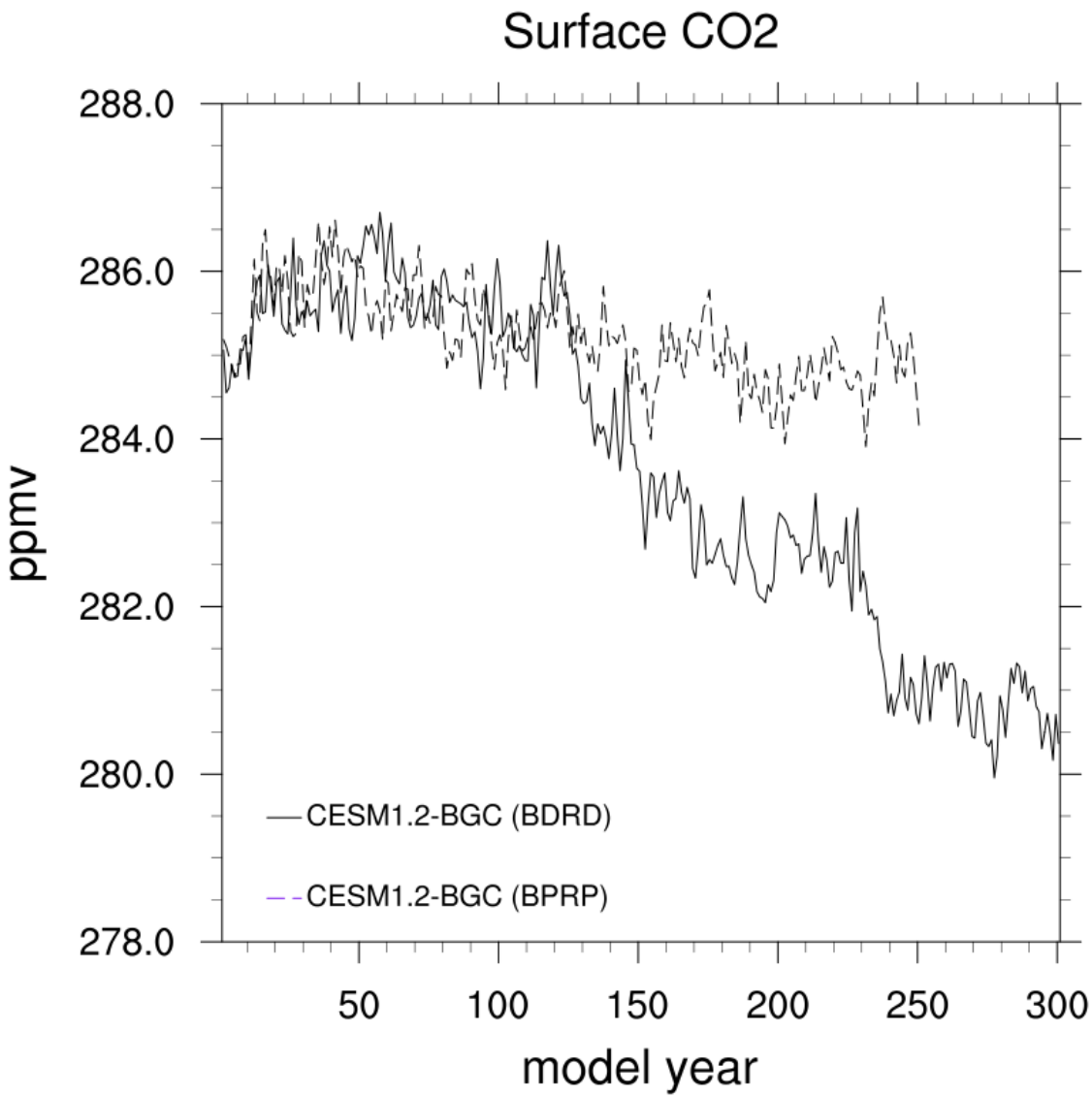
- CAM5 physics, Finite Volume Dy Core
  - Include radiation bug fixes since Large Ensemble
- POP physics
  - Increased lateral mixing
- CLM45BGC+
  - Fire module fix since CESM 1.2
  - C isotopes (^{13}C, ^{14}C)
- CESM 1.2+ version of BEC
  - Treatment of light under sea ice categories
  - DOM, Fe:C updates
  - C isotopes (^{14}C)

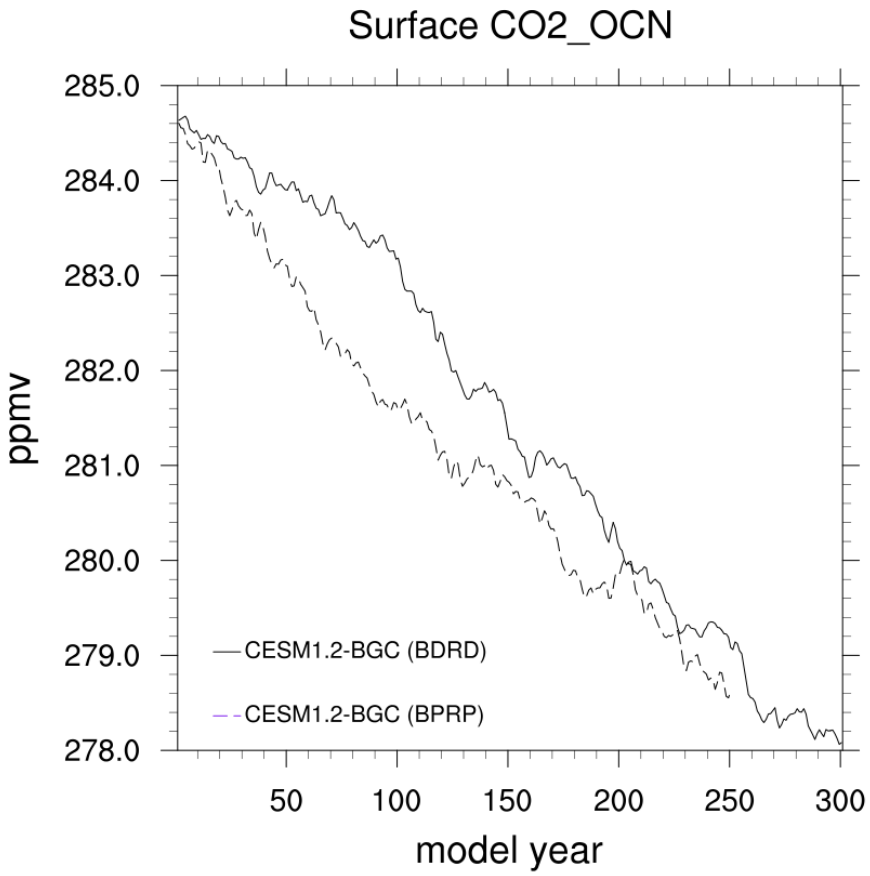
Status of CESM 1.2+ Runs

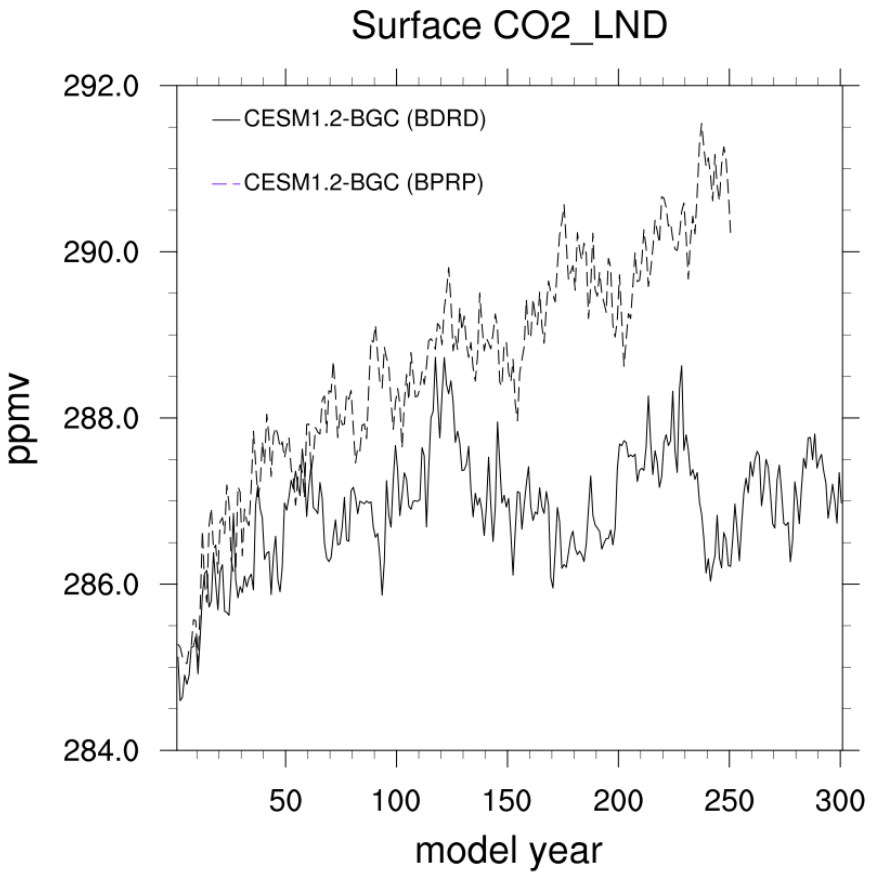
- BDRD 1850 control out 300 years
- BPRP 1850 control out 250 years

- 20C BDRD & BPRP runs done
  - surface fields necessary to run independent ocean-ice and land-only runs were saved

- RCP8.5 in progress

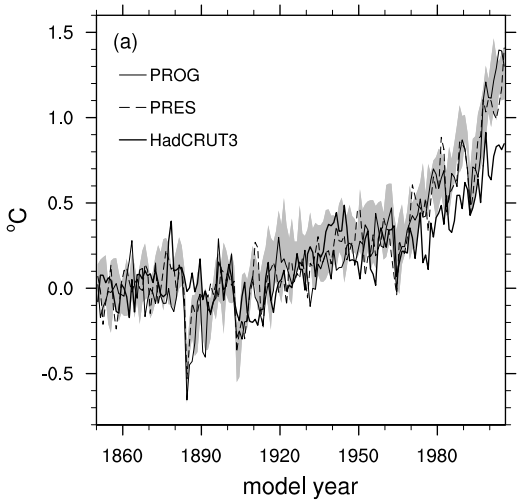

Surface CO2
288.0
286.0
284.0
282.0
280.0
278.0
ppmv
50
100
150
200
250
300
model year
CESM1.2-BGC (BDRD)
CESM1.2-BGC (BPRP)

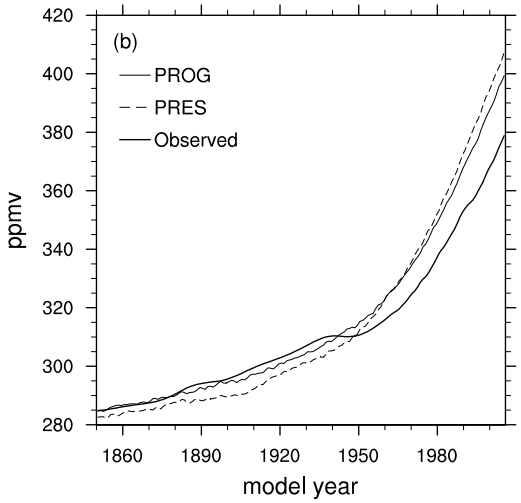

Surface CO2_OCN
285.0
284.0
283.0
282.0
281.0
280.0
279.0
278.0
ppmv
CESM1.2-BGC (BDRD)
CESM1.2-BGC (BPRP)
50
100
150
200
250
300
model year


Surface CO2_LND
292.0
290.0
288.0
286.0
284.0
ppmv
CESM1.2-BGC (BDRD)
CESM1.2-BGC (BPRP)
50
100
150
200
250
300
model year

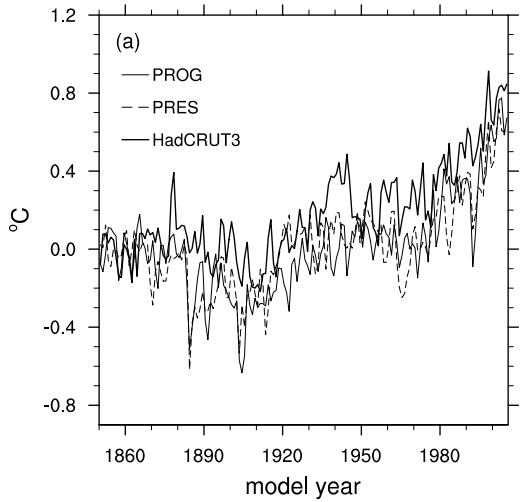
Global 20th Century 2m Air Temp and Bottom CO_2

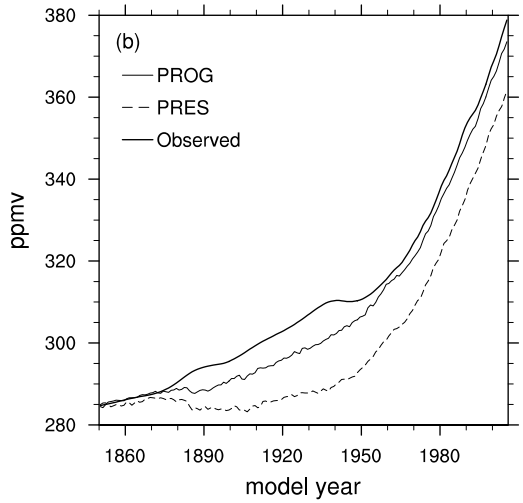
CESM1(BGC)



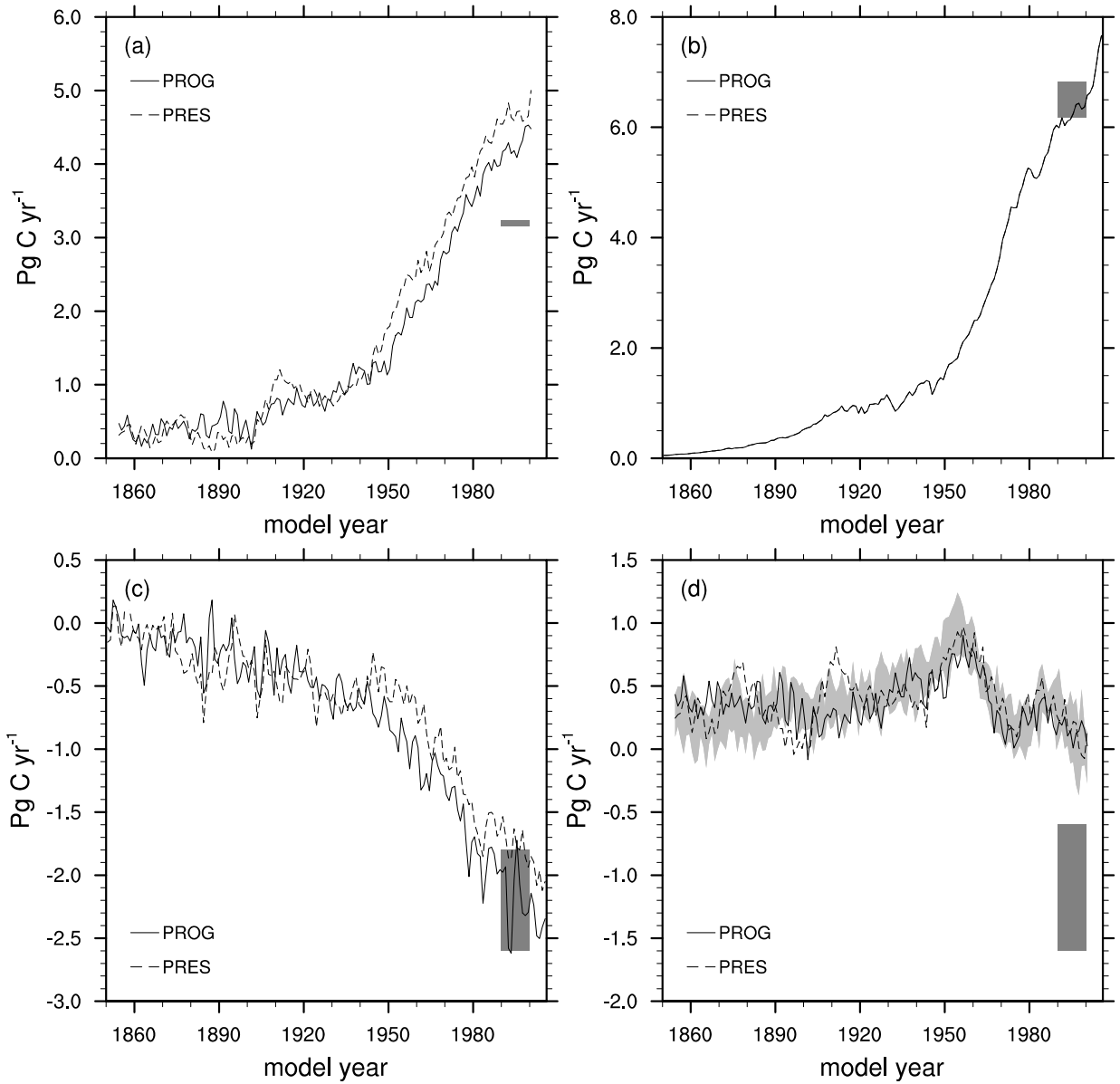


CESM1.2+(BGC)

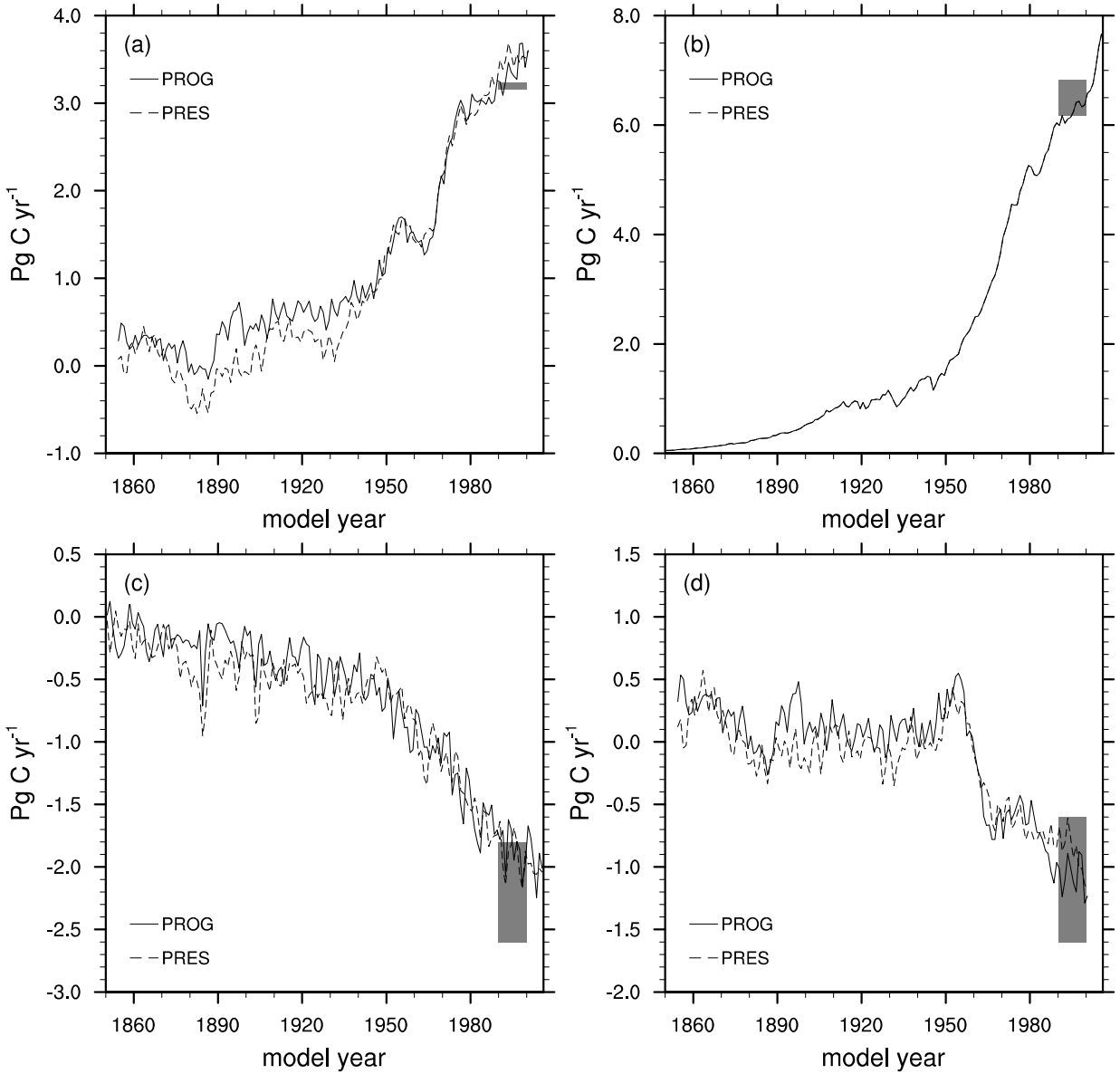




Global 20th Century Surf CO_2 Fluxes, CESM1(BGC)

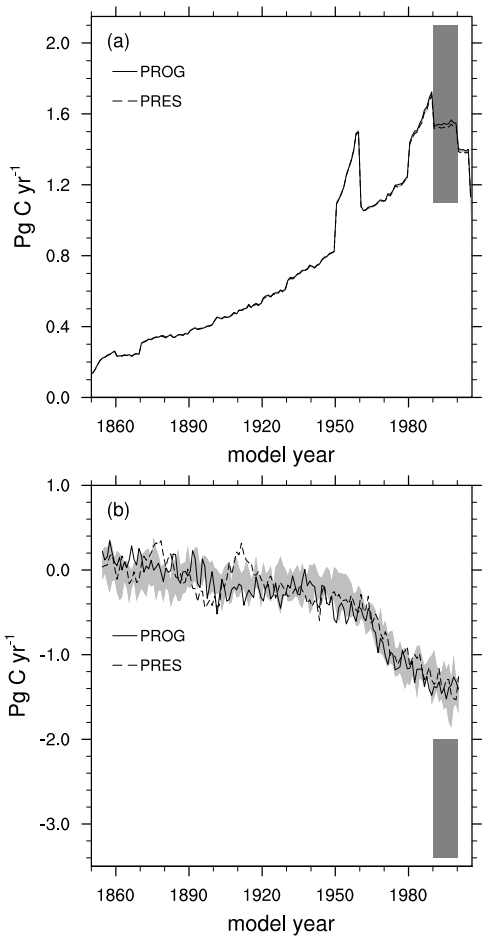


Global 20th Century Surf CO_2 Fluxes, CESM1.2+(BGC)

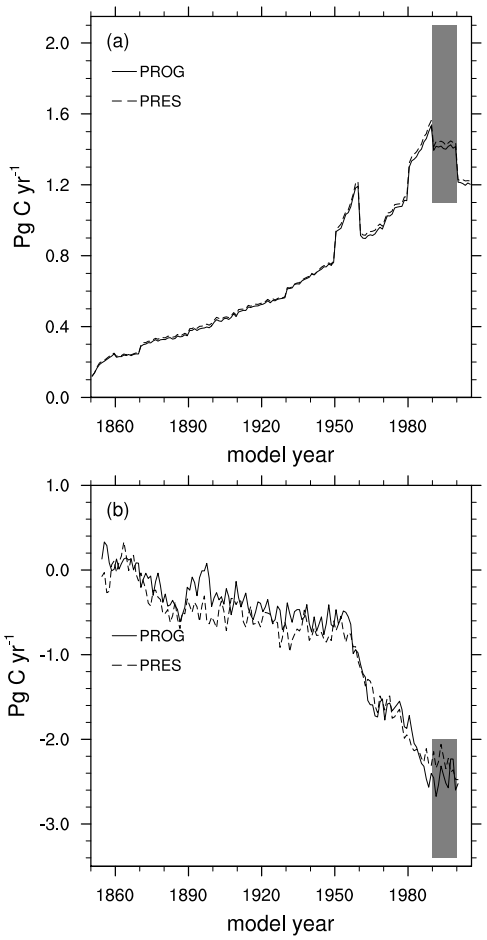


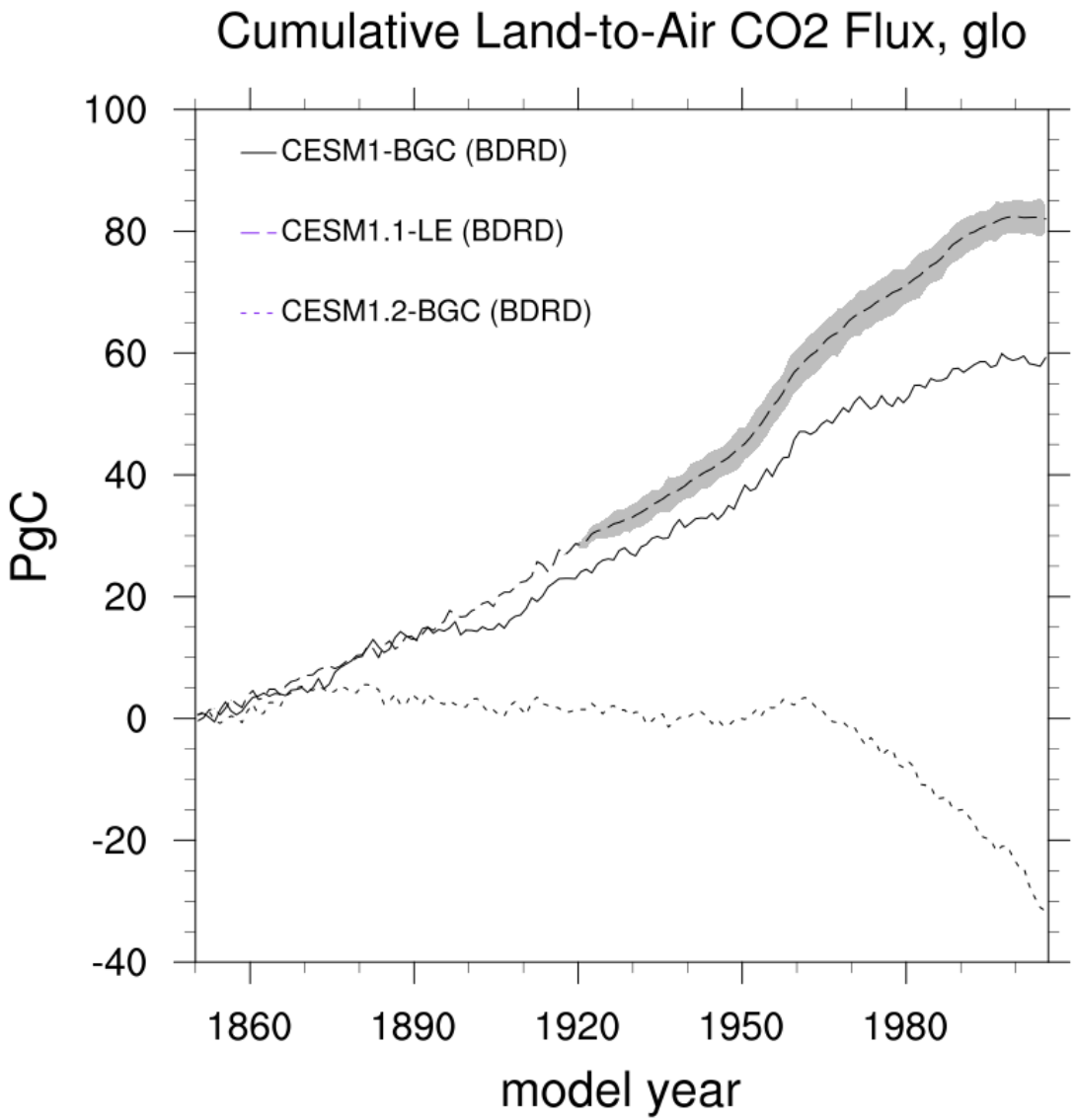
Land Use and Land Residual CO_2 Flux

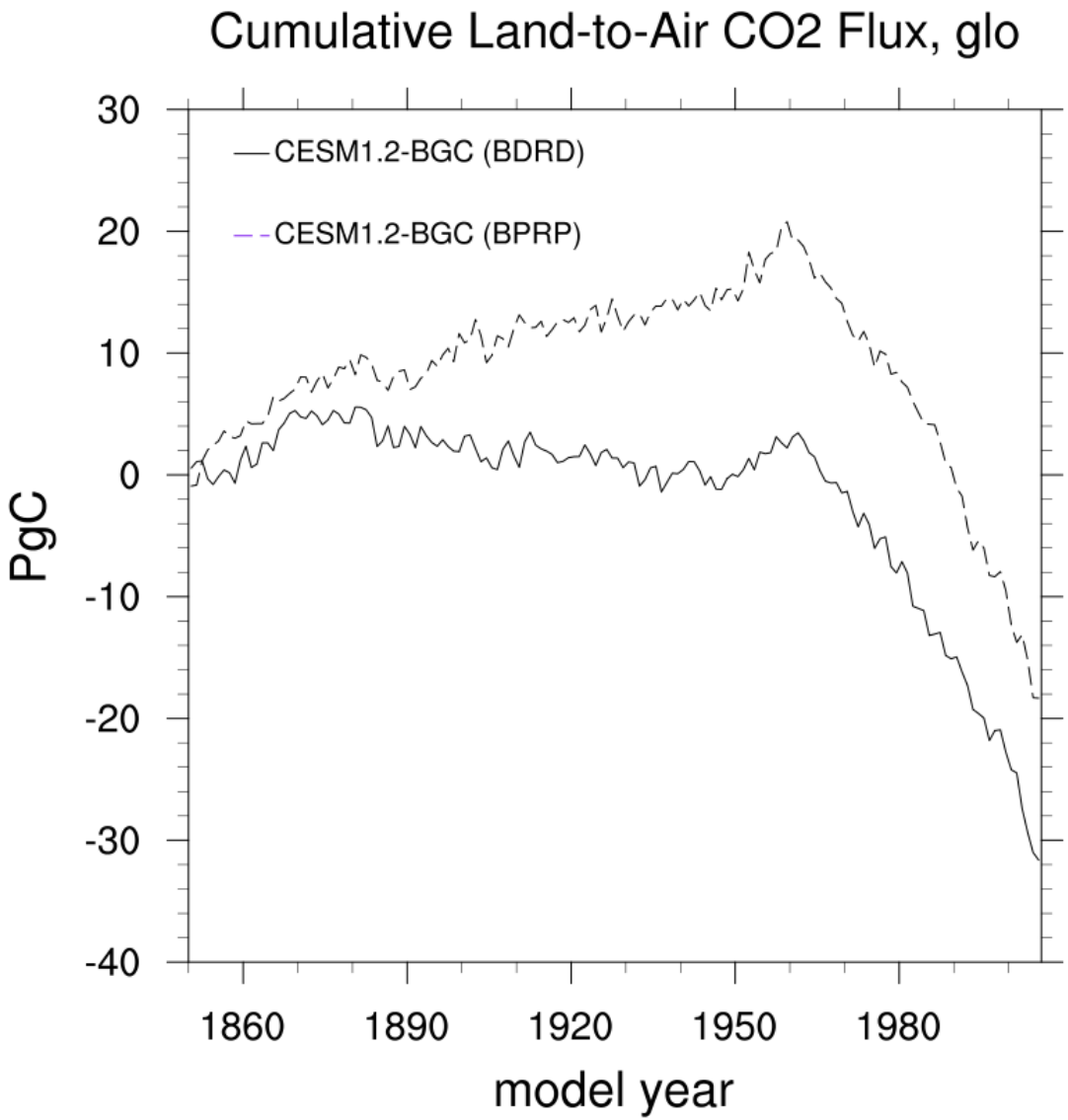
CESM1(BGC)

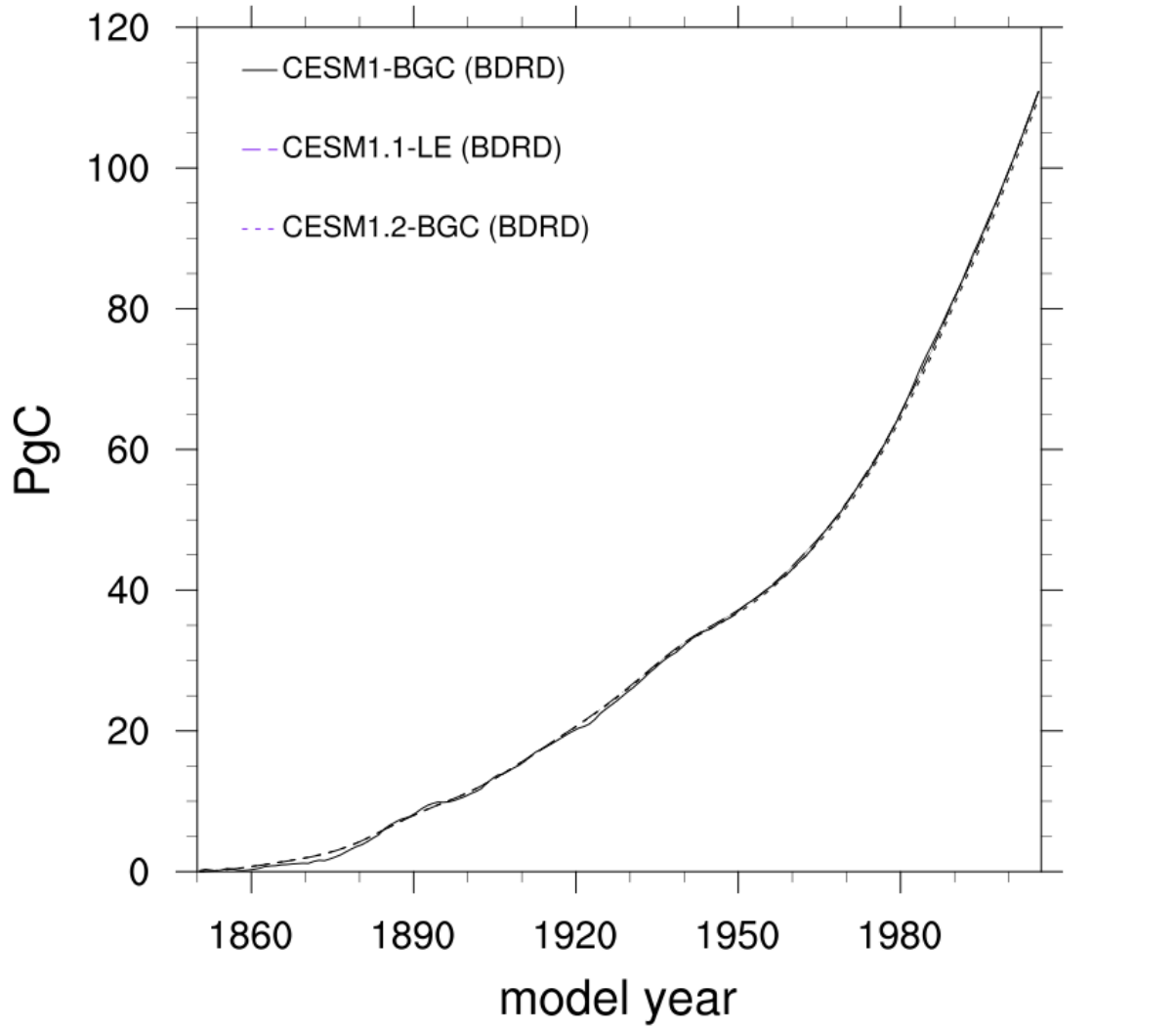


CESM1.2+(BGC)

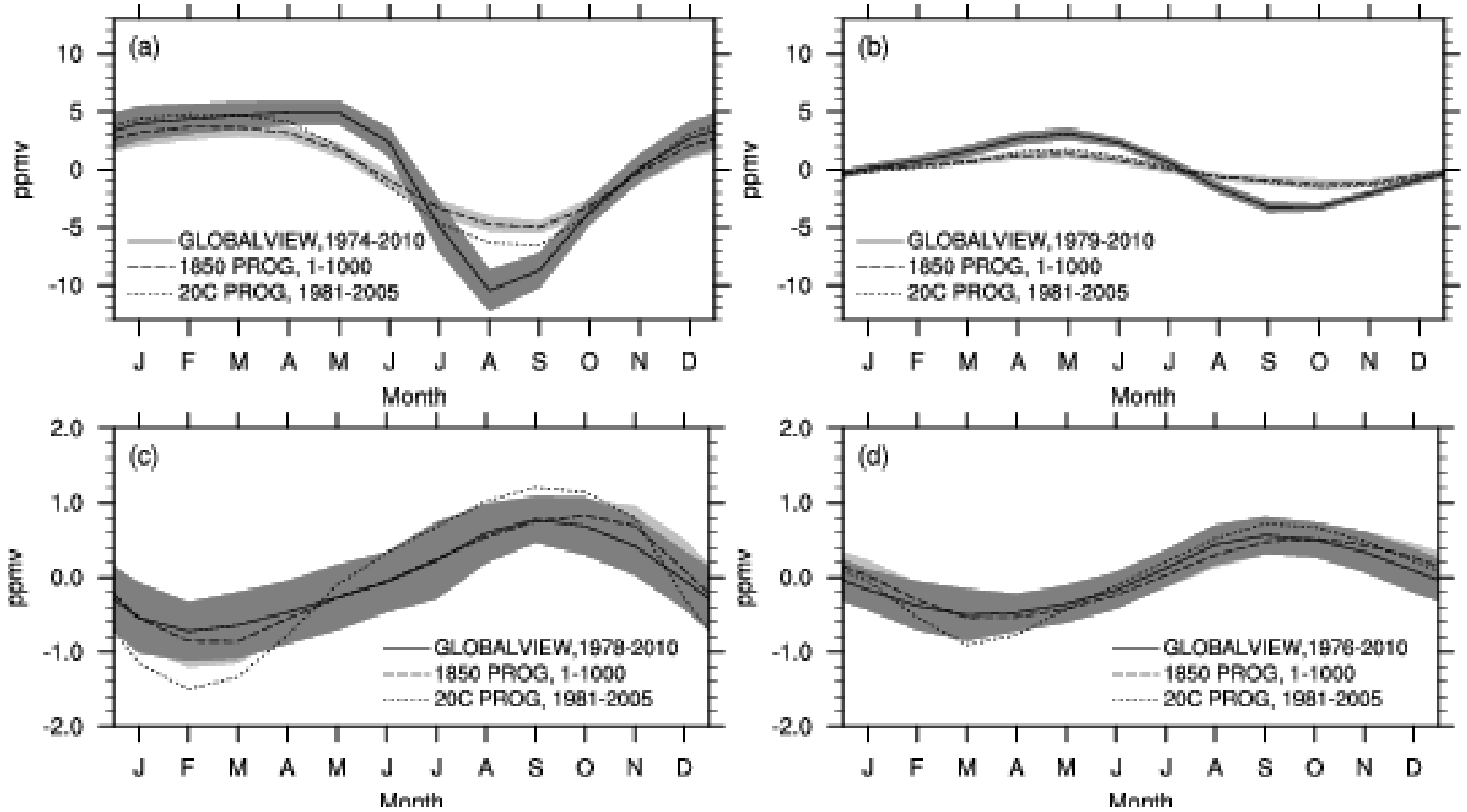



Cumulative Land-to-Air CO2 Flux, glo
CESM1-BGC (BDRD)
CESM1.1-LE (BDRD)
CESM1.2-BGC (BDRD)
PgC
100
80
60
40
20
0
-20
-40
1860
1890
1920
1950
1980
model year

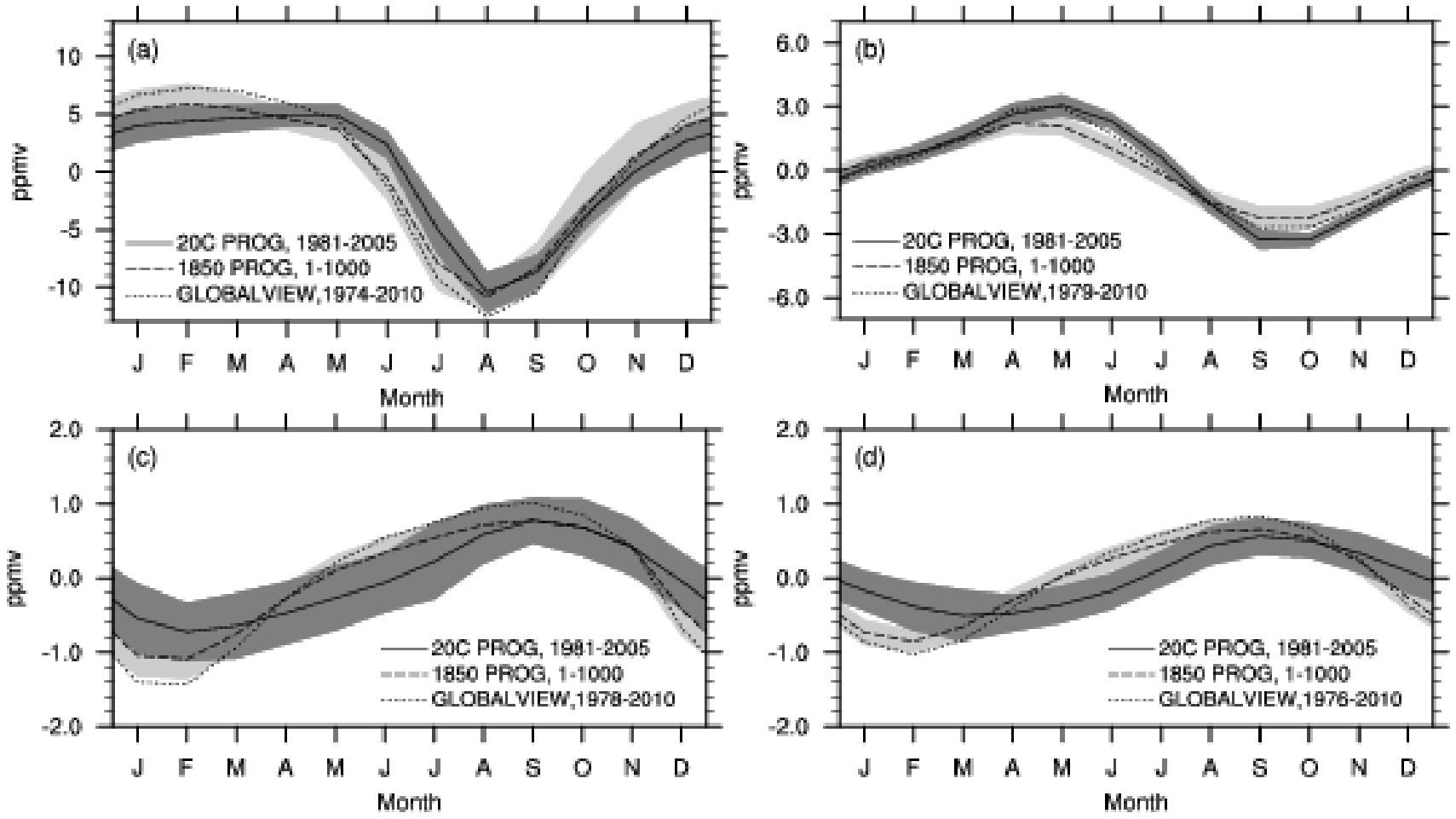

Cumulative Land-to-Air CO2 Flux, glo
CESM1.2-BGC (BDRD)
CESM1.2-BGC (BPRP)
30
20
10
0
-10
-20
-30
-40
PgC
1860
1890
1920
1950
1980
model year


Cumulative Anthropogenic Air-to-Sea CO2 Flux, glo
CESM1-BGC (BDRD)
CESM1.1-LE (BDRD)
CESM1.2-BGC (BDRD)
PgC
120
100
80
60
40
20
0
1860
1890
1920
1950
1980
model year

Seasonal Cycle of CO_2, CESM1(BGC)



Seasonal Cycle of CO_2, CESM1.2+(BGC)



Summary

- Carbon Cycle Spin-up worked reasonably well
  - TODO: get functionality to CESM trunk, make process more turn-key
- Updates in CLM45BGC yielded substantial improvements in simulated atmospheric CO_2
  - difference between 20C BDRD & BPRP not understood
  - model results are sensitive to surface forcing
- Not much effect from POP physics mods
- RCP8.5 in progress
- Analysis of results only scratching the surface
  - interannual variability, C isotopes, carbon-climate feedbacks