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

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Last glacial maximum

Kleman et al. (2013)
Inception regions

Kleman et al. (2013)

Bold lines:
~10-20 kyrs after incept.
When was the last glacial inception?
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When was the last glacial inception?
When was the last glacial inception?

Time

Pre-industrial

LGM

PGM

Last glacial cycle

LIG

Holocene

July insolation 65°N [Wm⁻¹]

CO₂ [ppmv]

1000 years before present

160 140 120 100 80 60 40 20

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When was the last glacial inception?

116 ka insolation minimum
When was the last glacial inception?

- **Time**
  - 116 ka insolation minimum
  - CO₂ fairly stable around 280 ppmv
NCAR CESM2 (Community Earth System Model 2)

Land -> **Ice Sheet**
(10 elev. classes + bare land)
- Surface mass balance
- Surface elevation
- Surface temperature

**Land surface**
(Ice sheet surface mass balance; FV1)

**Ice sheet**
(Dynamics; 4x4km)

Ice Sheet -> **Land**
- Ice extent
- Ice sheet elevation
- SMB mask

Ice Sheet -> **Atmosphere**
- Ice sheet elevation (offline)

**Atmosphere**
(FV1; ~1°)

**Coupler**

**Ocean**
(~1°)

Ice Sheet -> **Ocean**
- Liquid and solid runoff

**Sea Ice**
(~1°)
Last glacial inception (116 ka)

Pre-industrial

116 ka — Pre-industrial

JJA surface temperature
Extended ice-sheet model domain (4x4 km)

Default domain

(416 x 704)
Extended ice-sheet model domain (4x4 km)

Default domain

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Extended ice-sheet model domain (4x4 km)
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Year 500
Extended ice-sheet model domain (4x4 km)
Year 1000

~7.7 m SLE

Extended ice-sheet model domain (4x4 km)
Extended ice-sheet model domain (4x4 km)

Year 1000

~7.7 m SLE
Missing feedbacks: increased dust deposition

Ohgaito et al. 2018 (Clim. Past discussion)
Missing feedbacks: stationary-wave feedback

Influence of LGM topography

Liakka & Lofverstrom (in prep. for Clim. Past discussion)
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)