

# 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

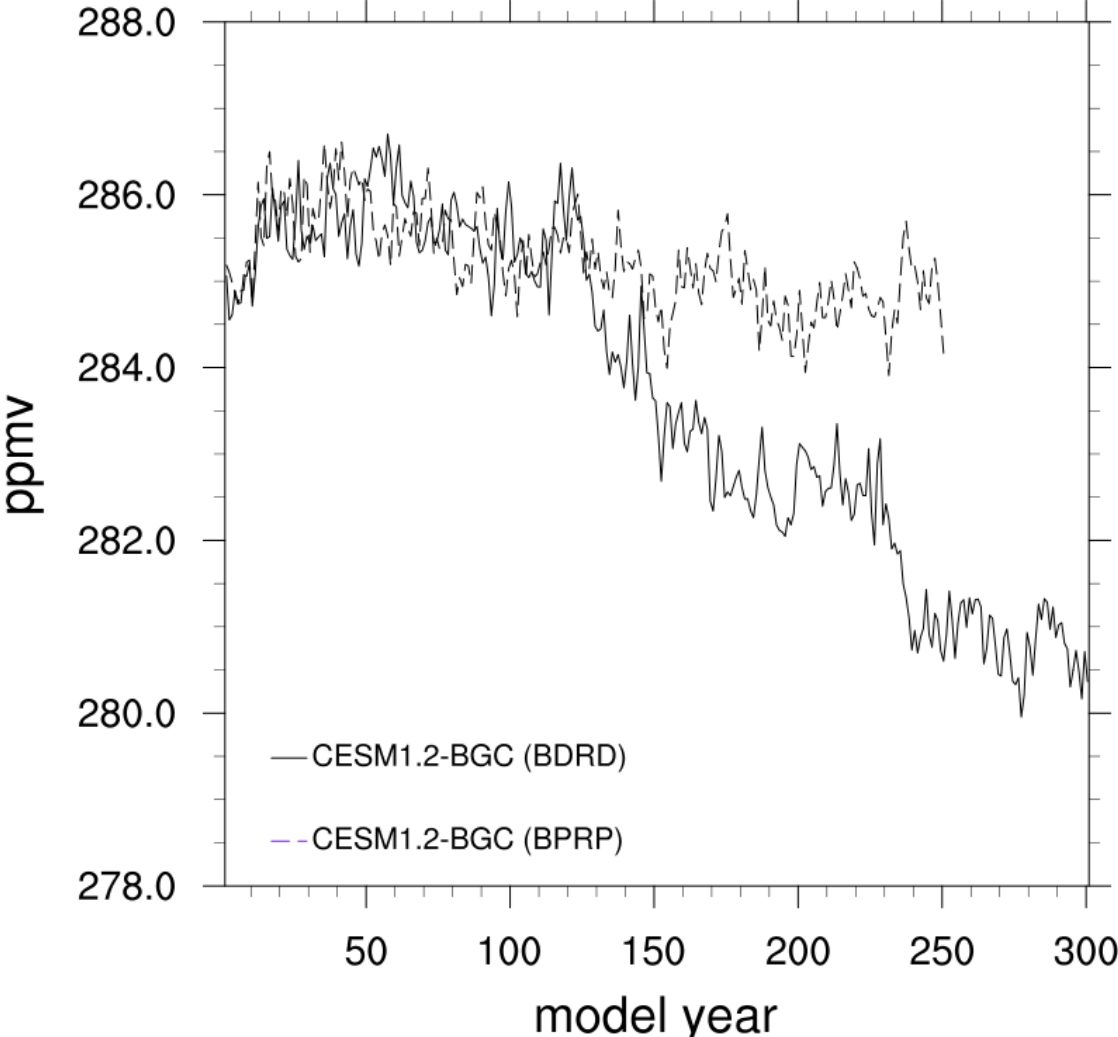
# Model Updates in CESM 1.2+ Runs

- 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 ( $^{13}\text{C}$ ,  $^{14}\text{C}$ )
- CESM 1.2+ version of BEC
  - Treatment of light under sea ice categories
  - DOM, Fe:C updates
  - C isotopes ( $^{14}\text{C}$ )

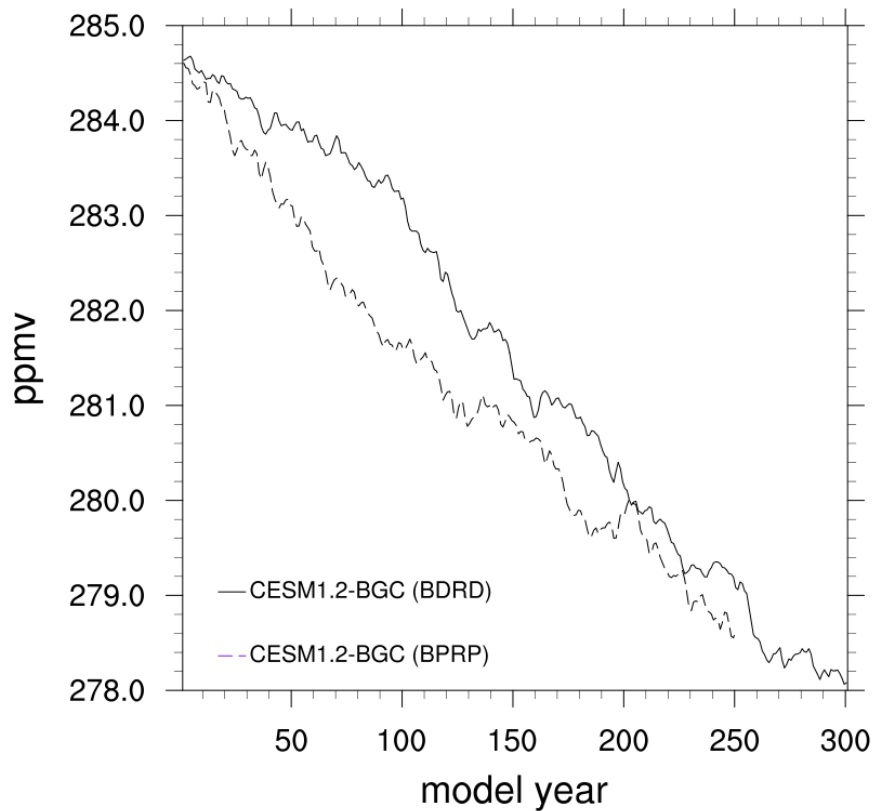
# Status of CESM 1.2+ Runs

- 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

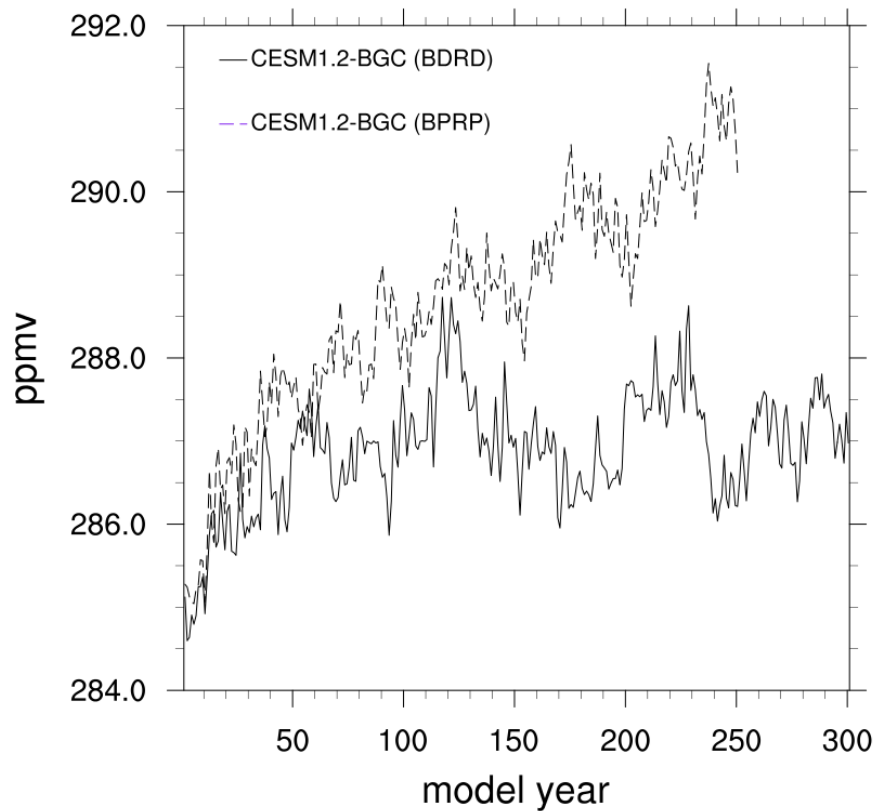
# Surface CO2



Surface CO2\_OCN

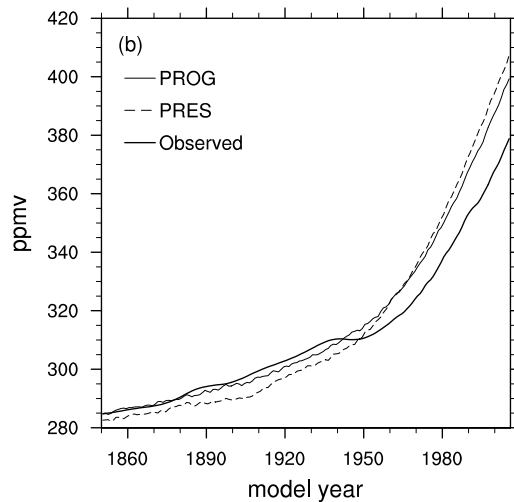
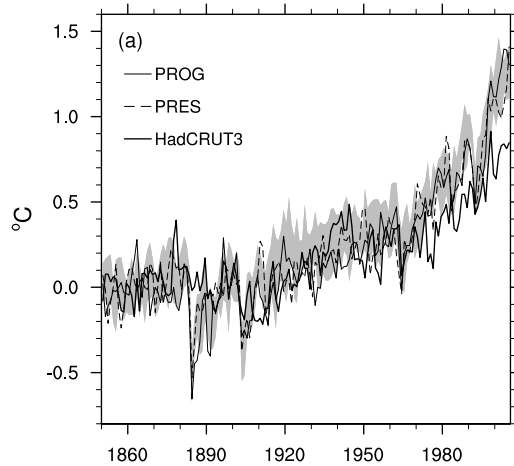


Surface CO2\_LND

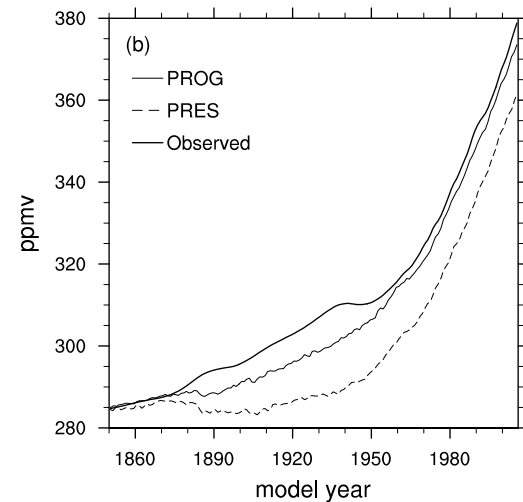
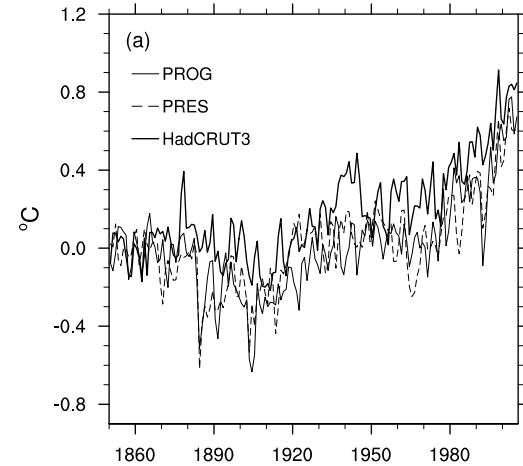


# Global 20<sup>th</sup> Century 2m Air Temp and Bottom CO<sub>2</sub>

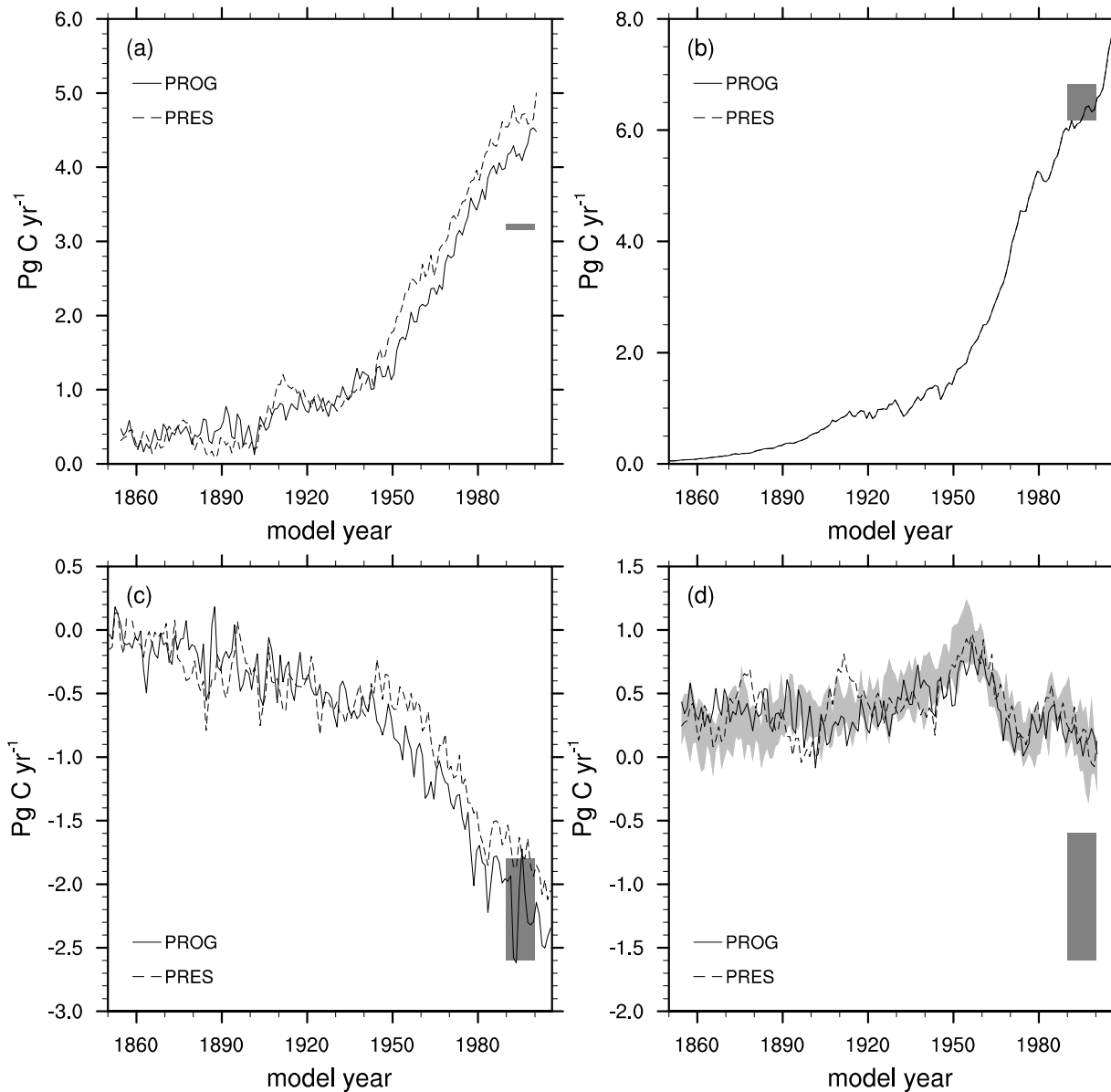
## CESM1(BGC)



## CESM1.2+(BGC)

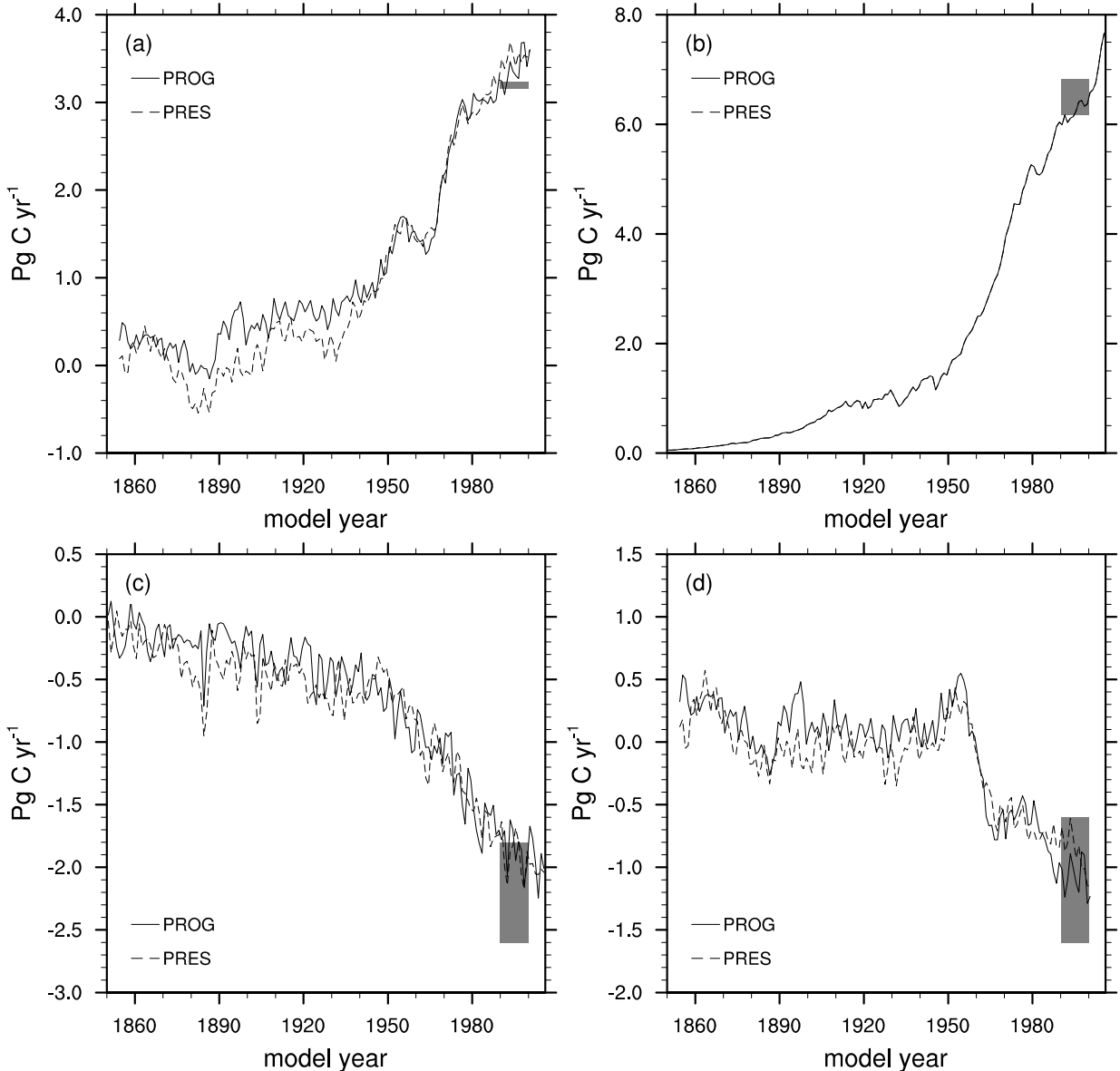


# Global 20th Century Surf CO<sub>2</sub> Fluxes, CESM1(BGC)



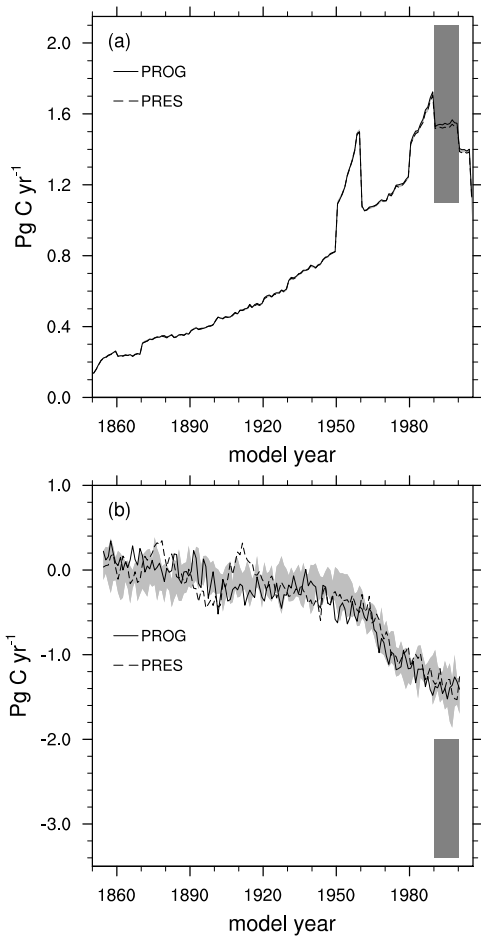


# Global 20th Century Surf CO<sub>2</sub> Fluxes, CESM1.2+(BGC)

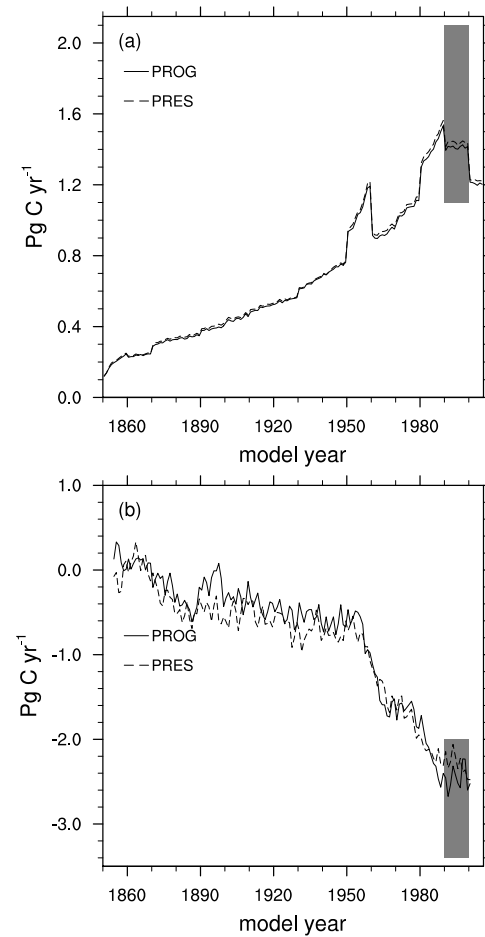


# Land Use and Land Residual CO<sub>2</sub> Flux

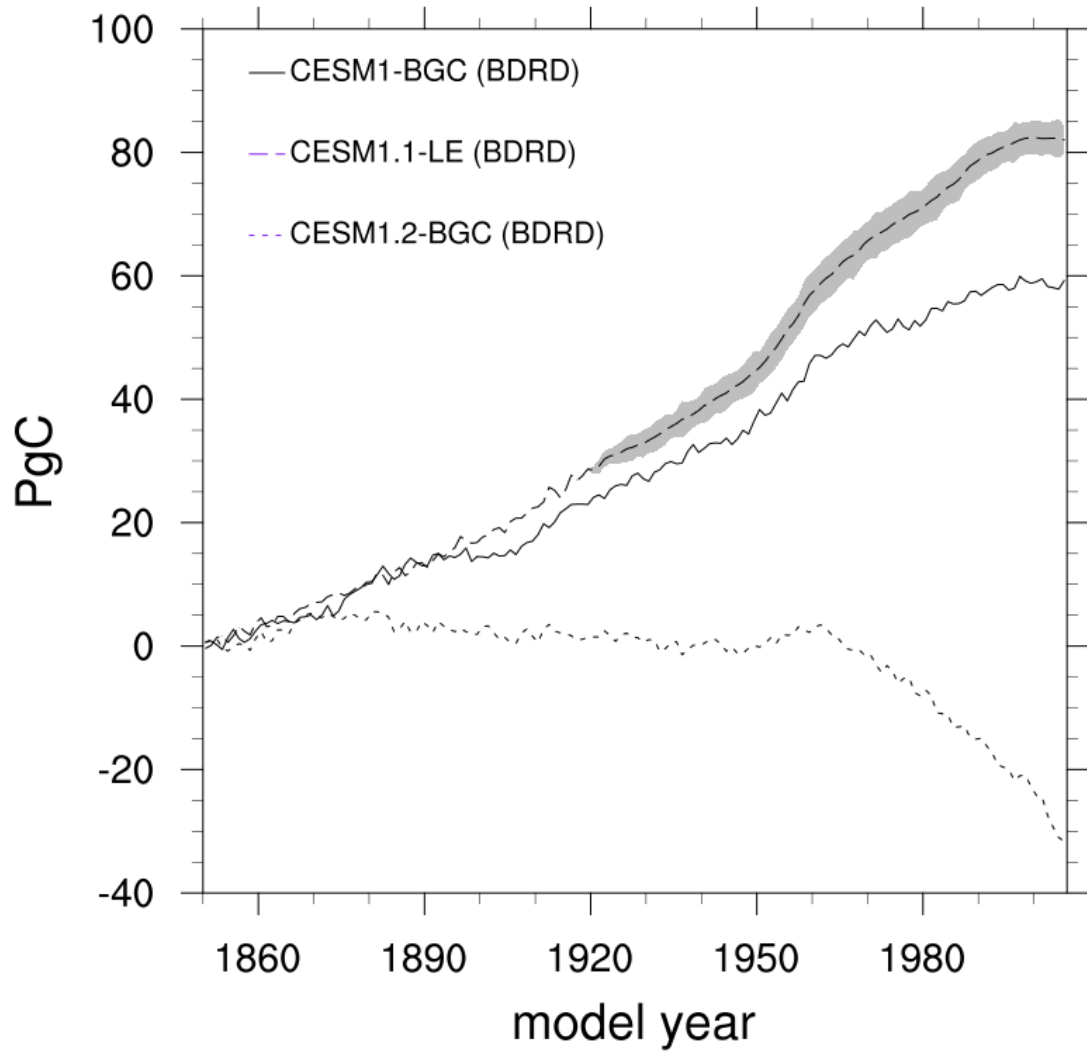
## CESM1(BGC)



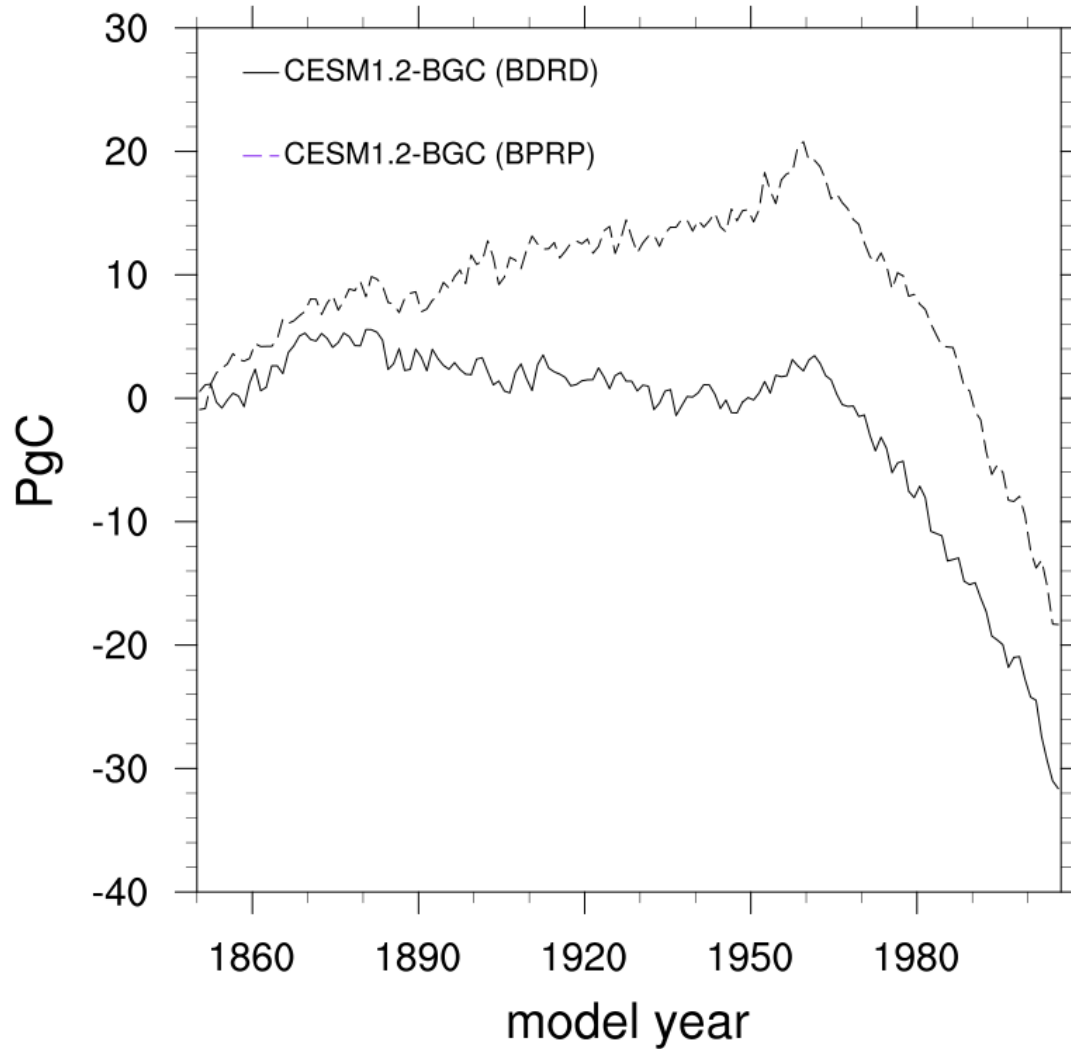
## CESM1.2+(BGC)



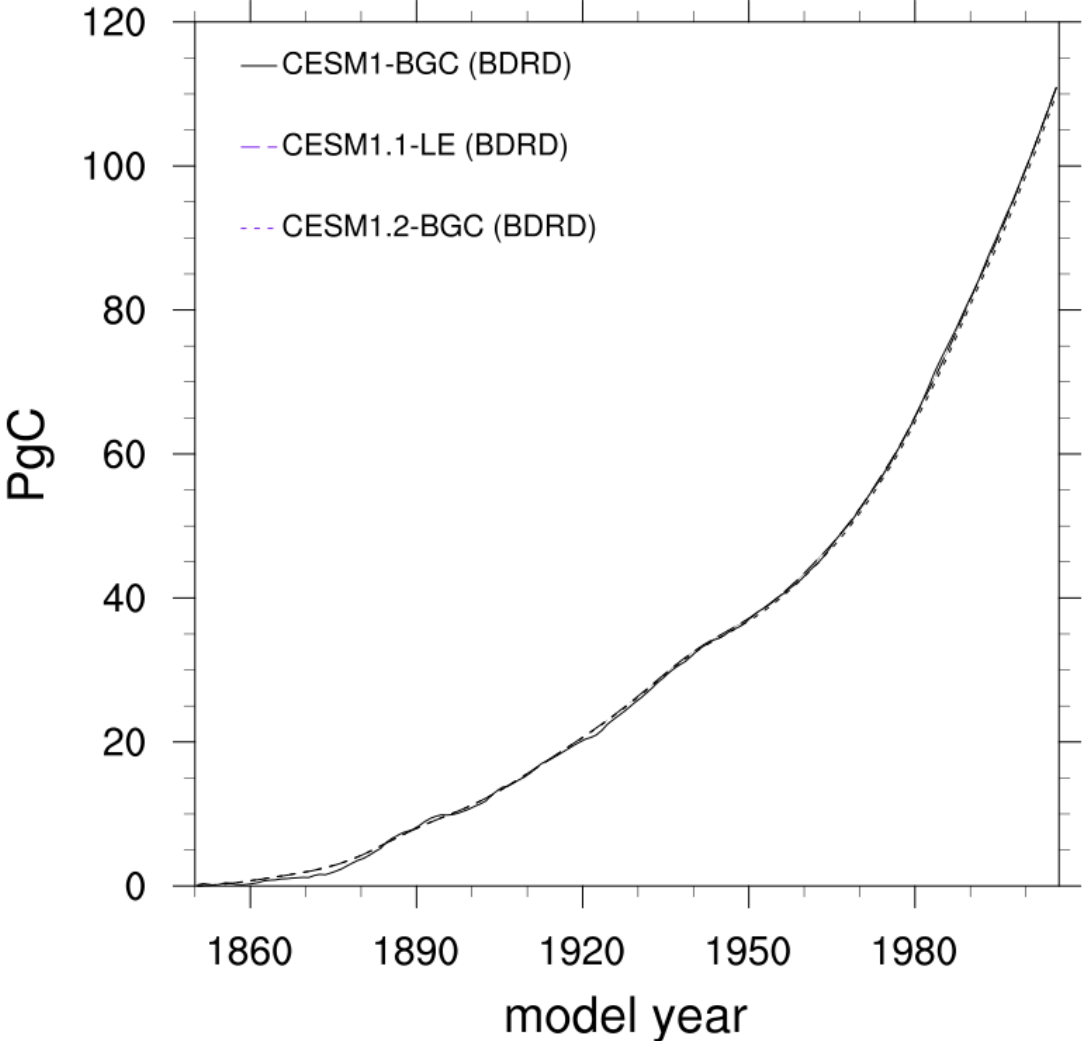
# Cumulative Land-to-Air CO2 Flux, glo



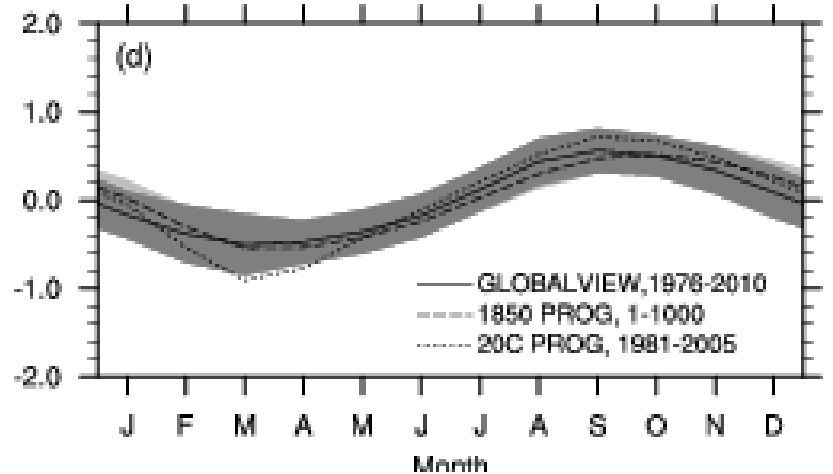
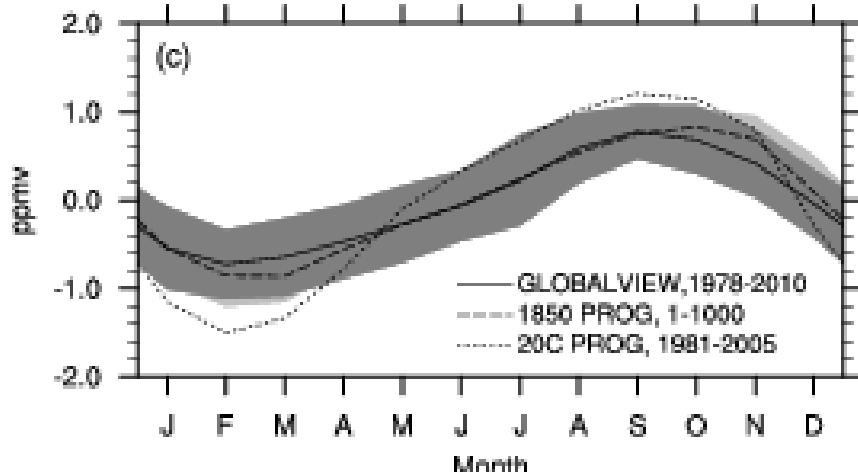
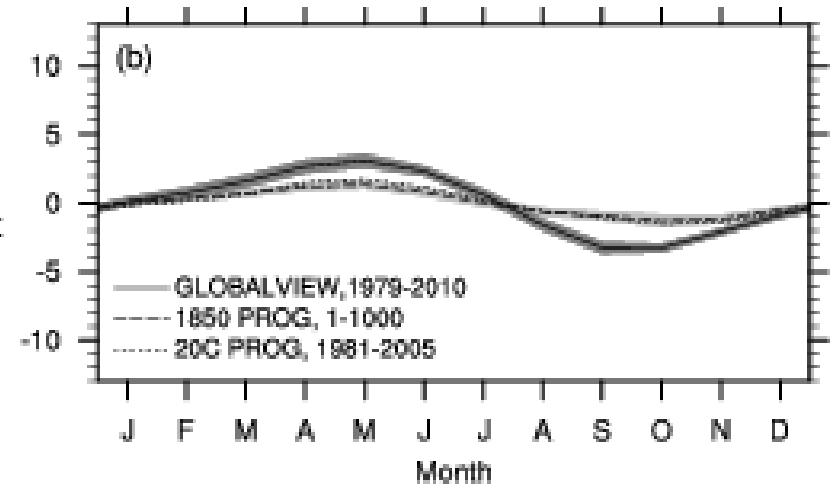
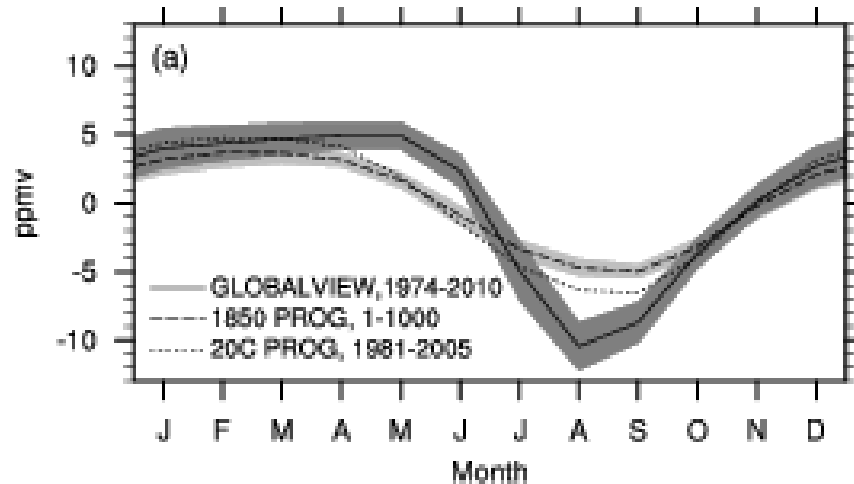
# Cumulative Land-to-Air CO2 Flux, glo



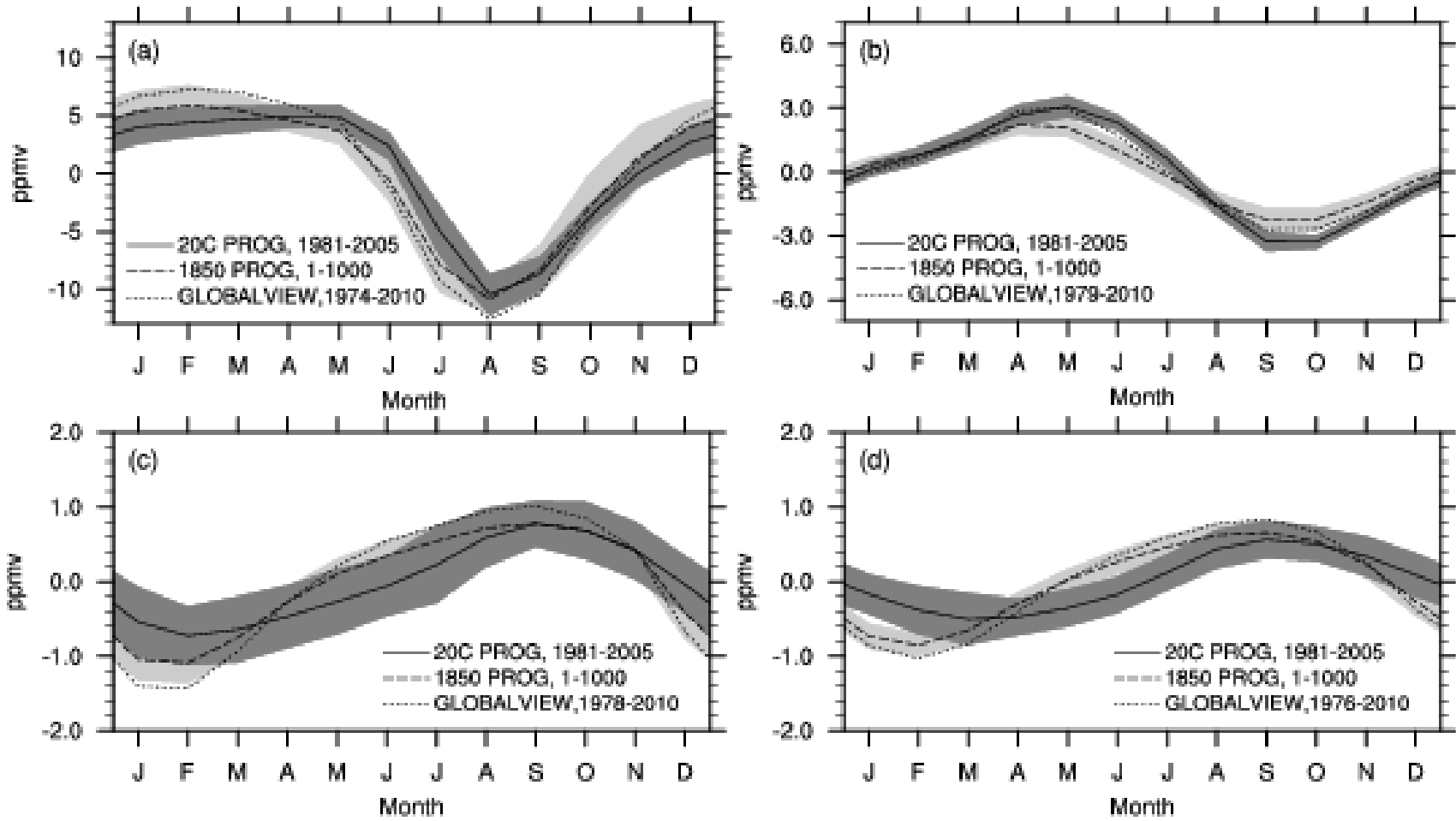
# Cumulative Anthropogenic Air-to-Sea CO2 Flux, glo



# Seasonal Cycle of CO<sub>2</sub>, CESM1(BGC)



# Seasonal Cycle of CO<sub>2</sub>, 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<sub>2</sub>
  - 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