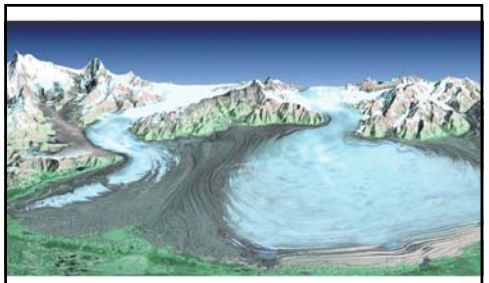
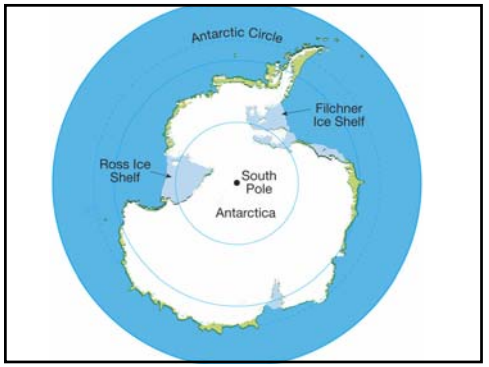
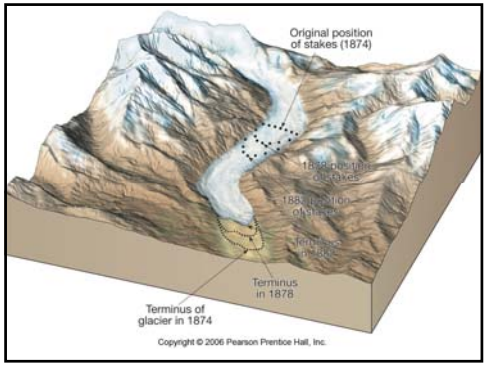
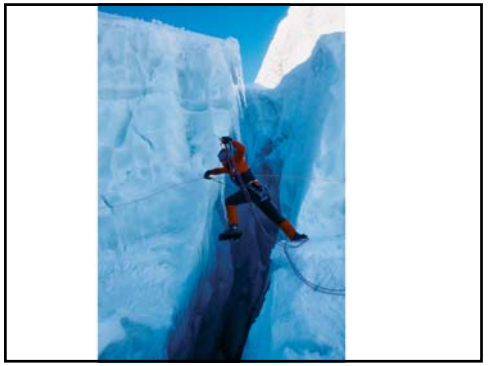
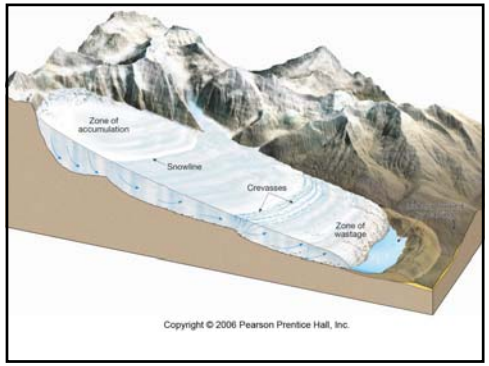


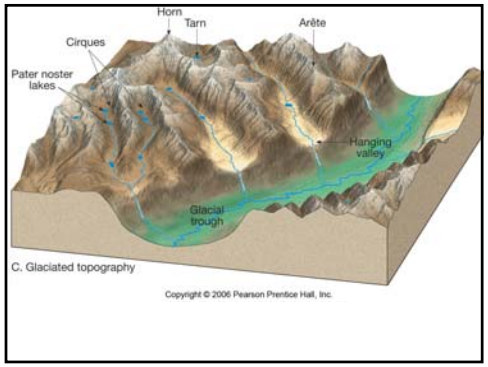
- Malaspina Glacier, Alaska










Horn
Tarn
Arête
Cirques
Pater noster lakes
Hanging valley
Glacial trough
C. Glaciated topography
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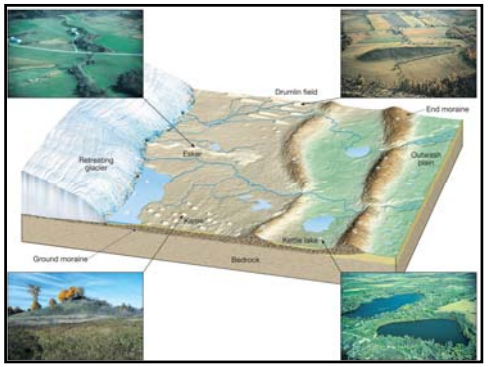
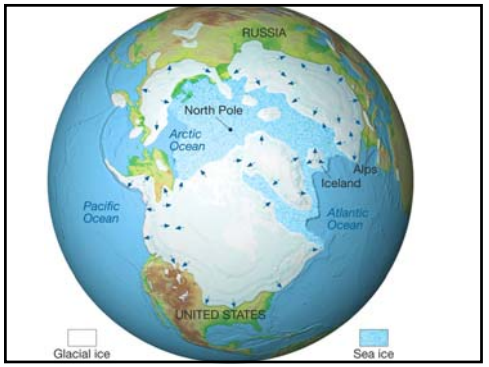
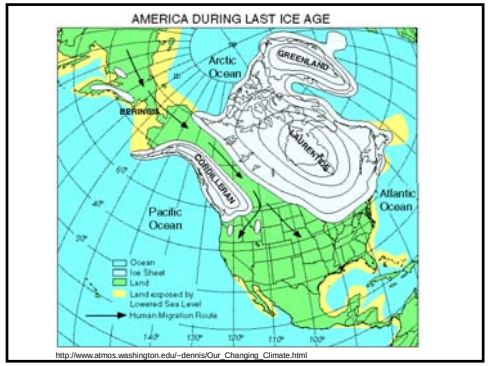
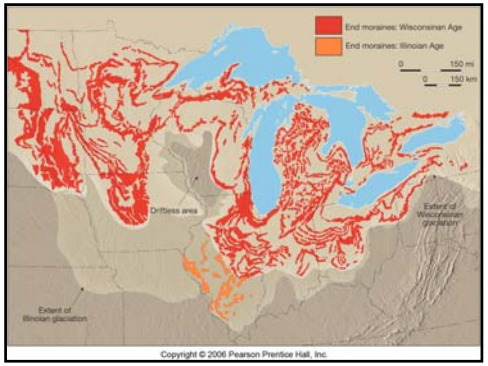
Hanging valley

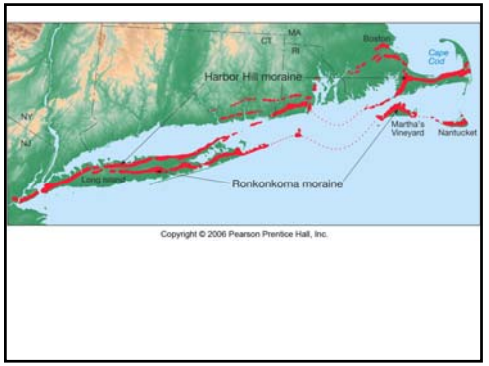

http://jesse.usra.edu/articles/iceagemodule/iceagemodule-paper.html

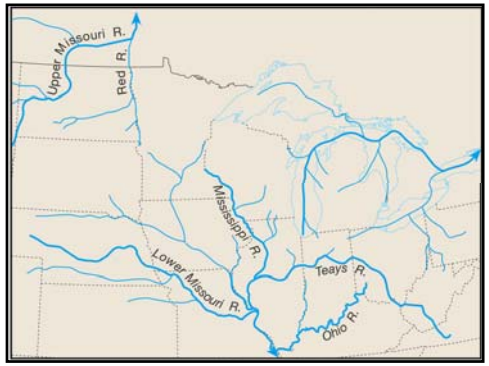












- Deranged drainage after ice melts

Pluvial Lakes of Southwest

Past Glacial Ages

- Pliocene-Pleistocene
  - Ice in Antarctica starting about 40 m.y.a.
  - Widespread N. Hemisphere ice about 3 mya
  - Advances every 40,000 to 100,000 years
- Karoo Ice Ages
  - 260 to 350 mya
  - Lasted 90 million years
  - Wegener's evidence of continental movement

Location of 300 MY Continental Glaciation

Location of 300 MY Continental Glaciation with continents located 300 mya

Past Glacial Ages

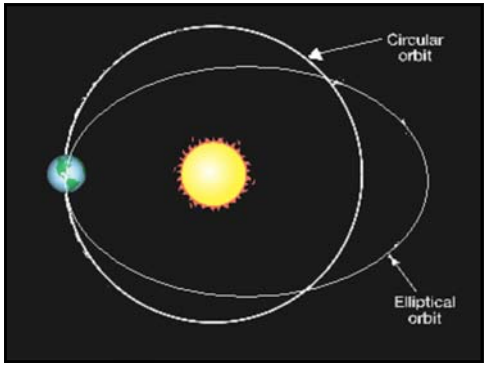
- Andean-Saharan Ice Ages
  - 430 to 460 mya
  - Lasted 30 million years
- Cryogenian
  - 630 to 850 mya
  - Lasted 200 million years
  - Periods of all Earth covered with glacier
- Huronian
  - Over 2 billion years ago
  - Lasted 300 to 400 million years

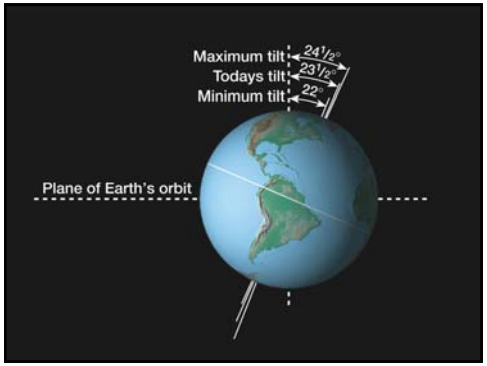
Documentation

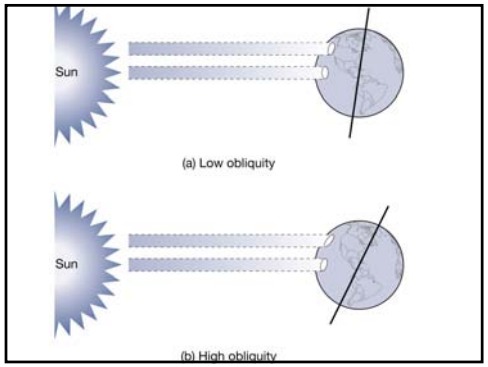
- Drift
- Loess and marine deposits
- Oxygen isotope ratio in shells
- Air trapped in ice—CO_2 levels

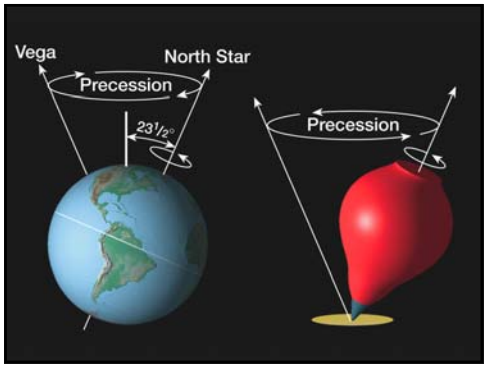
Causes

- Land mass configuration
  - High latitude land mass—Antarctica
  - High elevation in westerlies—Andes, Cascades
- Coincidence of astronomical variations of Earth in relation to Sun
  - Orbit shape: eccentricity
  - Axial tilt amount: obliquity
  - Tilt direction superimposed on orbit shape: progression of the equinox
- CO_2 levels—may be effect and not cause

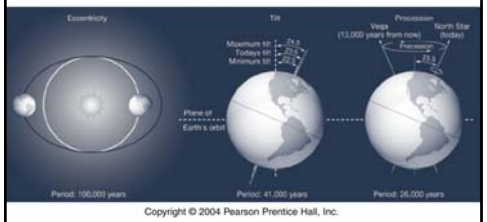






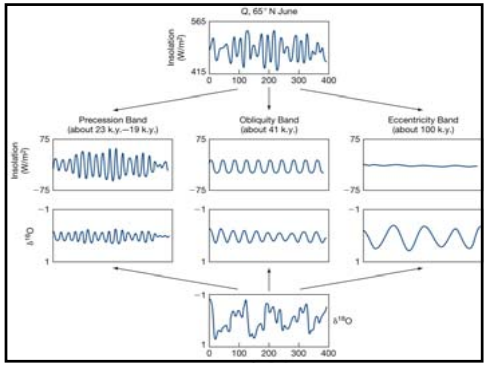


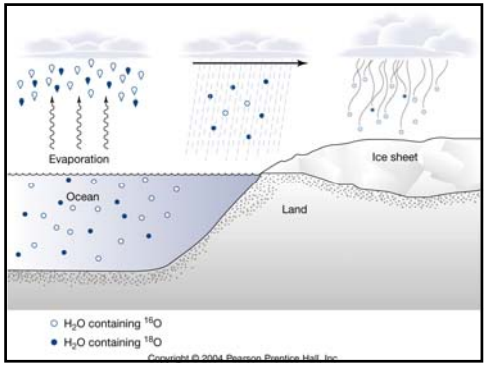
Milankovitch cycles



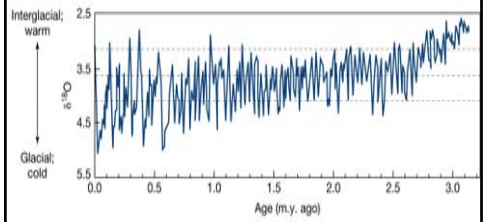
- Link to a lovely explanation of these cycles

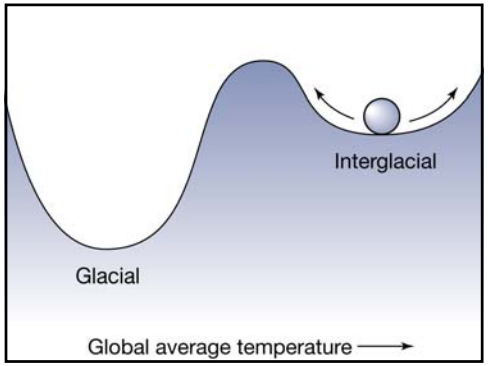
http://skepticsplay.blogspot.com/2008/12/axial-tilt-milankovitch-cycles.html





Temperature record from O-18

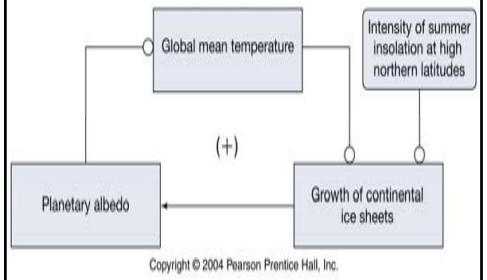




Positive Climate Feedback Loops

- Ice albedo decreases temperature, increases ice. Reduced ice increases temperature

Ice-albedo feedback loop

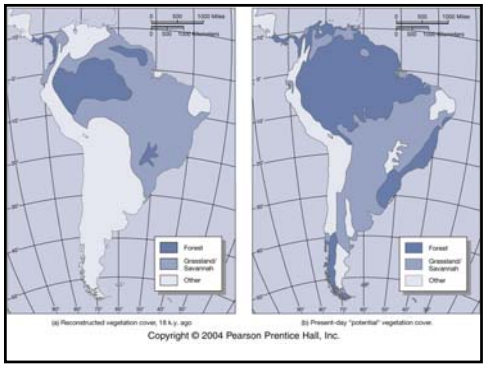


Positive Climate Feedback Loops

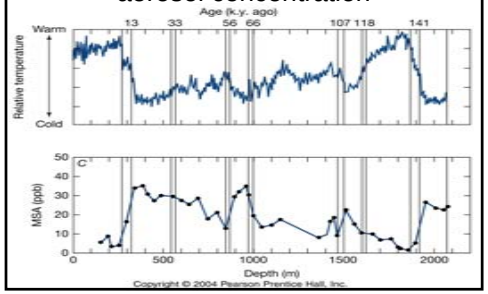
- Ice albedo decreases temperature, increases ice. Reduced ice increases temperature
- Glacial periods result in larger arid areas, increasing delivery of iron nutrients to sea, increasing algae productivity, lowering CO_2 levels, and temperature
- Lowering sea level will expose reefs to weathering. Reaction consumes CO_2 , lowering temperature. Rising sea level has opposite effect: reef preserved, does not consume CO_2

Negative Climate Feedback Loop

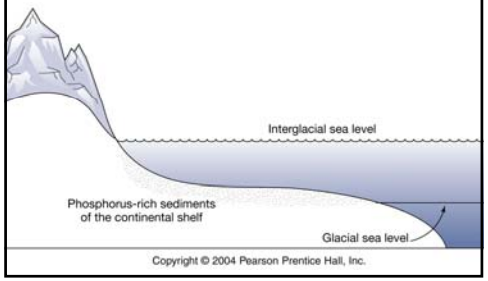
- Forest die out during glacial ages, reducing mechanism to remove CO_2 from atmosphere, increasing CO_2, allowing temperature to increase



Temperature compared to sulfur aerosol concentration



Nutrients related to sea level change



Nutrient cycle