^{10}Be in the South Pole Ice Core

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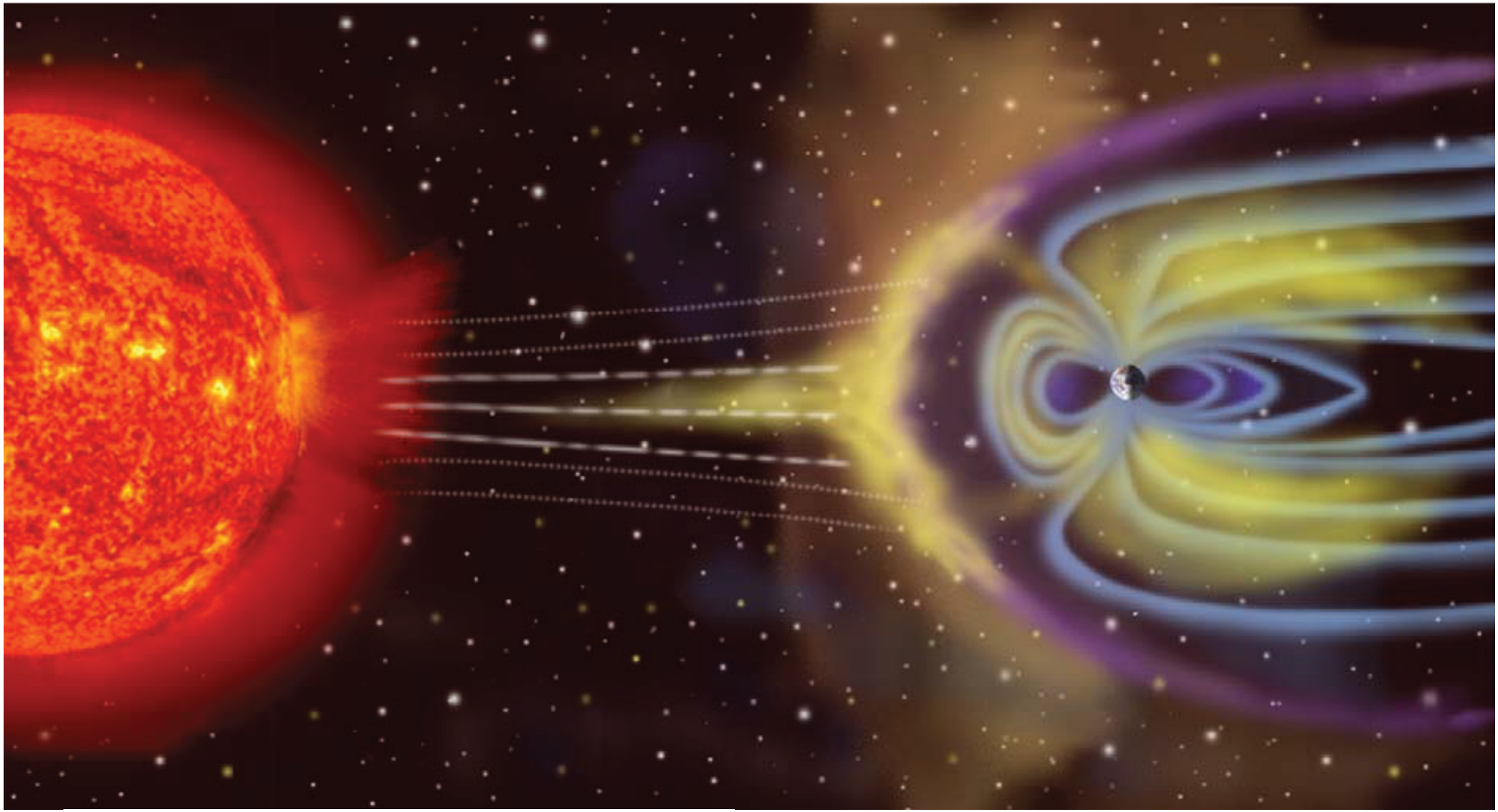
1: Lamont/Columbia University; 2: UC Santa Barbara; 3: UW Seattle; 4: LLNL



NASA http://sec.gsfc.nasa.gov/popscise.jpg

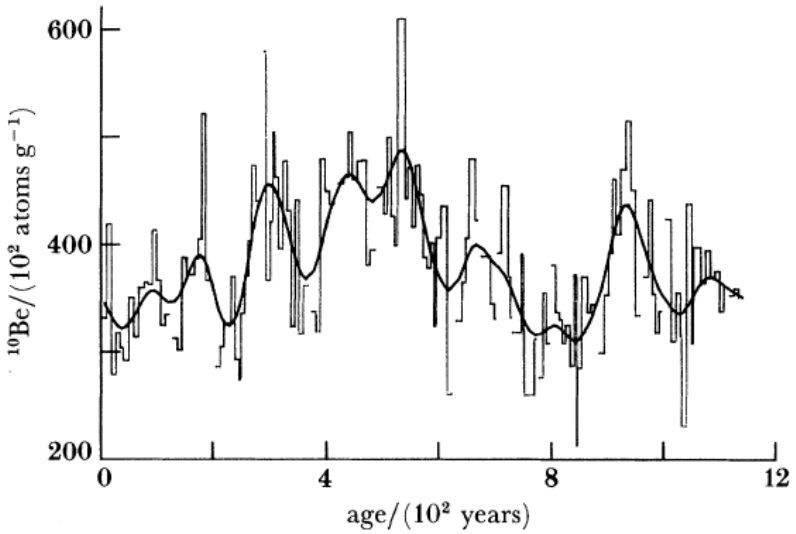
Why South Pole ^{10}Be now?

^{10}Be in South Pole snow good measure for 10Be production → solar irradiance

1990 South Pole ^{10}Be record has become reference record for climate models

Ice clean, aerosols don't interfer with analytics

Making use of recent geochemical-analytical advances in ^{10}Be measurement

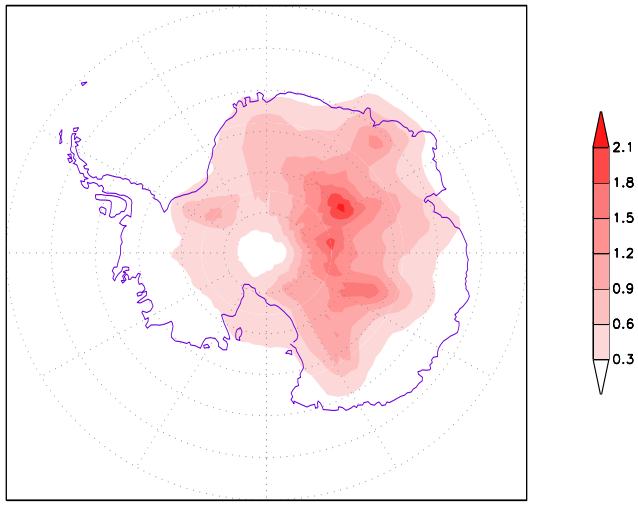


Raisbeck et al., 1990

ECHAM5-HAM is forced by observed SST/sea ice (1950- 2015) but constant ^{10}Be production rate

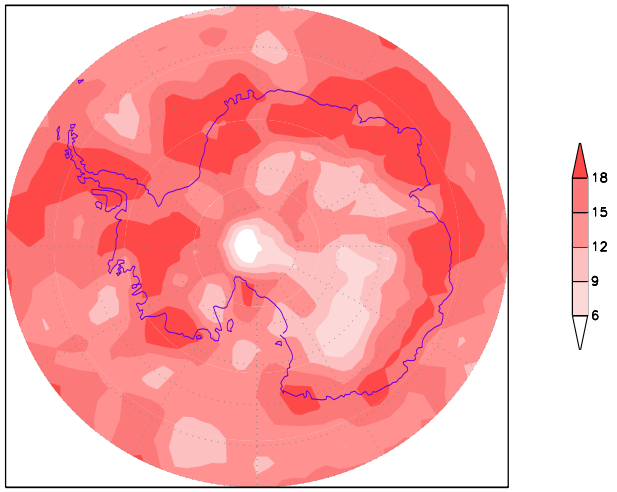
Examine the sensitivity of ^{10}Be concentration to large scale climate

Variance of ^{10}Be concentration



at/g ×10^4

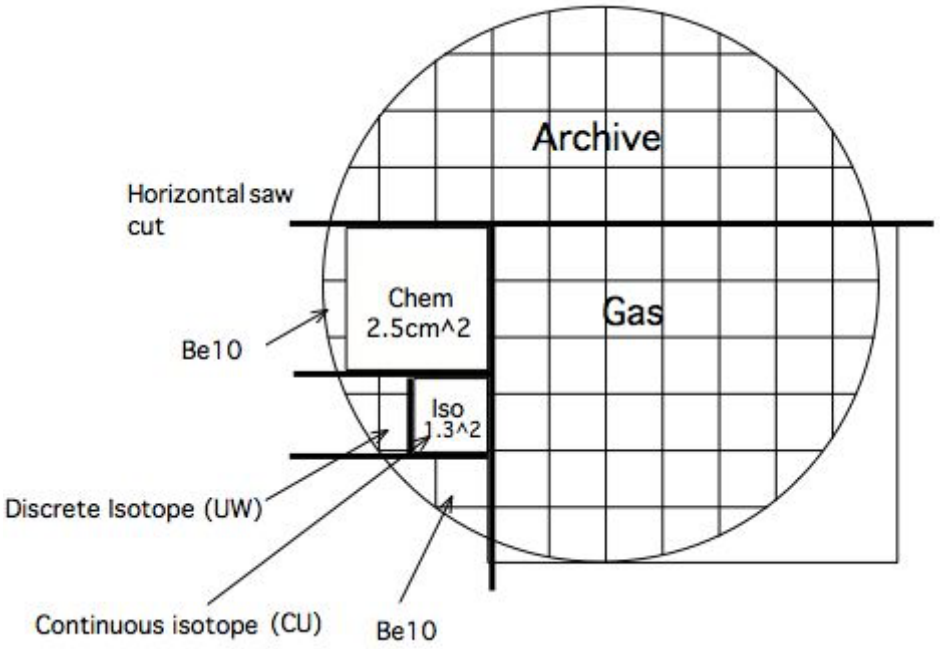
Variance of ^{10}Be flux



at/m^2 /s

^{10}Be flux and concentration are very sensitive to larger scale climate almost everywhere in the Antarctic (except the South Pole)

How much ice do we need for ^{10}Be measurements from ice cores?



^{10}Be concentration at South Pole
~3-10 x 10^4 ^{10}Be at/g

Blank levels: ~5000 ± 3000 at

→ 10 g of ice enough

At 10 ka: annual layer ~ 5 cm thick

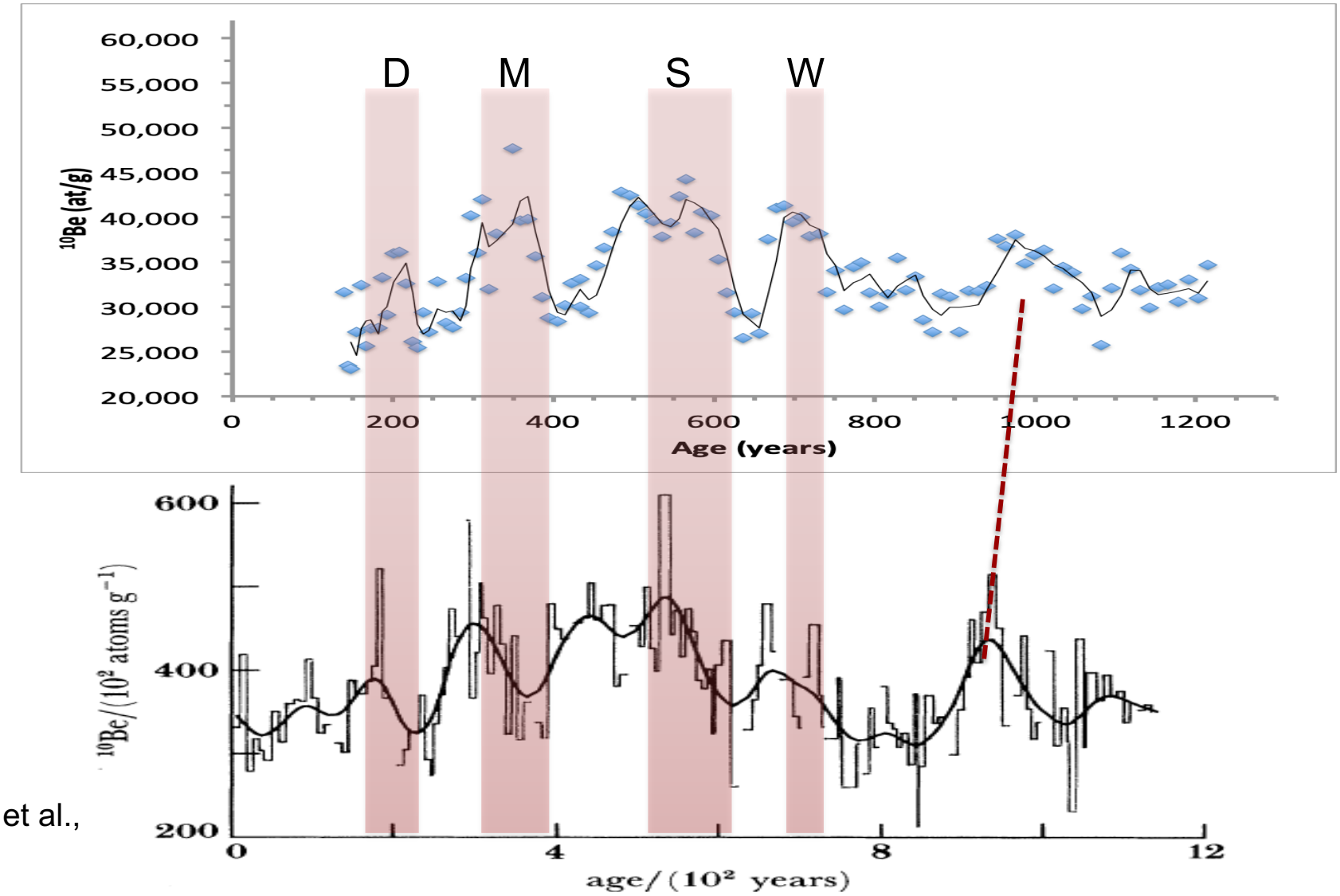
→ annual resolution possible!

SPICE ^{10}Be - Method

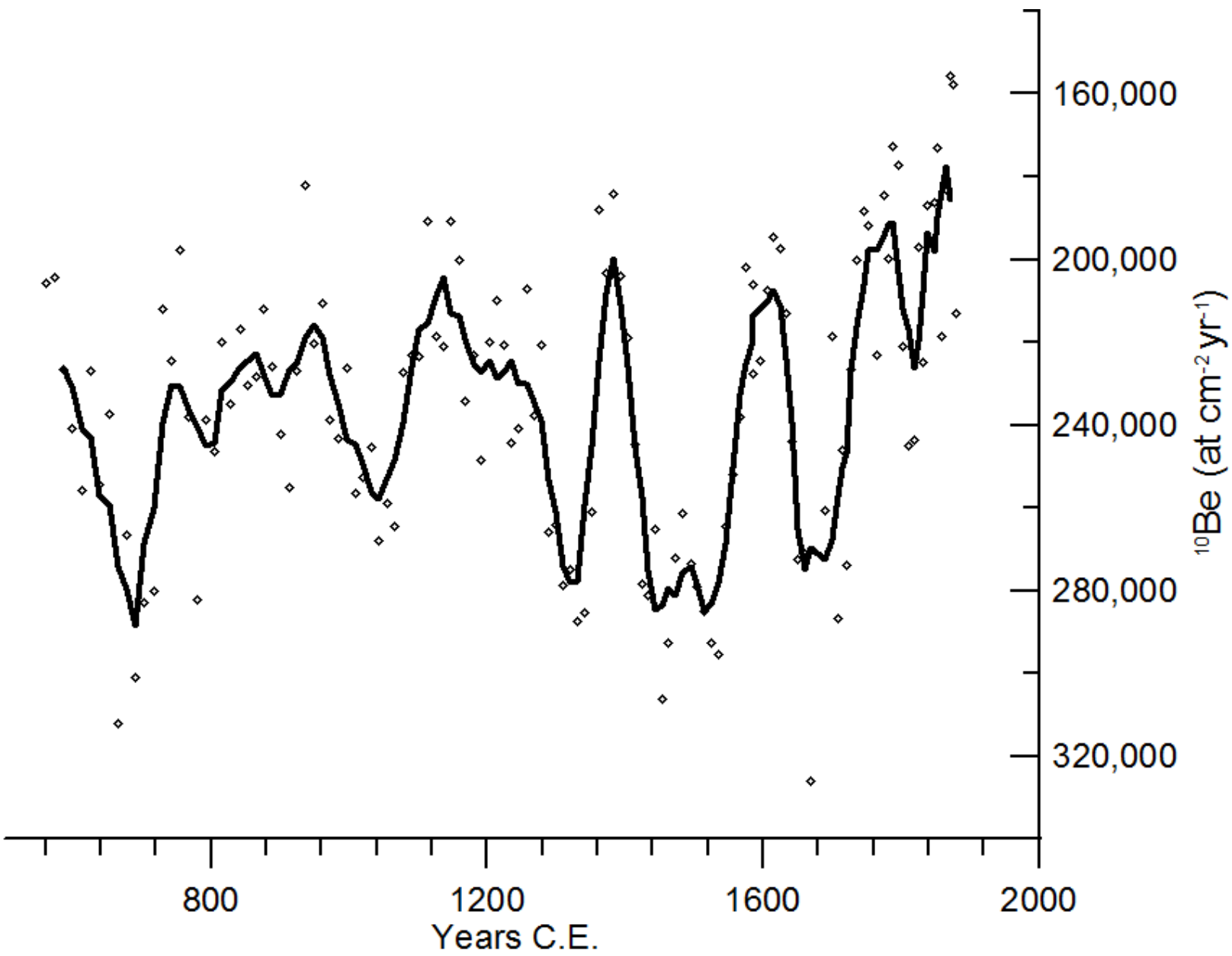
- Decontaminate ice sample by melting outer 30-50%
- ^{9}Be spike added to melted 'inner samples' (we use between 20 - 100 g ice, can further reduces this by a factor of 2-3)
- SPICE ice clean enough that no column chemistry needed,
  Be-hydroxide precipitation,
  followed by conversion to BeO (baking) → fast, low blanks!
- Total ^{10}Be atoms in SPICE core measurements are 2 to 3 orders of magnitude above blank levels

South Pole Ice Core - Last millennium Be-10 records

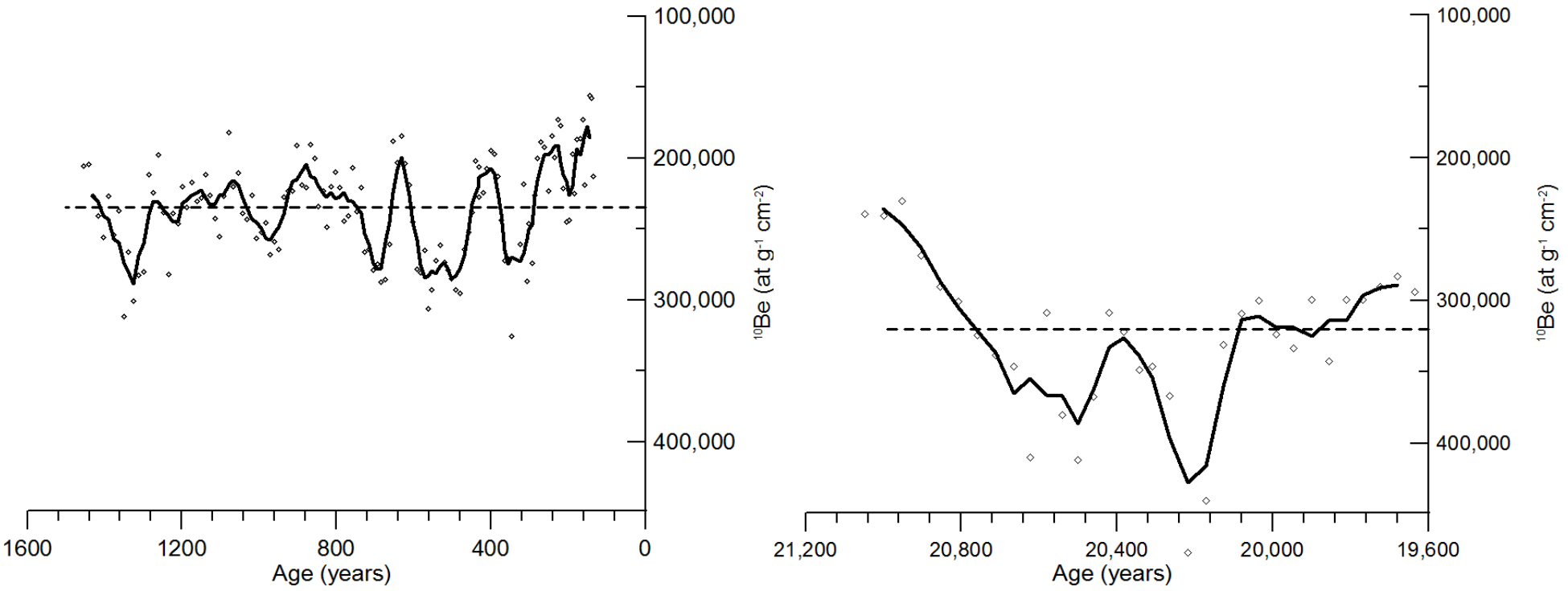
Red bars=solar minima; D=Dalton; M=Maunder; S=Spörer; W=Wolf



Raisbeck et al., 1990


^{10}Be flux
160,000
200,000
240,000
280,000
320,000
^{10}Be (at cm^{-2} yr^{-1})
800
1200
1600
2000
Years C.E.

Glacial – Interglacial, ^{10}Be flux



Preliminary Conclusions

- South Pole a prime location to record atmospheric 10Be production → Solar Irradiance1
- Excellent agreement between SPICE ^{10}Be measurements and Raisbeck at al (1990) ^{10}Be South Pole record → solar minima detected!
- Glacial ^{10}Be flux to South Pole slightly higher than Inter-glacial ^{10}Be flux
- Next 1: SPICE ^{10}Be extended at 1 m resolution back to 3000 BP
- Next 2: Annual resolution ^{10}Be measurements at selected intervals!
  11-year solar cycle visible and trackable through time?