Carbon and Glacial Inception

Markus Jochum

presented by Keith Moore (UCI)

with

Synte Peacock, Keith Lindsay, Keith Moore and Sam Levis

(NCAR)
Carbon dixoide 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. CO$_2$ concentration fixed

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)
Freshening of the North Atlantic led to reduction in Meridional Overturning Circulation
Air sea carbon fluxes integrated over latitude bands (after Gruber et al. 2009)
carbon fluxes

CONT

OP115-CONT

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 (dyna/cm²)

d) surface wind stress OP115–CONT (dyna/cm²)
Atmospheric CO$_2$ concentrations for 2 simulations with fully coupled land model and freely evolving atmospheric CO$_2$ equivalent to CONT (black) and OP115 (red)
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 CCSM4/115kya suggests that ice sheet modelling can begin!!!