



POTSDAM INSTITUTE FOR
CLIMATE IMPACT RESEARCH



**PAL
MOD**

GERMAN
CLIMATE
MODELING
INITIATIVE

Towards transient simulations of the last deglaciation with interactive carbon cycle using CLIMBER-X

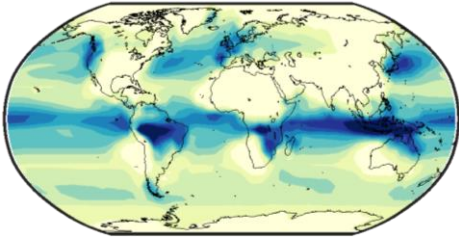
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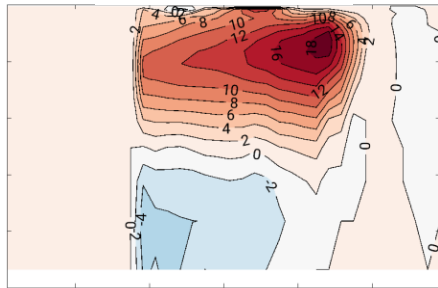
EGU 2020

CLIMBER-X

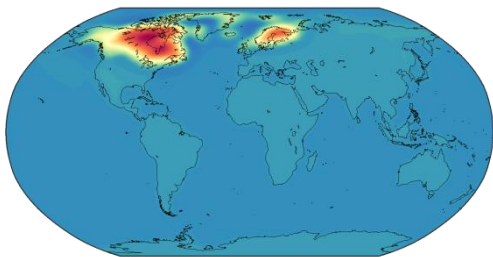
Precipitation



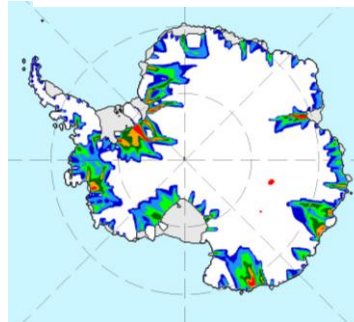
AMOC



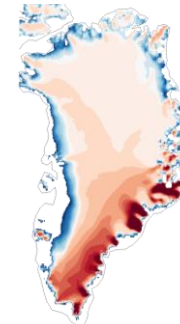
Relative sea level



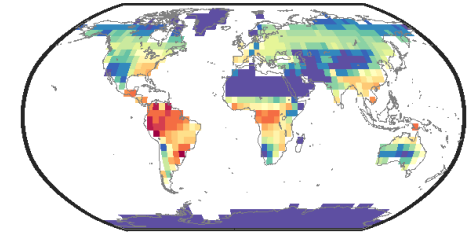
Basal water layer



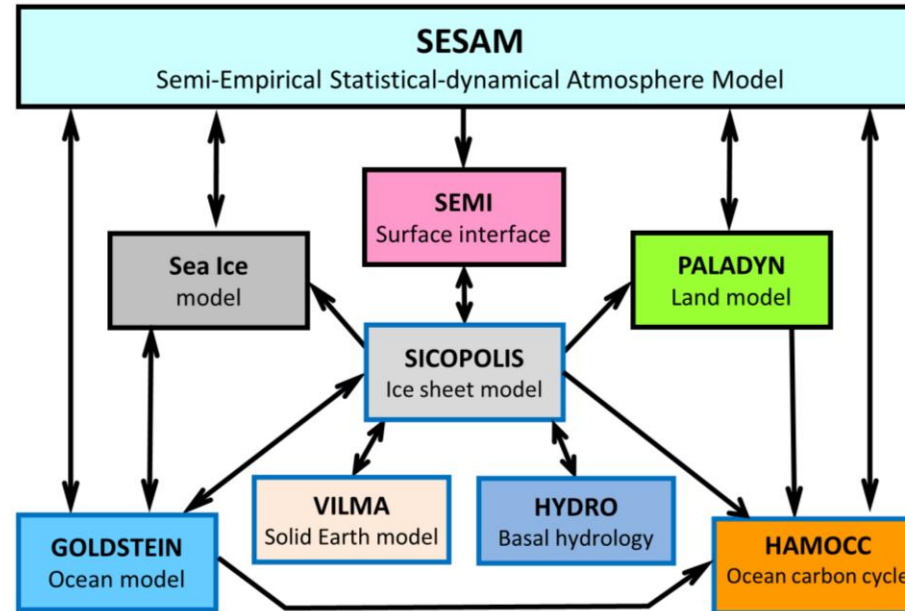
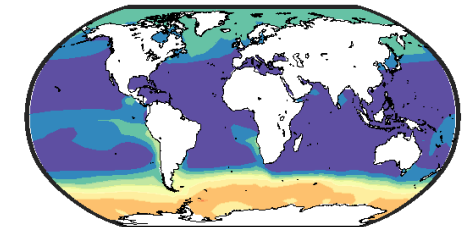
Surface mass balance



Gross primary production



Surface NO₃



Spatial resolution of the climate component: 5° x 5°

Computational performance: > 10,000 model years per day

 Modules developed at PIK
 Modules developed by PIK partners

CLIMBER-X overview

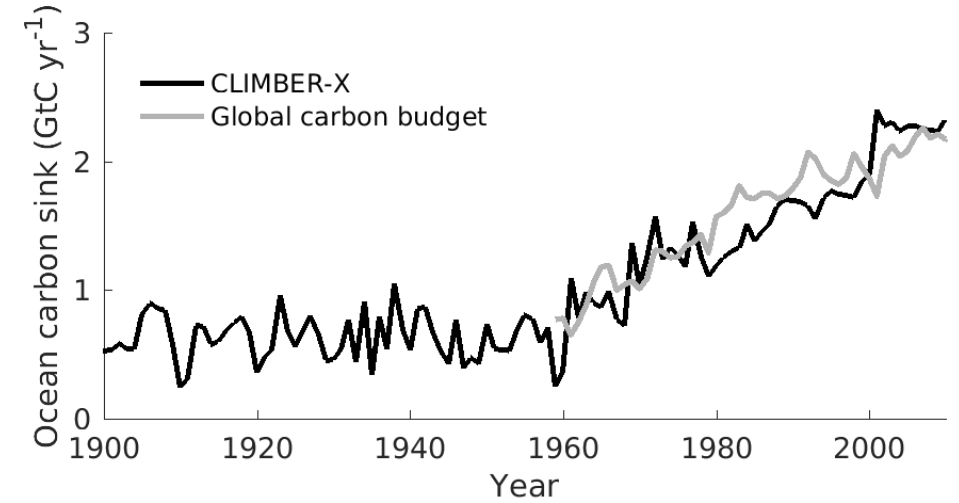
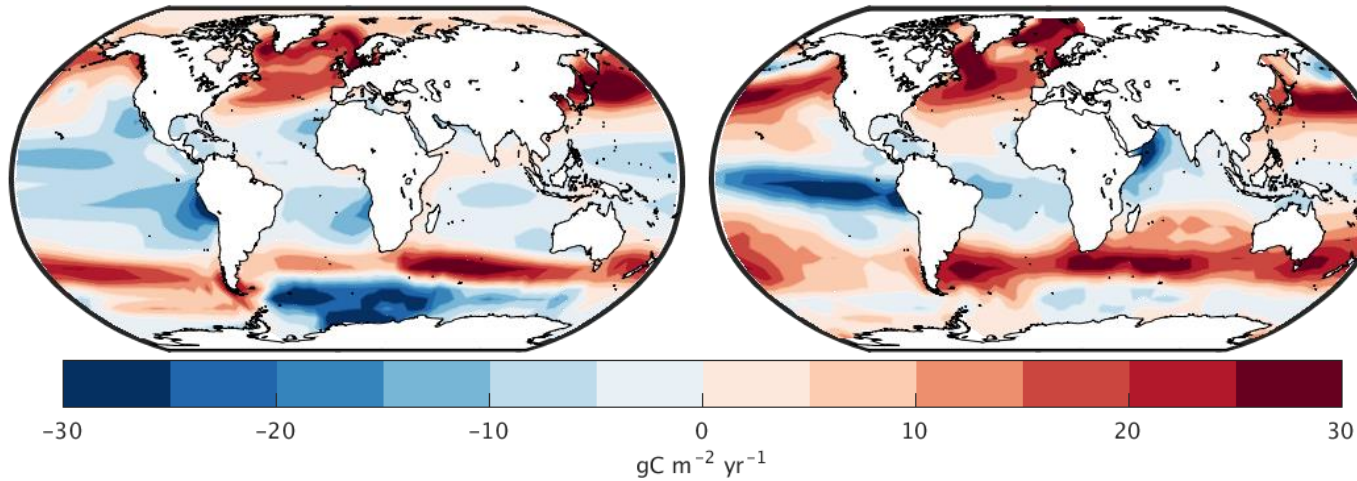
- atmosphere/ocean/land are of comparable complexity and share the same horizontal grid (5°x5°)
- fully interactive carbon cycle (including ^{13}C and ^{14}C)
 - HAMOCC: ocean biogeochemistry + sediments
 - PALADYN: dynamic vegetation + land carbon cycle + weathering
- several ice sheet model domains at different resolution
- solid Earth model which also solves the sea-level equation
- land/sea mask responds to changing sea level

Historical, carbon fluxes

air-sea CO₂ flux

CLIMBER-X air-sea CO₂ flux

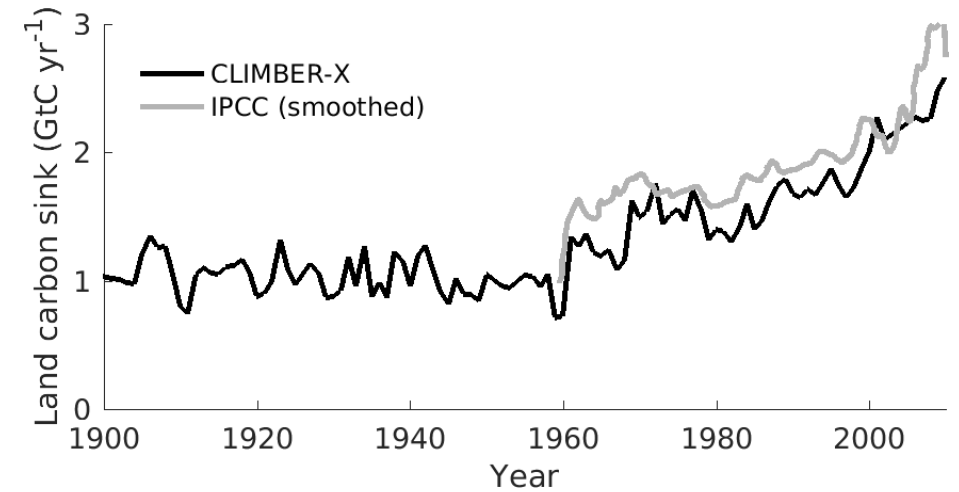
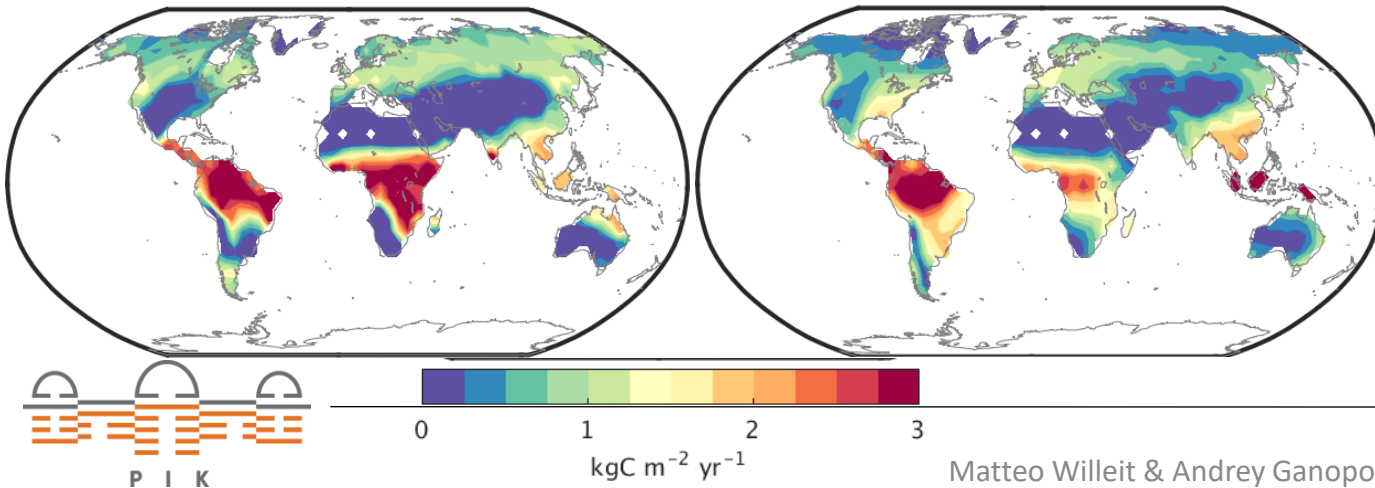
Landschuetzer et al. 2017



Gross primary production

CLIMBER-X GPP

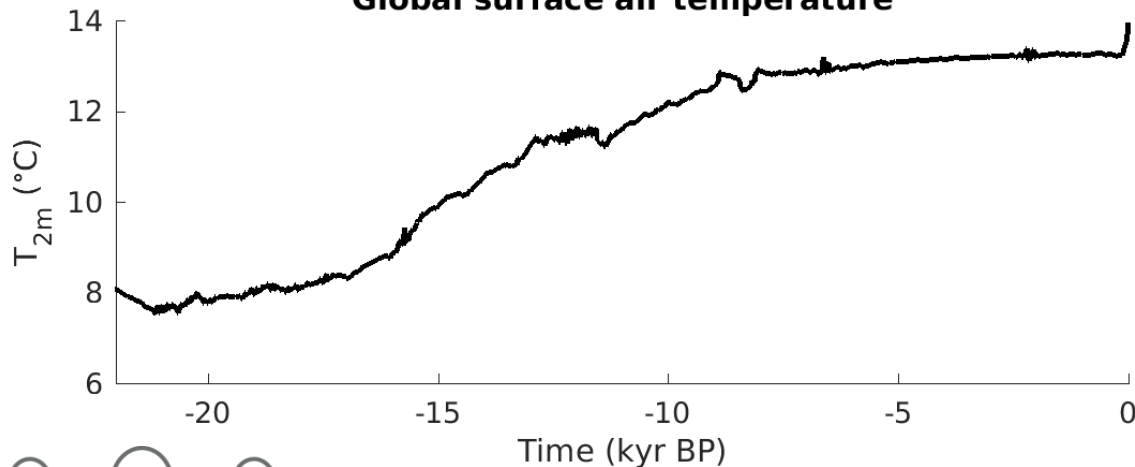
MTE



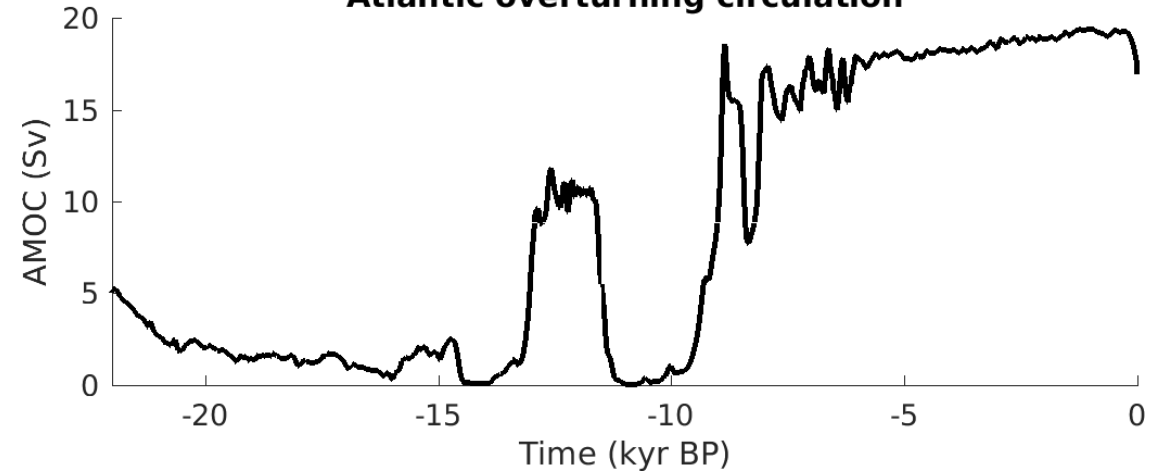
Transient deglaciation, climate model only

- transient simulation from 22 ka to present
- prescribed atmospheric CO₂
- prescribed ice sheets from GLAC-1D (Tarasov)
 - freshwater flux from implied ice sheet melting routed to ocean

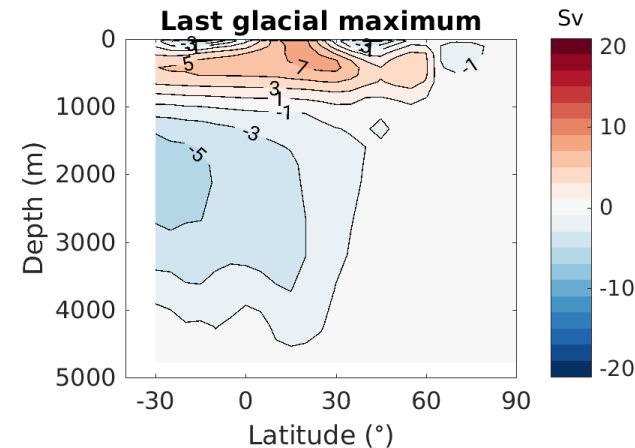
Global surface air temperature



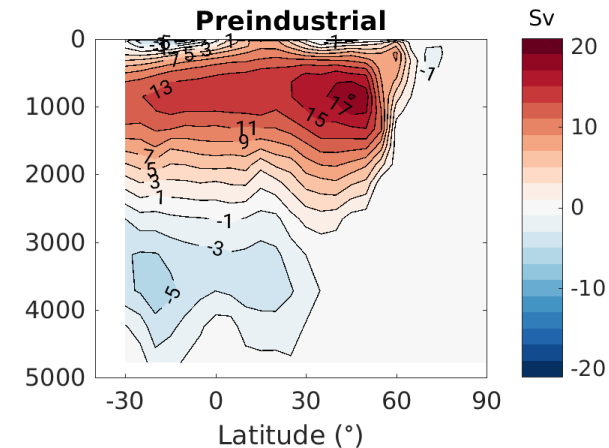
Atlantic overturning circulation



Last glacial maximum



Preindustrial



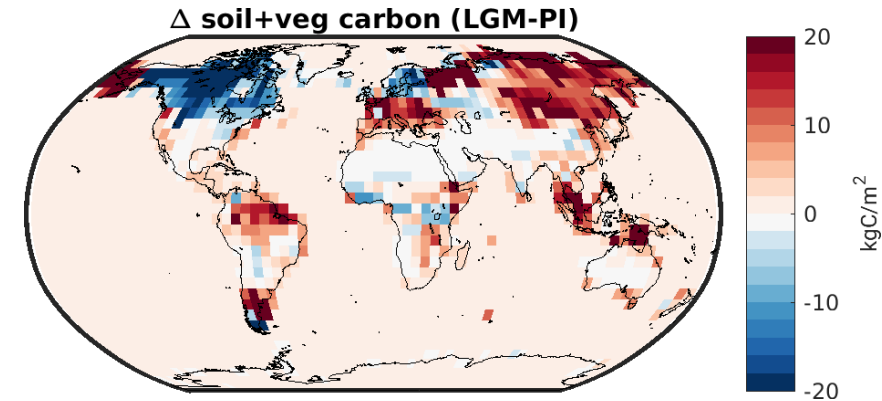
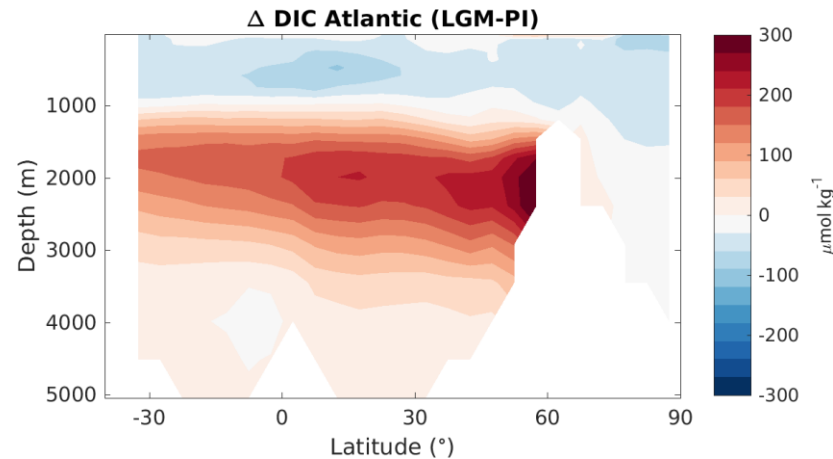
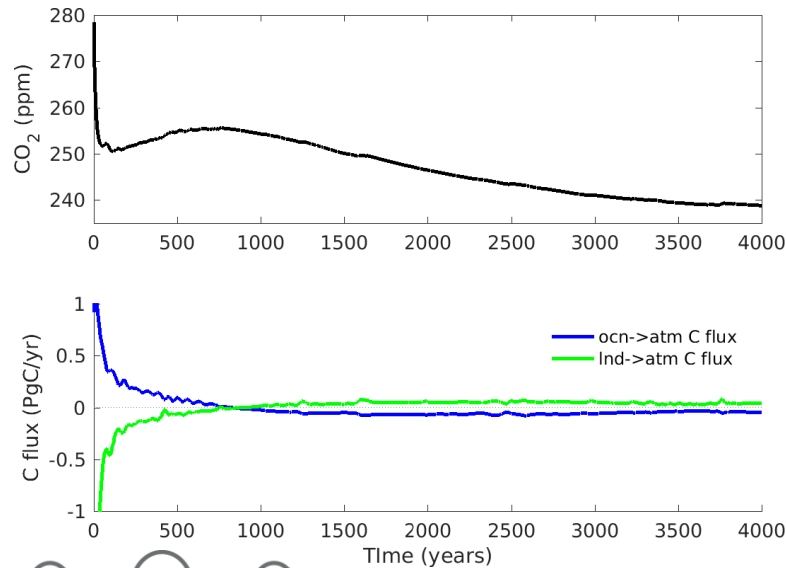
LGM time slice, preliminary results

- **closed** carbon cycle setup:

- no weathering
- no sediment burial
- no volcanic degassing

- prescribed LGM ice sheets
- prescribed LGM sea level and land/sea mask
- prescribed $\text{CO}_2=180$ ppm for radiation

start from preindustrial equilibrium, switch to LGM boundary conditions and interactive CO_2 (for carbon cycle only) and run for 4000 years (not fully equilibrated yet)



work in progress...

