Dust Simulations in the Last Deglaciation

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Background

- Mineral dust is one of the most important aerosols in terms of both atmospheric loading and radiative effects.
- Dust is known to have direct and indirect radiative effects as well as biogeochemical effects in the Earth’s climate system.
- Records from ice cores and marine sediment cores show large variations of dust accumulation rates during the Quaternary.
- High dust accumulation rates correspond to cold climate and vice versa.
Dust and climate in the past

Glacial-interglacial cycles

- δD
- CO2
- CH4
- Dust

Last deglaciation

- Greenland
- Peru
- Antarctic

Both from Raynaud et al., 2003 in Paleoclimates, Global Change and the Future, Alverson Ed., Springer
**Background (continued)**

- Greater source due to higher wind speed, lower soil moisture, less vegetation cover, exposed continental shelves, and glaciogenic production of fine sediments
- Longer lifetime and greater transport range due to less precipitation
- Dust may also have played active roles in the climate changes;
  - Radiative effects: net radiative effect of dust on climate is the cooling effect
  - Biogeochemical effects: dust supplies nutrients to terrestrial and marine ecosystems to enhance the carbon sink
Dust simulation in the QUEST Deglaciation Project

- QUEST Deglaciation Project aims to develop a fuller understanding of what has driven changes in climate, atmospheric composition and biogeochemical cycles during the period since the Last Glacial Maximum ~21K years

- First transient simulation of the last deglaciation using a full complexity Earth System model

- Development of new model components dealing with many important processes including dust and other aerosols

- Dynamical representation of key biogeochemical feedbacks

- Comprehensive evaluation of model against existing and newly developed datasets
Modeling framework

FAMOUS

Temperature
Precipitation
Radiation
CO₂

Surface wind

3-D fields;
Wind
Temperature
Precipitation
Humidity, etc

LPJ-SPITFIRE DGVM
Vegetation cover
Surface roughness
Soil moisture

Dust Emission
Scheme

TOMCAT (or within FAMOUS)
Dust transport and deposition (wet and dry)

Preferential dust source regions, Soil texture

Dust distributions

Radiative + biogeochemical effects
couple synchronously or asynchronously?

Jones et al., 2005, Thonicke in prep, Tegen et al., 2002, Chipperfield and Simon 1996
FAMOUS

• FAmet Met Office/UK Universities Simulator

• A low resolution version of HadCM3, which is a coupled general circulation model (AOGCM)

• Atmospheric resolution is 7.5° x 5.0° x 11 levels

• Ocean resolution is 3.75° x 2.5° x 20 levels (same as HadCM3L)

• Reported to do reasonable jobs compared with higher resolution models but known to have some biases such as underestimates of storm track intensity

• Computes radiative transfer and transport of spices

• Will be coupled with atmospheric and marine biogeochemical components

• See Jones et al. (2005) in Climate Dynamics 25 for details
More details and very preliminary results

Please come to the poster session and find out! Feedbacks will be appreciated!!!