

Carbon and Glacial Inception

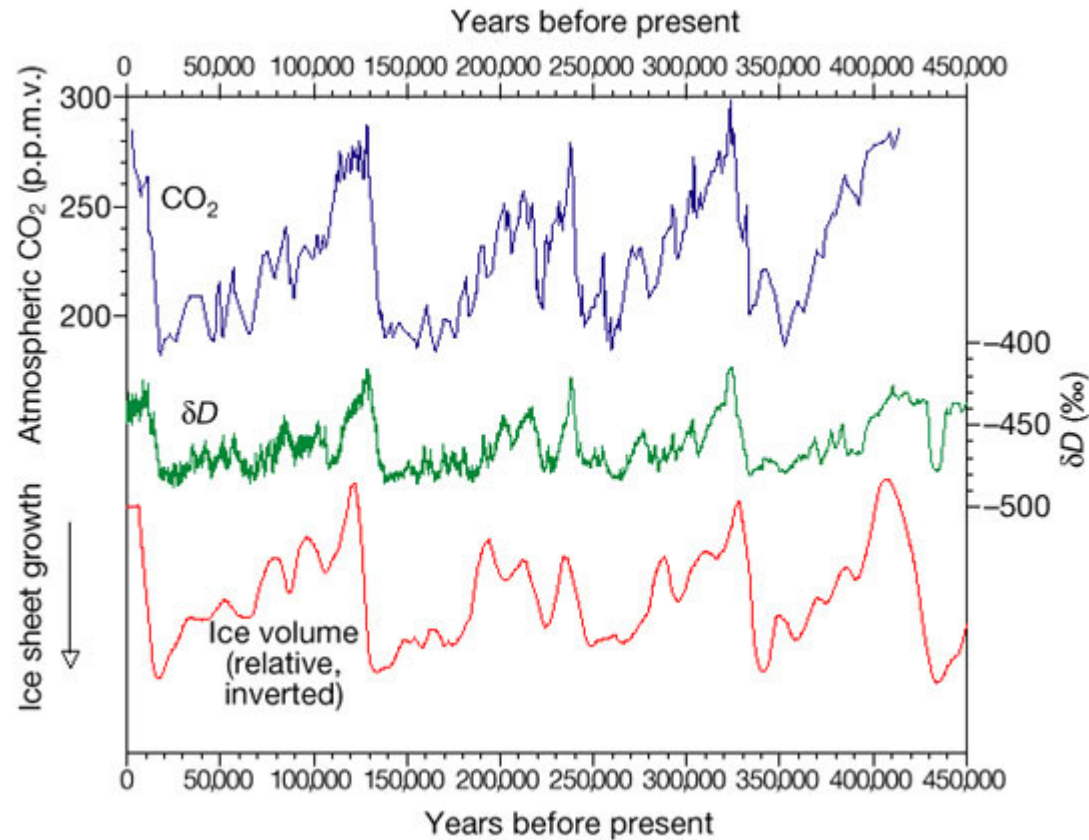
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presented by Keith Moore (UCI)

with

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(NCAR)



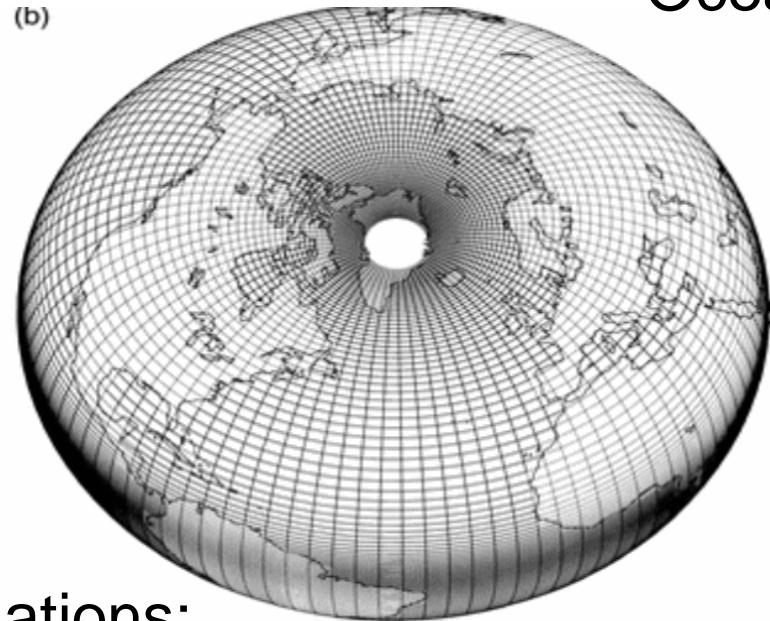
Carbon dioxide and deuterium/hydrogen ratio from the Vostok ice core, and global ice volume from sediment cores (Sigman and Boyle 2000)

Model & Experiments

T31x3 / CCSM3.5

& ocean ecosystem,
land cover and atmos.
CO₂ concentration fixed

Ocean Grid

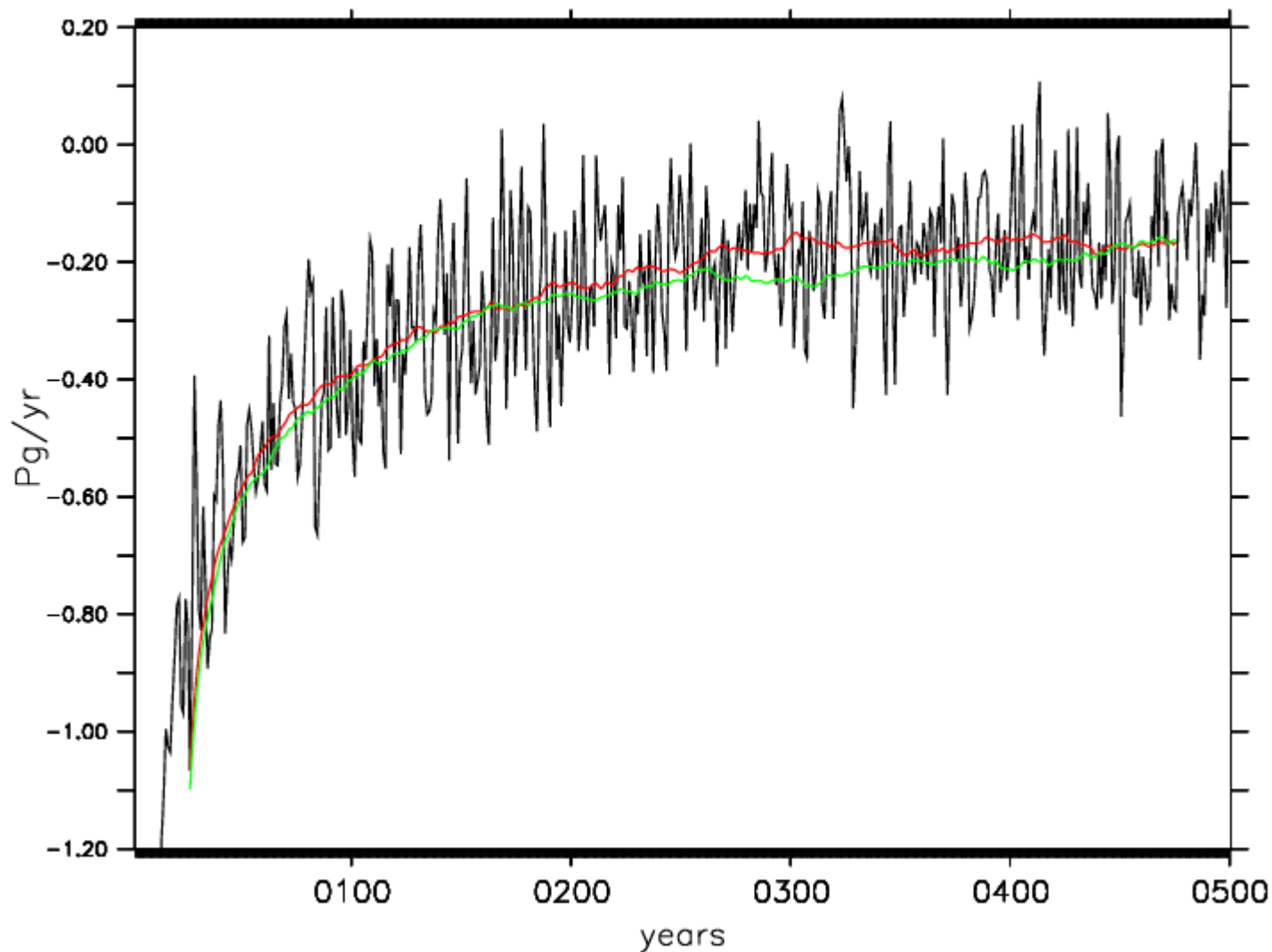


Two 500 year fully coupled simulations:

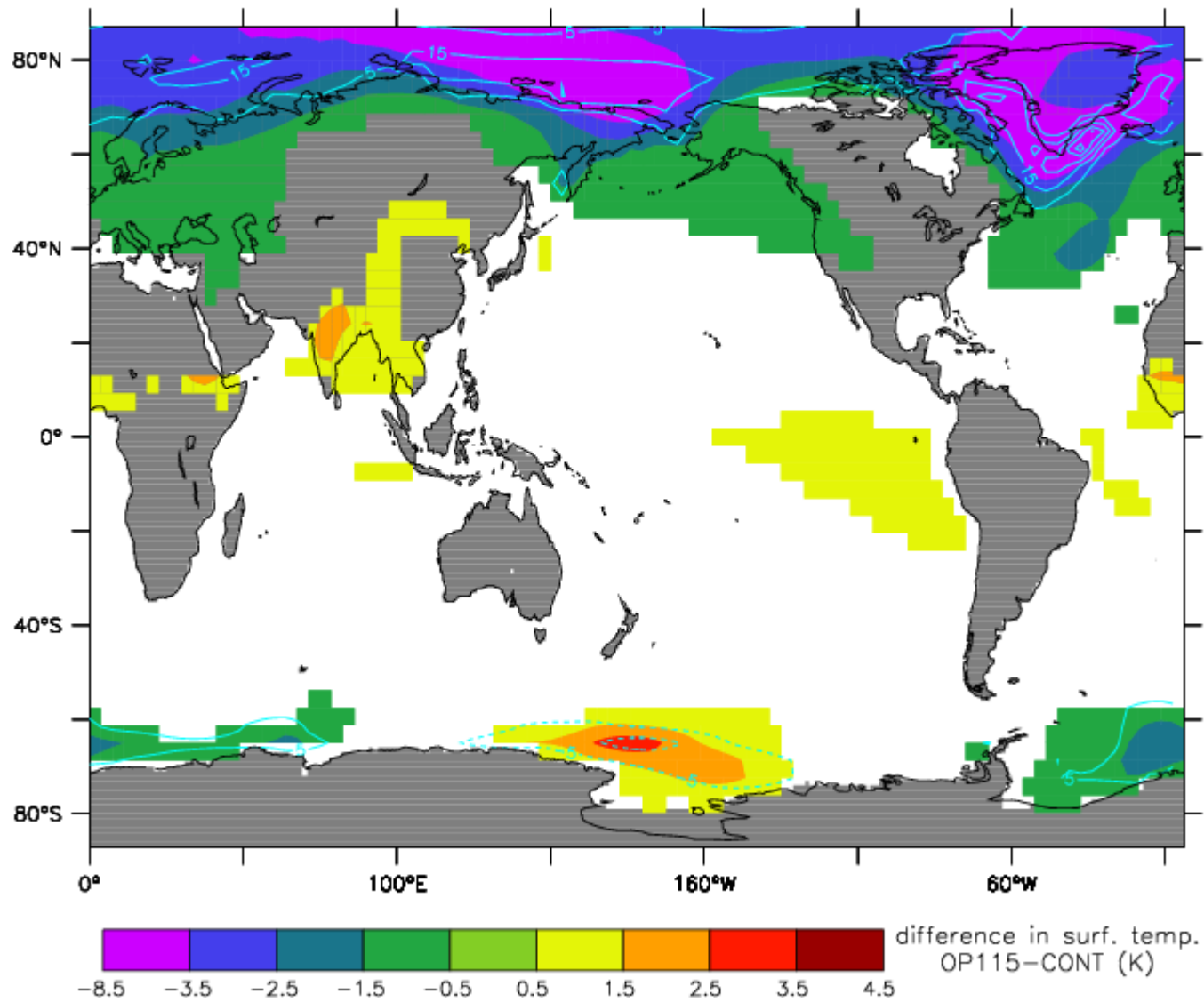
- 1850 control (CONT)
- like CONT but with orbital parameters
from 115,000 years ago (OP115)

both start from Levitus 1998 initial conditions

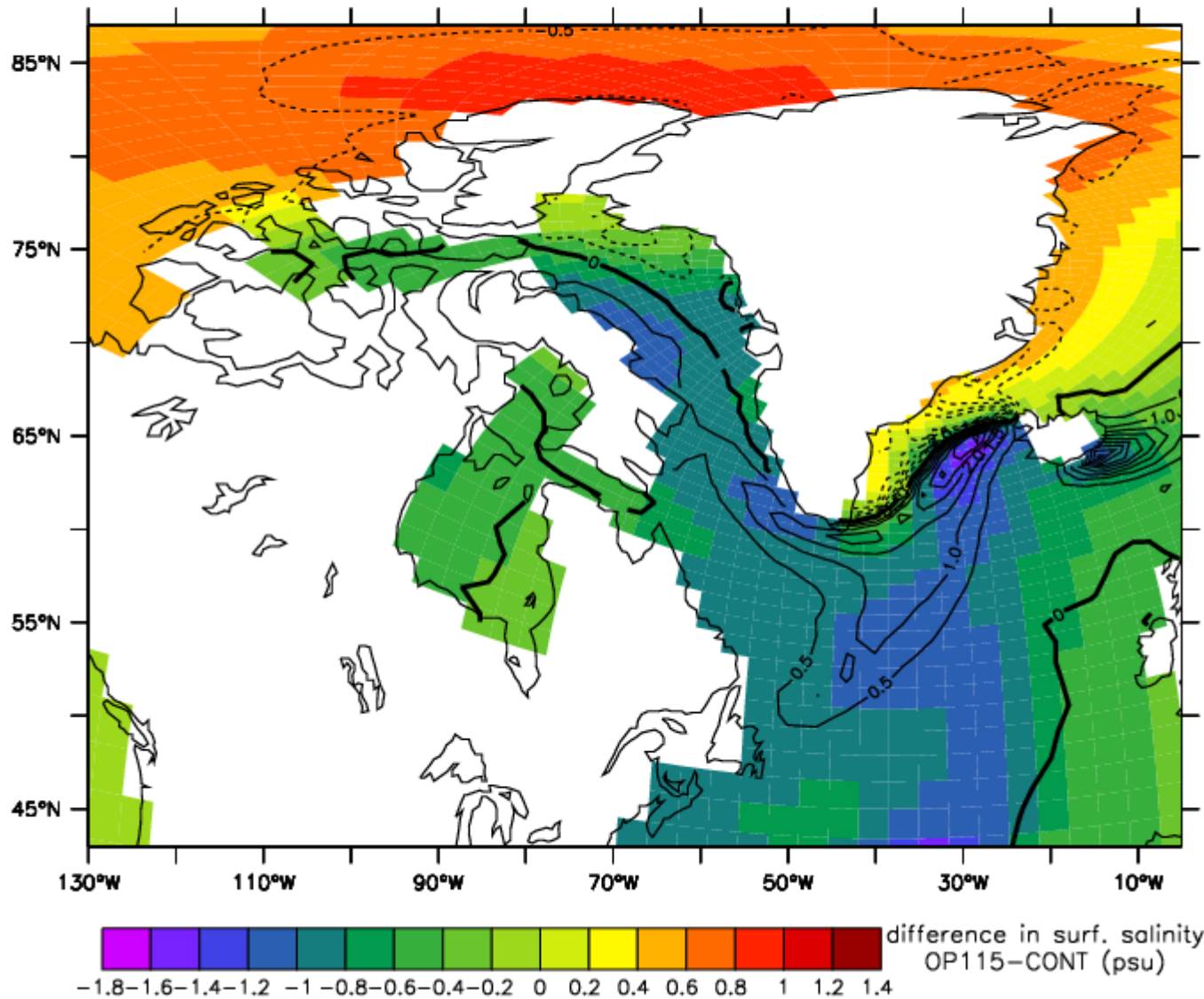
Recently repeated similar experiment with CCSM4/CESM1



Global air-sea carbon fluxes (negative = outgassing)
Black: CONT, Red: CONT (smoothed), Green OP115

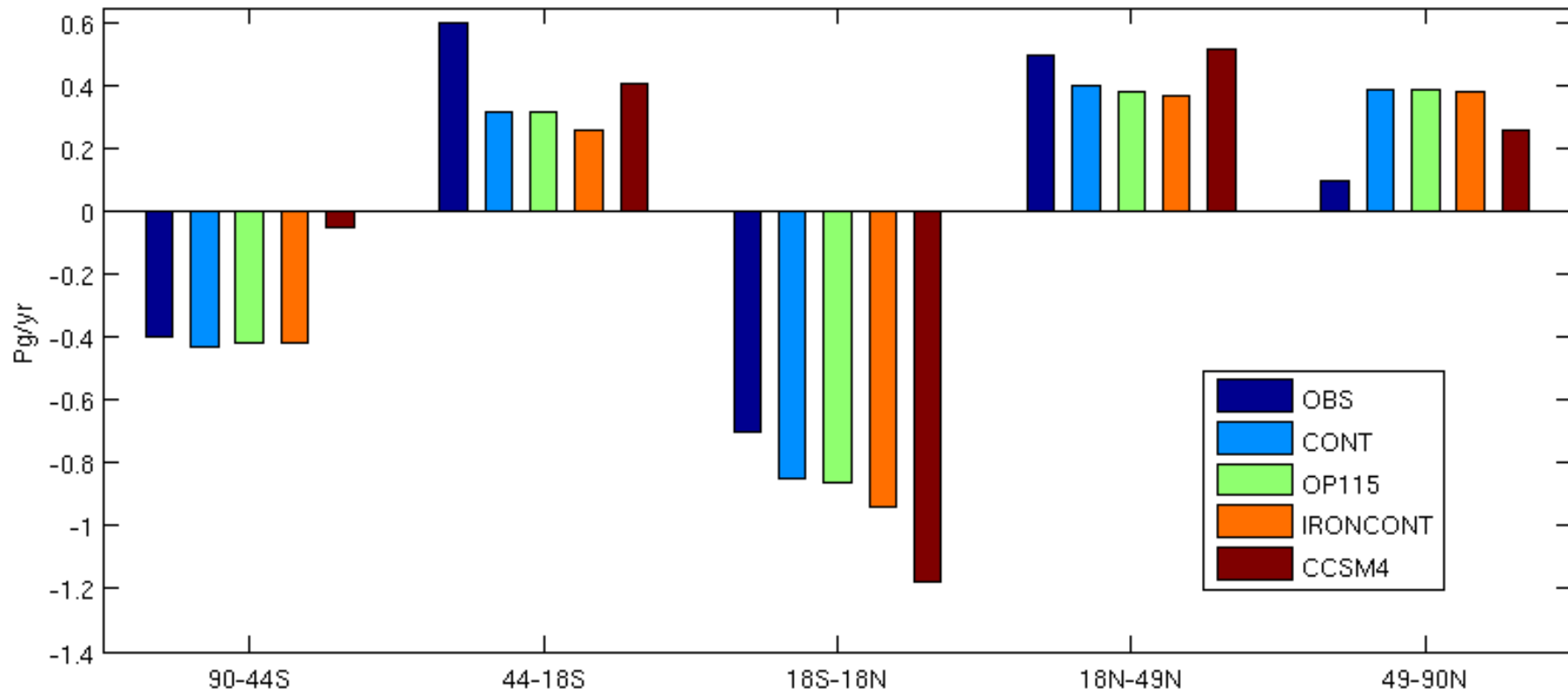


Difference in surface air temperature (OP115-CONT)



Difference in SSS (color) and meltwater flux (in m/yr) OP115-CONT
 Freshening of the North Atlantic led to reduction in
 Meridional Overturning Circulation

Quantifying Carbon Fluxes

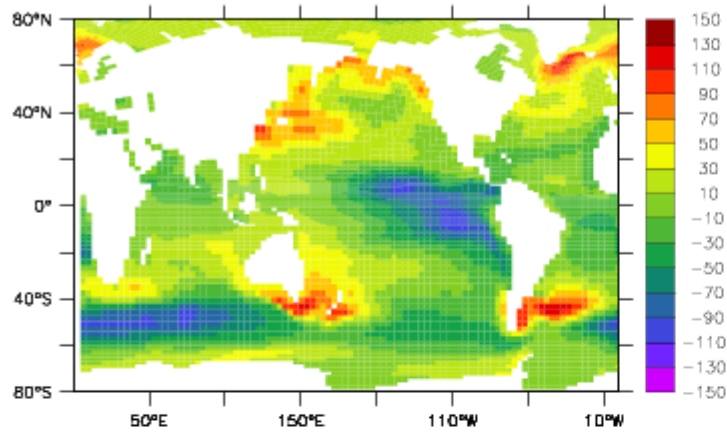


Air sea carbon fluxes integrated over latitude bands (after Gruber et al. 2009)

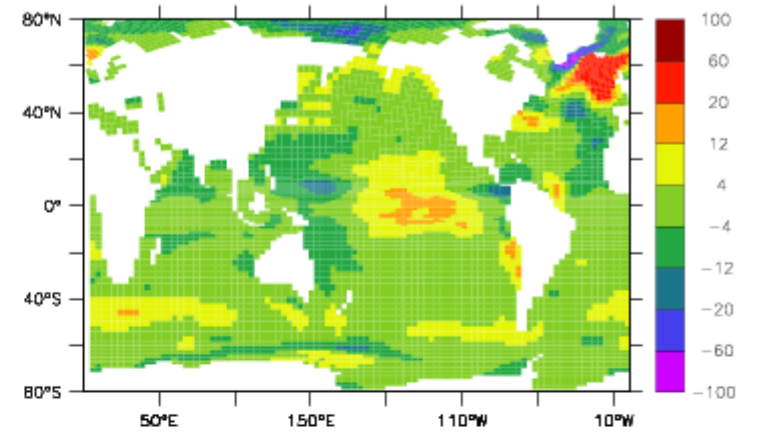
CONT

OP115-CONT

carbon fluxes

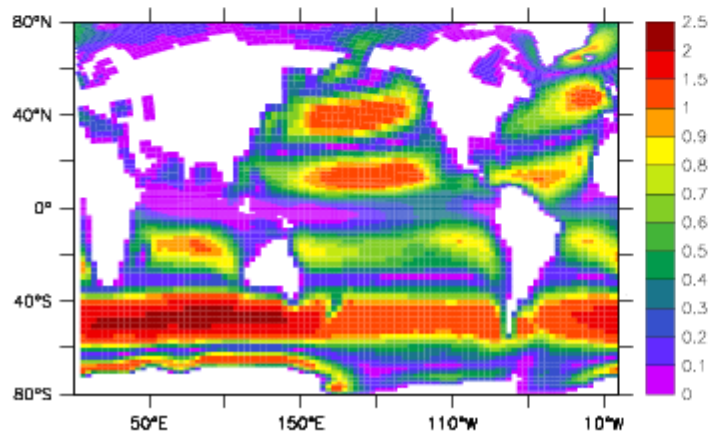


a) air-sea carbon fluxes CONT (nmol/m²/s)

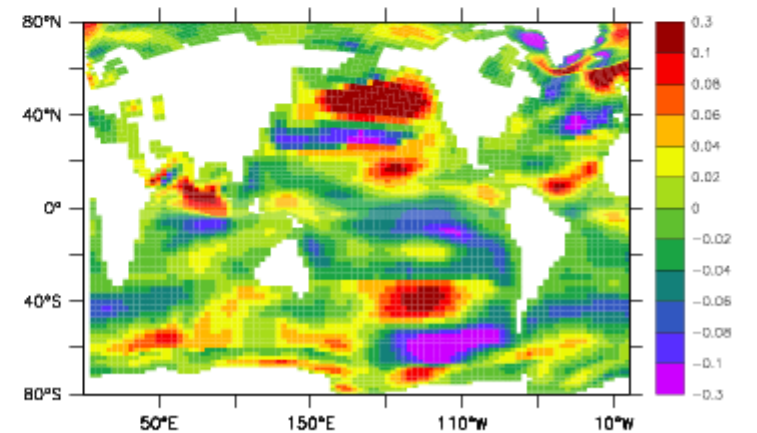


b) air-sea carbon fluxes OP115-CONT (nmol/m²/s)

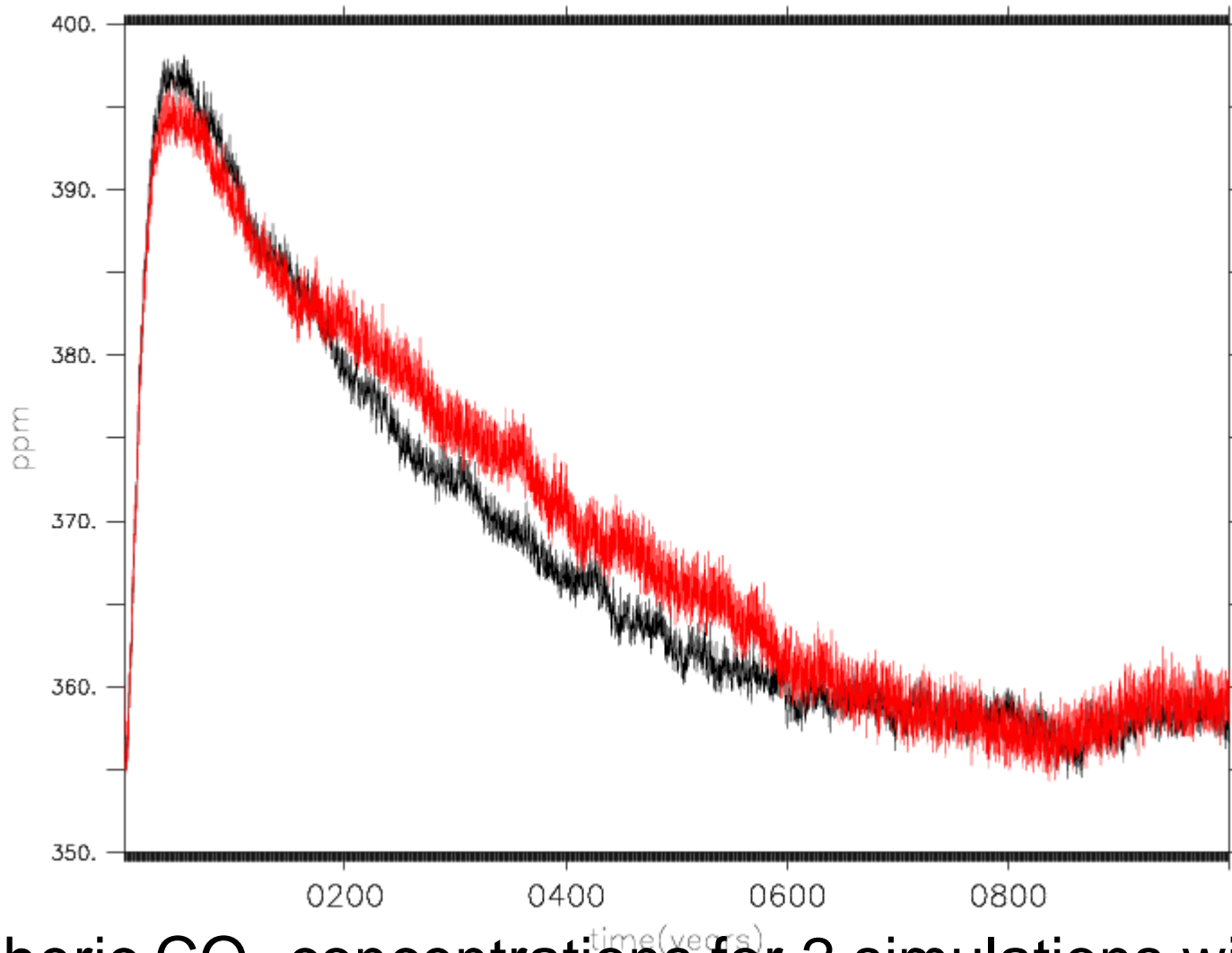
wind stress



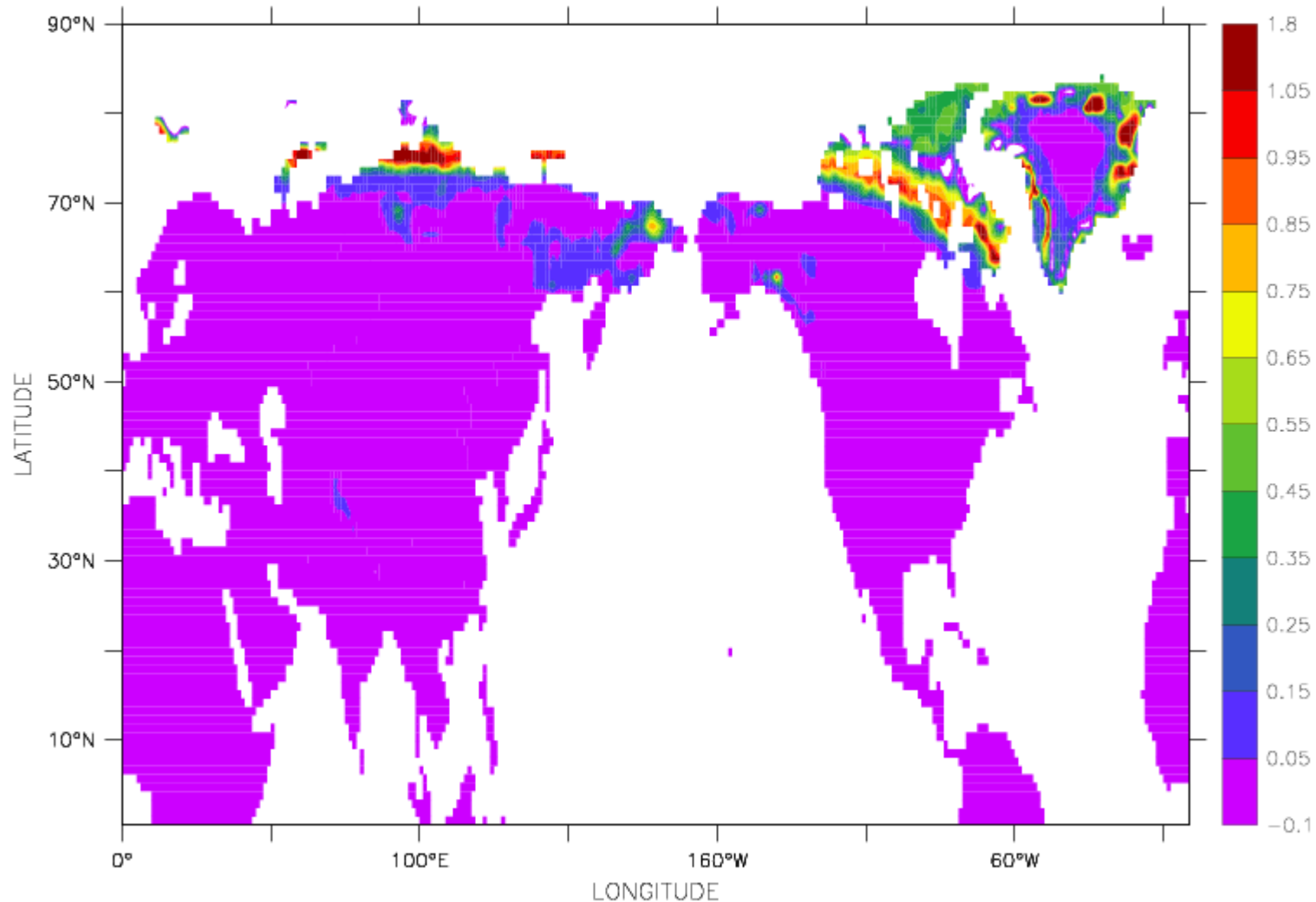
c) surface wind stress CONT (dyne/cm²)



d) surface wind stress OP115-CONT (dyne/cm²)



Atmospheric CO₂ concentrations for 2 simulations with fully coupled land model and freely evolving atmospheric CO₂ equivalent to CONT (black) and OP115 (red)



Difference in snow depth between 115kya and today

Difference in annual mean snow depth (in meters) between OP115 and CONT for the CCSM4 experiment

Conclusions

- CCSM results suggest that Milankowitch was right, and that the seaice – MOC feedback is a crucial part of the feedback
- The glacial-interglacial CO₂ variations cannot be explained by the solubility pump
- Further work needed to identify missing processes
- The increased snowfall in the CCSM4/1 15kya suggests that ice sheet modelling can begin!!!