

A transient fully coupled climate–ice-sheet simulation of the last glacial inception

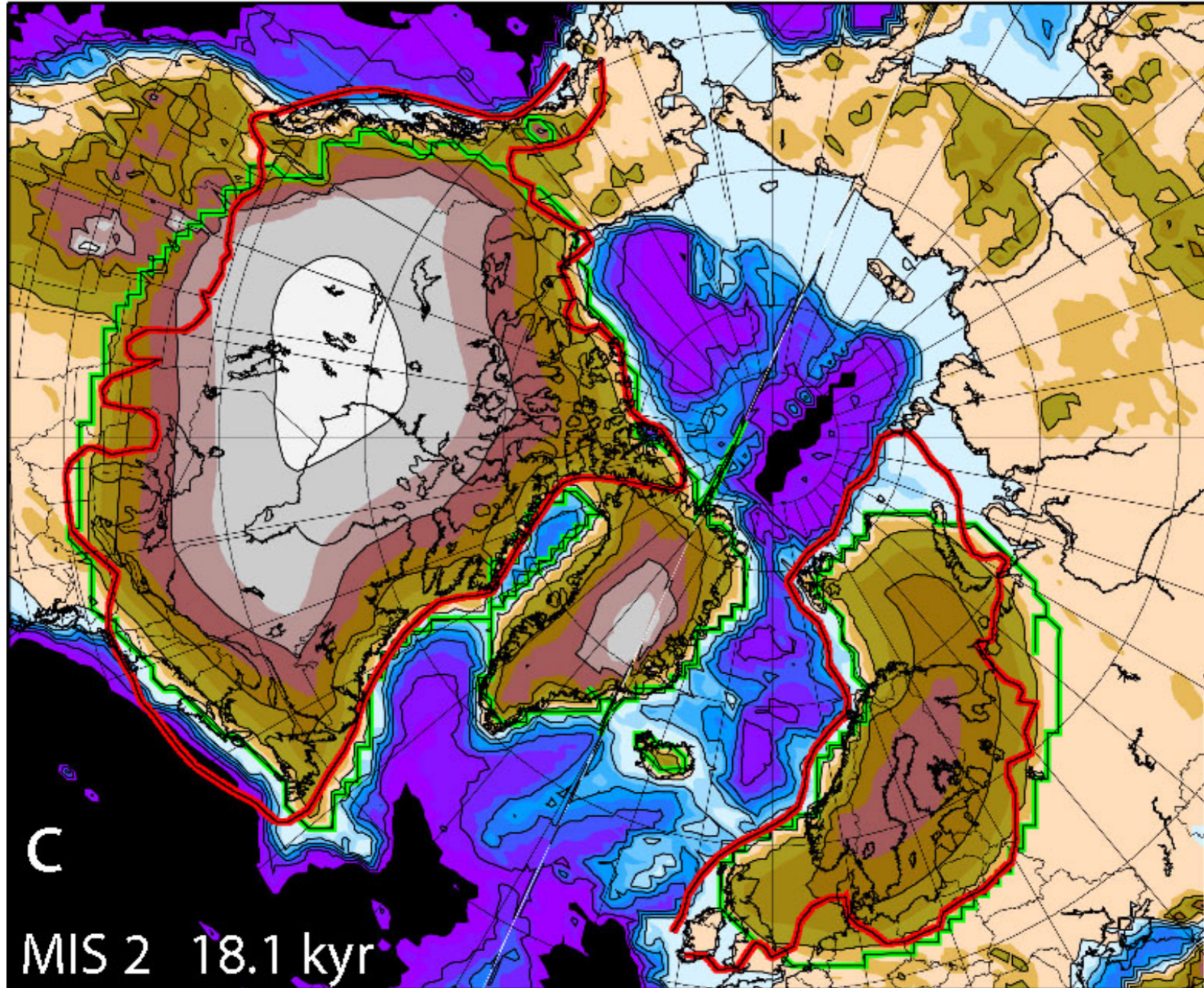
Bette Otto-Bliesner, Bill Sacks, Bill Lipscomb, Jeremy Fyke, Shawn Marshall, Esther Brady

Marcus Lövverström
NCAR

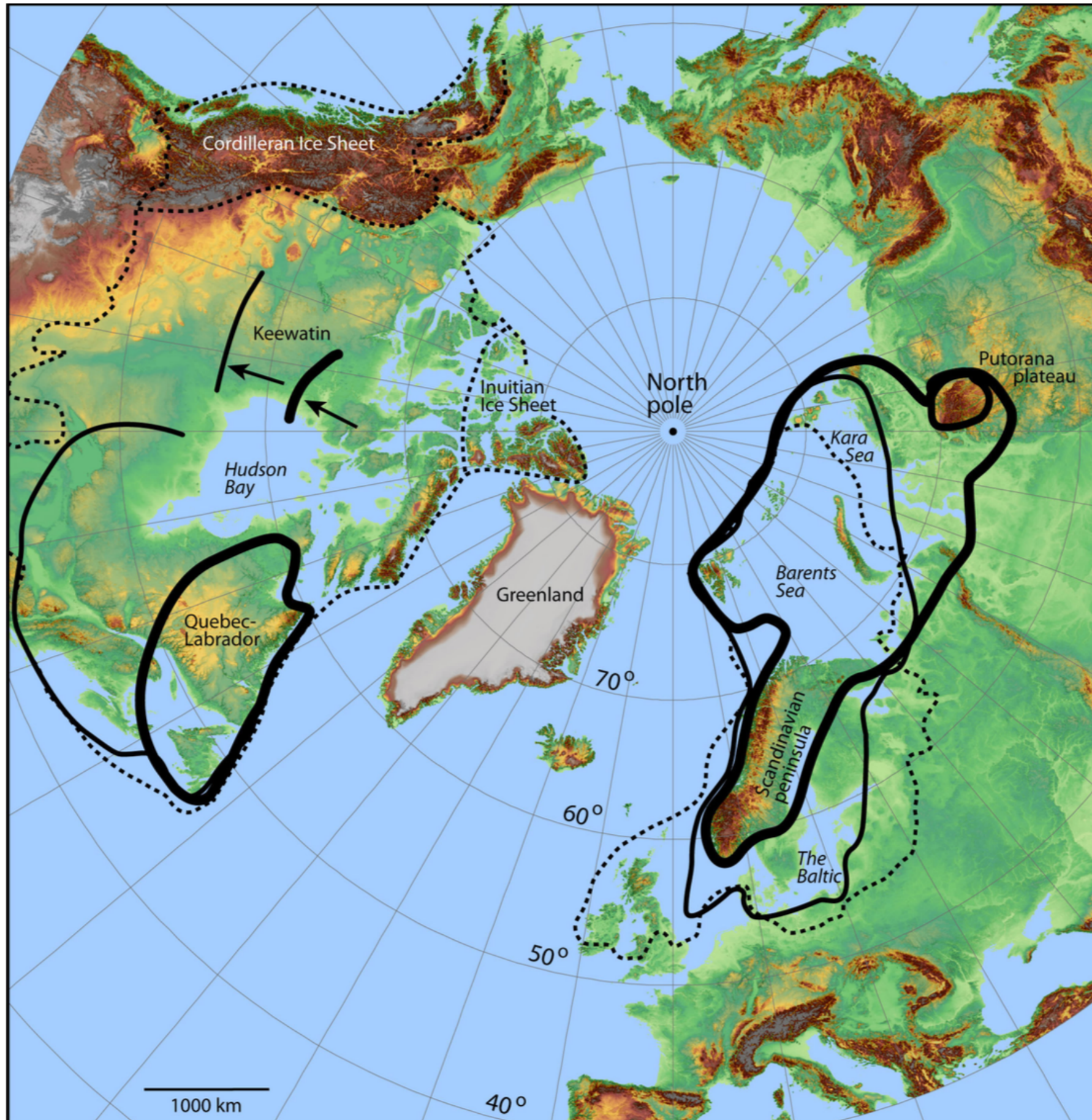
PaleoWG winter meeting, Austin, TX, 2018



Last glacial maximum

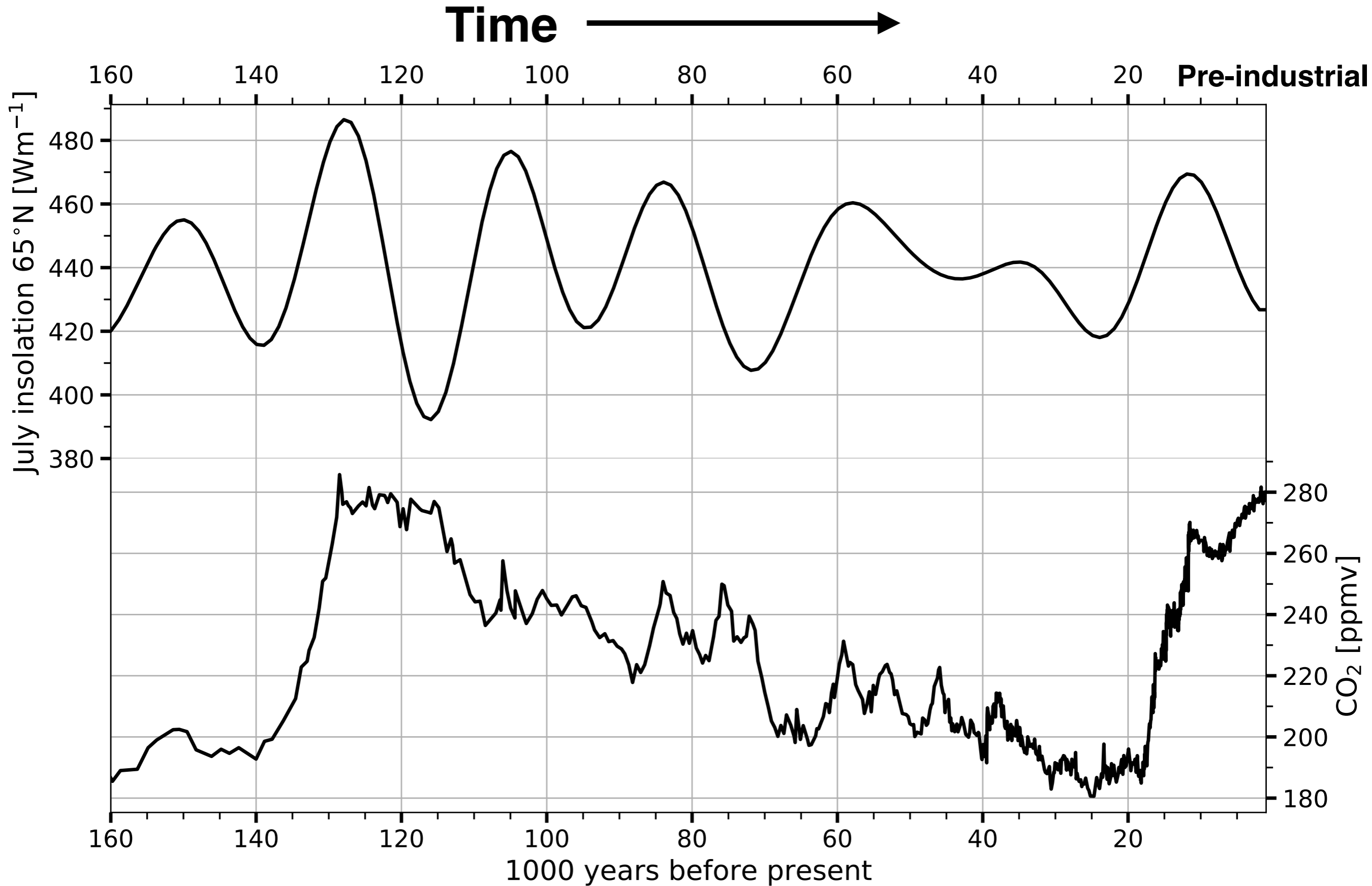


Inception regions

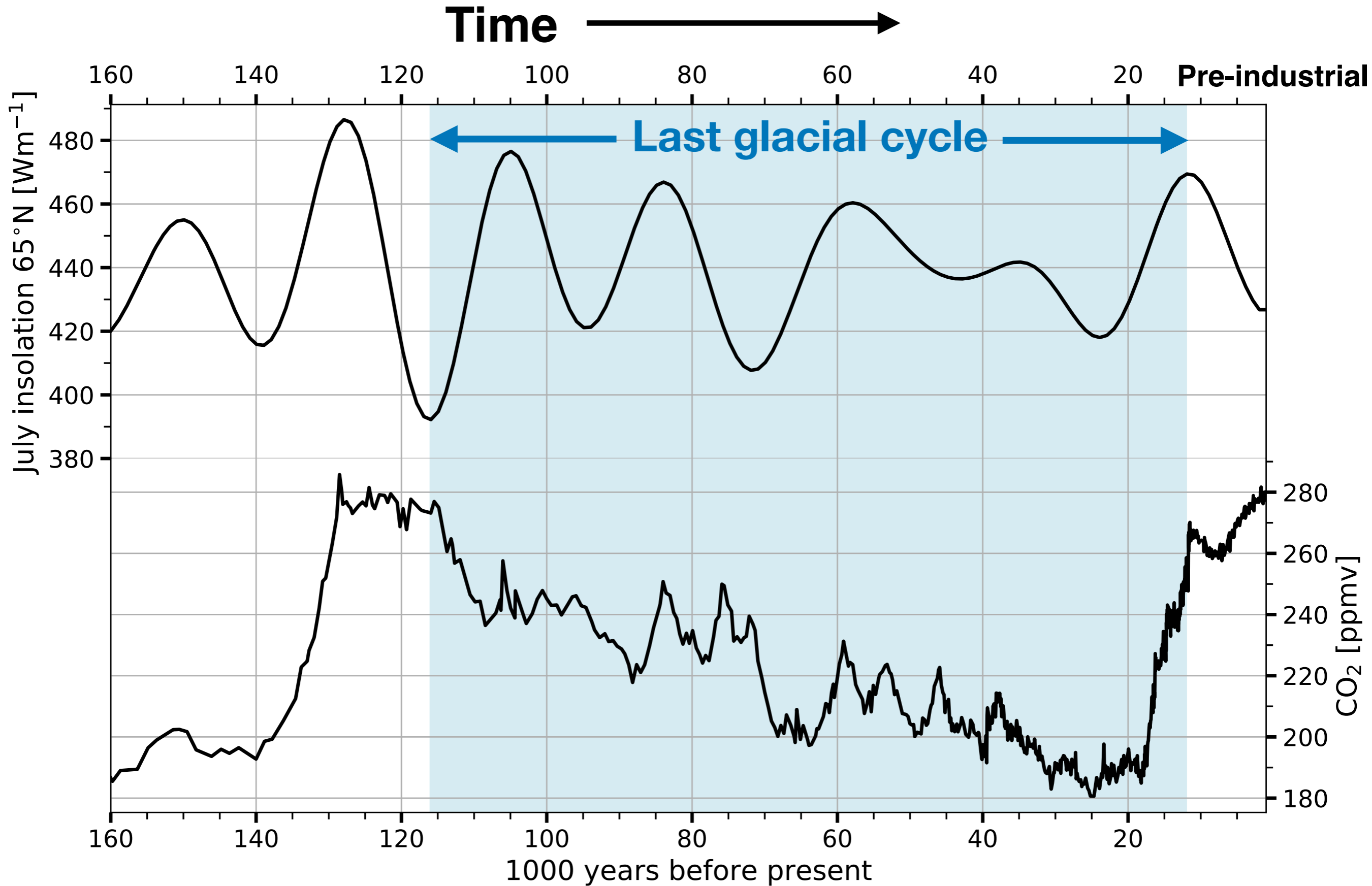


Bold lines:
~10-20 kyrs
after incept.

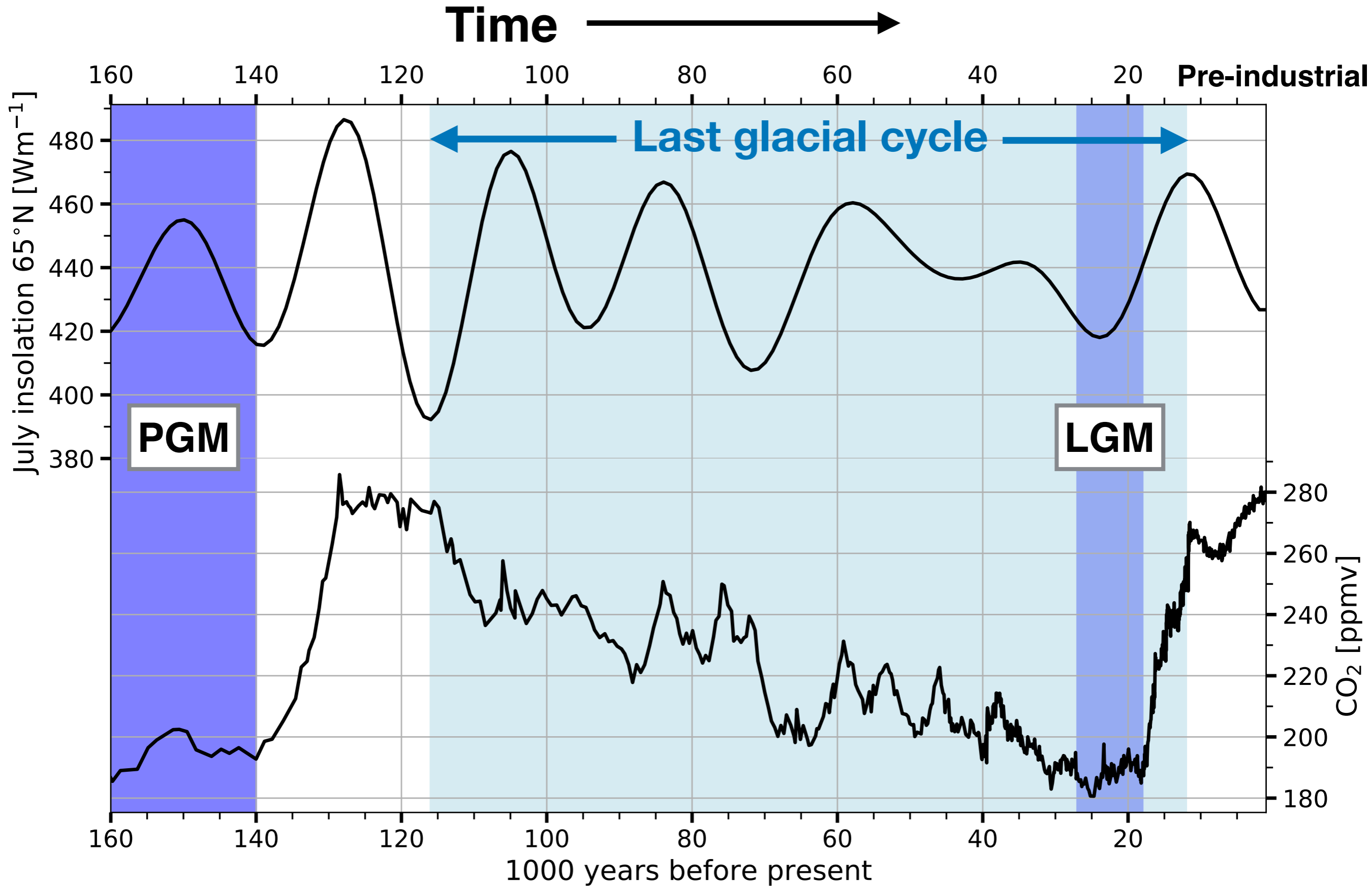
When was the last glacial inception?



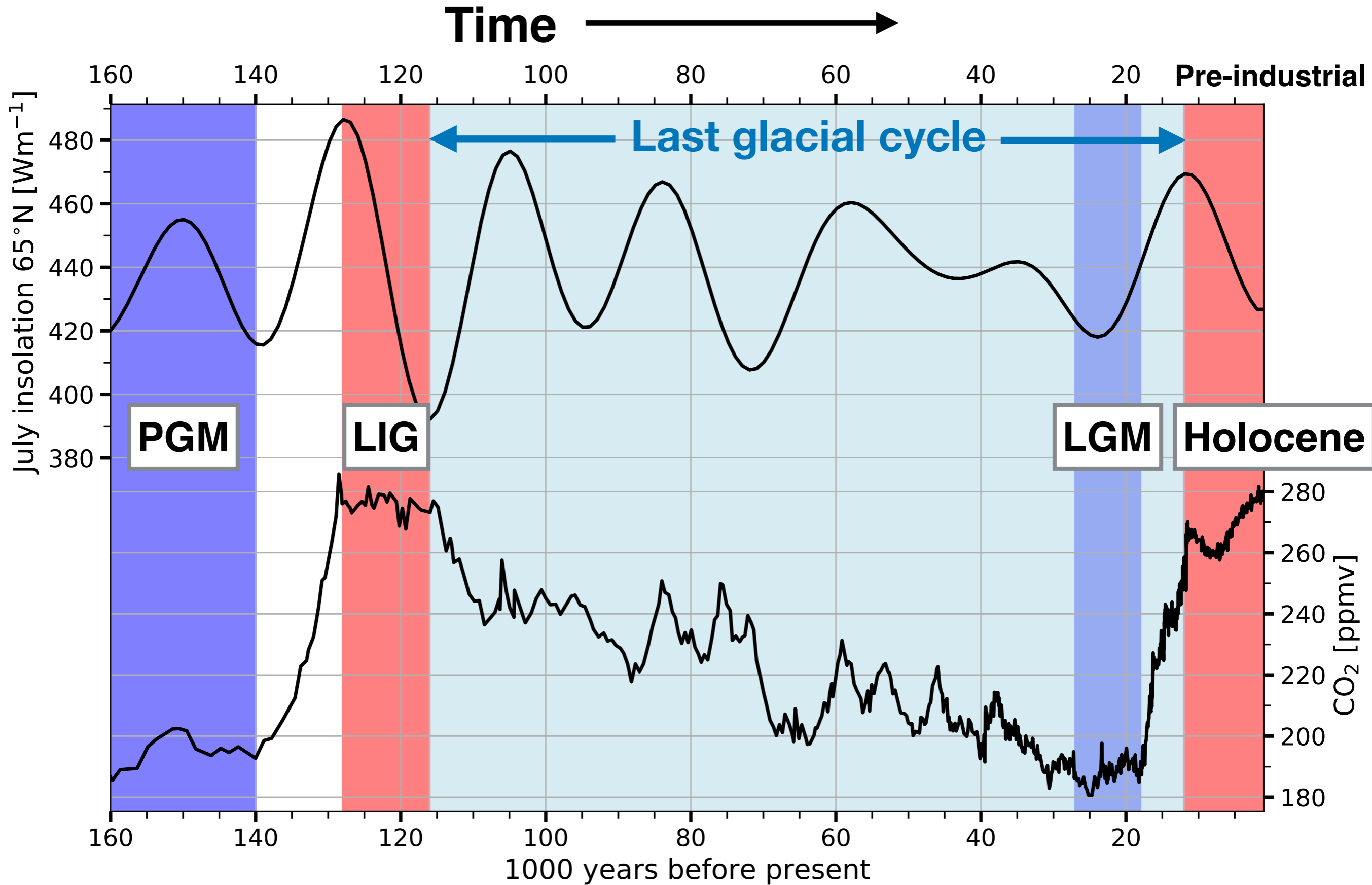
When was the last glacial inception?



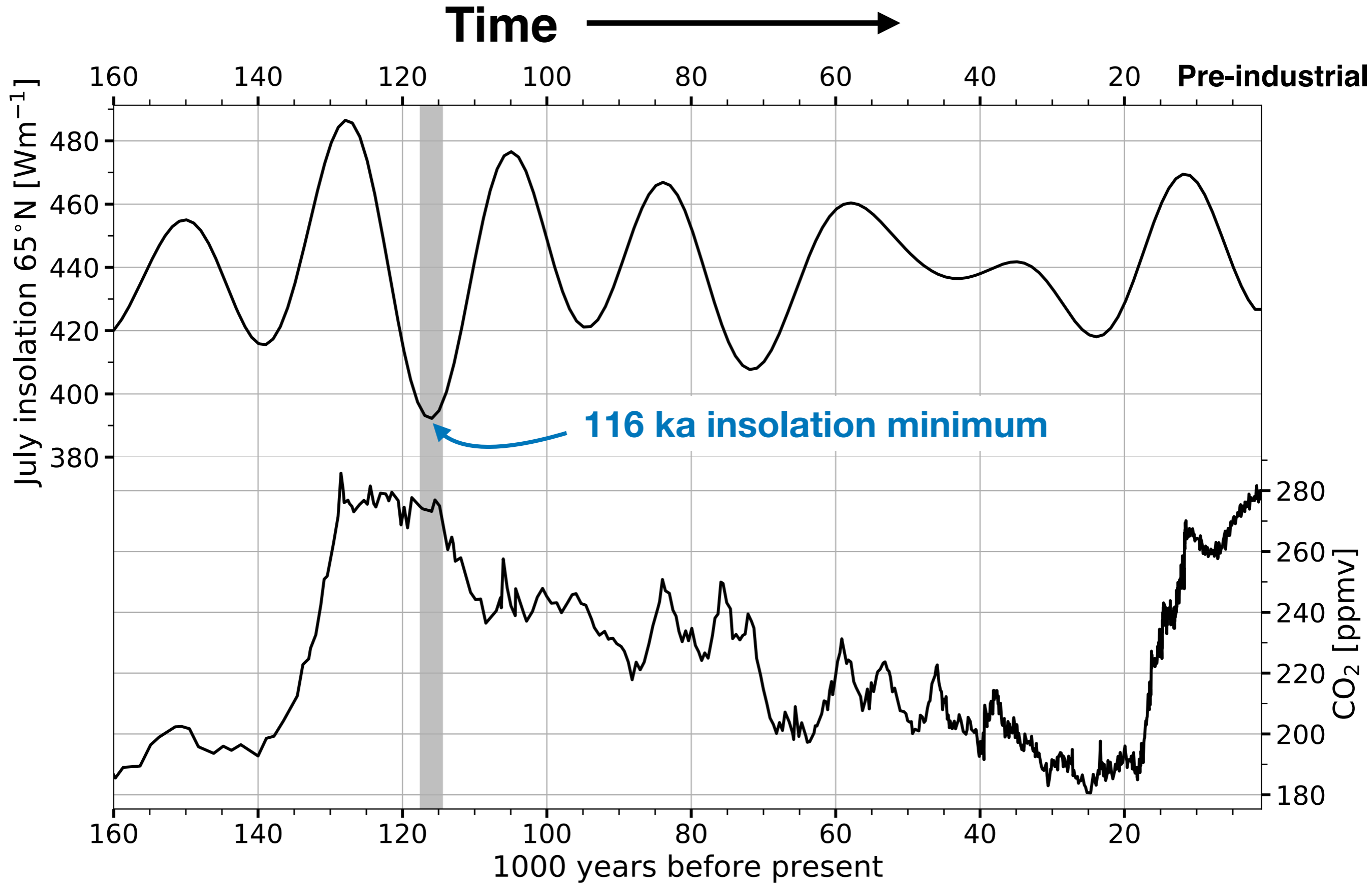
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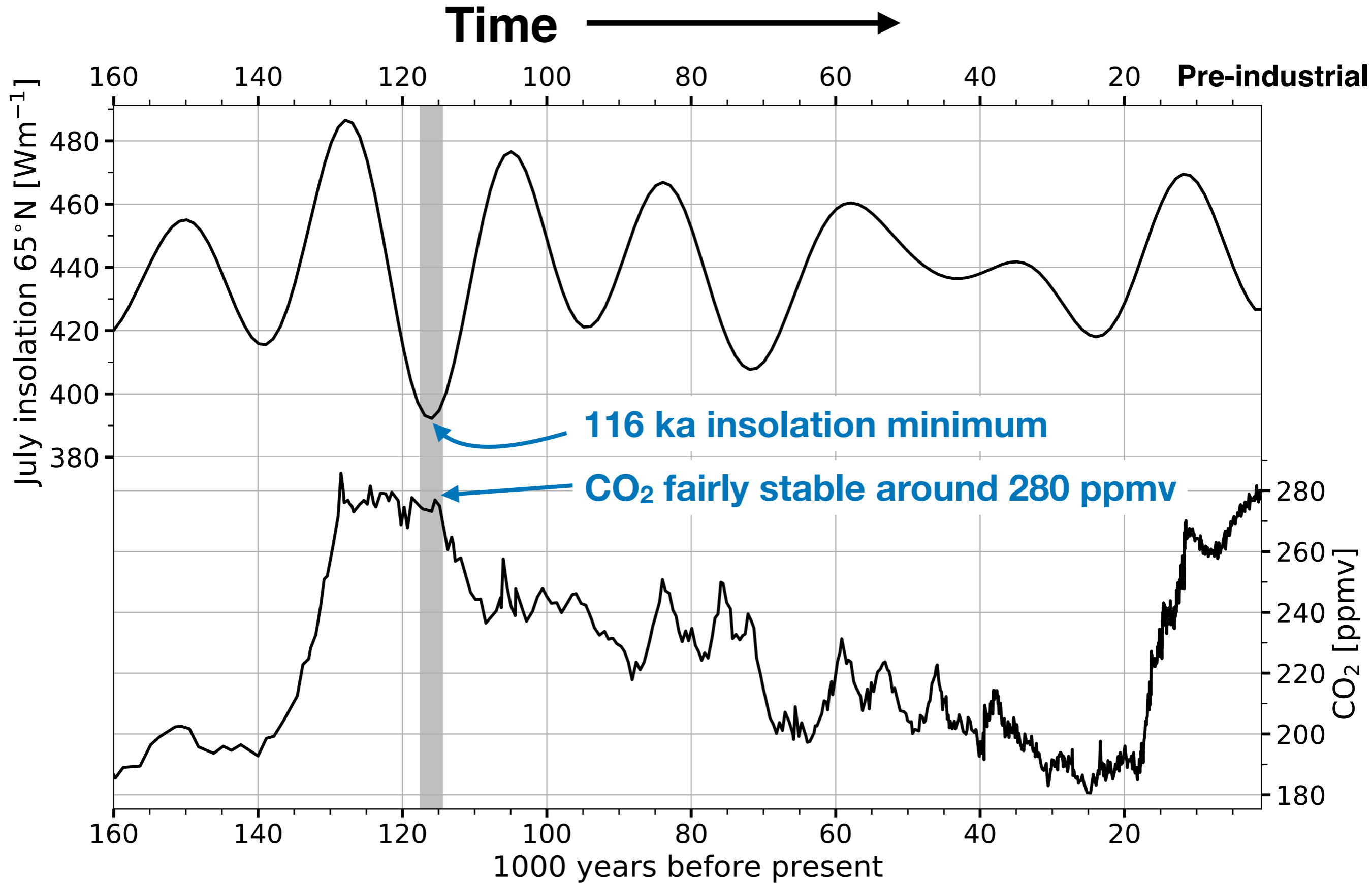
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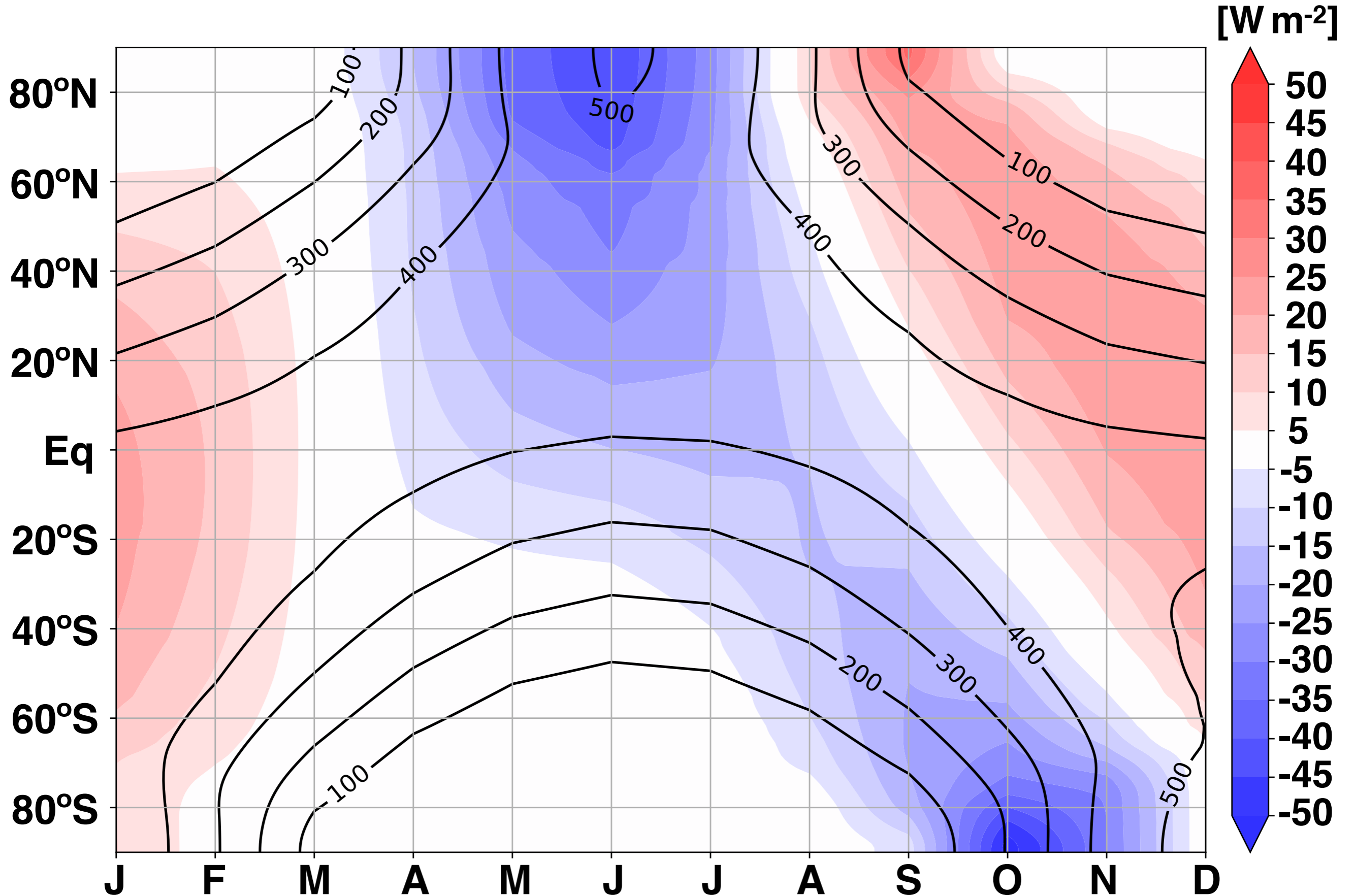
When was the last glacial inception?



When was the last glacial inception?



TOA insolation: 116 ka – PI



NCAR CESM2 (Community Earth System Model 2)

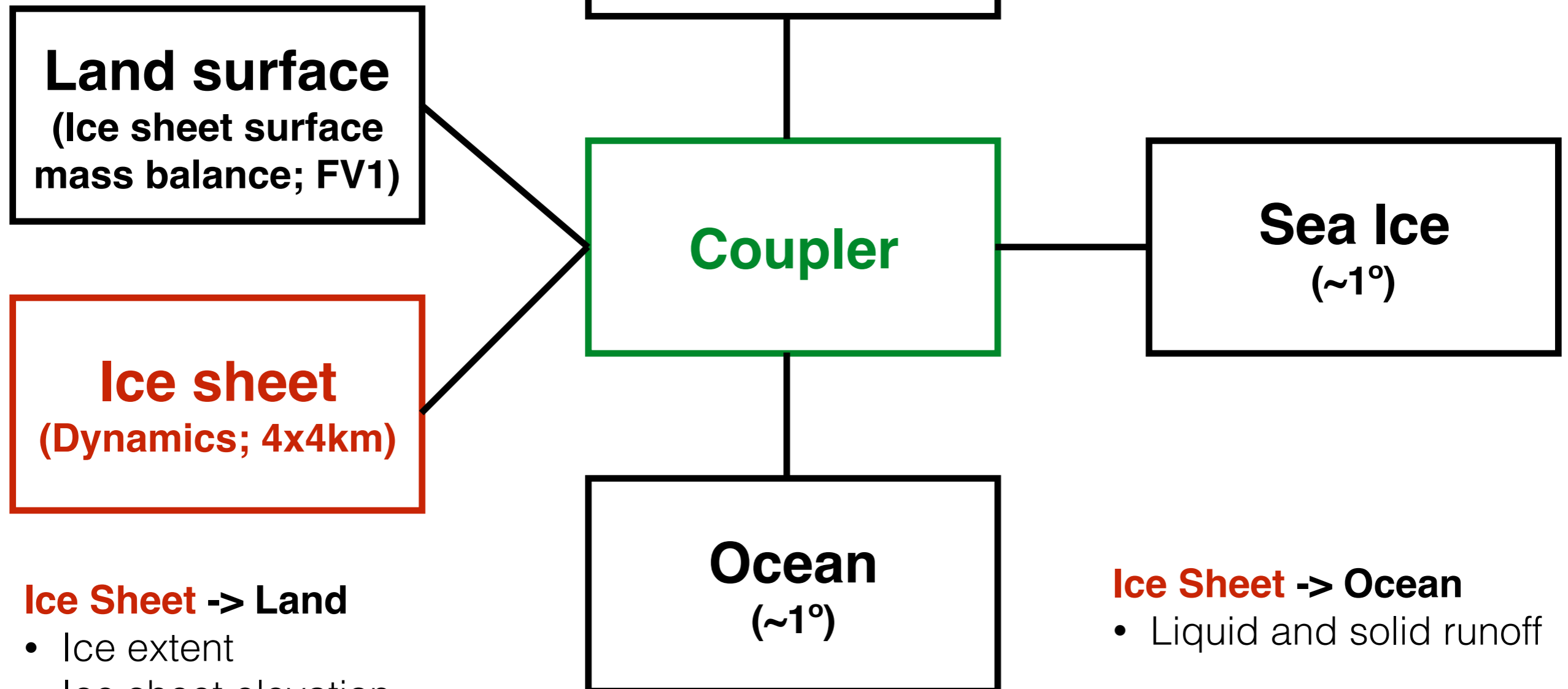
Land -> Ice Sheet

(10 elev. classes + bare land)

- Surface mass balance
- Surface elevation
- Surface temperature

Ice Sheet -> Atmosphere

- Ice sheet elevation (offline)



Land surface
(Ice sheet surface mass balance; FV1)

Ice sheet
(Dynamics; 4x4km)

Atmosphere
(FV1; ~1°)

Coupler

Ocean
(~1°)

Sea Ice
(~1°)

Ice Sheet -> Land

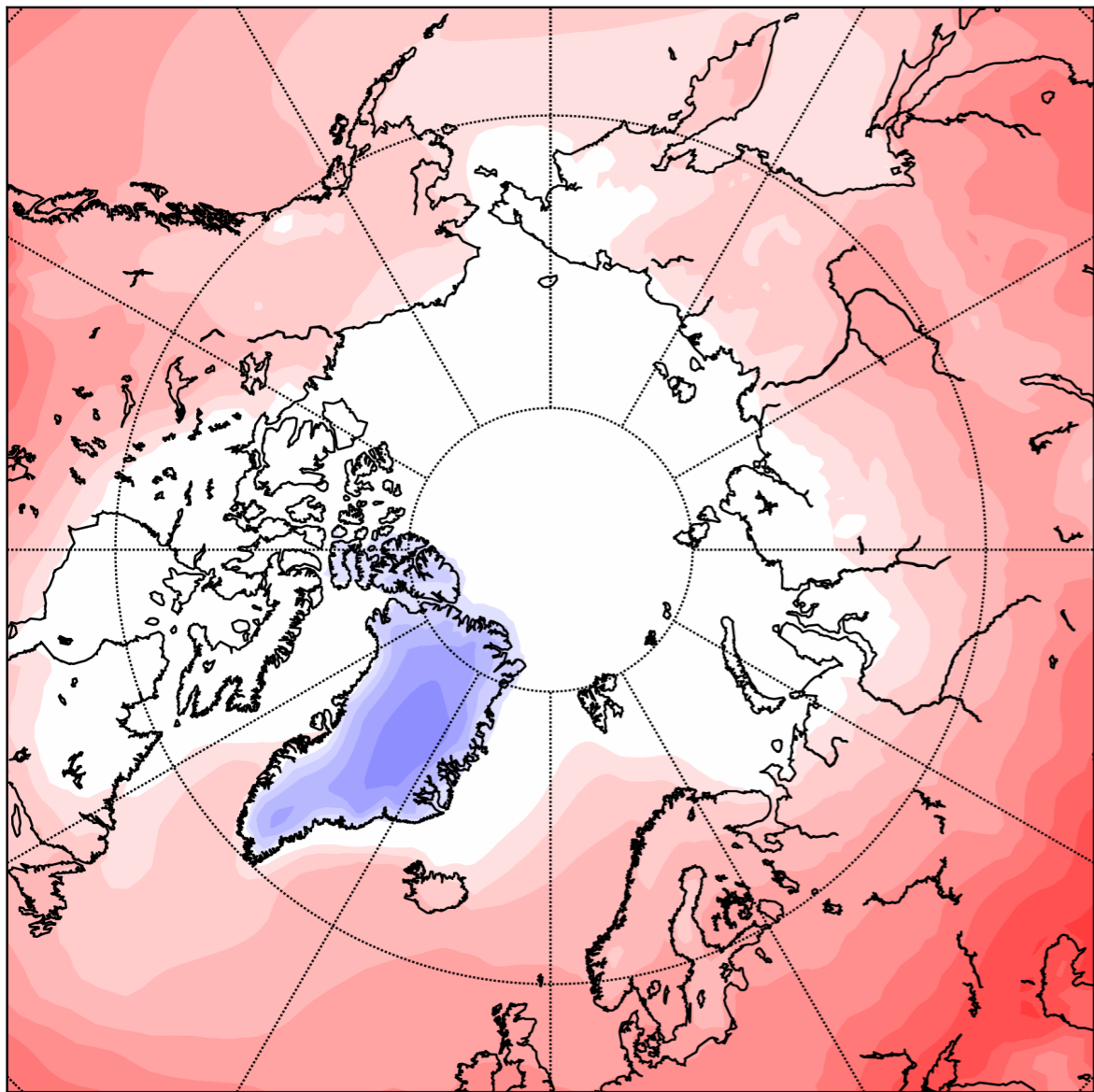
- Ice extent
- Ice sheet elevation
- SMB mask

Ice Sheet -> Ocean

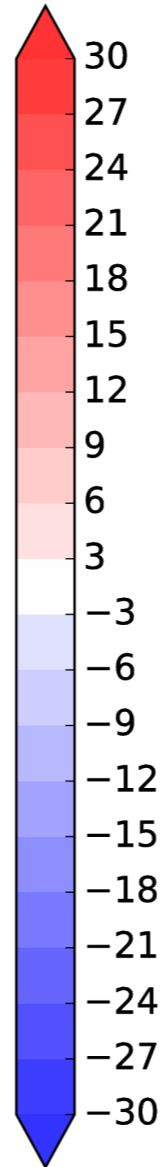
- Liquid and solid runoff

Last glacial inception (116 ka)

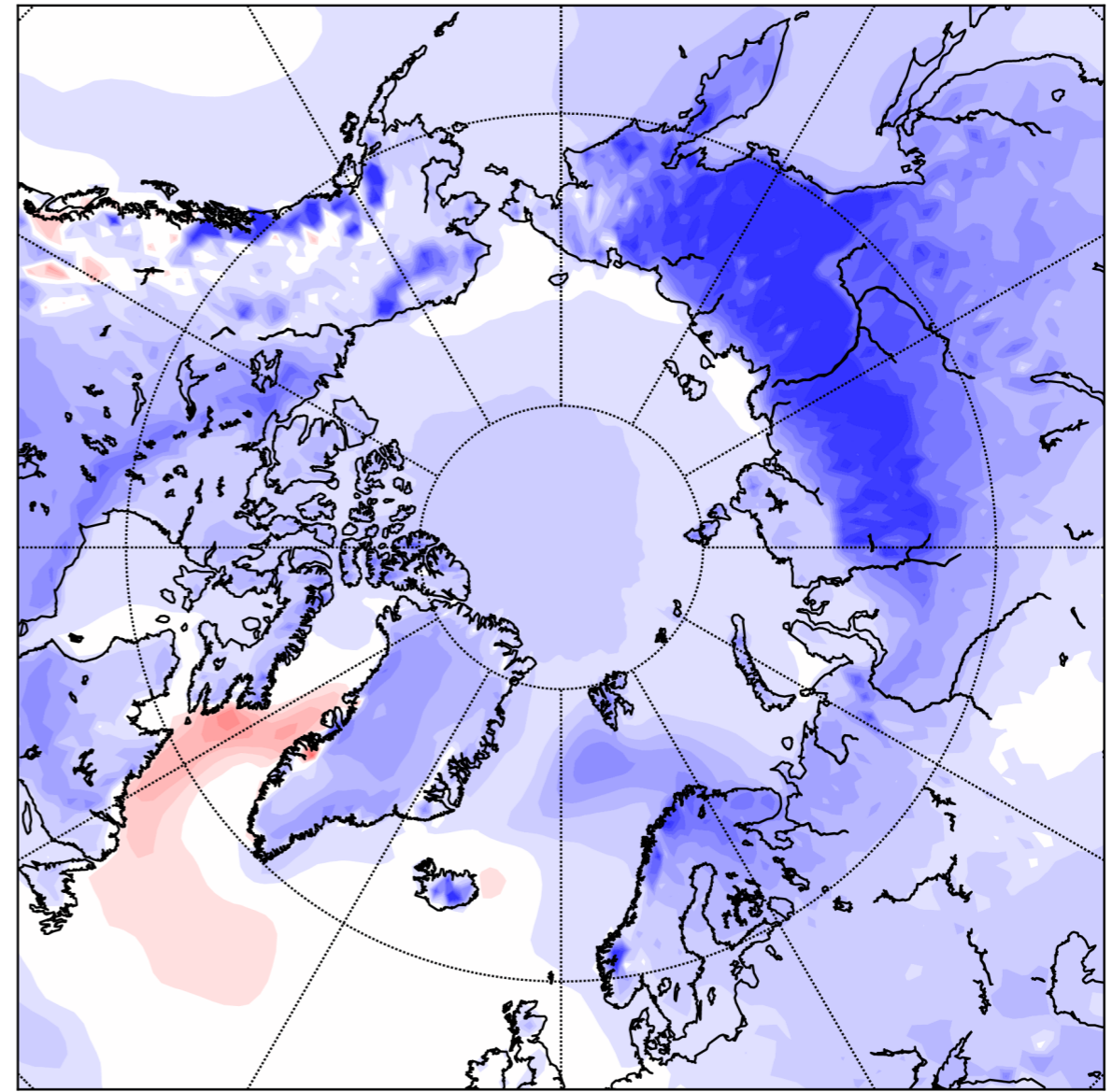
Pre-industrial



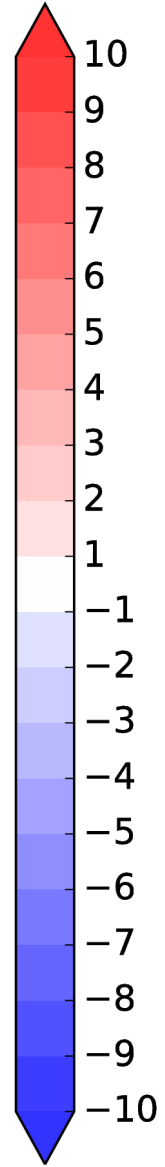
[°C]



116 ka — Pre-industrial



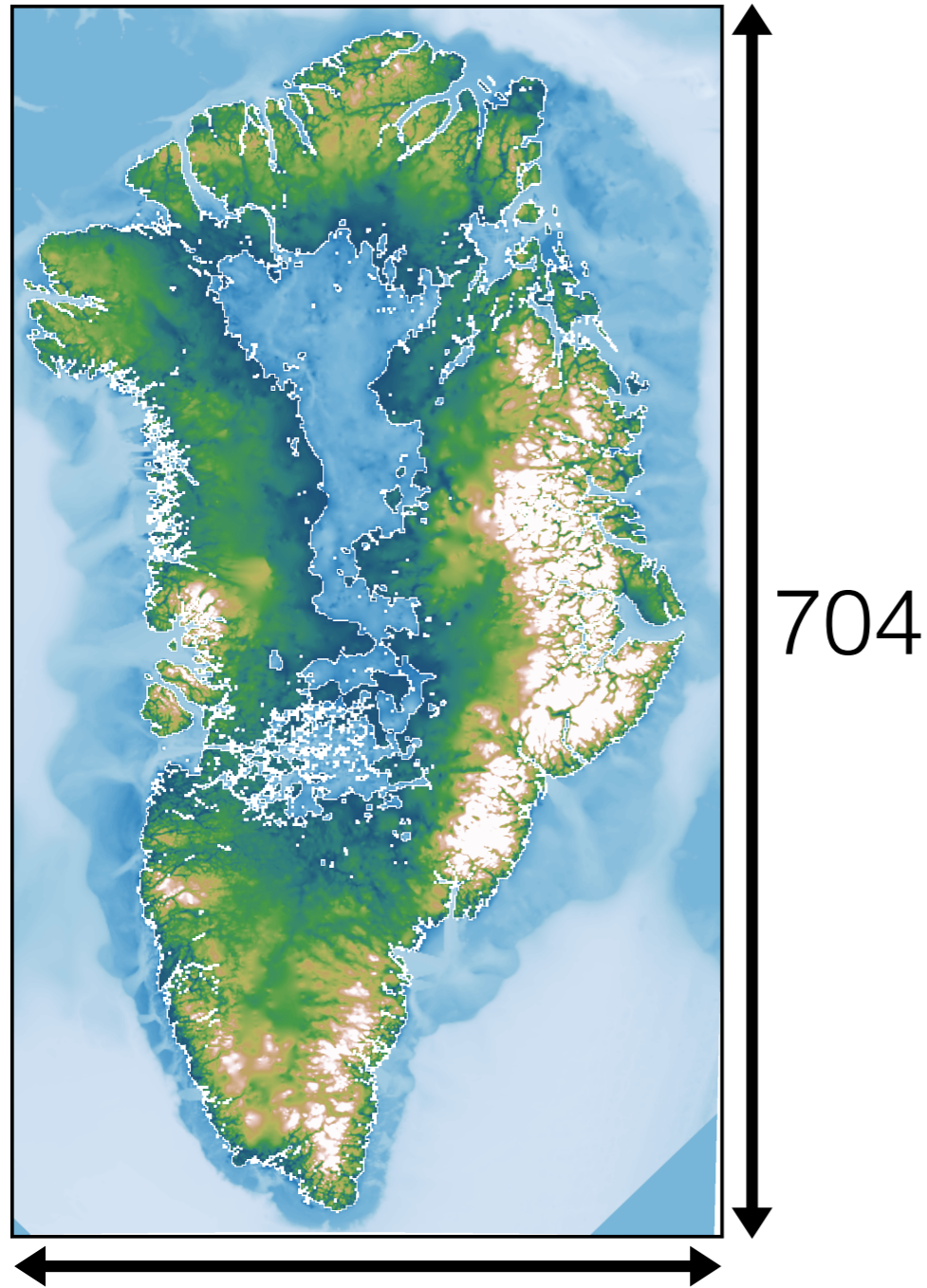
[°C]



JJA surface temperature

Extended ice-sheet model domain (4x4 km)

Default domain



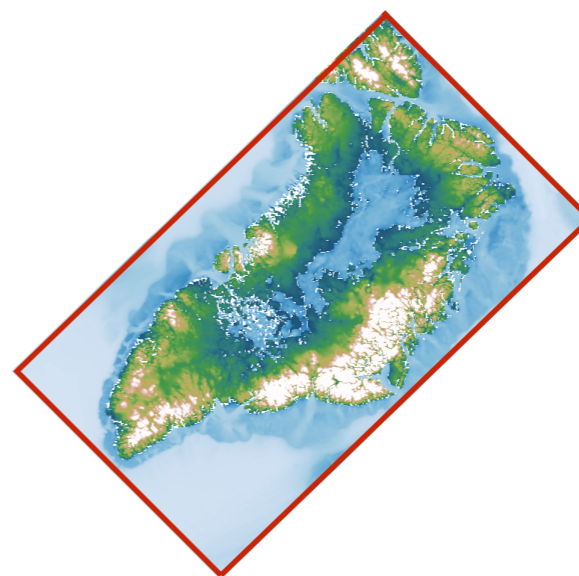
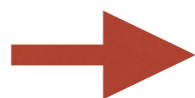
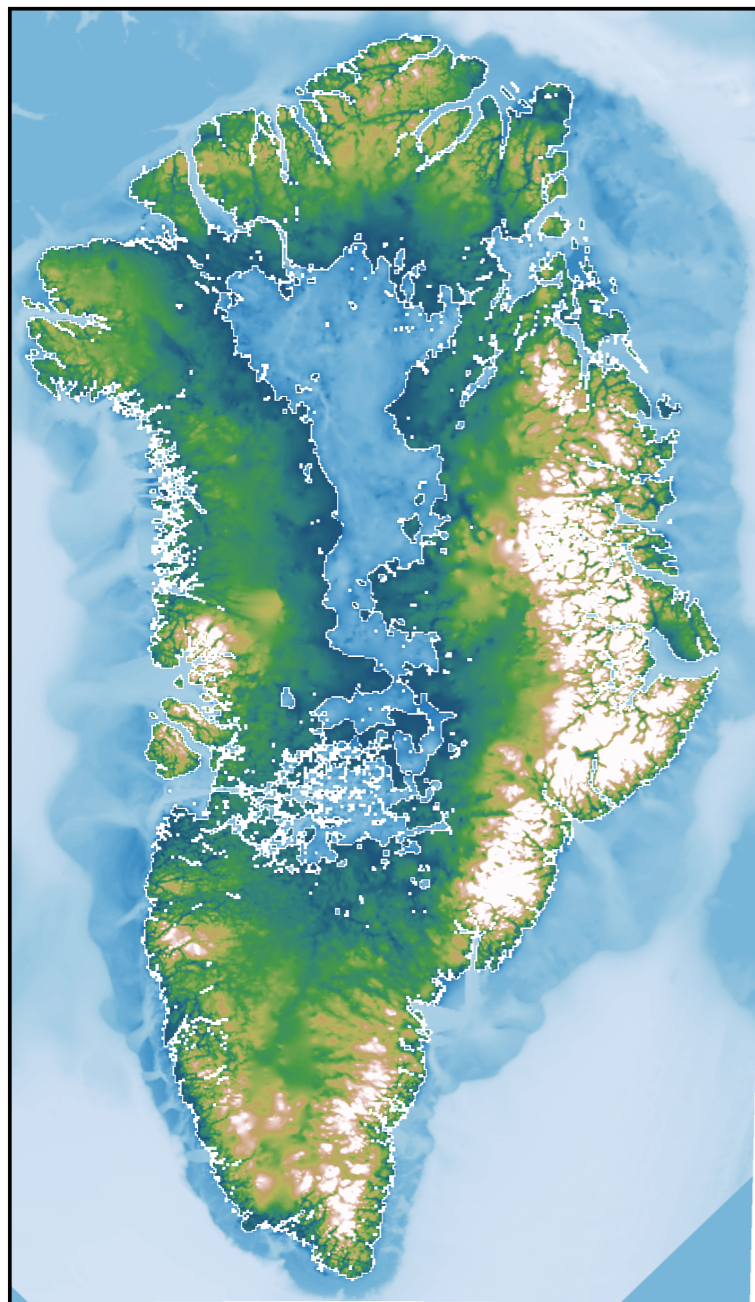
704

416

(416 x 704)

Extended ice-sheet model domain (4x4 km)

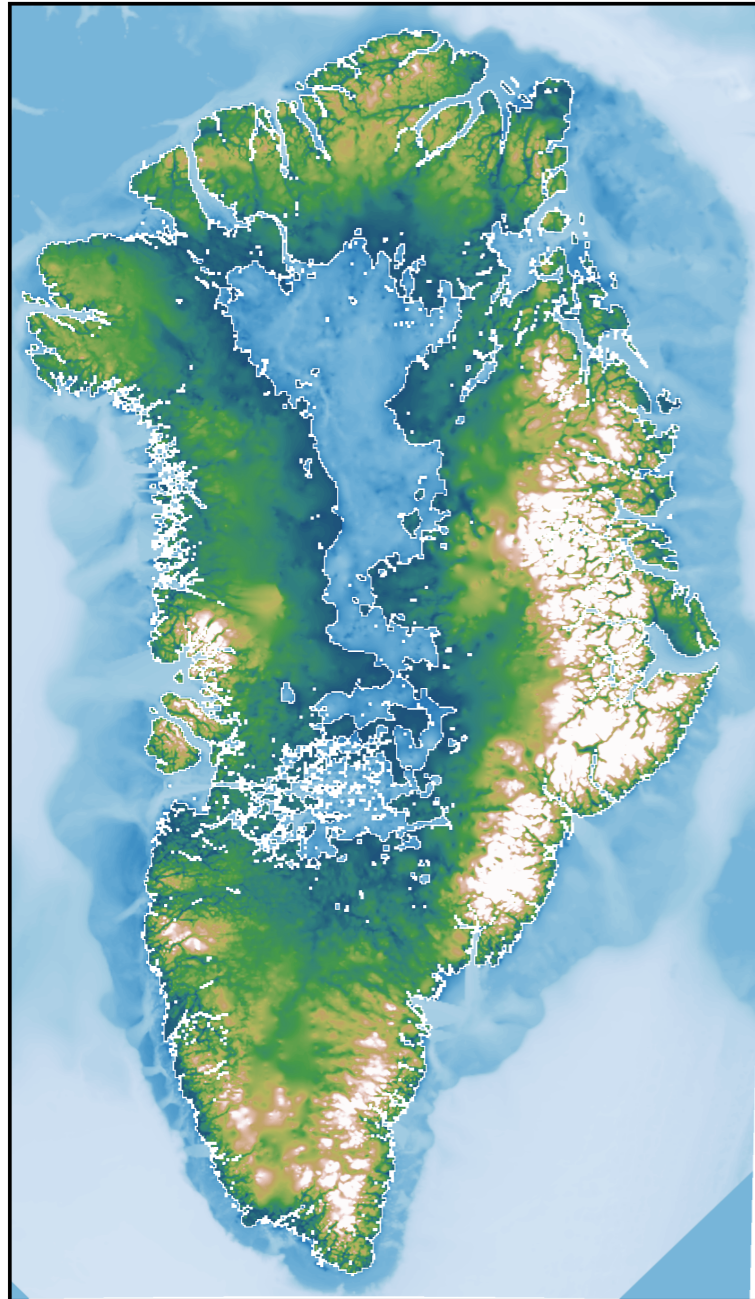
Default domain



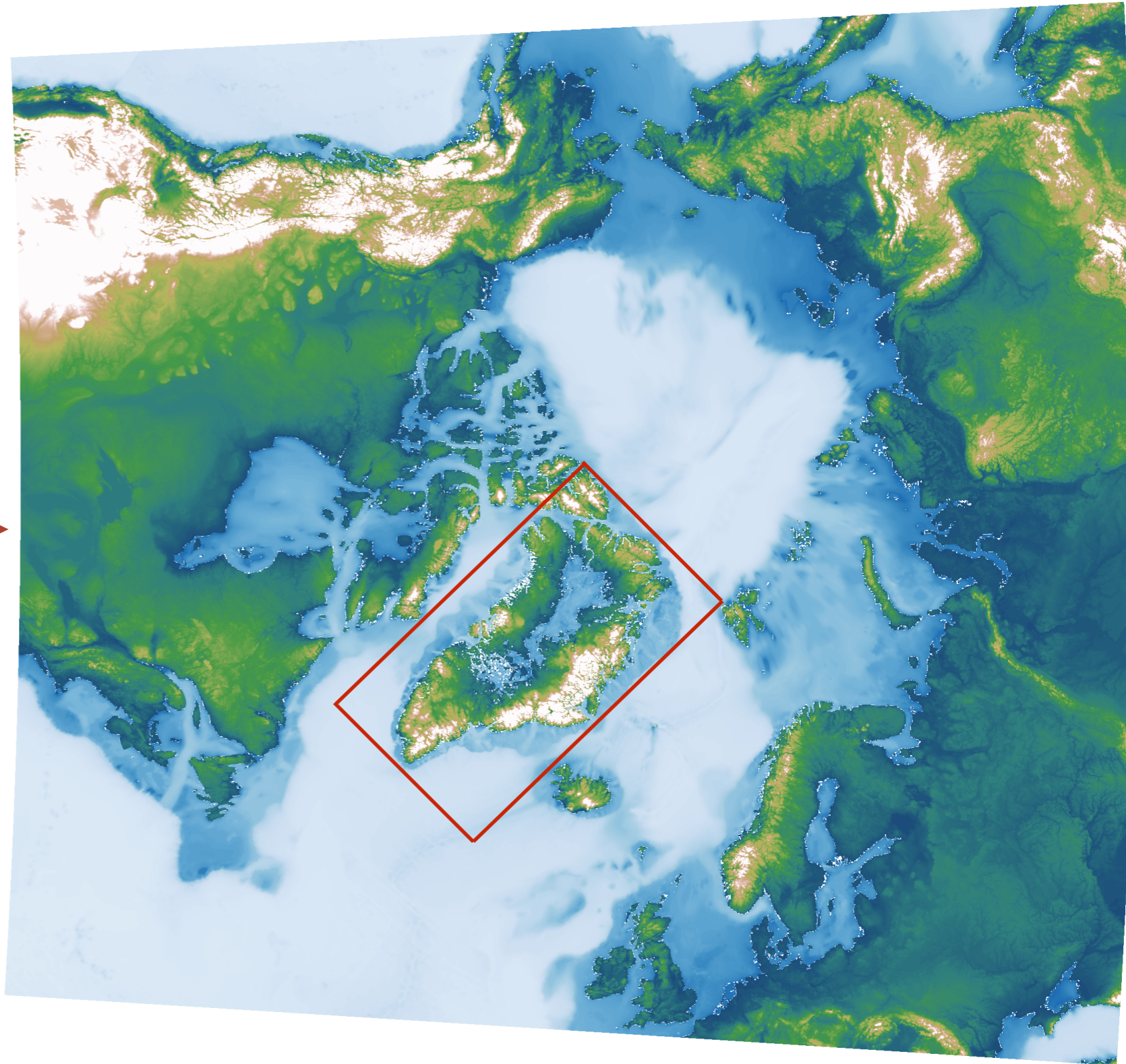
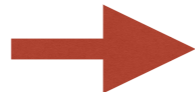
(416 x 704)

Extended ice-sheet model domain (4x4 km)

Default domain

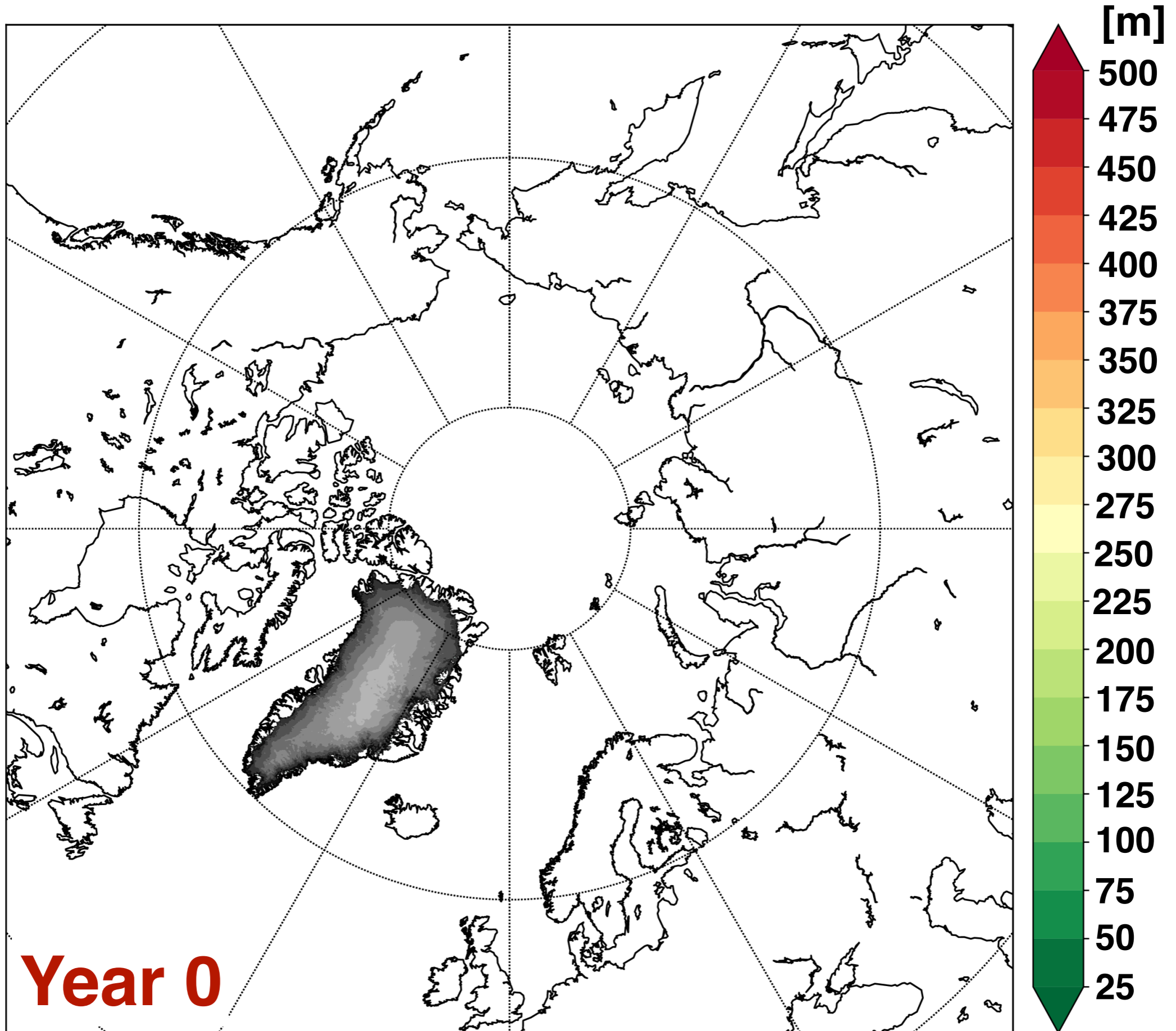


(416 x 704)

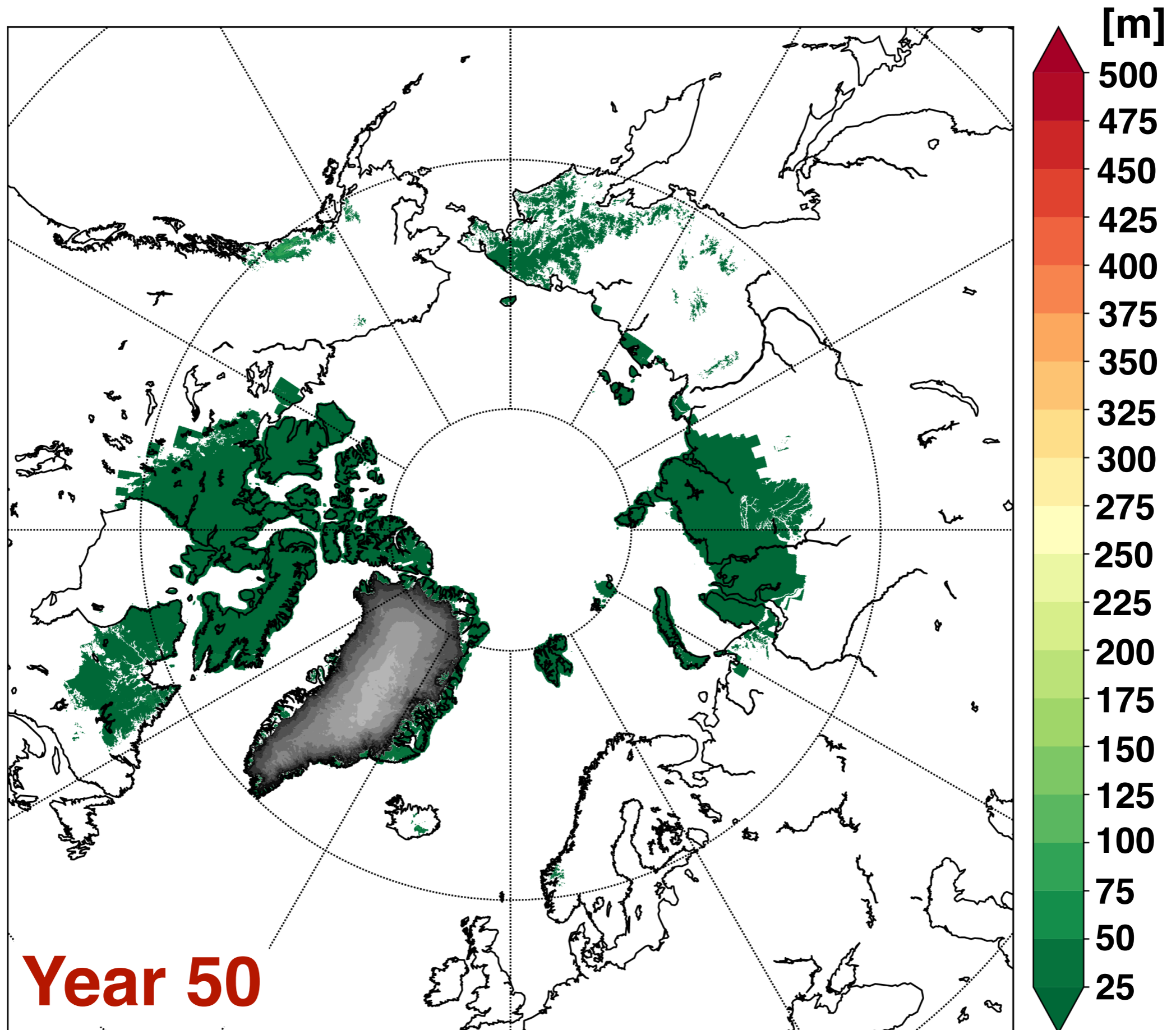


(2400 x 2080)

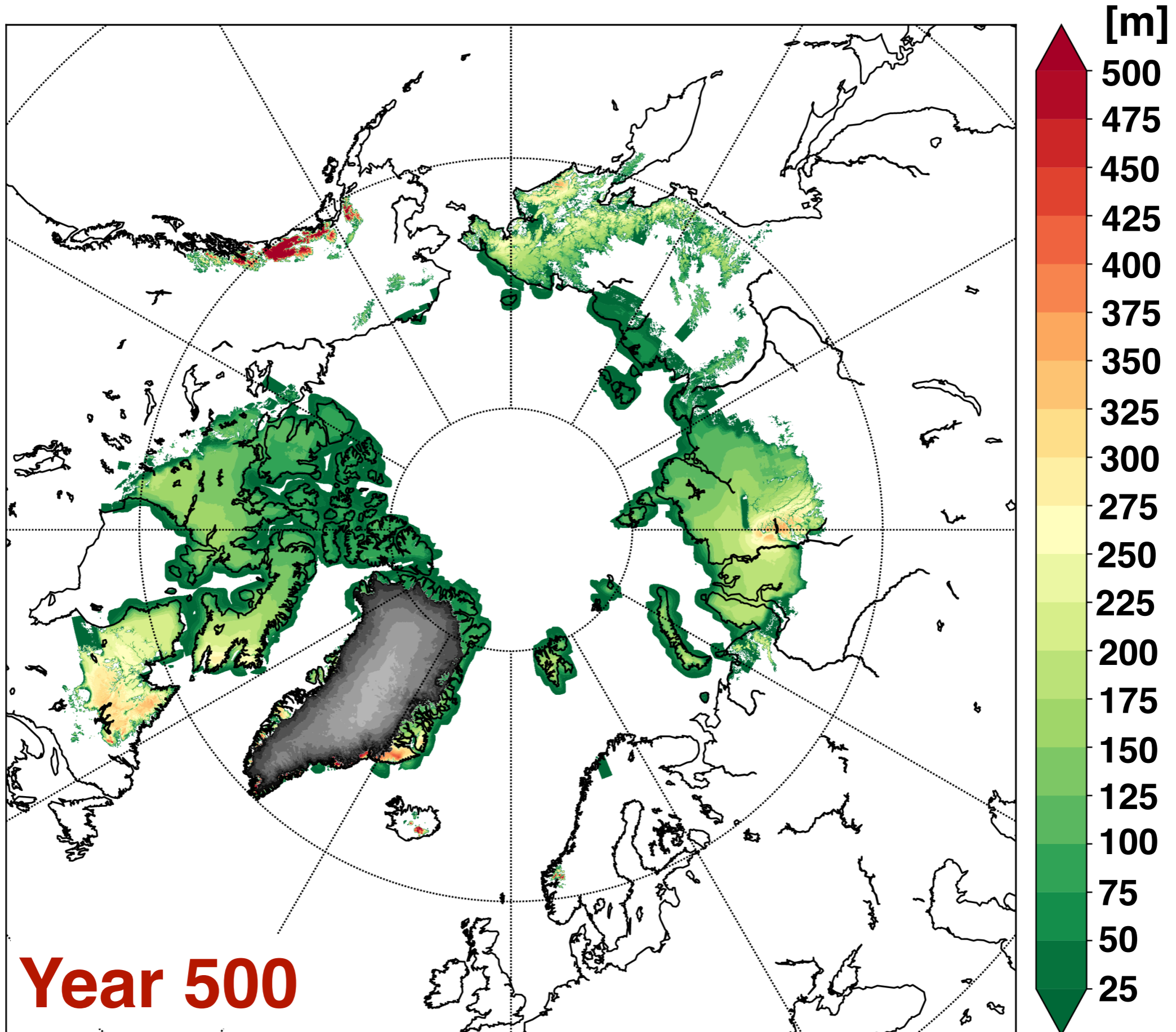
Extended ice-sheet model domain (4x4 km)



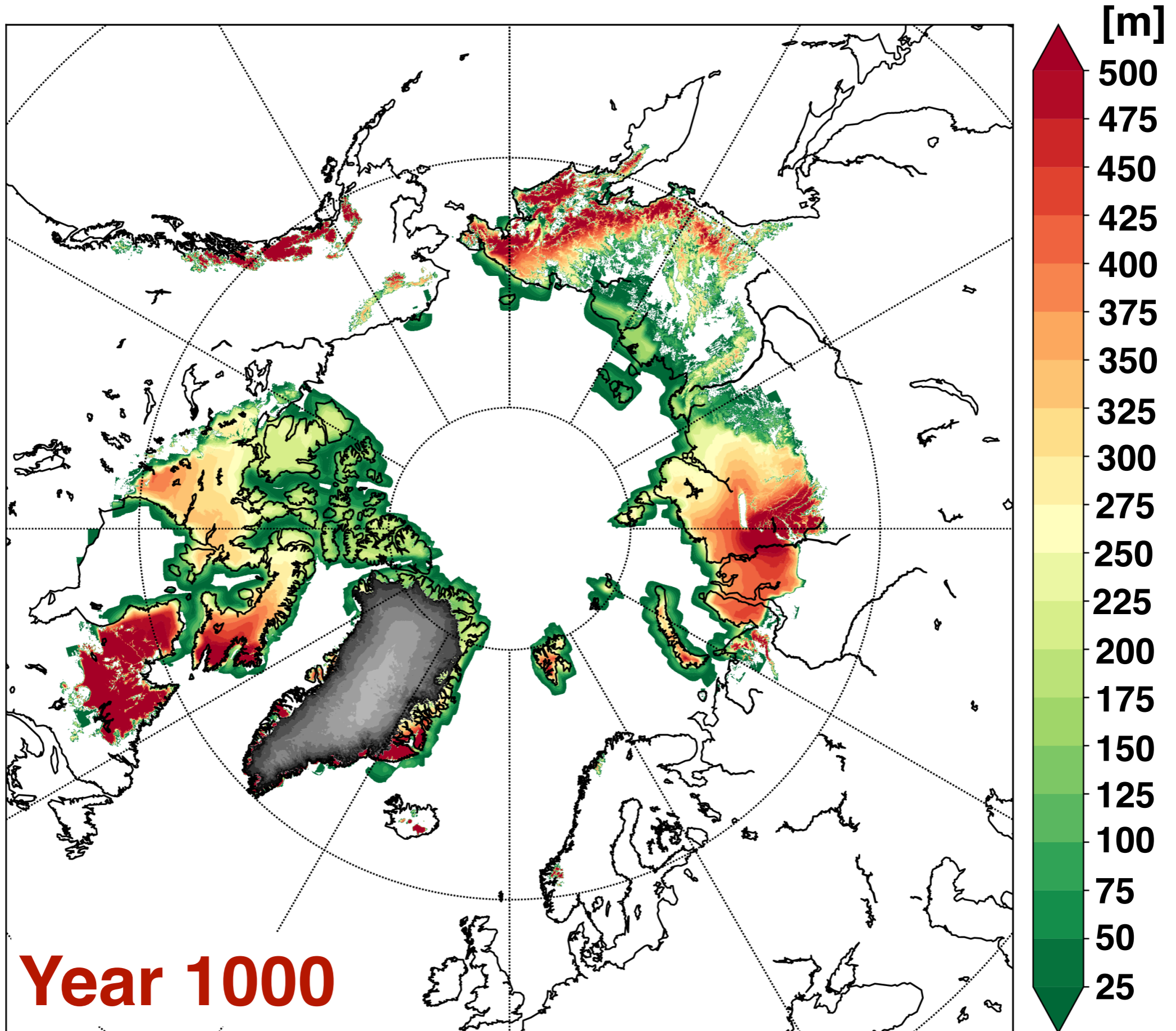
Extended ice-sheet model domain (4x4 km)



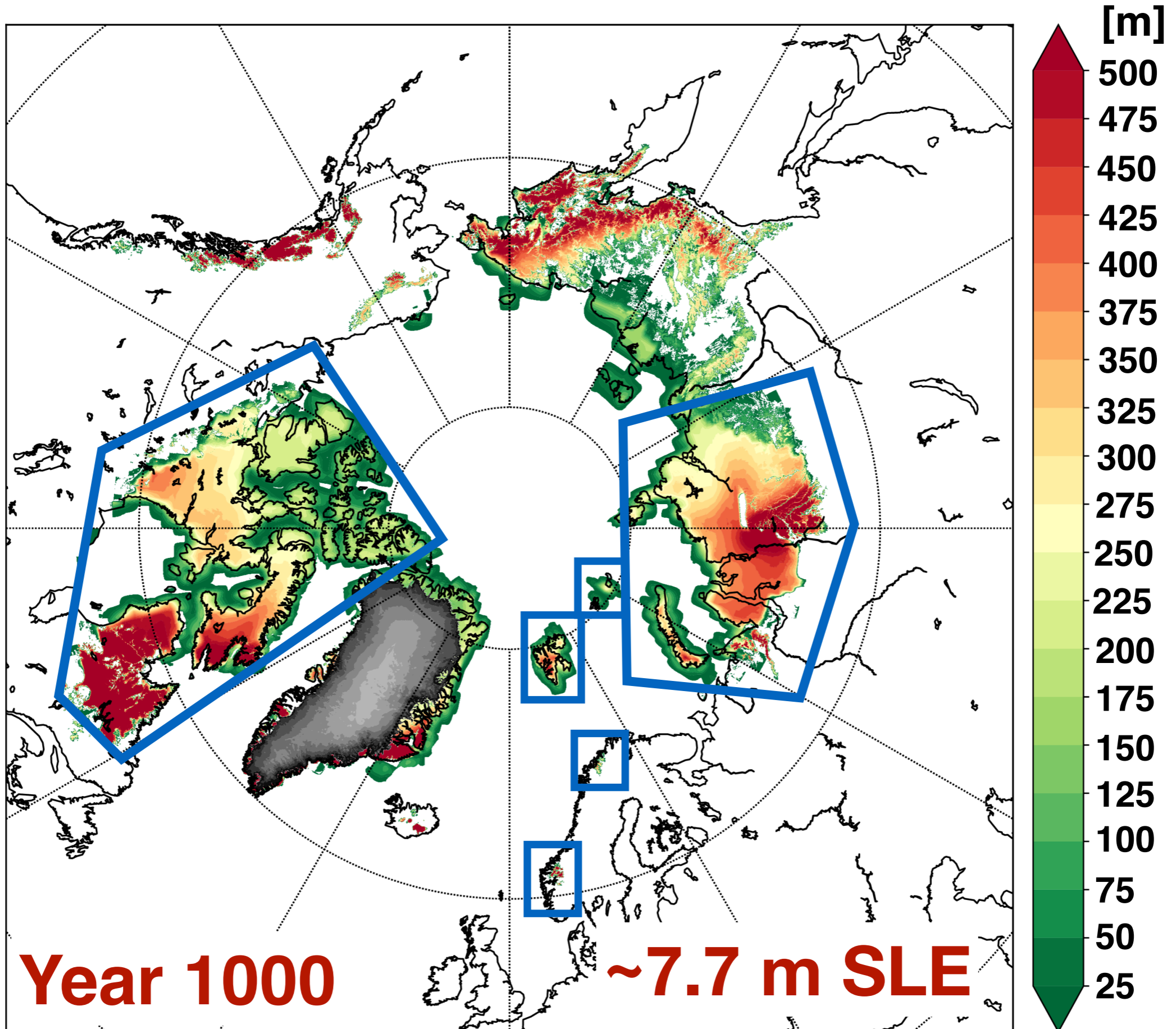
Extended ice-sheet model domain (4x4 km)



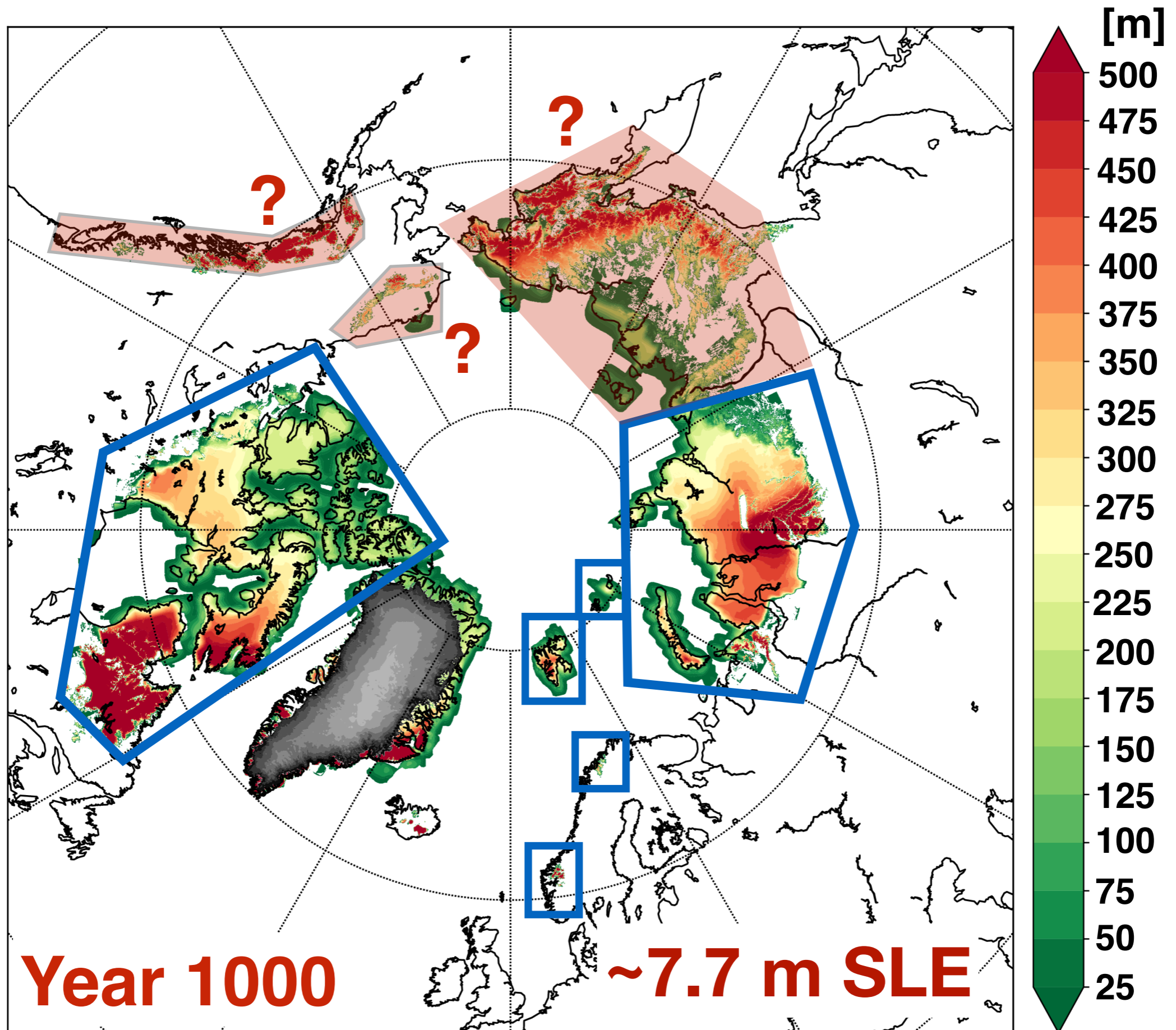
Extended ice-sheet model domain (4x4 km)



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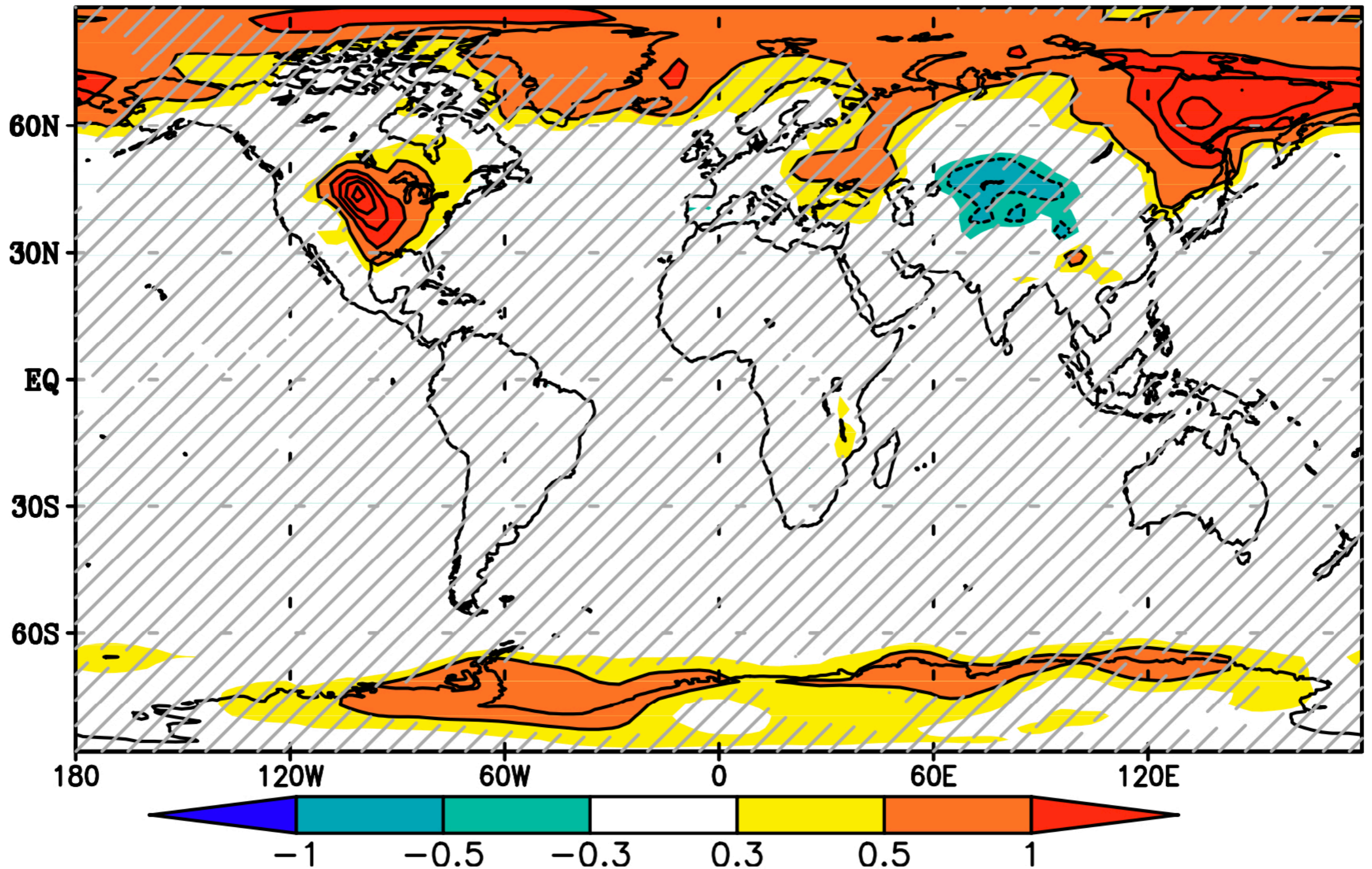


Extended ice-sheet model domain (4x4 km)



Missing feedbacks: increased dust deposition

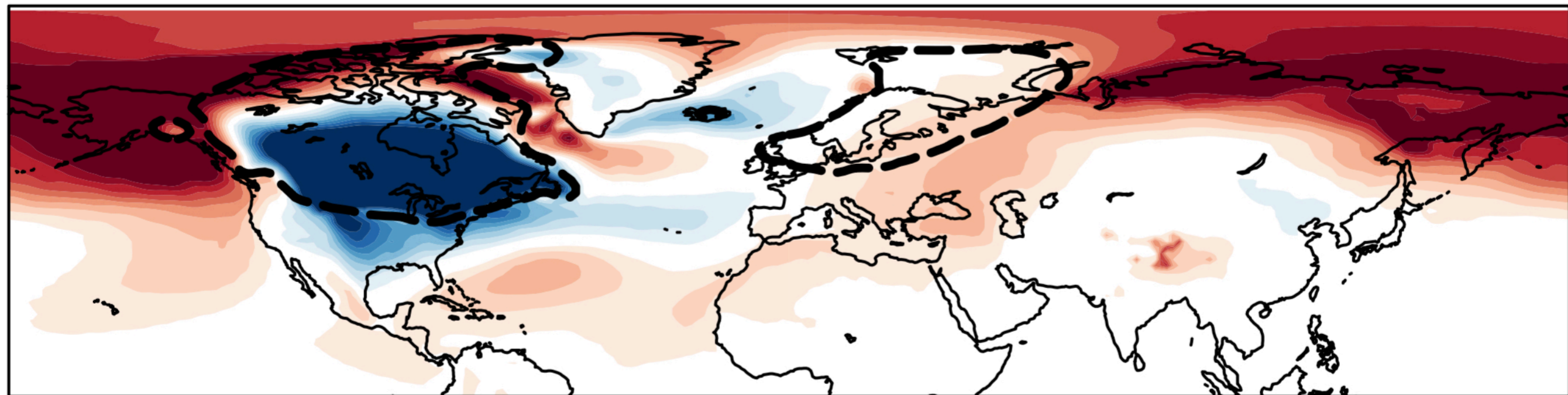
LGMglac.a–LGM.a (°C)



Missing feedbacks: stationary-wave feedback

Influence of LGM topography

LGMalb - LGM



-9 -8 -7 -6 -5 -4 -3 -2 -1 1 2 3 4 5 6 7 8 9

Surface temperature [°C]

Conclusions

Summary:

- First ever fully coupled simulation of the glacial inception
- Ice growth in Canadian Archipelago and north-central Siberia
- Difficult to suppress ice growth in eastern Siberia

Missing feedbacks:

- Dust deposition from exposed shelves
- Stationary-wave feedback (from ice-sheet topography)