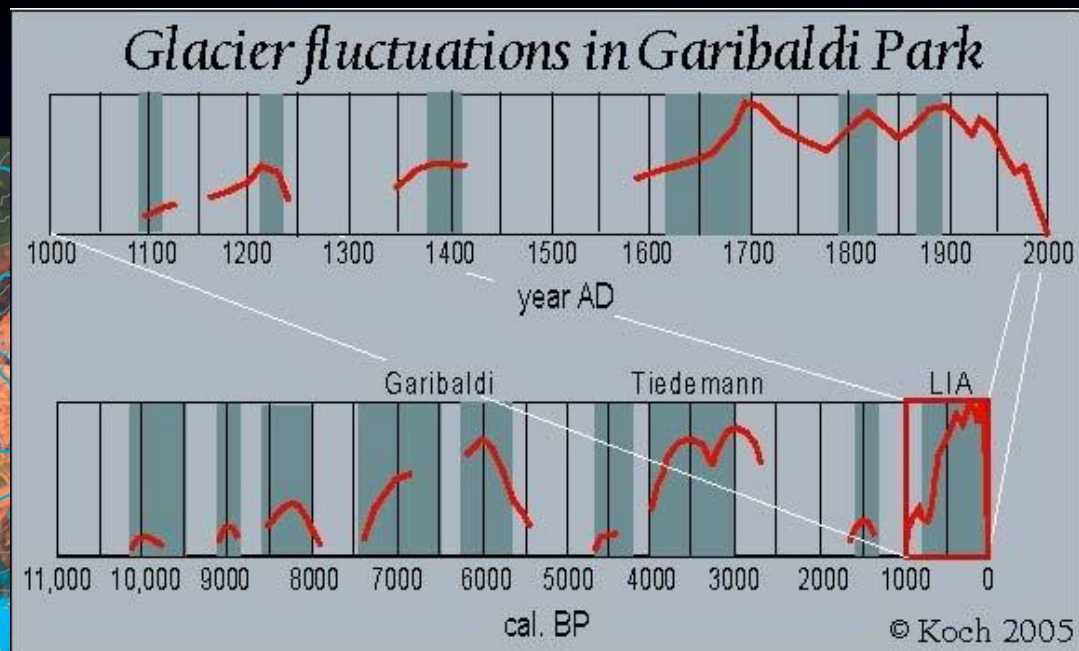
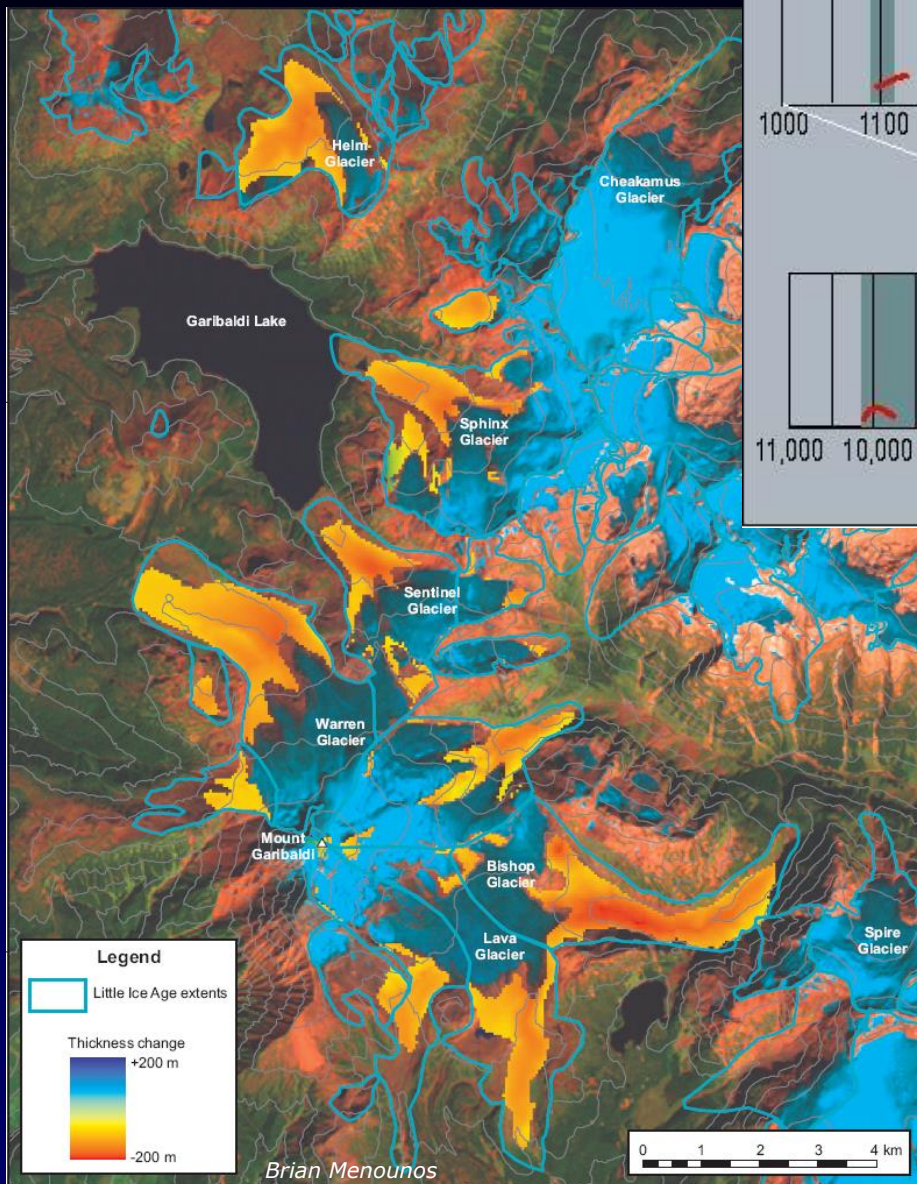


Dating Alpine Glacial Events _ An Epistle in Recognition of the 'Pope'

Pax vobiscum



**John J. Clague,
Centre for Natural Hazard Research
Simon Fraser University**



Methods of dating glacier advance and retreat

- **Tree rings**
- **Radiocarbon ages**
- **Surface exposure ages (commonly ^{10}Be)**

Methods of dating glacier advance and retreat

- **Tree rings**
- **Radiocarbon ages**
- **Surface exposure ages (commonly ^{10}Be)**

However....

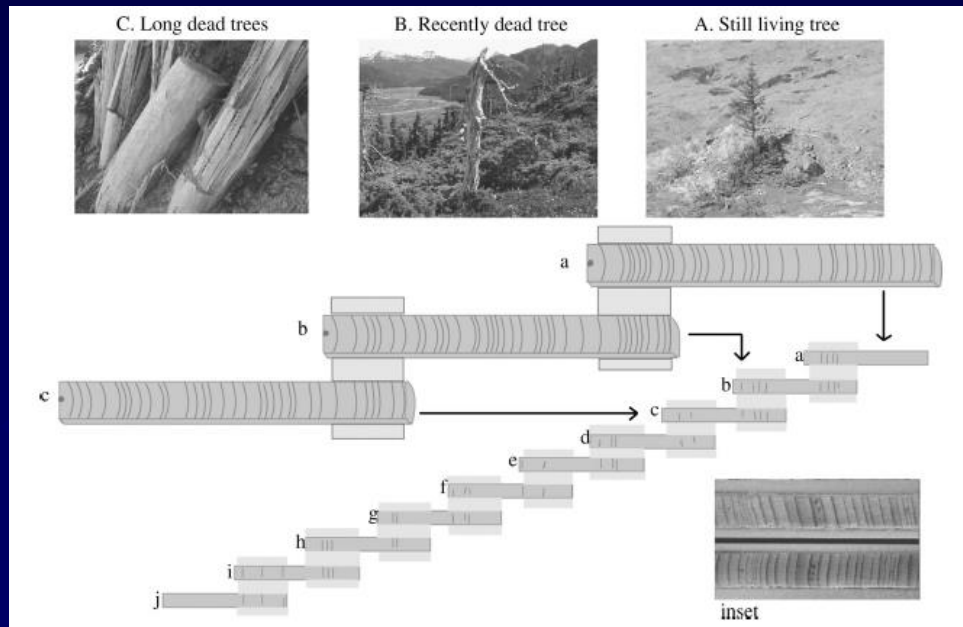
... these methods date different phases of a glacier's advance and retreat

As a consequence, the dates are not directly comparable

Tree rings



Alberto Reyes



Greg Wiles

Tree rings



Dates time glacier advanced past this point



Dates time glacier reached its recent maximum limit



Radiocarbon ages -

Plant remains in growth position in glacier forefield

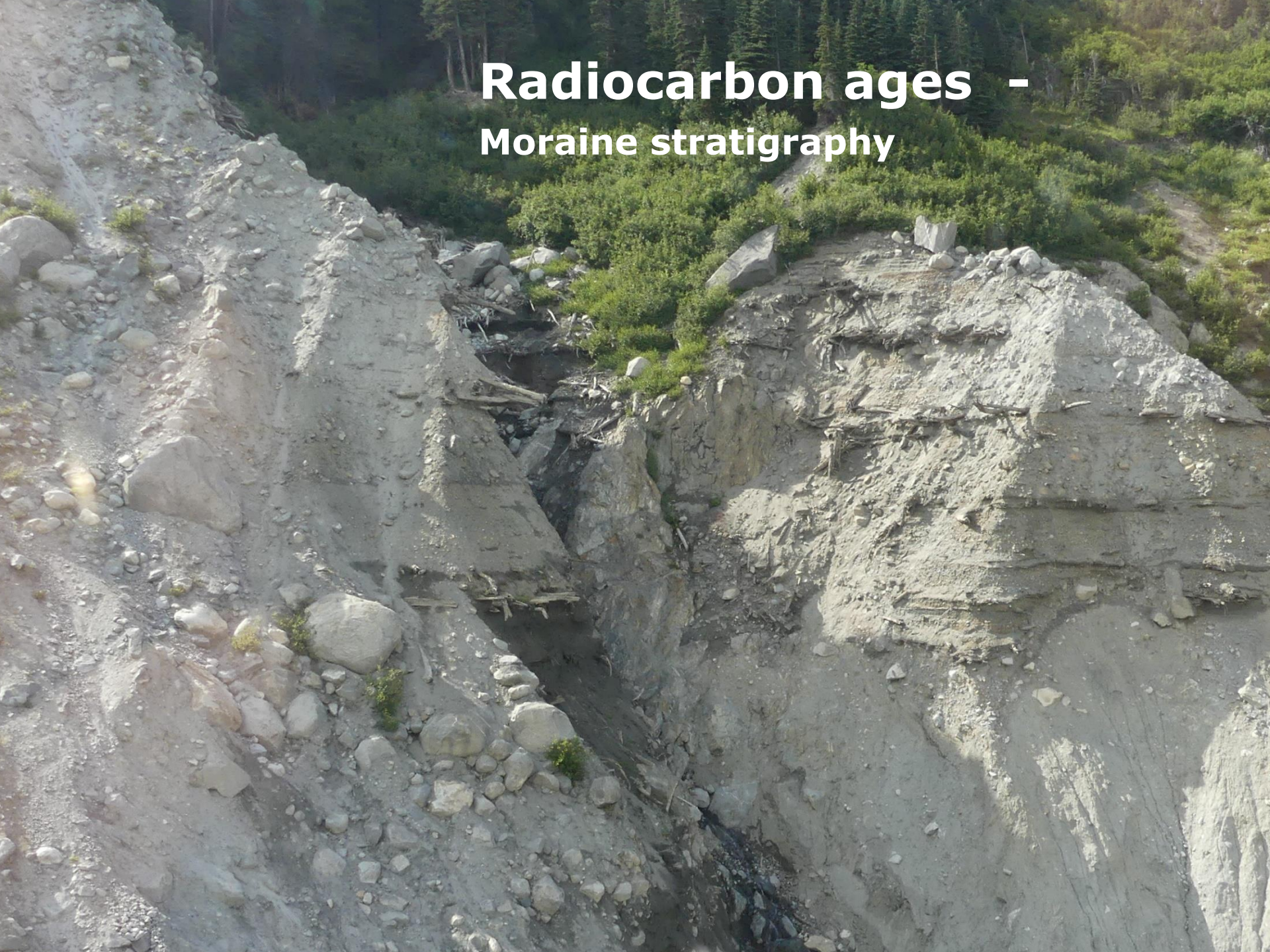


Dates time glacier advanced past this point

However, radiocarbon ages have inherent and unavoidable laboratory uncertainties

And the uncertainties commonly become larger with calibration

Radiocarbon ages - Moraine stratigraphy



In-situ plant remains

Time that glacier thickened to the elevation of the dated sample






**Detrital plant
remains:**

Maximum age for time
glacier thickened to
elevation of dated sample

***Again, all radiocarbon ages have
inherent and unavoidable laboratory
uncertainties***

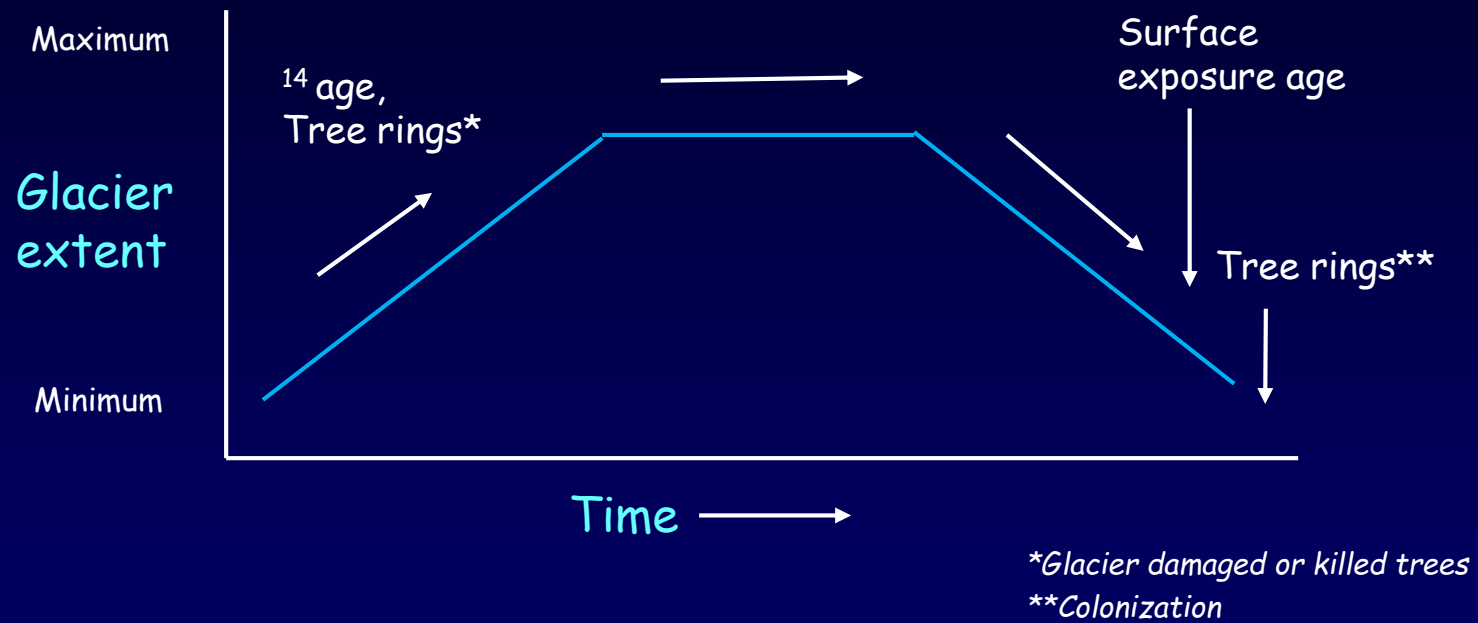
Surface exposure ages



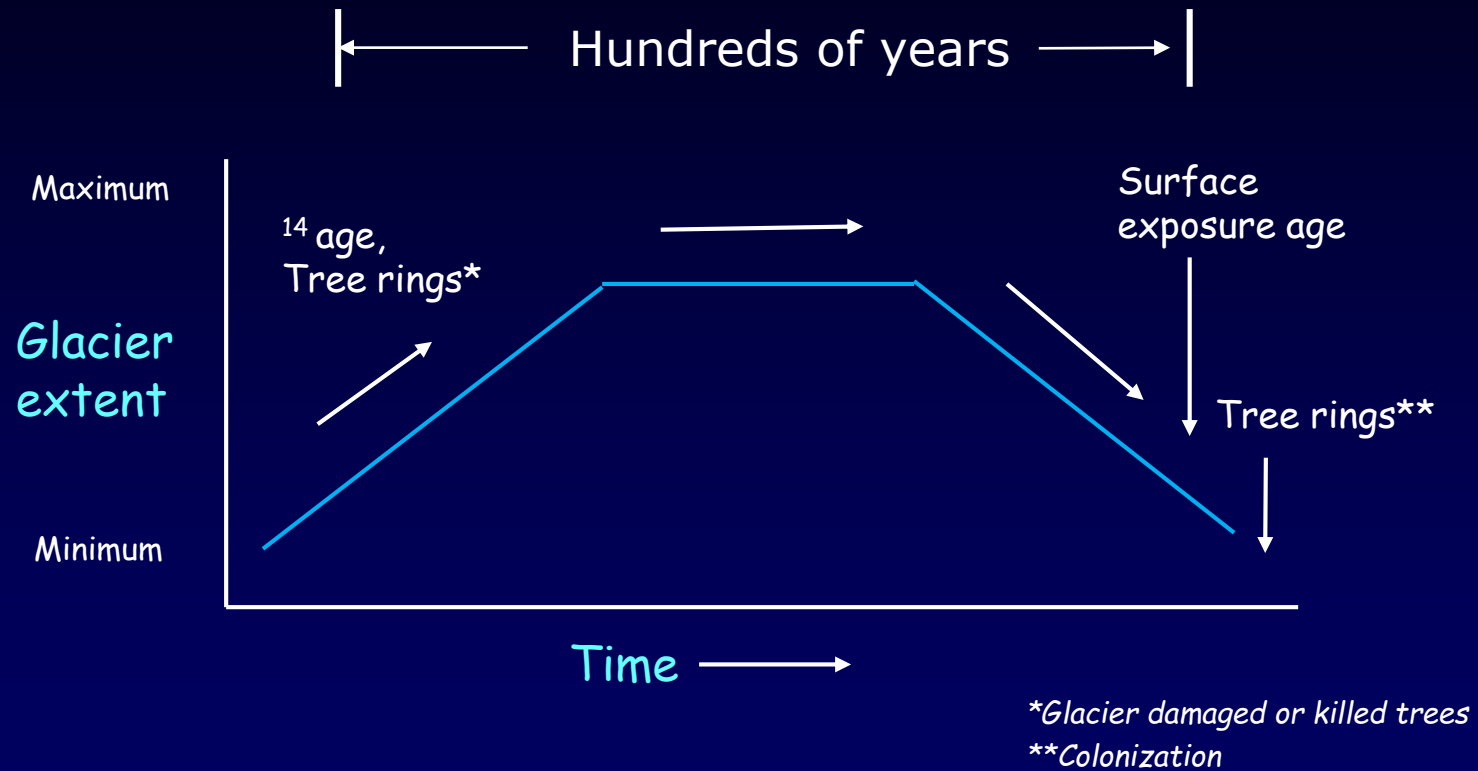
Boulders on moraine:
Time moraine **became stable** (i.e. after moraine formed and the glacier retreated from it)



Surface exposure ages have uncertainties equal to or larger than radiocarbon ages



How much time might separate these dates?





The End of the Papal Epistle