Global climate change and the Quaternary

Outline

• Review the big picture of global climate change
  • Oceans
  • Glaciers
  • Land
• Drivers of change
  • Possibilities
  • Supporting evidence
What is the Quaternary?

• Since at least the nineteenth century, different groups of geologists have used conflicting terms to describe the recent past. Some simply describe the past 23 million years as the Neogene period. But others invoke an extra period — the Quaternary — which follows the Neogene and began around 2 million years ago.

• The last 2.588 million years
What is the Quaternary?

• Since at least the nineteenth century, different groups of geologists have used conflicting terms to describe the recent past. Some simply describe the past 23 million years as the Neogene period. But others invoke an extra period — the Quaternary — which follows the Neogene and began around 2 million years ago.

• The last 2.588 million years...
Why is it so significant?
The Big Picture of Glaciation

Proxy data from ice cores in Antarctica

Chinese loess

Four Climatic Cycles: Climate Records Over the Last 400,000 Years

Paleoclimate, Global Change and the Future
Alverson, Bradley and Pederson eds., 2002
Chapter 2: D. Raynaud et al., fig. 2.2, p. 19
Glacials/Interglacials
Oxygen Isotope Stages
Glaciation in Australia

Regional map showing the extent of glaciation and the coastline in Tasmania during the LGM (from Barrows et al. 2002).

The distribution of periglacial landforms provide good constraints on temperature change.

- 8-10 °C in E Australia (29-37 °S)
- 8-9 °C in SE Australia (37-40 °S)
- 5-7 °C in Tasmania (40-44 °S)
Sea Level Changes Over Four Glacial Cycles

- Coral reef estimates
- Rohling [1998]
- Waelbroeck et al. [prep]
- Error +, m
- Error -, m
- Shackleton [2000]
Evidence from the Land

**EXTENT OF RAINFOREST**

![Map showing the extent of rainforests](image)

**PRESENT**

- Tropical rainforest
- Pacific Ocean
- Banda Sea
- Indian Ocean

**LAST GLACIAL MAXIMUM**

- Tropical rainforest
- Pacific Ocean
- Indian Ocean
Milankovitch cycles influence climate change at larger time scales.
Lake Eyre Basin
Lake Eyre record of lake level, lake area, and lake volume as proxy for Australian monsoon over past 150 k.y.

Playa-floor deflation events, indicative of significant aridity and therefore reduced Australian monsoon

Comparison to sea level and solar insolation

High lake levels = low southern hemisphere insolation
=> Lower evaporation and/or stronger monsoon
The Peopling of New Guinea
New Guinea

Savannah

Altitude above present sea level (X1000 m)
New Guinea

Lowland Rainforest

Altitude above present sea level (X1000 m)
New Guinea

Nival Zone

Altitude above present sea level (X1000 m)
Palaeoecology of Tropical Rainforests

Last Glacial Maximum

- Tree line
- Snow
- TFG
- UMF
- LMF
- LR/S

Late Holocene

- Tree line
- Snow
- ?

Altitude above present sea level (X1000 m)
Pollen Records from the Highlands of New Guinea

Tari Basin pollen record (Haberle 1998)
Case Study....
Tropical Rain Forest of Northern Australia

• The rainforest vegetation includes mixtures with sclerophyll tree species that occur as emergent and co-dominant species in the canopy. Fringing the rainforests are areas of tall, open forest and tall, medium and low woodland.

• The palaeoecological record is from Lynch’s Crater, an ancient crater lake at 730 masl near the boundary of sub-montane rainforest and sclerophyll woodland.
Tropical Rain Forest of Northern Australia

38-6ka:
• Schlerophyll Woodland-
  loss of Araucaria

75-38ka:
• Mosiac Schlerophyll Woodland-
  Cool Sub-Montane Rain Forest

130-75ka:
• Mosiac Schlerophyll Woodland-
  Warm Sub-Montane Rain Forest