Extreme climate conditions in Sweden in a 100,000 year time perspective

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The project

Motivation

- The Swedish Nuclear Fuel and Waste Co (SKB) are planning for a final repository for nuclear fuel waste.
- After 100,000 years the radioactivity of the waste has decreased to enriched uranium levels.

Climate modelling

- Identify extreme climate conditions that may occur during the coming 100,000 years.

(www.skb.se)
Three periods

- **Glacial climate**: period with an extensive ice sheet covering large parts of Northern Europe

- **Permafrost climate**: cold period with relatively small ice sheet covering the Scandinavian region

- **Warm climate**: high atmospheric greenhouse gas concentrations and complete loss of the Greenland ice sheet

(Petit et al, 1999)
Global and regional modelling

Global modelling: CCSM (at T42gx1v3)

Regional modelling: Rossby Centre Regional Climate Model (RCA)

Regional comparison with paleodata
Glacial climate (LGM)

Forcing and boundary data:

- Insolation: 1365 W / m²
- Orbital year: 21ka BP
- Atmospheric GHG conc.
  - CO₂ 185 ppmv
  - CH₄ 350 ppbv
  - N₂O 200 ppbv
- Ozone: preindustrial conc.
- Sulfates: preindustrial conc.
- Dust & salt: preindustrial/ simulated for LGM (Mahowald)
- Ice sheets: ICE5G
- Topography+bathymetry: ICE5G
- Vegetation: preindustrial/ simulated vegetation (Mahowald)
- Sea level: ca -120 m
Northern hemisphere Ts

NCAR year 1-400

Tornado year 401-813

NH Annual ts
Northern hemisphere sea ice

NCAR year 1-400

Tornado year 401-813
Northern hemisphere sea ice

Trend (% per decade) icefrac 606–813 LGM
Forcing and boundary data:

• Insolation: 1365 W / m²
• Orbital year: 37 ka BP
• Atmospheric GHG.:
  • CO2 210 ppmv
  • CH4 575 ppbv
  • N2O 245 ppbv
• Ozone: preindustrial concentrations
• Sulfates: preindustrial concentrations
• Dust & salt: preindustrial / scaled LGM
• Ice sheets: Combination of simulated ice sheets
• Topography, bathymetry: From isostatic model
• Vegetation: preindustrial / LGM simulated
• Sea level: ca - 70 m

Näslund + Ganopolski
Warm climate

Forcing and boundary data:

- Insolation: 1365 W / m²
- Orbital year: 1990
- Atmospheric GHG conc.:
  - CO2 750 ppmv
  - CH4 present day
  - N2O present day
- Ozone: preindustrial
- Sulfates: preindustrial
- Dust & salt: preindustrial
- Ice sheets: present day without Greenland
- Topography, bathymetry: present day
- Vegetation: present day / simulated a1b (Scholze)
- Sea level: unchanged (+7 m in regional simulation)
Results ....

... at next years CCSM workshop!