

The Ice Ages

- The Ice Ages lasted 2.7 Myr BP to about 10,000 yrs ago

- Large Ice sheets covered Northwestern Europe and Northern North America
- Due to orbitally induced changes in northern hemisphere summer insolation
 - Ice volume changes are coordinated with CO₂ changes (shift of carbon between atmosphere and oceans)

Geologic Evidence For the Ice Ages

- Moraines, erratics, pollen records, etc
- Ocean sediments
 - Oxygen Isotopes in shells of organism in deep sea provide evidence of glacial ice amount
 - Waxing and waning of ice corresponds to changes in insolation (orbit around sun)
- Ice core records
 - Oxygen isotopes record local temperature
 - Air bubbles provide record of CO₂ and other gases
 - Remarkable correlation between local temperature and CO₂
- Cause of glacial cycles
 - Trigger involves changes in summer insolation in northern hemisphere due to orbital changes
 - Ice-albedo and water vapor feedbacks are important
 - CO₂ is coordinated with the changes in ice volume, but it is a minor feedback to the Ice Ages (mainly responsible for SH cooling)

Evidence of Glaciations: Moraines



Tasman Glacier, NZ

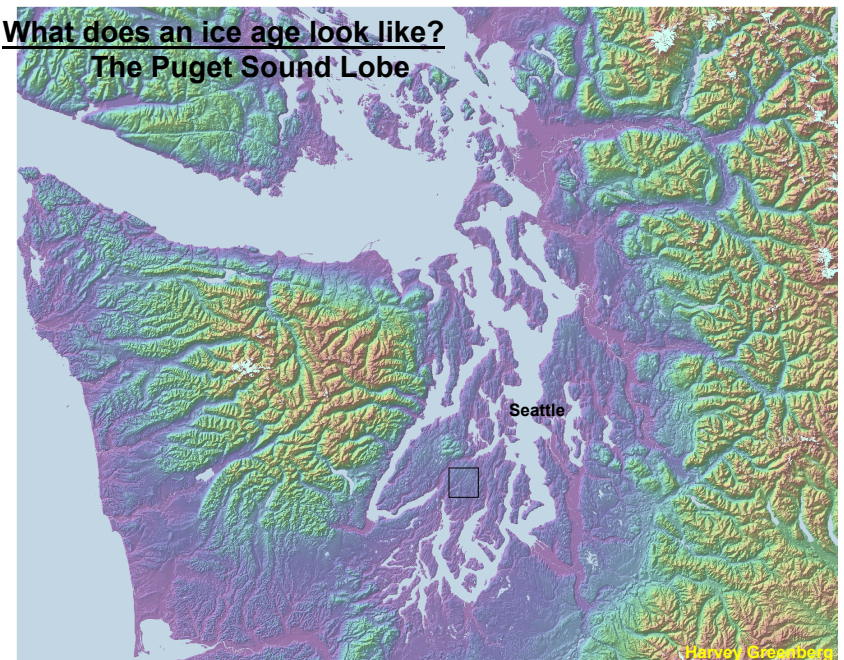


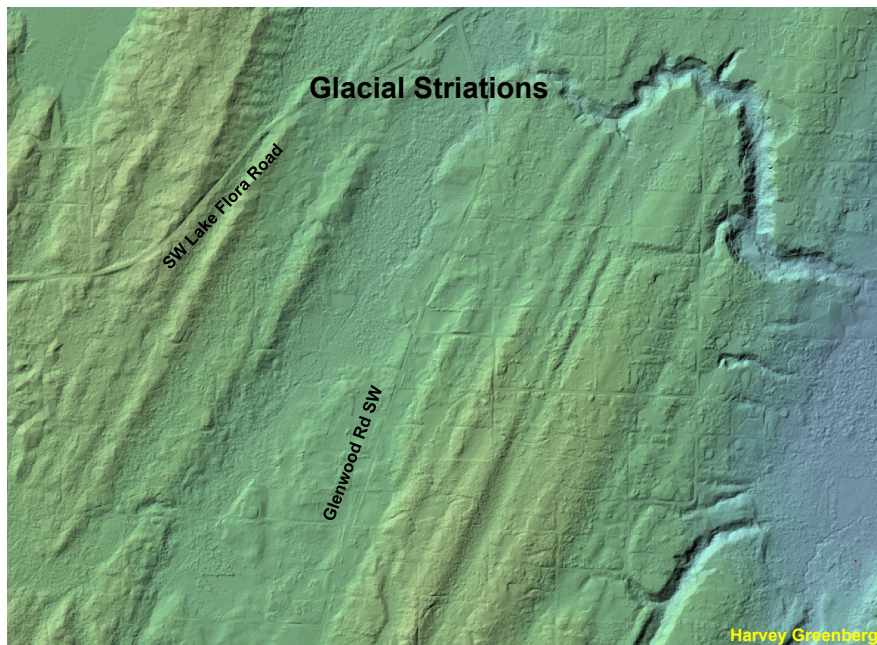
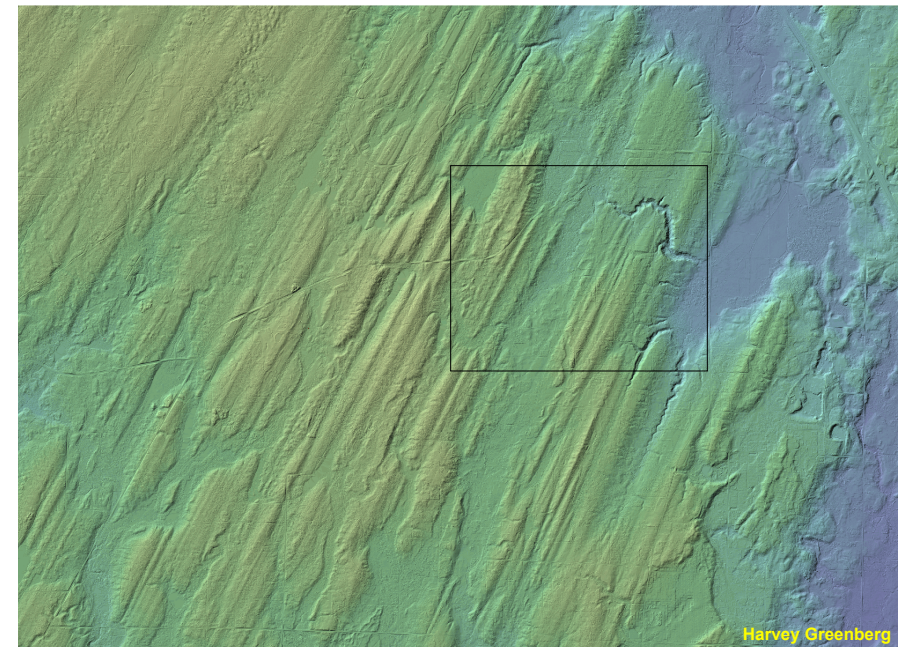
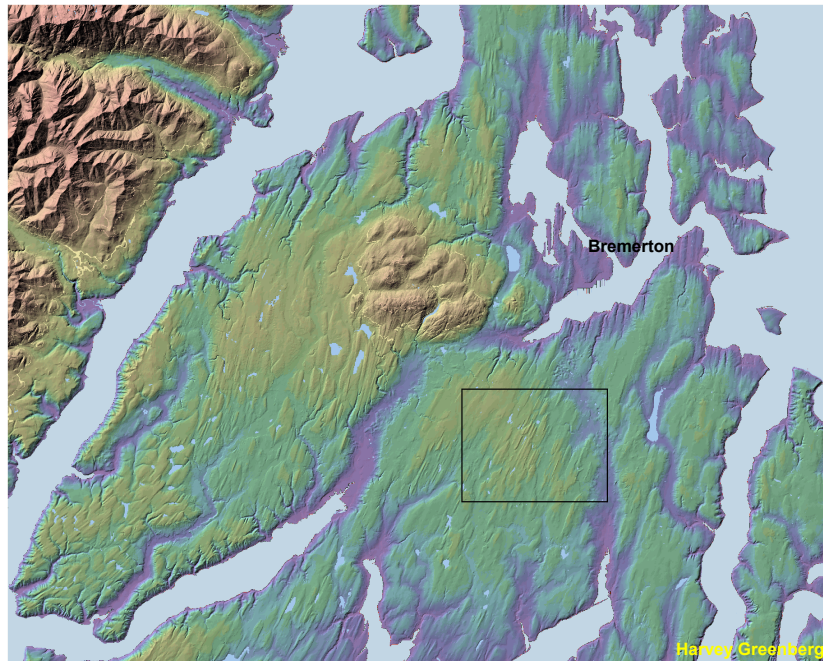
Mueller Glacier, NZ

Moraines and erratics can be dated

What does an ice age look like?

The Puget Sound Lobe

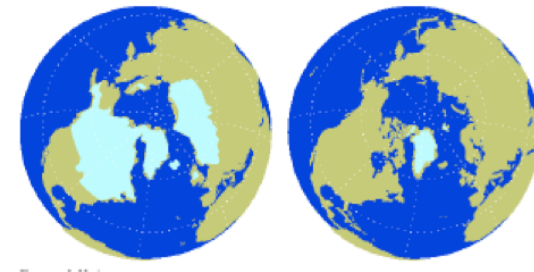




What does an ice age look like?

Last Glacial Maximum Conditions

- Ice sheet extent:
 - Over Canada, this ice sheet was up to 5 km thick
 - Global sea level was **125 meters lower** than today!
 - Greenland 25°C colder, tropics 4°C colder



Last Glacial Maximum

Present