Geography Course of Study
Professional Development

The Past and Future of Climate

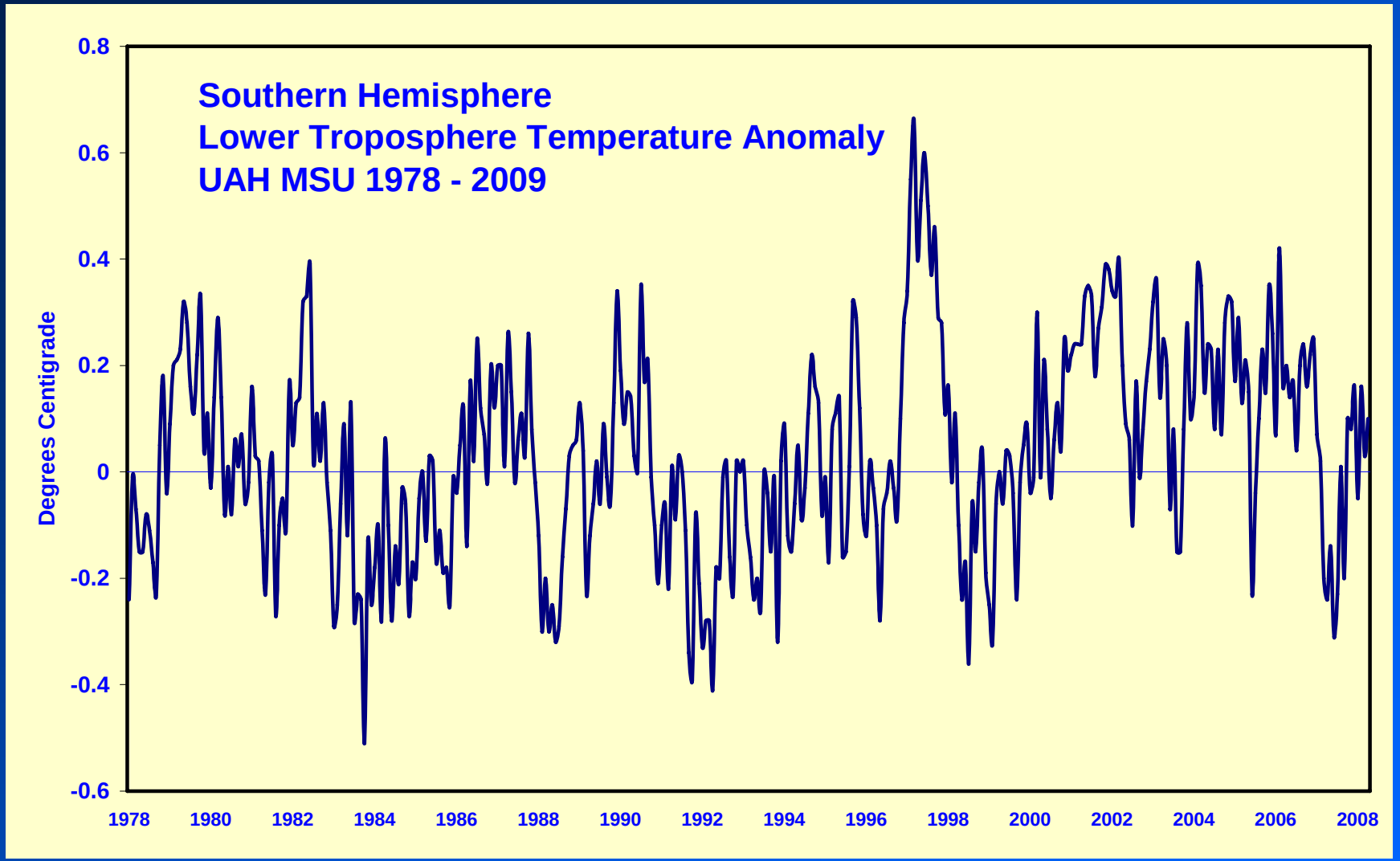
David Archibald

5th June 2009

Sections

- The Climate Record through Time
- The Solar Driver of Climate
- The Contribution of Carbon Dioxide
- The Benefit to Plant Growth
- Summary

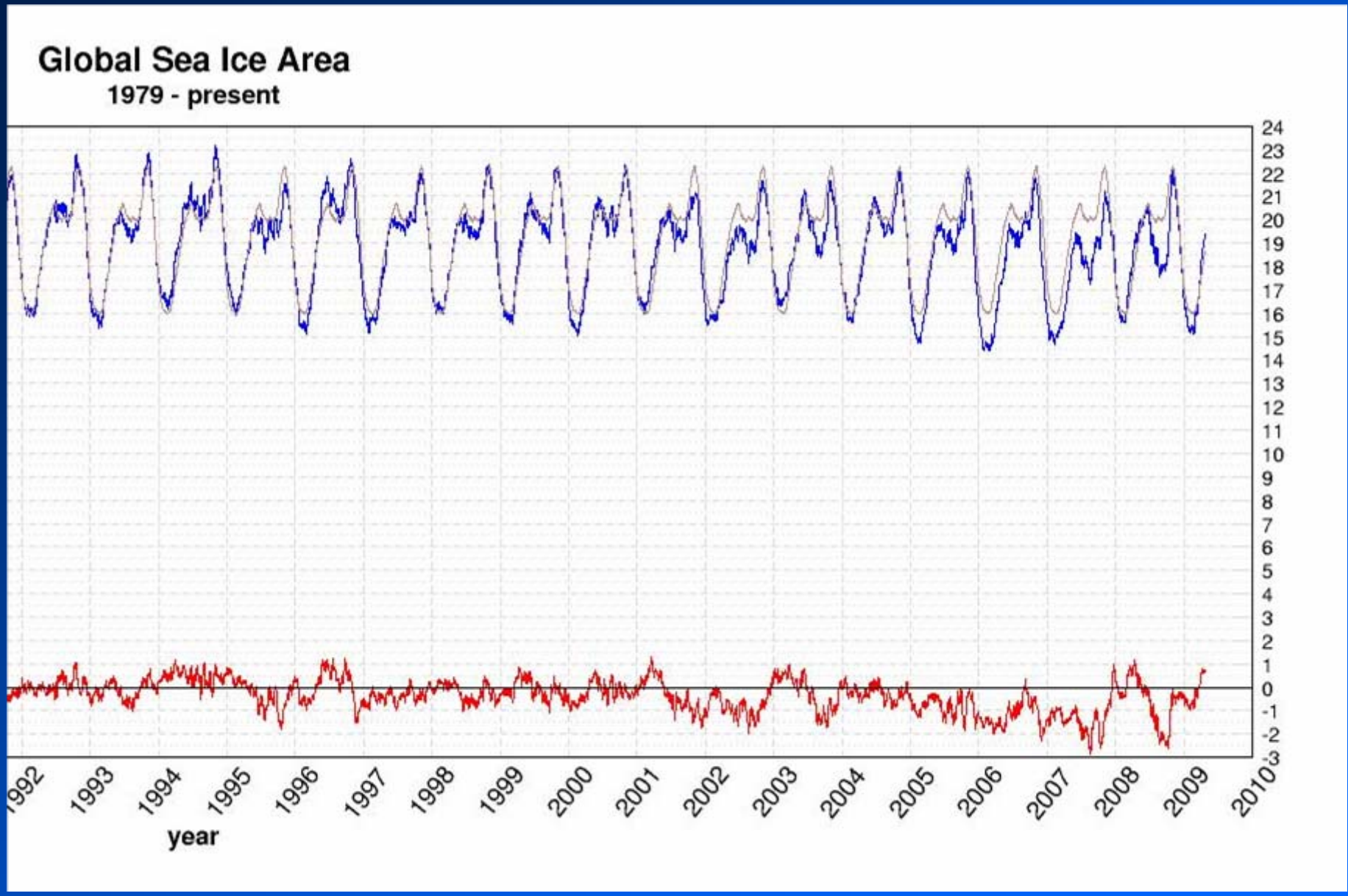
Section 1: The Climate Record



The 30 years of High Quality Satellite Data

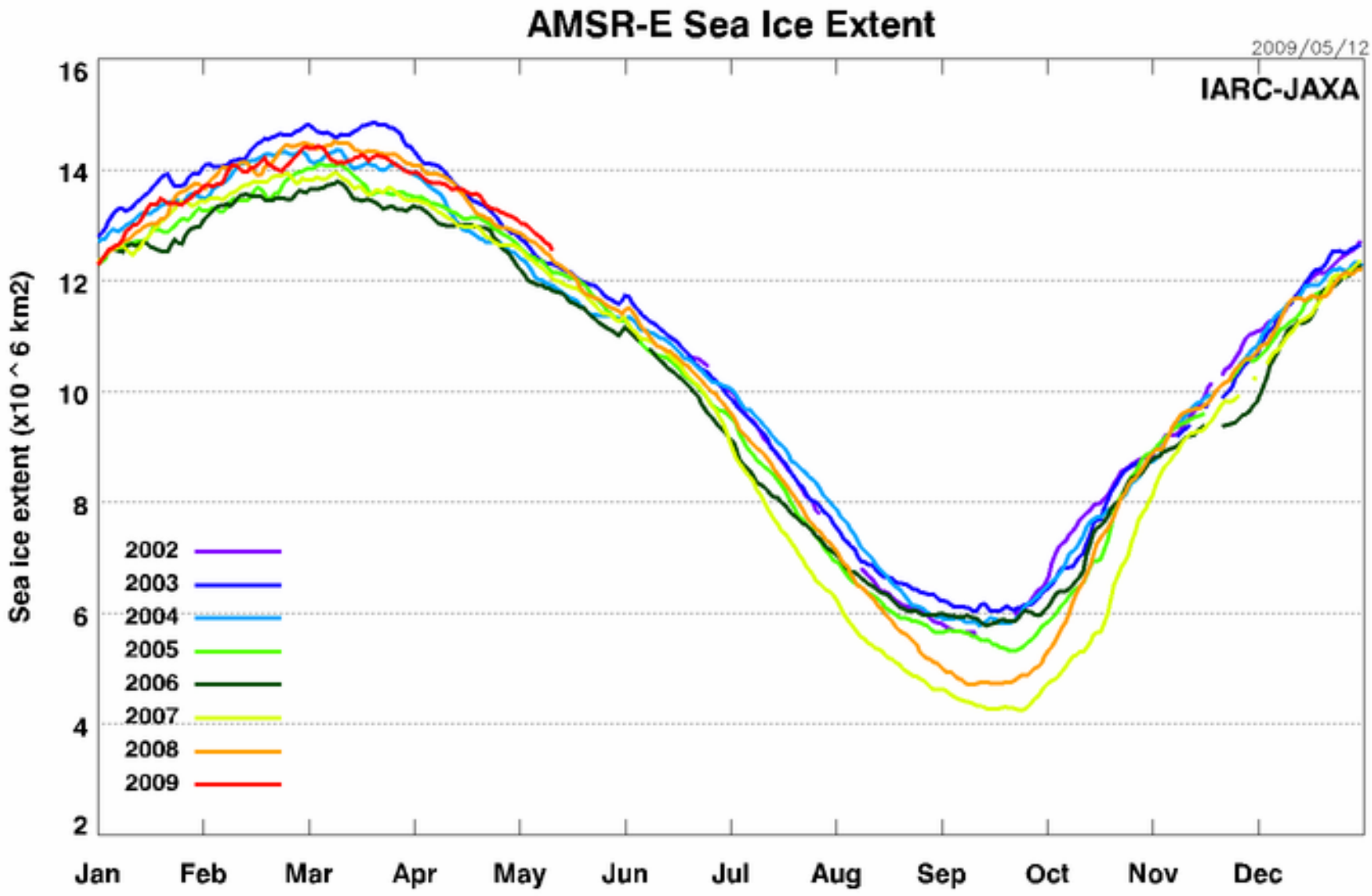
The Southern Hemisphere is the same temperature it was 30 years ago, the Northern Hemisphere has warmed slightly.

Global Sea Ice Area is above average.

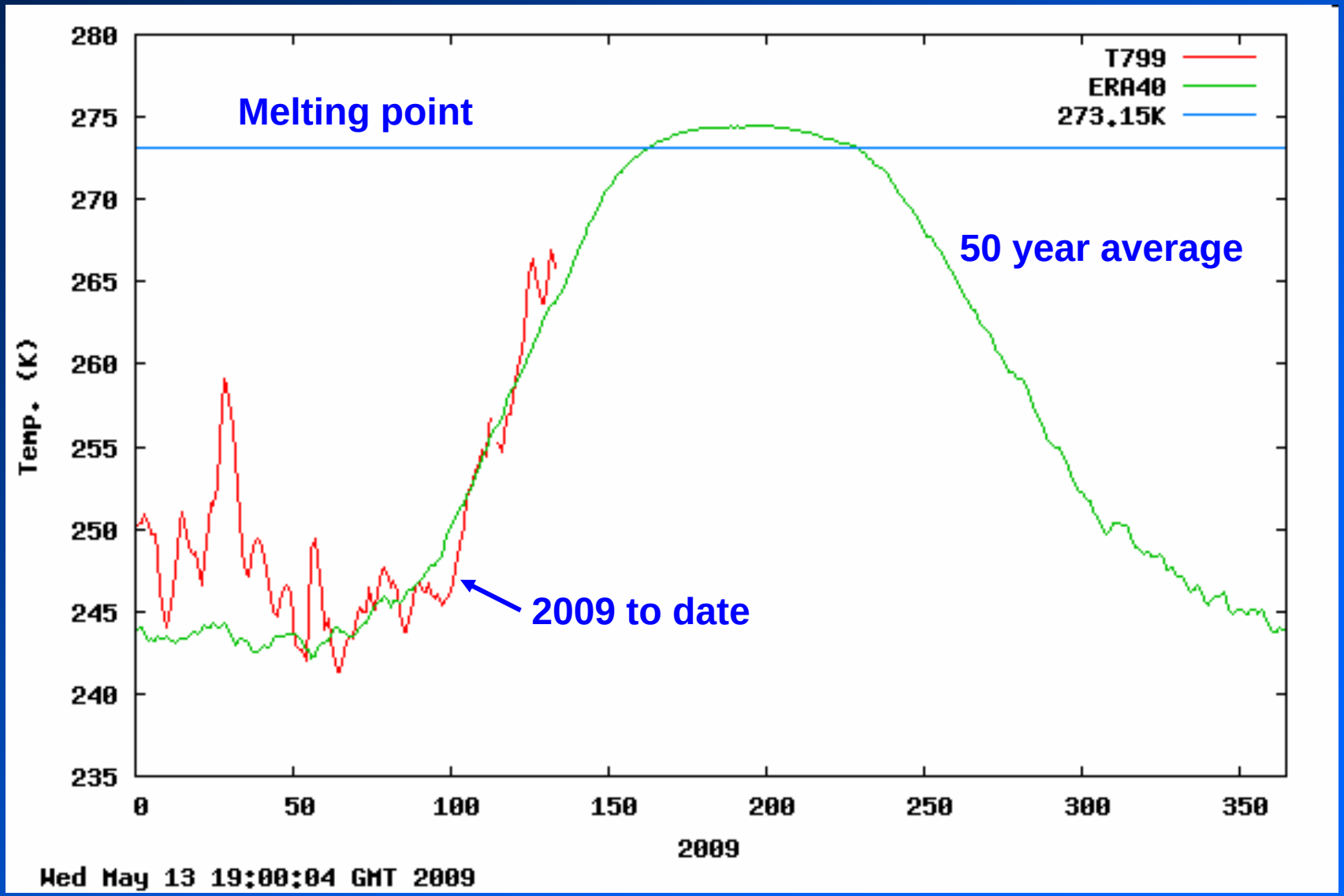


- equivalent to the area of Western Australia

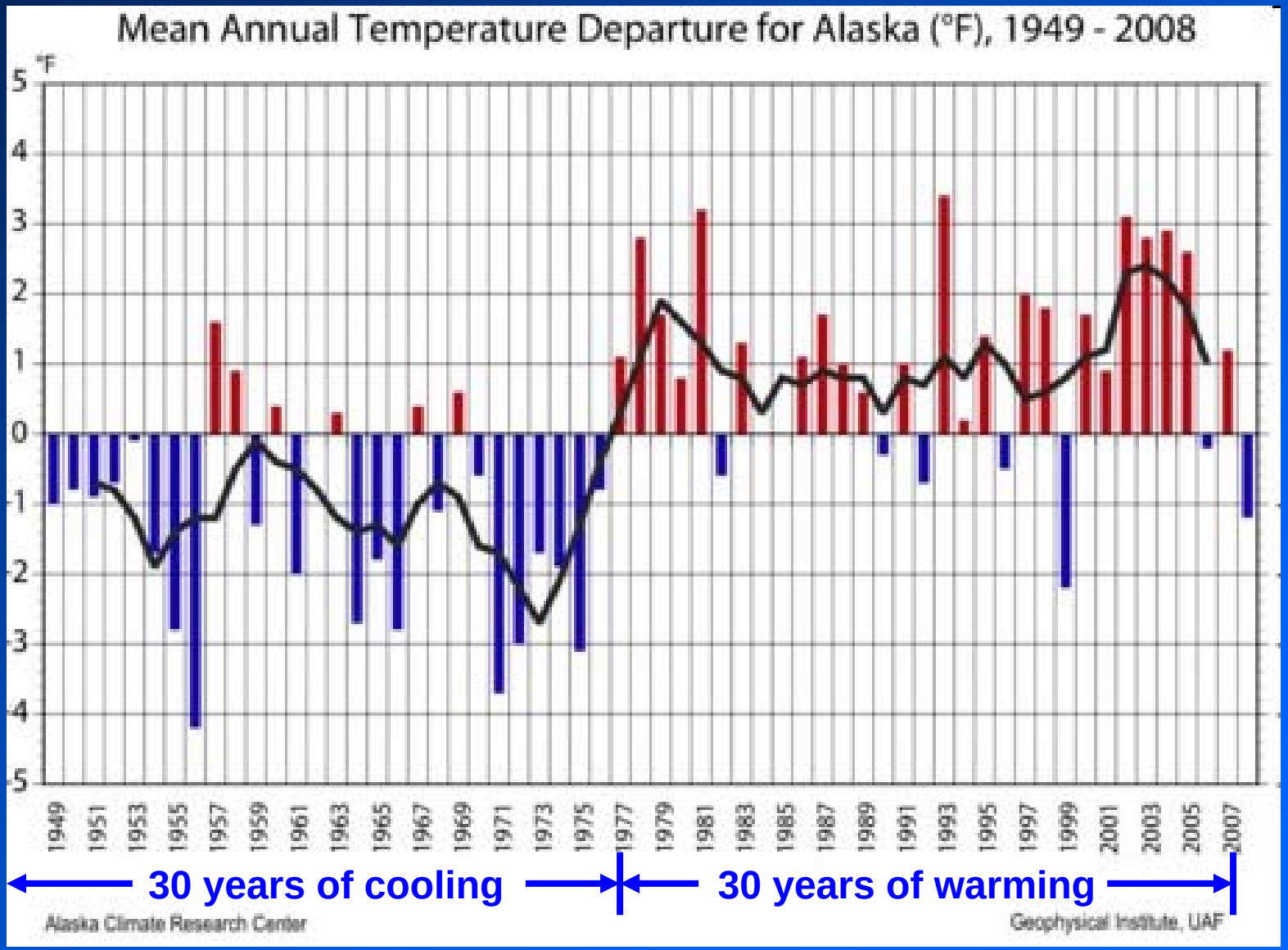
Arctic sea ice extent is now above normal.



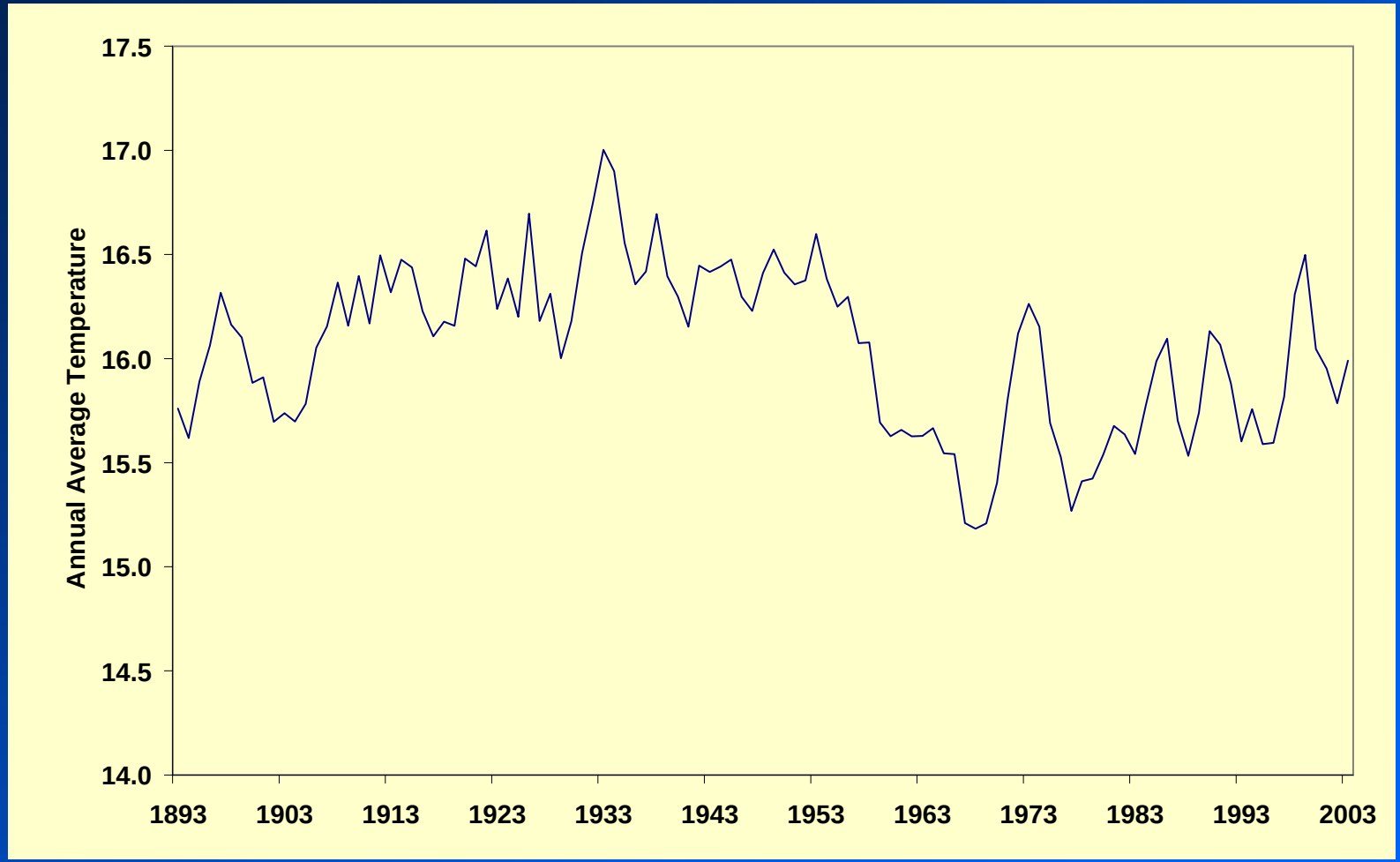
50 Years of Arctic Temperatures – still the same



70 years of Alaskan Data

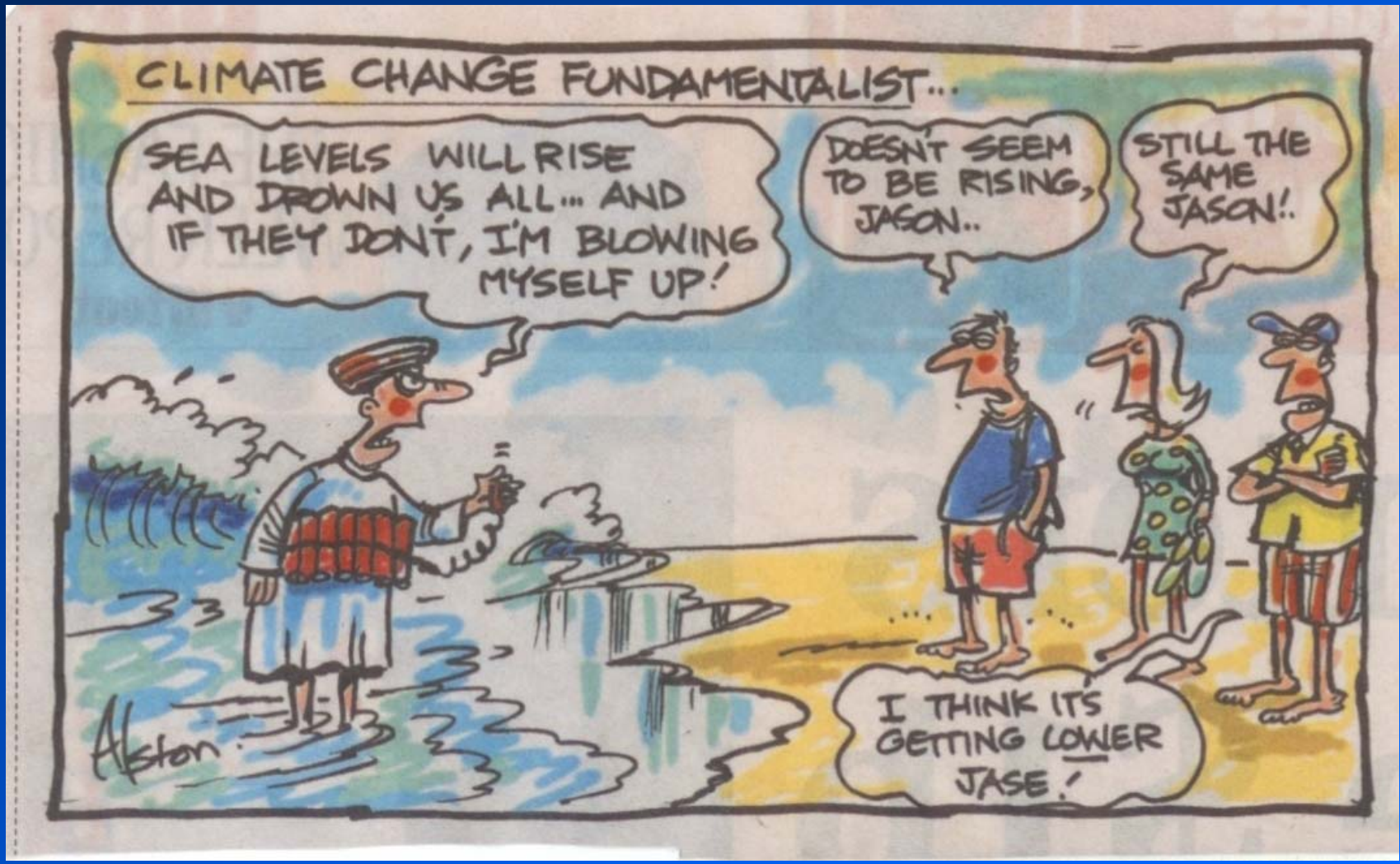


A Rural US Data Set

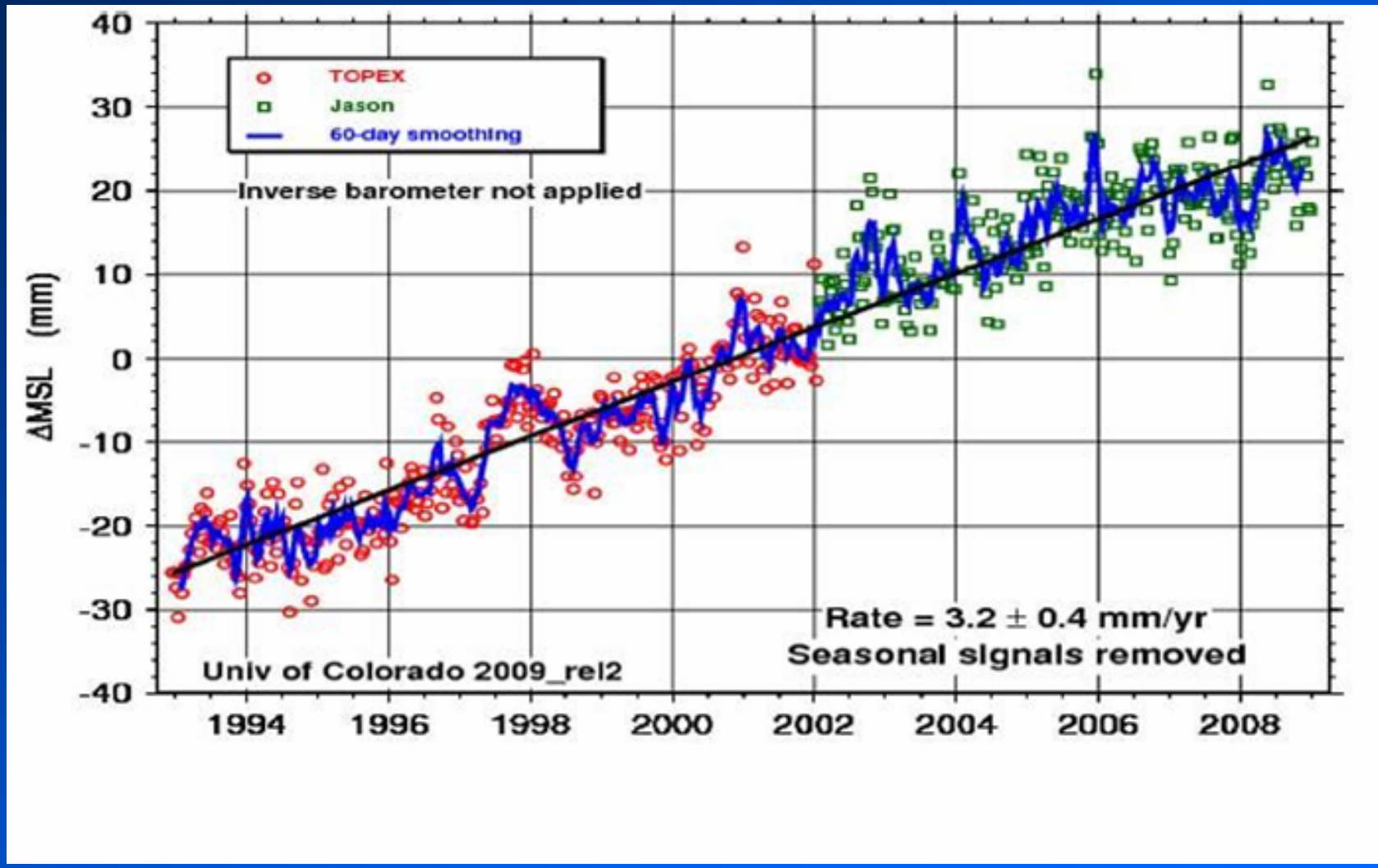


The smoothed average annual temperature of the Hawkinsville (32.3N, 83.5W), Glennville (31.3N, 89.1W), Calhoun Research Station (32.5N, 92.3W), Highlands (35.0N, 82.3W) and Talbotton (32.7N, 84.5W) stations is representative of the US temperature profile away from the urban heat island effect over the last 100 years (Data source: NASA GISS)

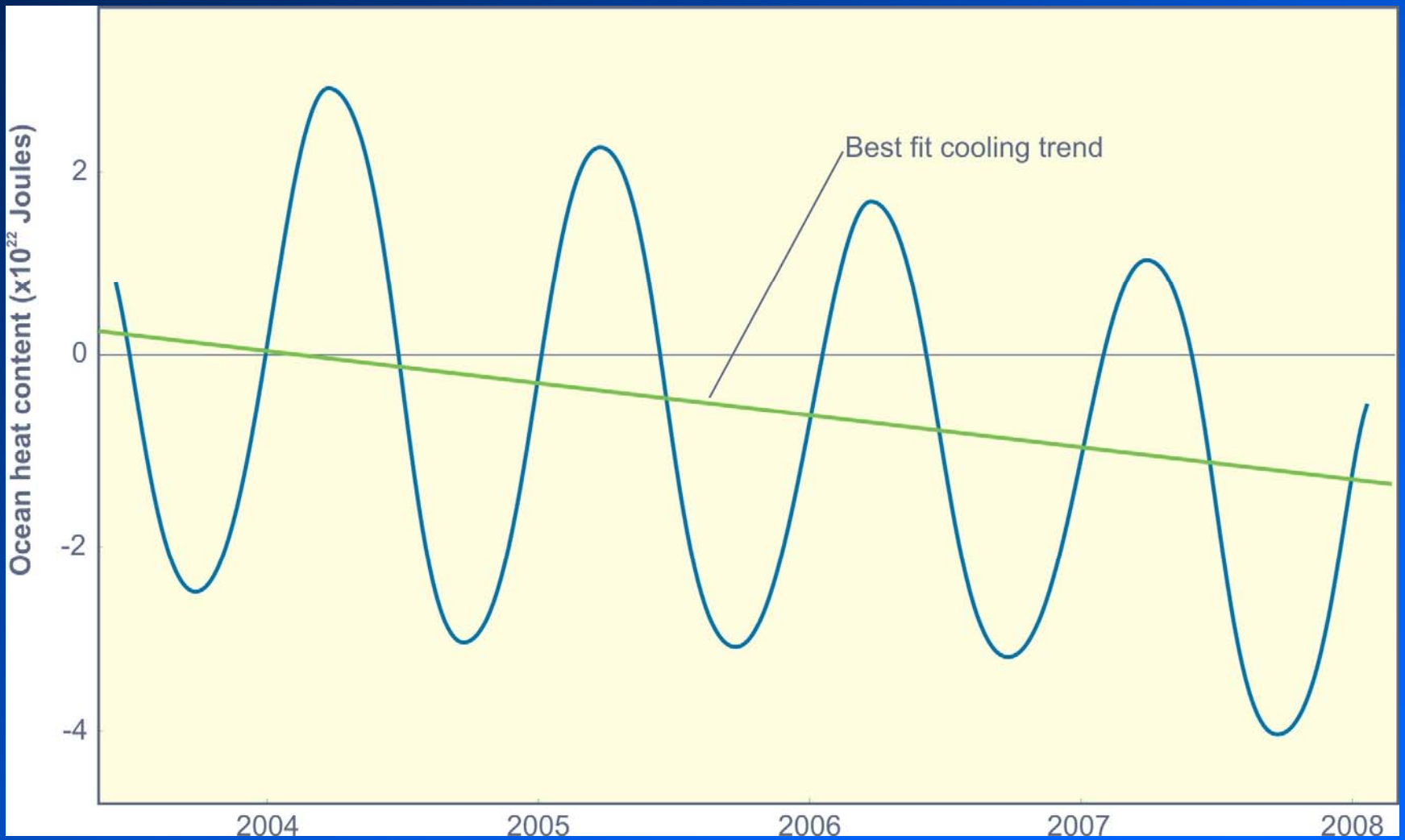
Discussion of the issue of sea level in the West Australian 13th May, 2009



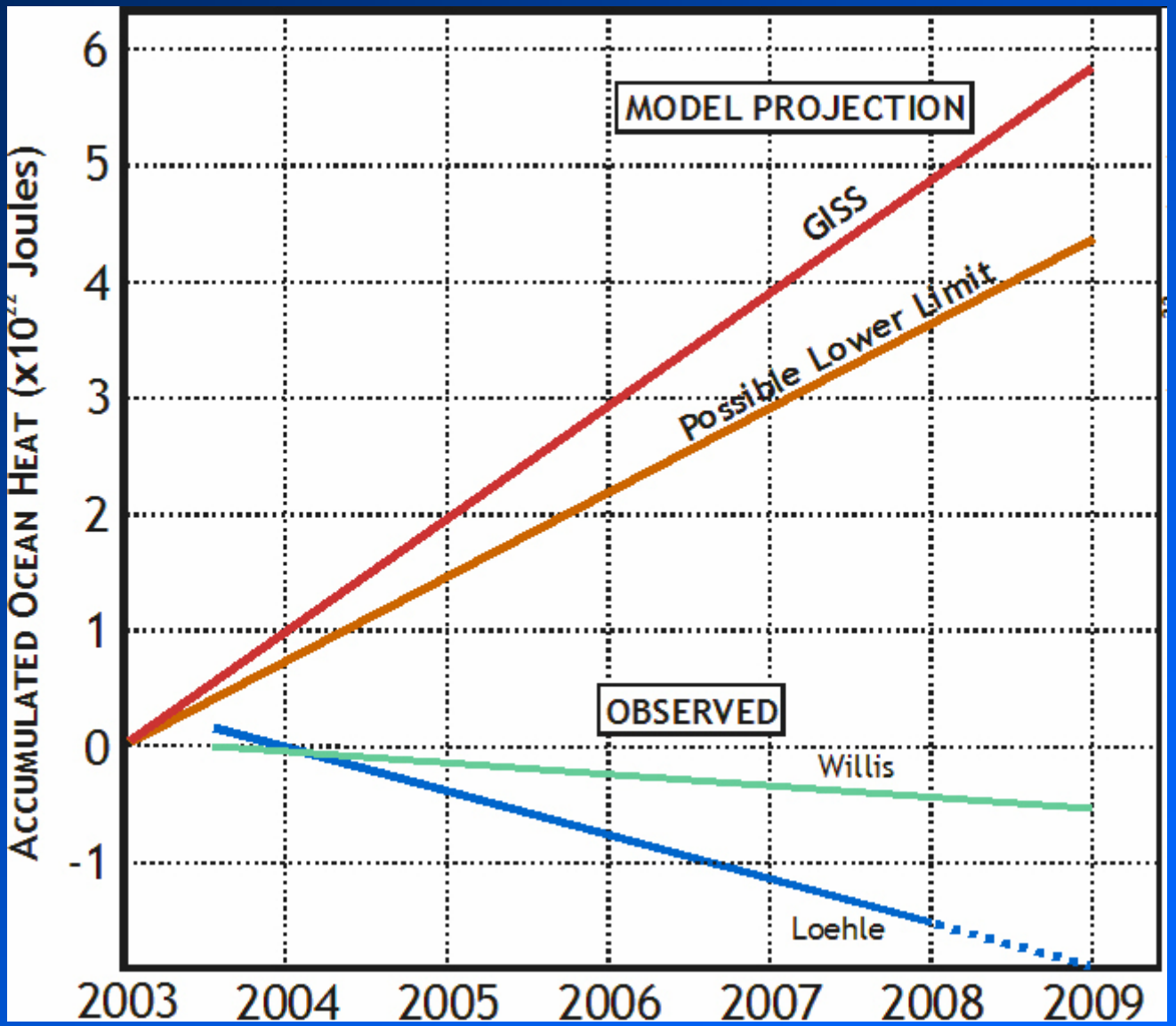
Sea level has now been flat for four years.



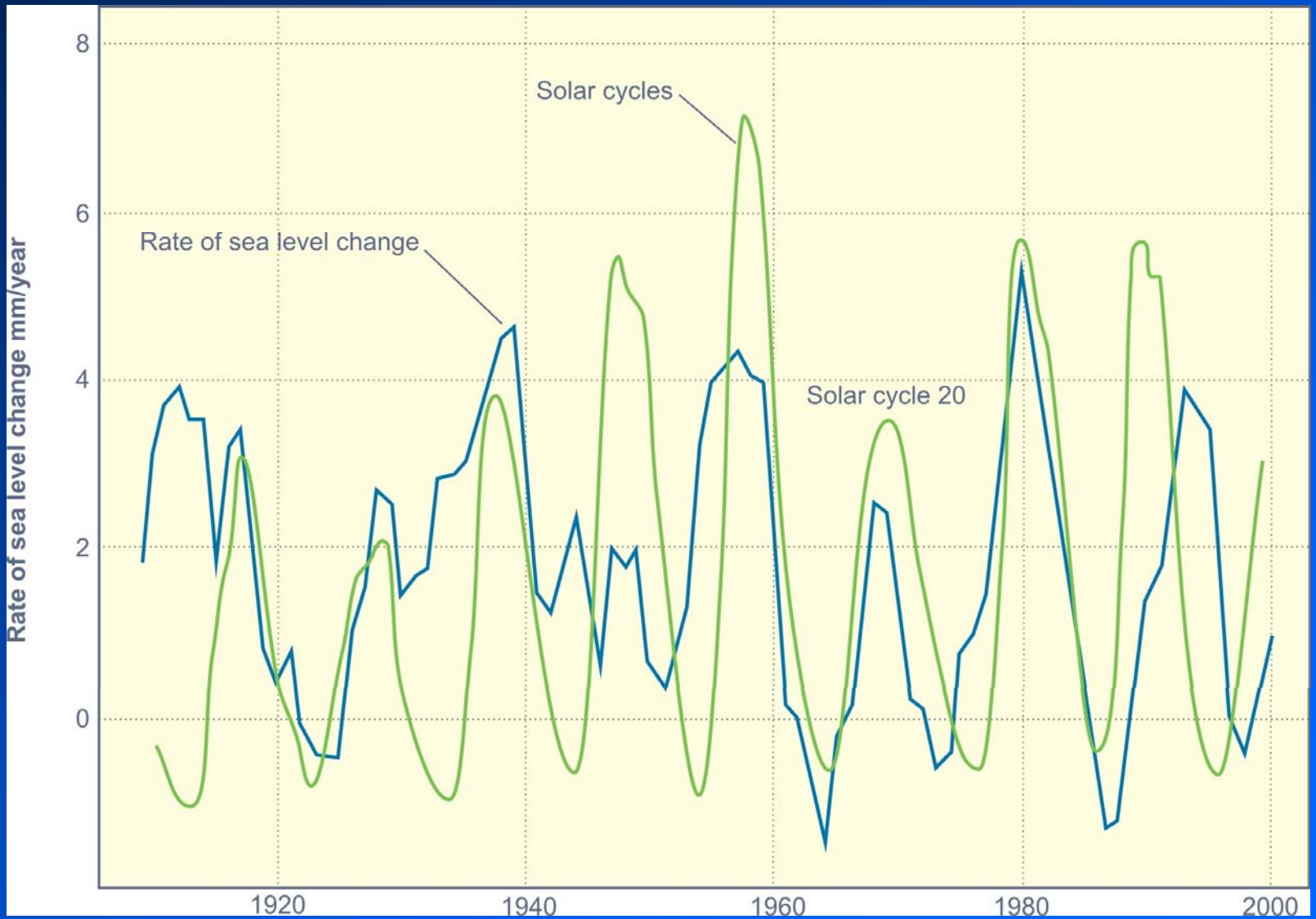
The oceans started cooling in 2003.



That ocean cooling proves the climate models wrong.

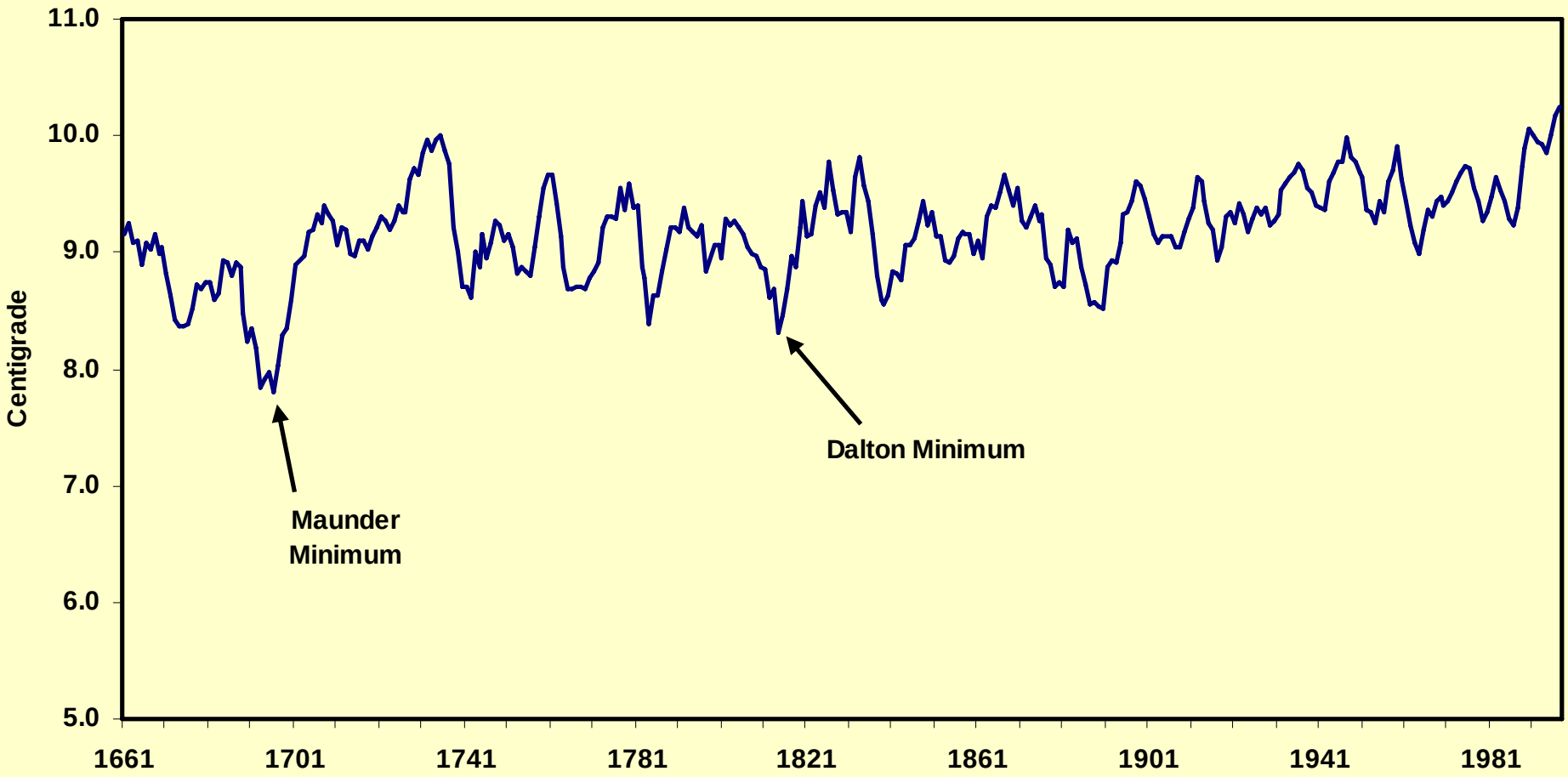


Rate of Sea Level Rise and Solar Cycles.

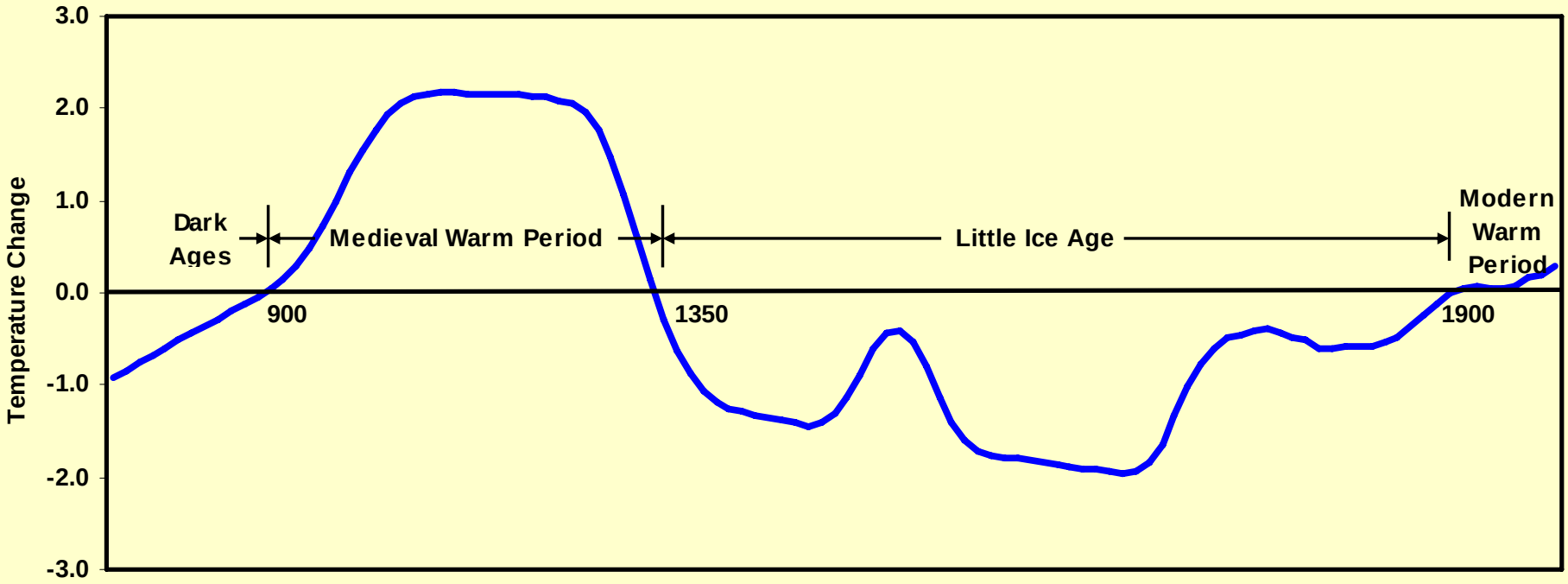


A 300 Year Thermometer Record

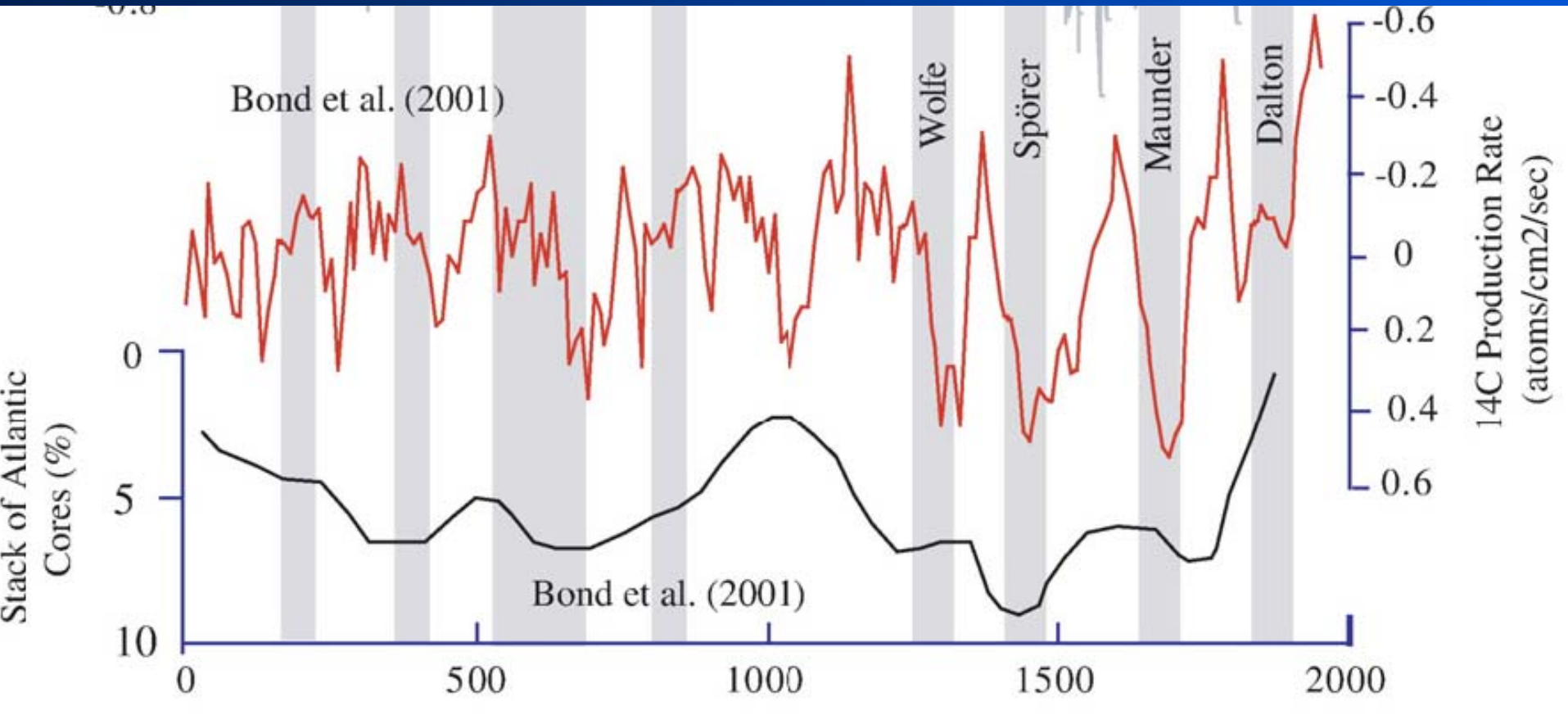
Central England Temperature



Medieval Warm Period – Little Ice Age

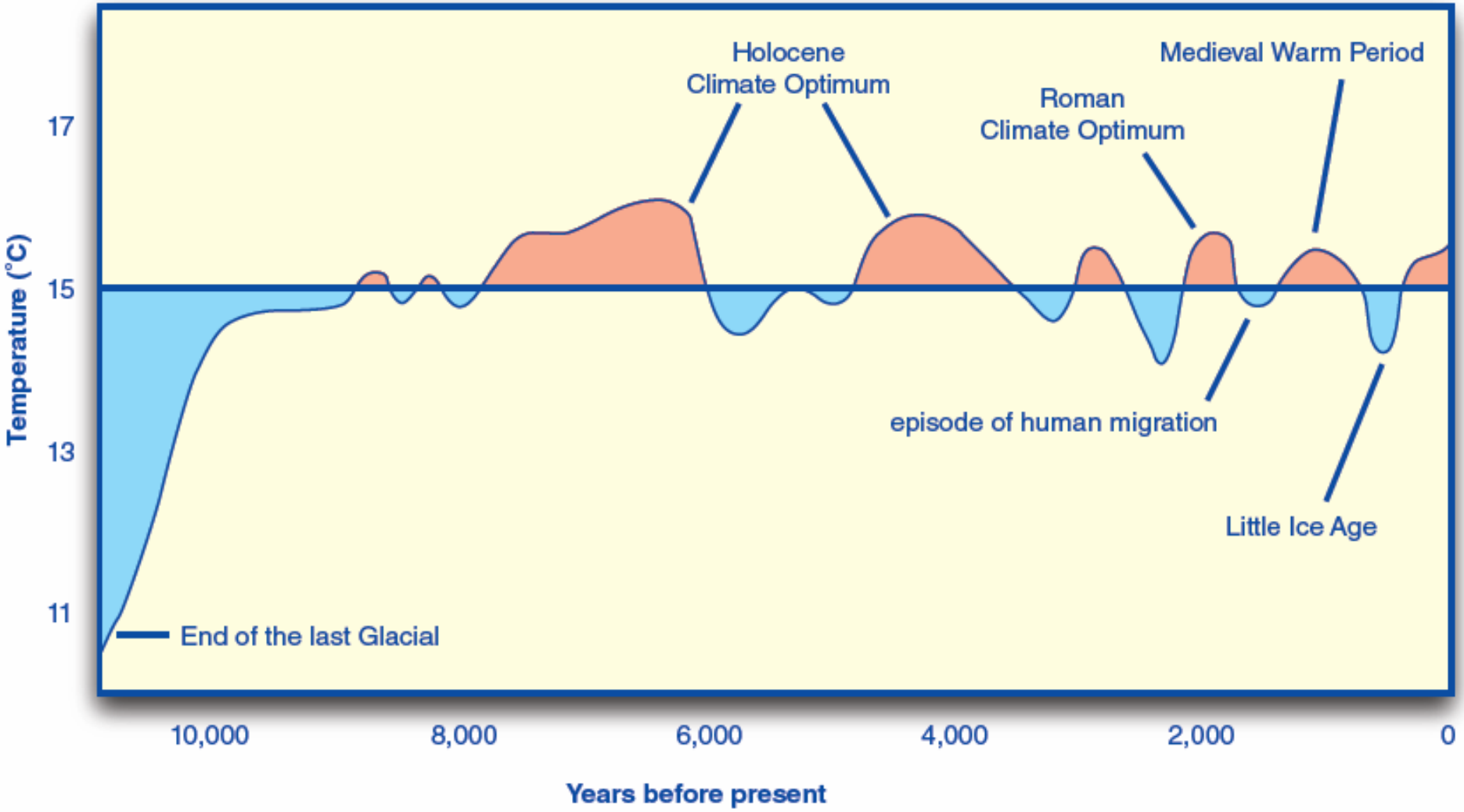


C14 and ice-rafted debris in North Atlantic seabed cores

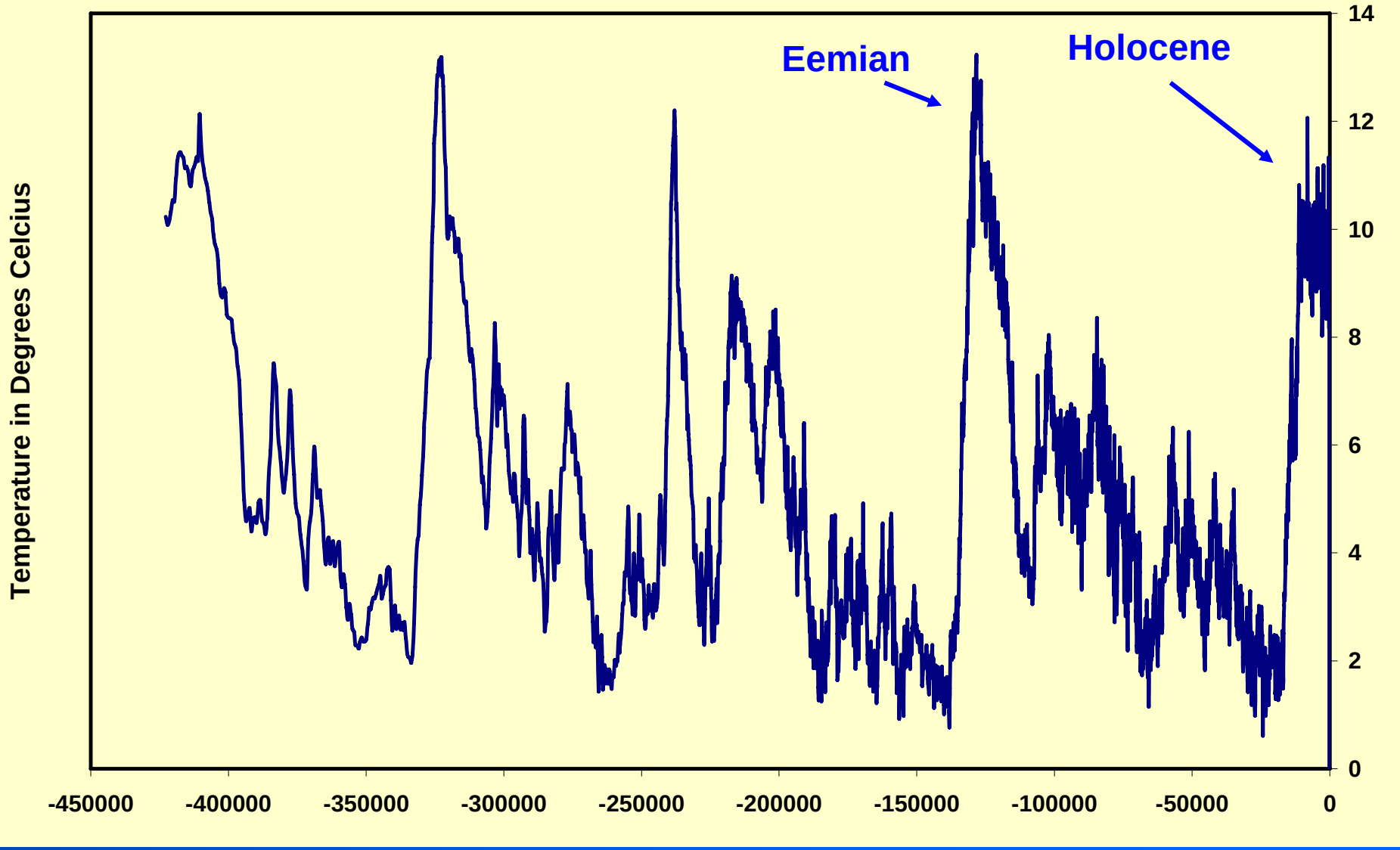


Glacial advances over the last two thousand years are coincident with minima in solar activity, on a 210 year (de Vries) cycle. As it is now 213 years since the beginning of the Dalton Minimum, the Earth is now due for another period of advancing glaciers.

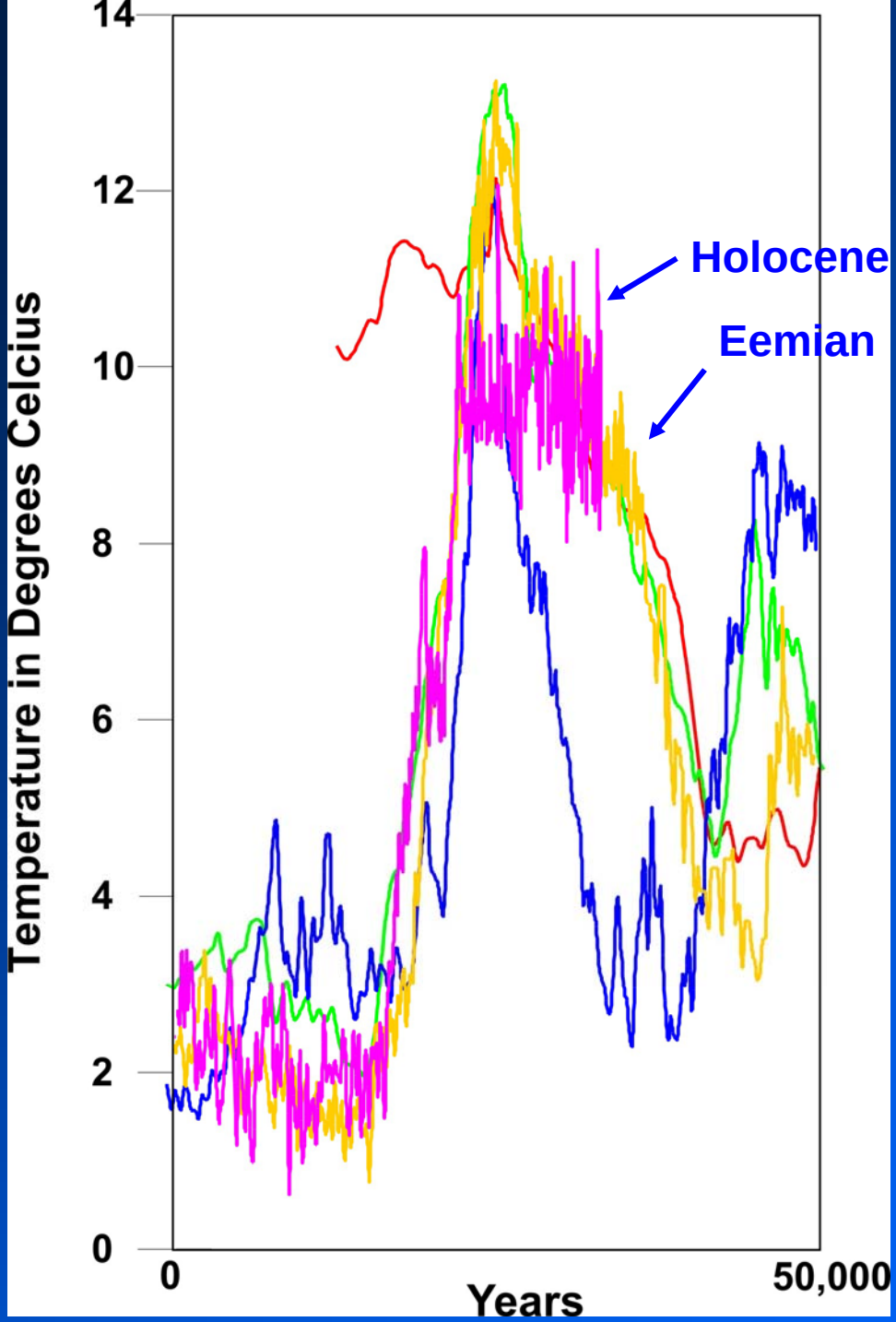
The Holocene Optimum

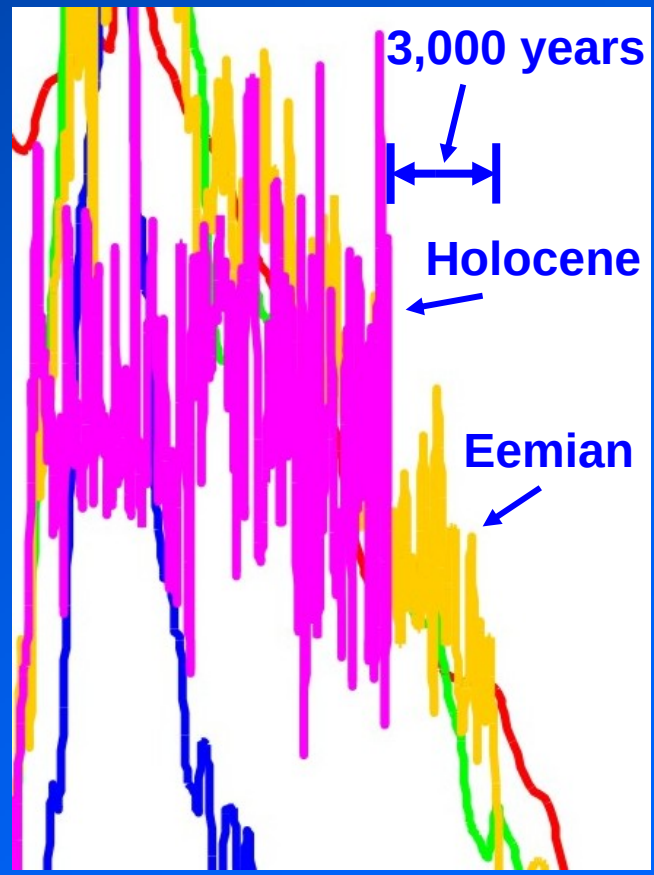


Vostok Ice Core Temperature

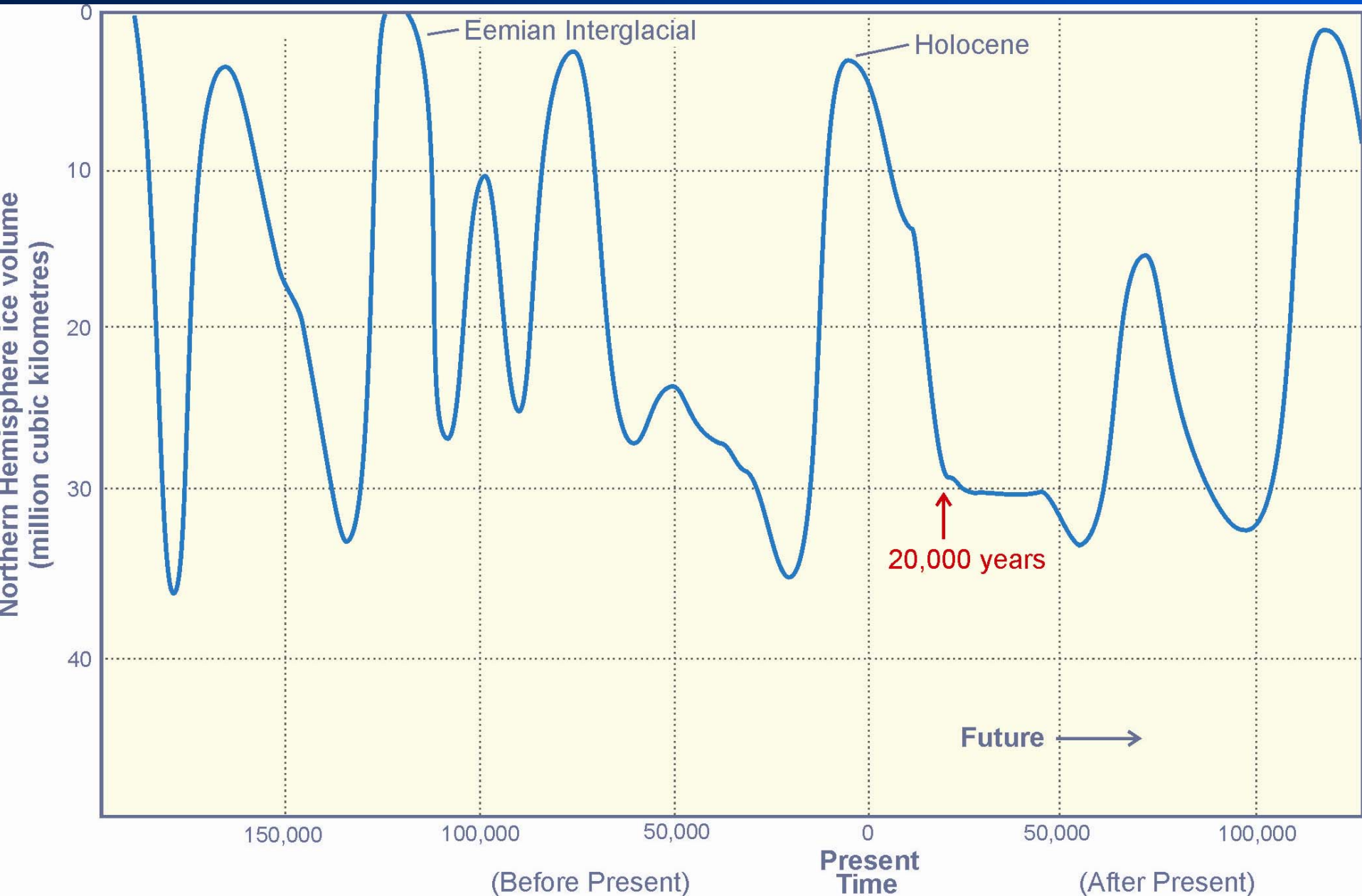


Vostok Interglacials Superimposed and aligned on Peak Temperature

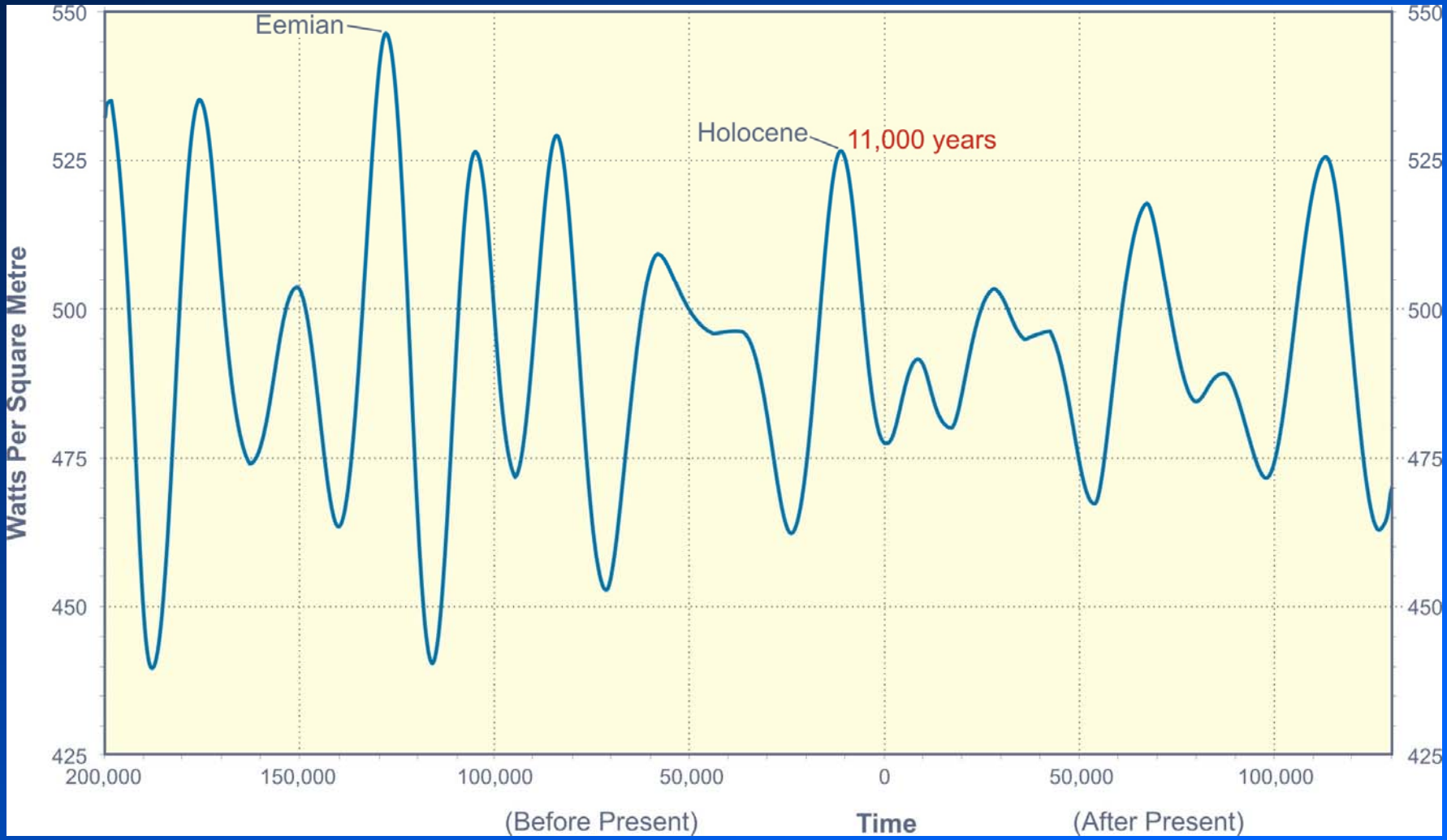




Time is up for our interglacial.

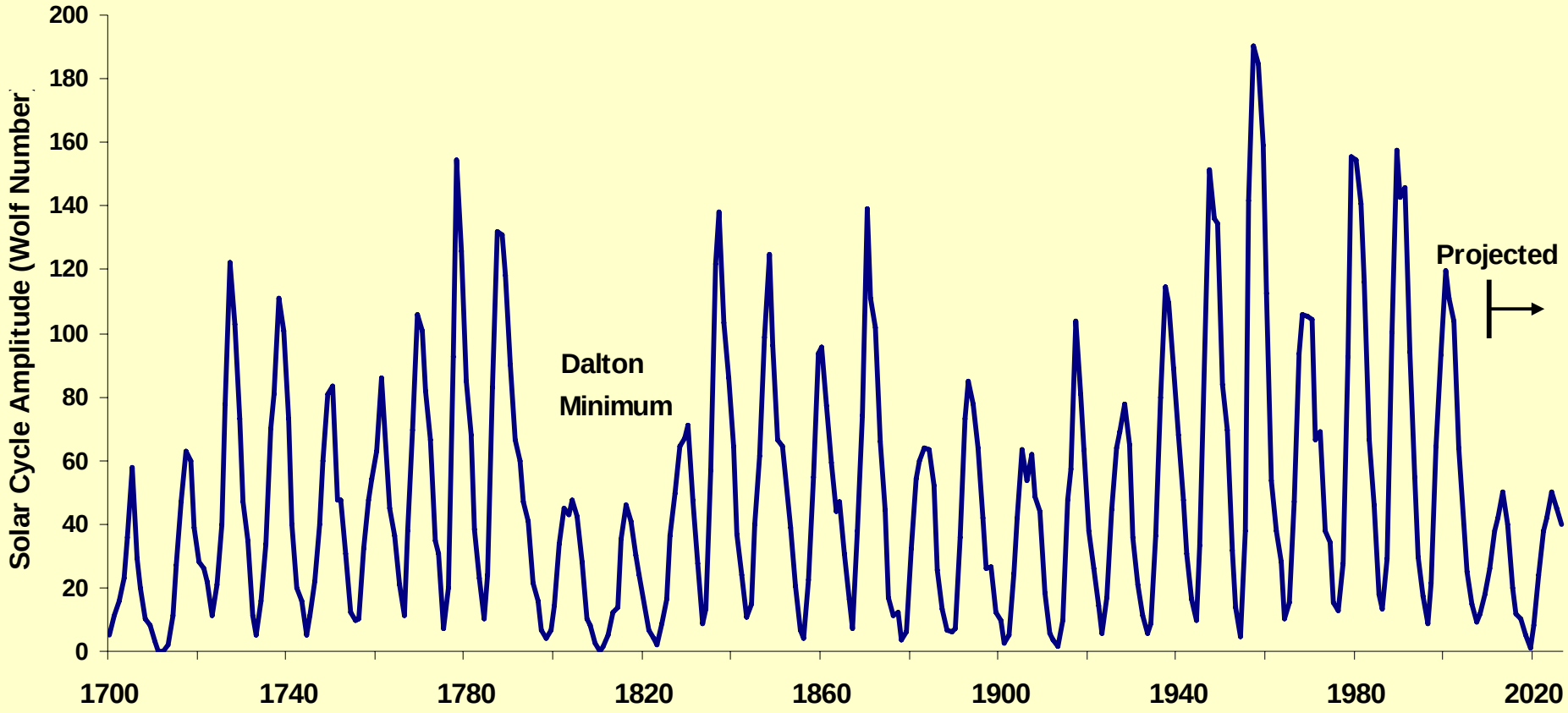


How glaciations start.

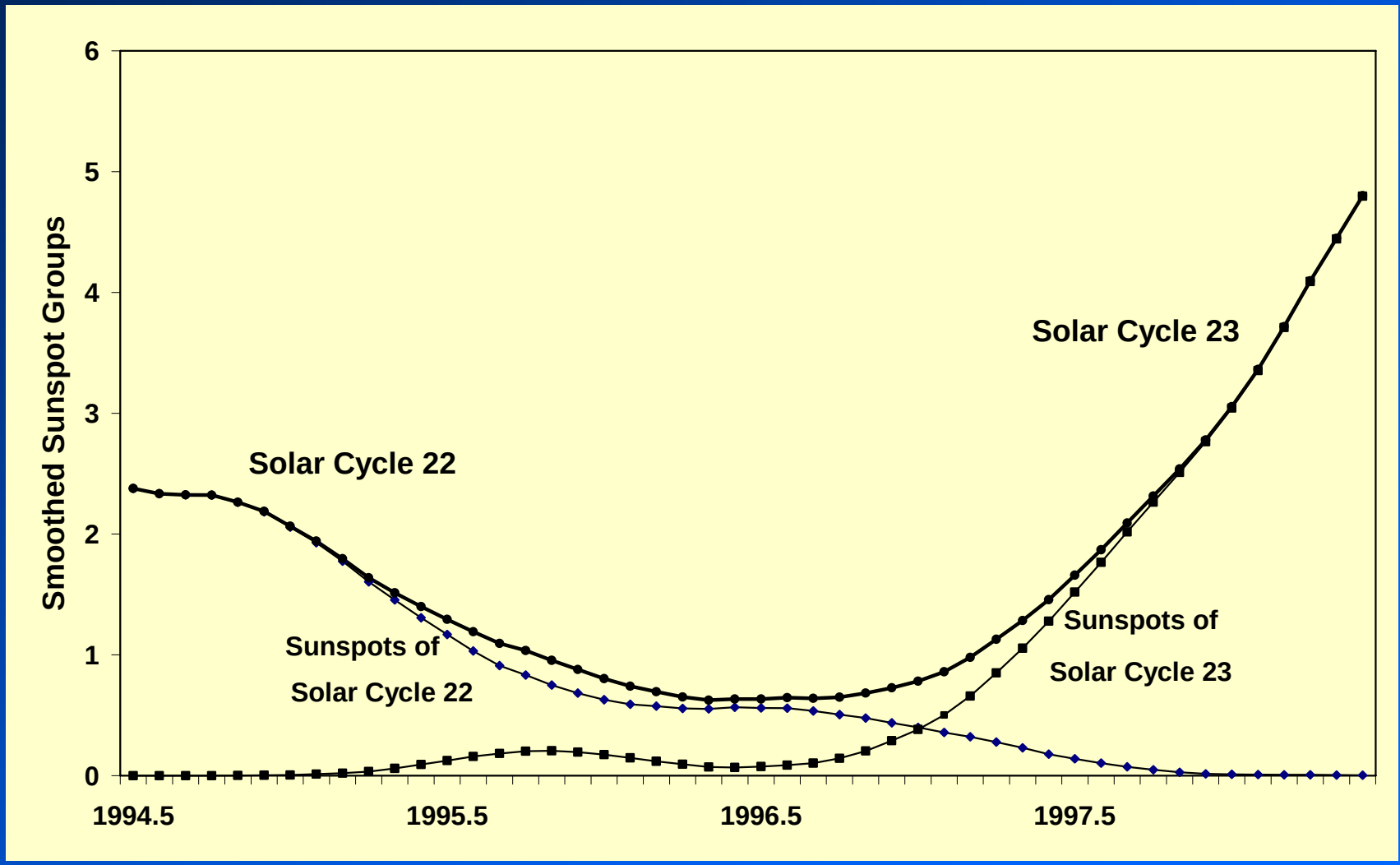


There is now a 50 watts per square metre difference at 60° north latitude.

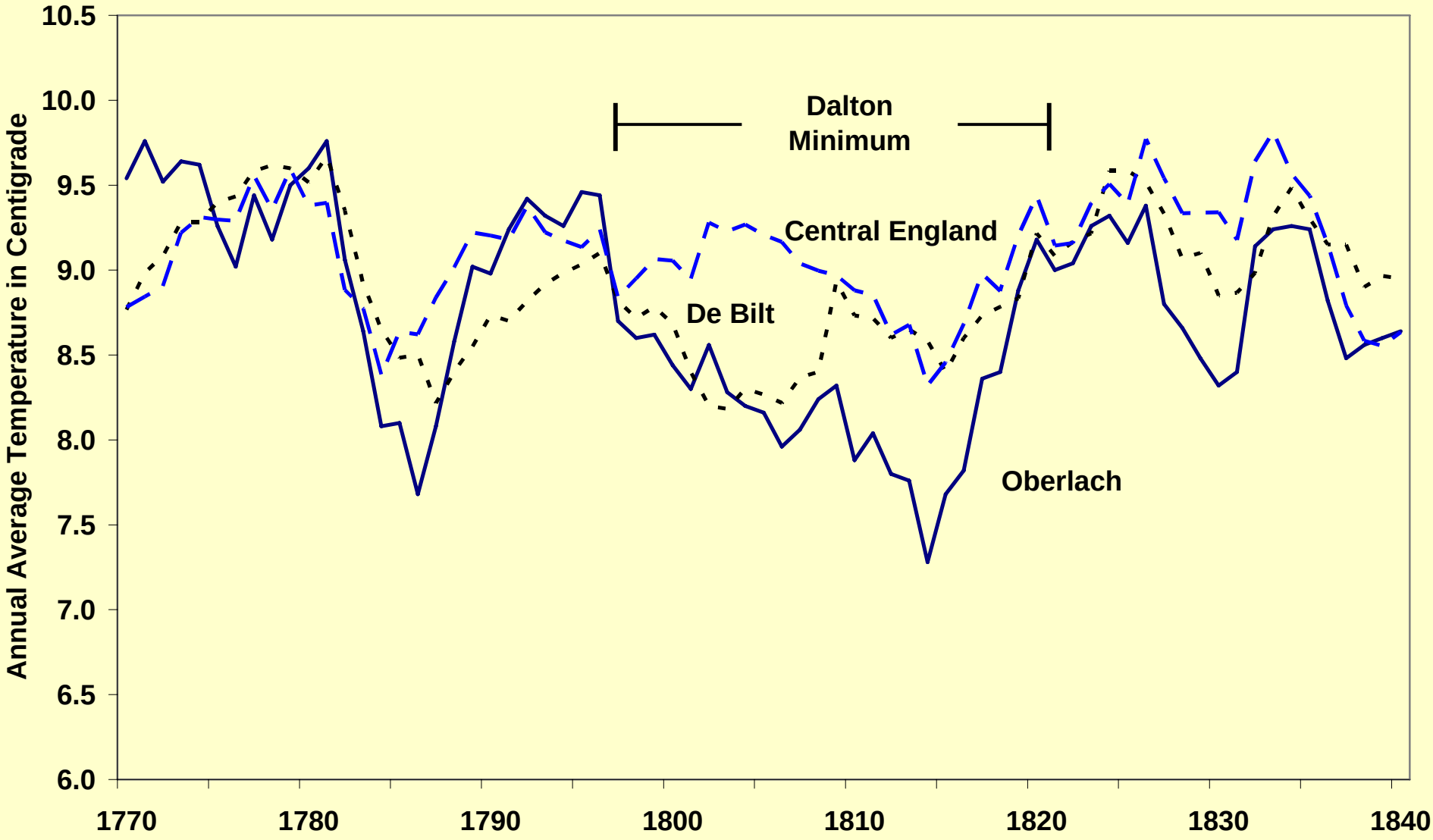
Section 2: The Solar Driver of Climate



The Transition from Solar Cycle 22 to Solar Cycle 23



The Dalton Minimum at Three European Stations 1770 to 1840



Sunspot Cycle Length Relative to Temperature

Armagh, Northern Ireland 1796 – 1992

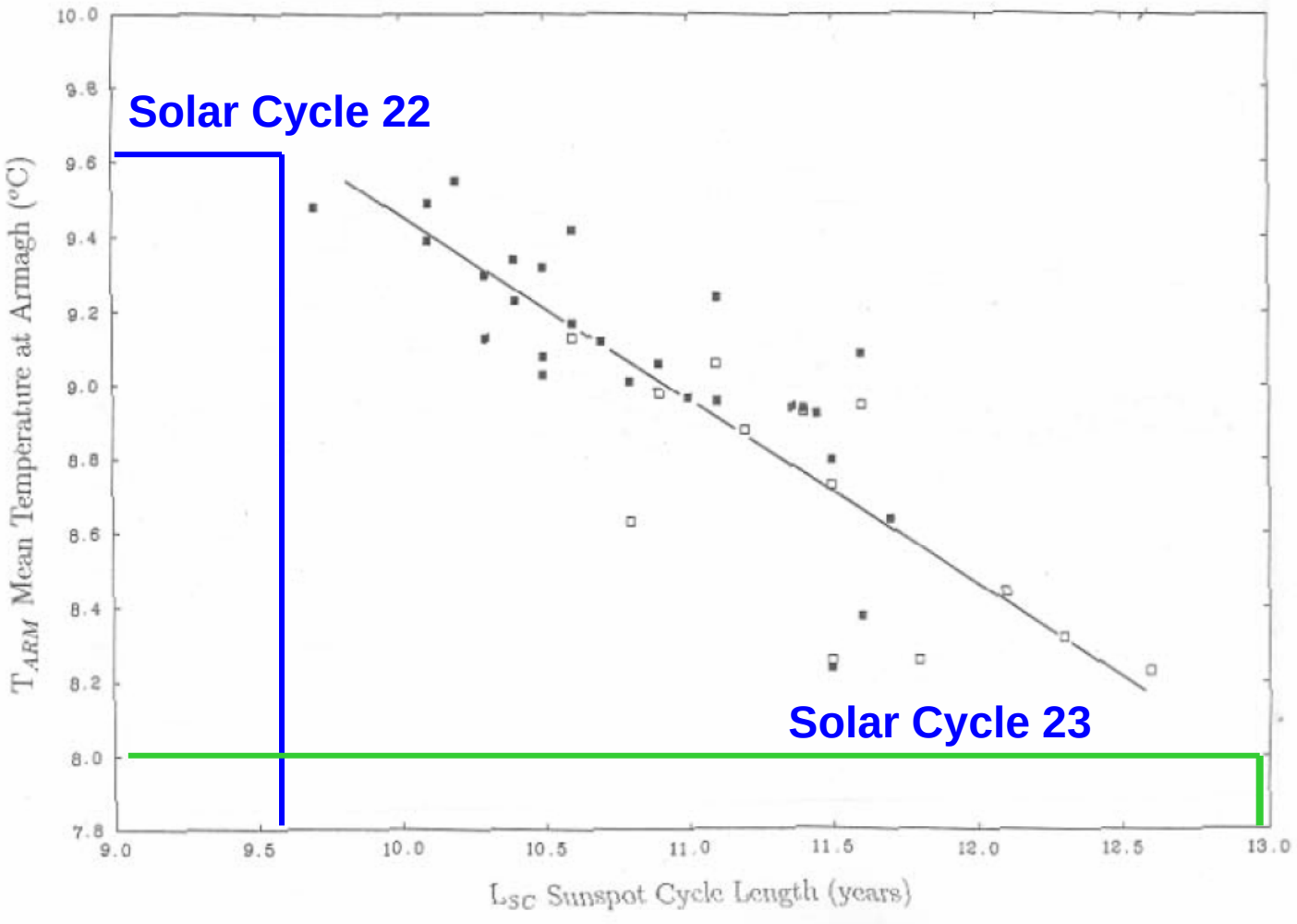


Figure 5. The mean temperature at Armagh for 11 year intervals, centred on years of sunspot maximum and minimum, plotted against the sunspot cycle length. Symbols: open squares - Series I, filled squares - Series II. The mean regression line is shown.

The baby boomers had the best weather too, caused by a run of short solar cycles.

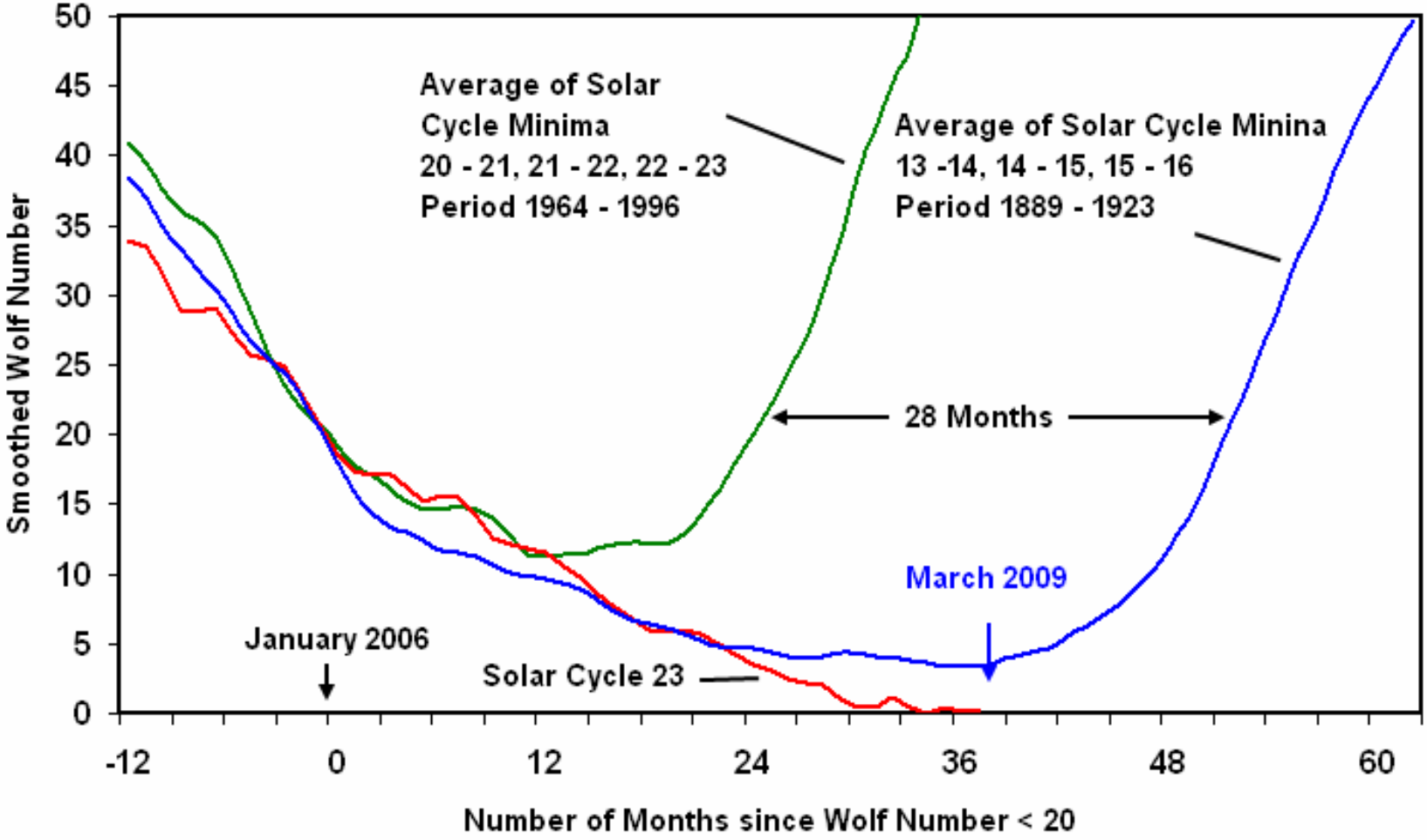
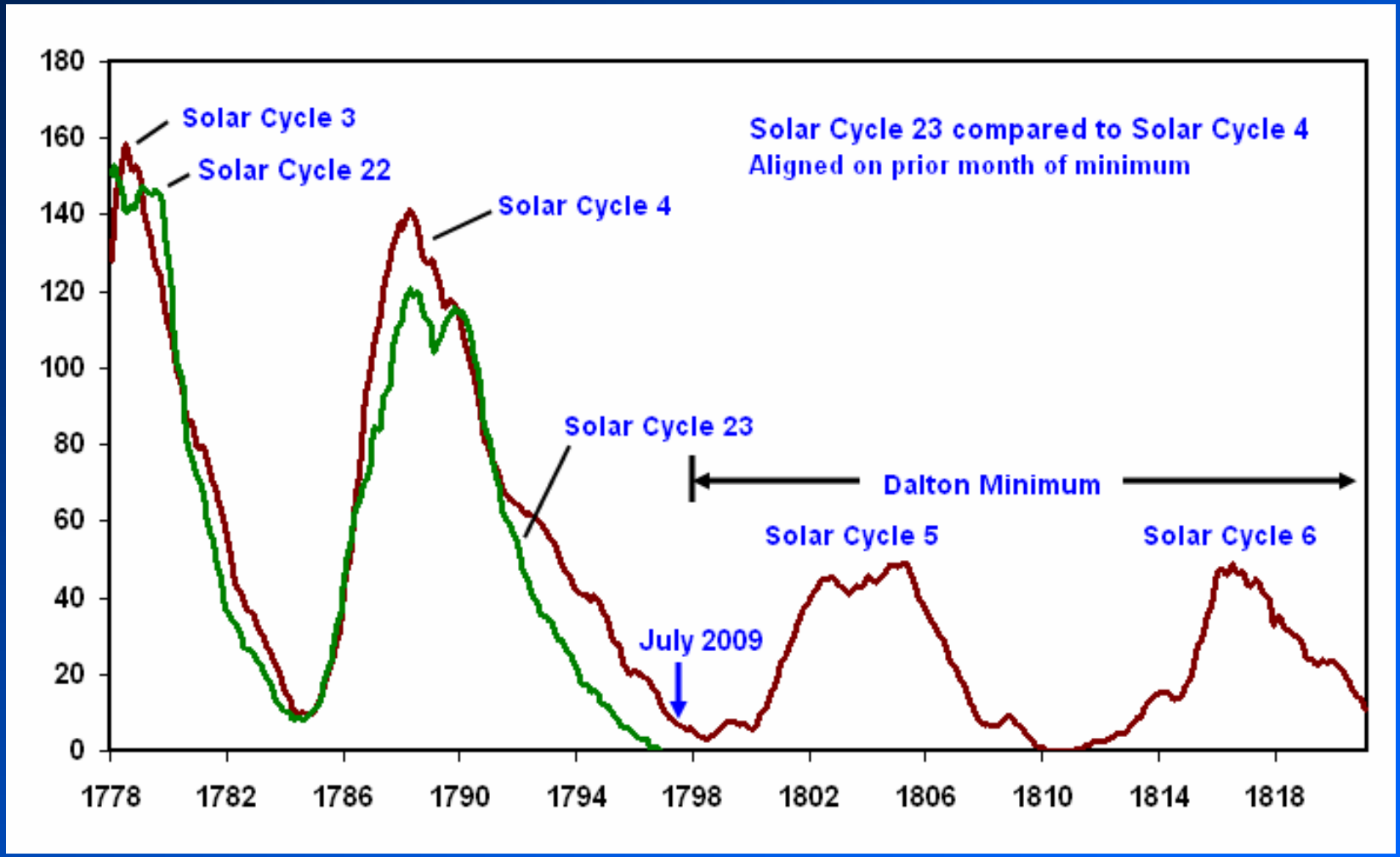


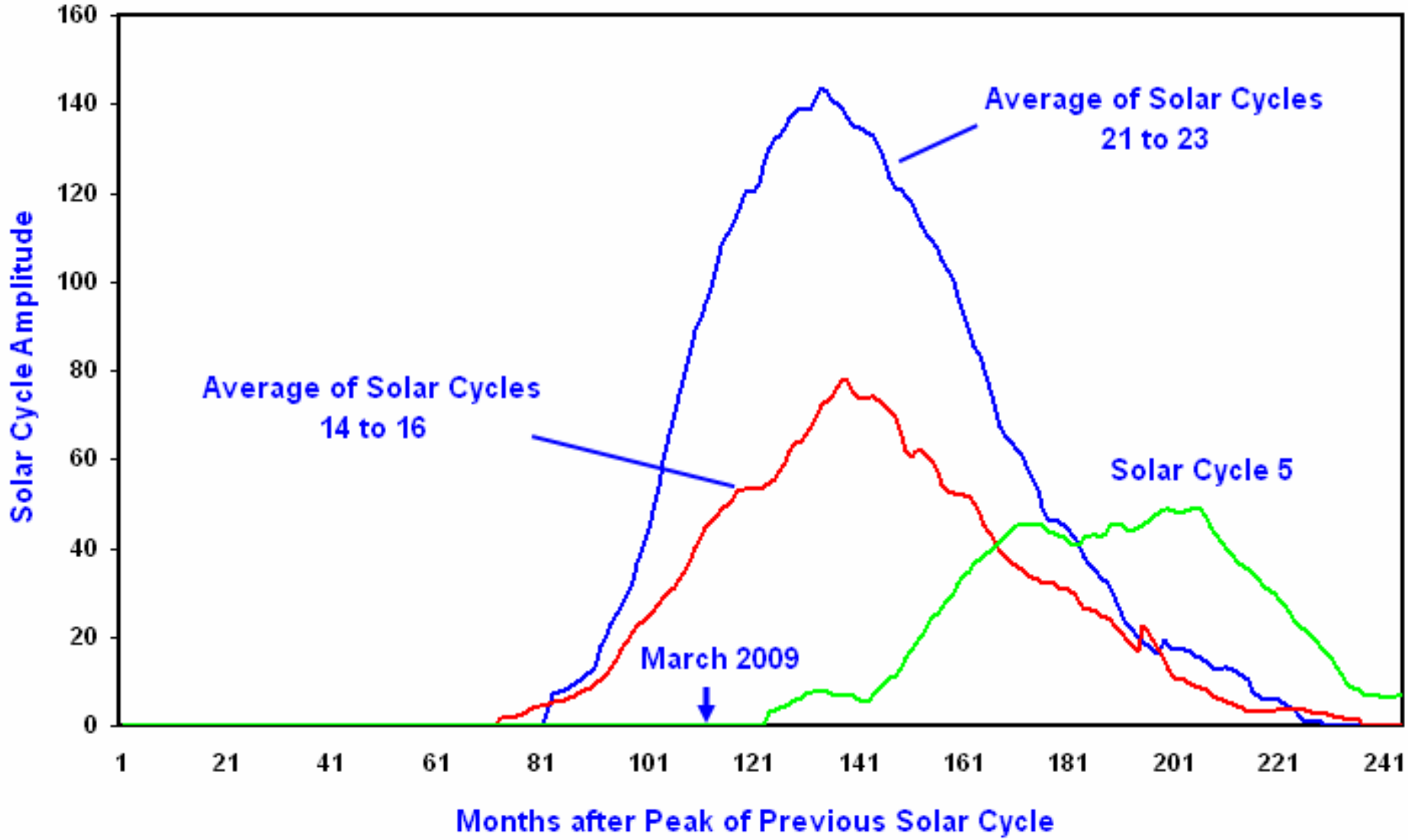
Figure source: Jan Janssens, annotated by David Archibald

Dalton Minimum Repeat?

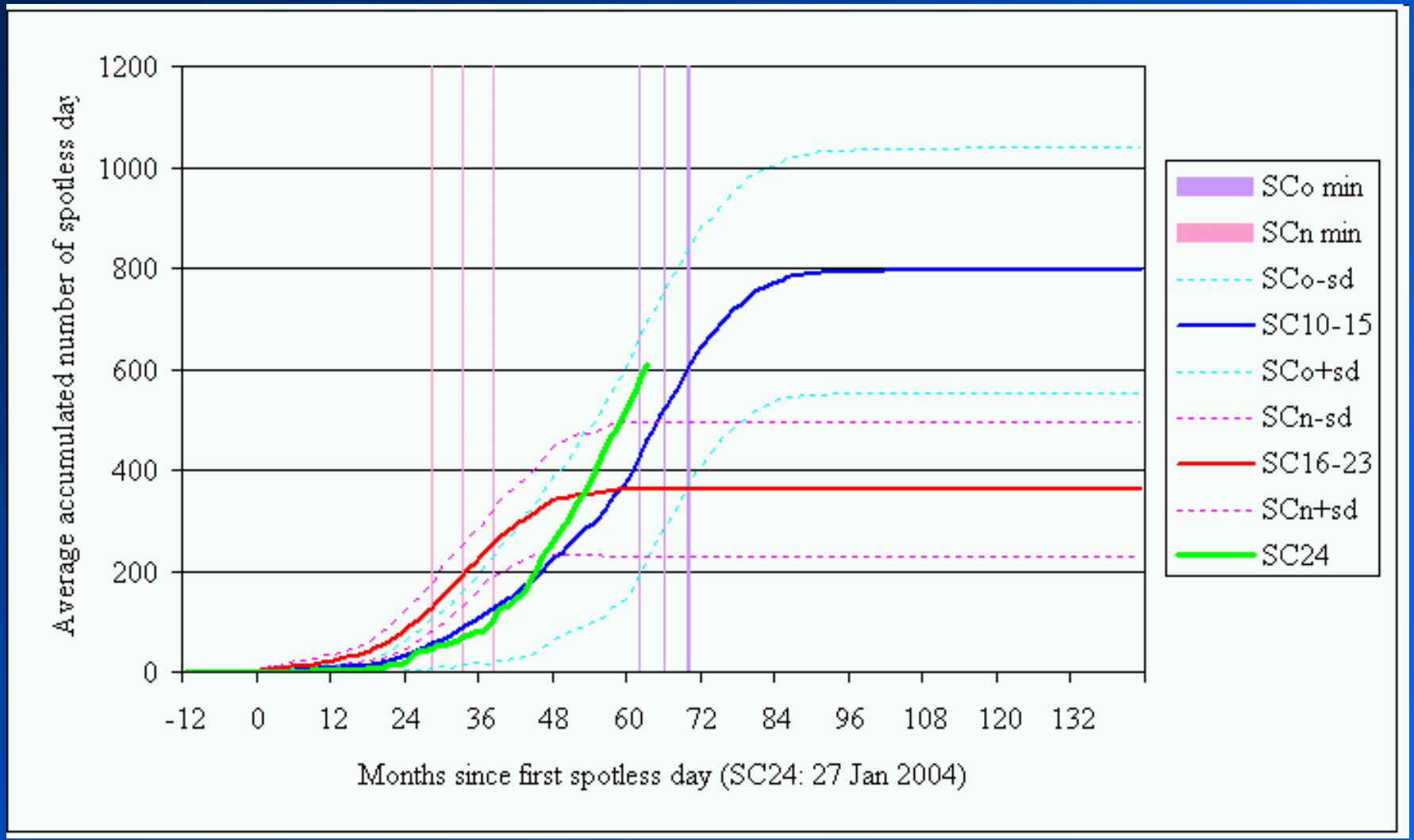


A repeat of the Dalton Minimum is not precluded by the data to date. July 2009 equates to a 13 year long Solar Cycle 23.

Late 20th Century Solar Cycles compared to Late 19th Century Solar Cycles

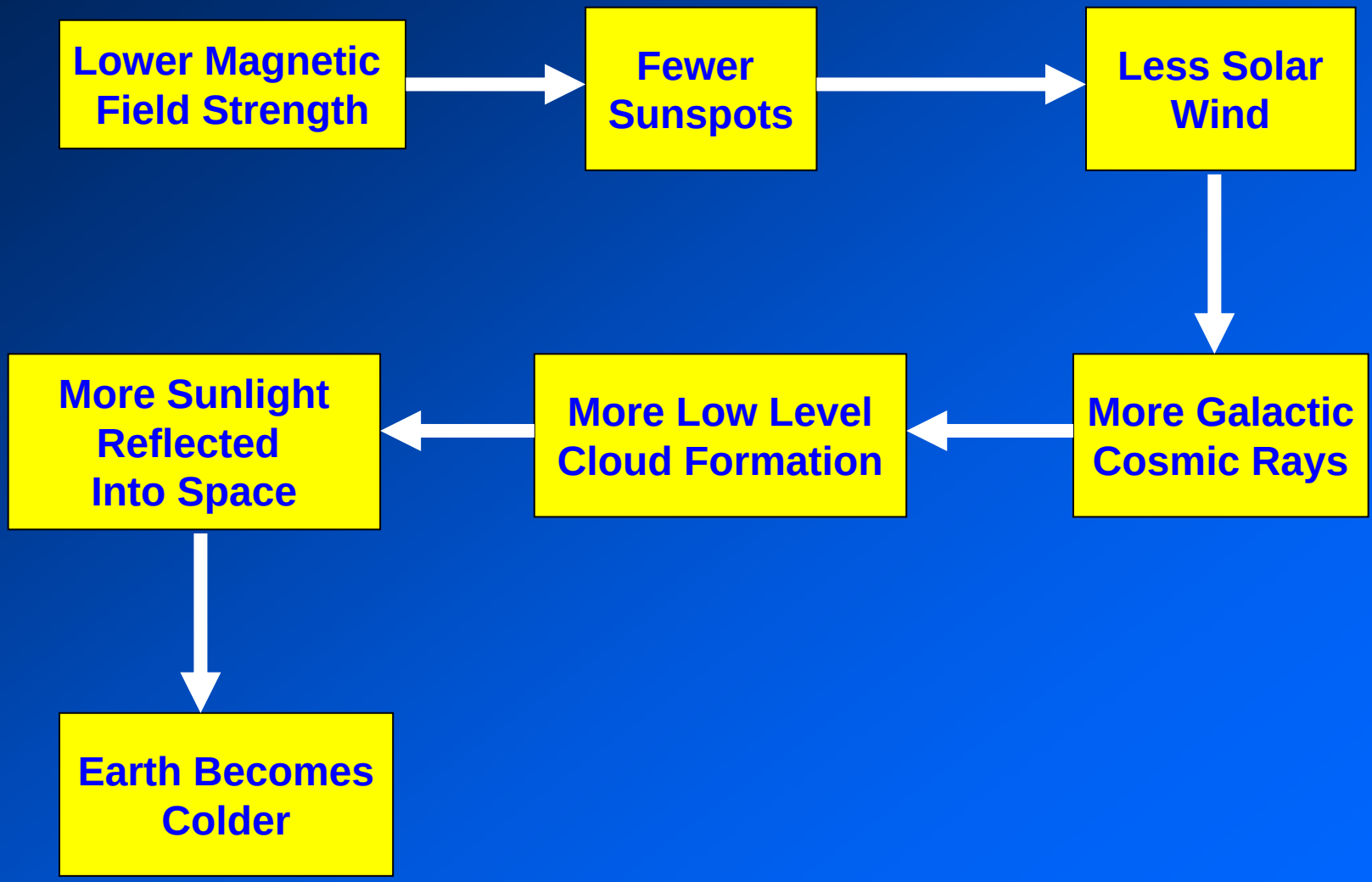


Spotless Days

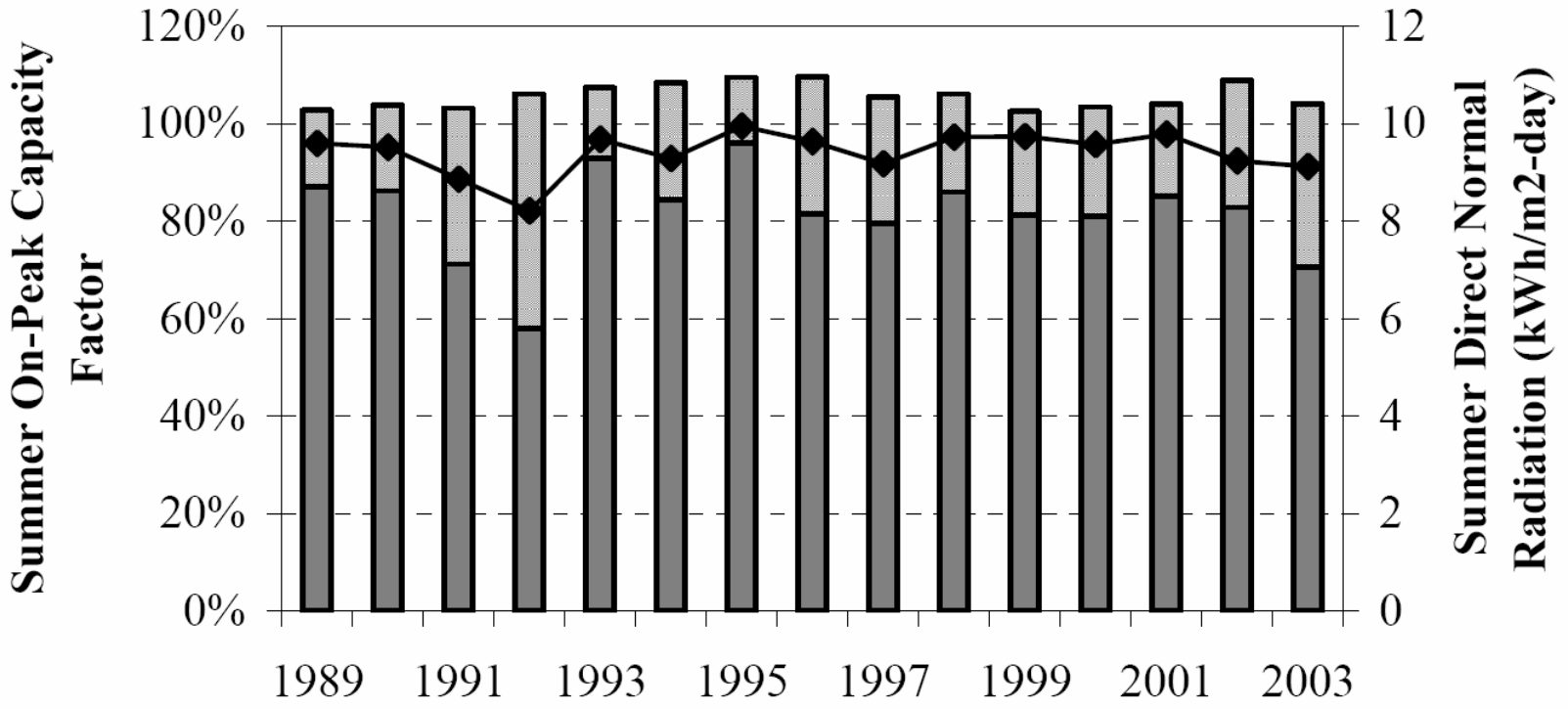


This minimum is now deeper than the late 19th century average.

The Solar – Climate Relationship

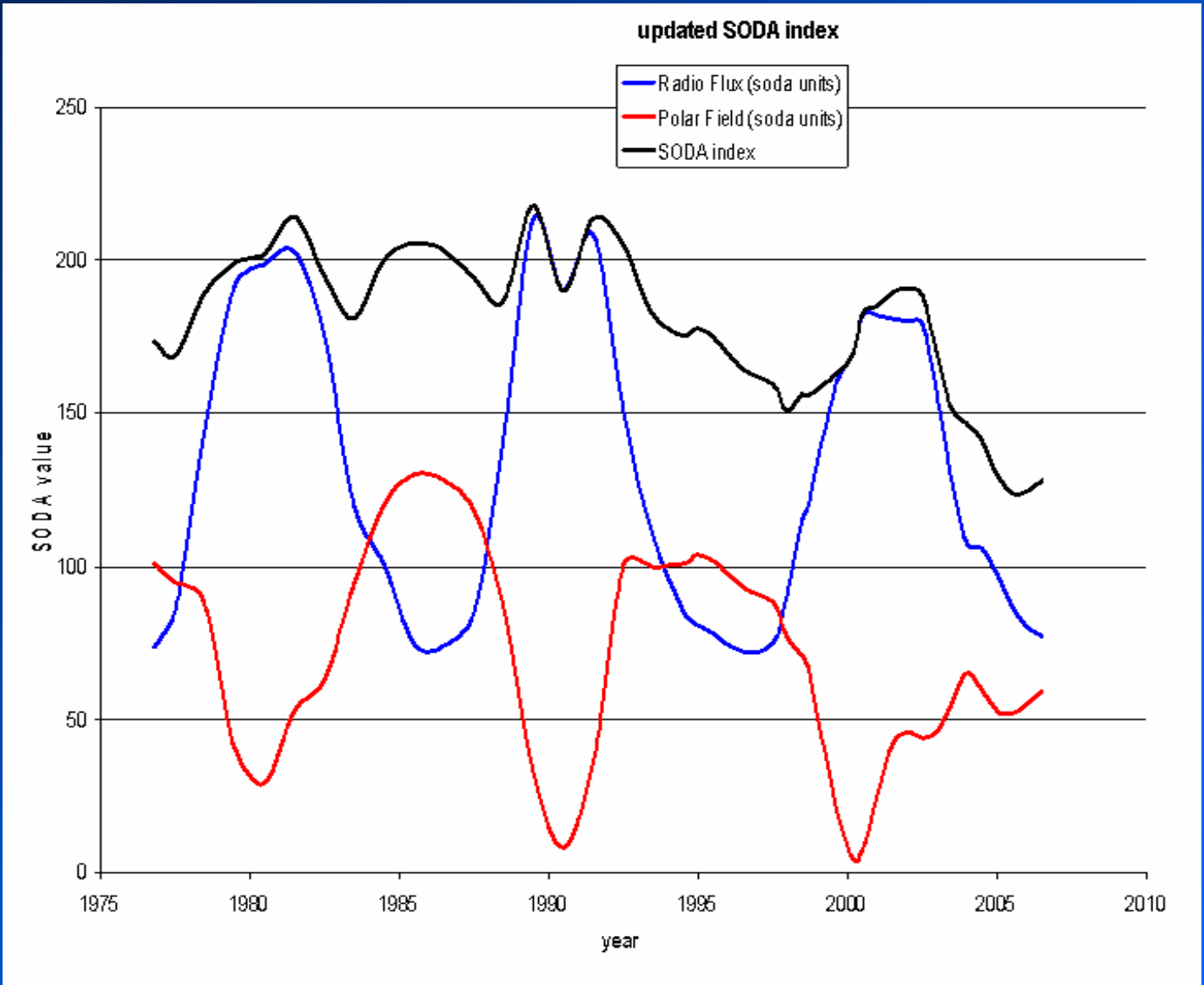


Effect of the June, 1991 eruption of Mt Pinatubo on the solar thermal power plants in California

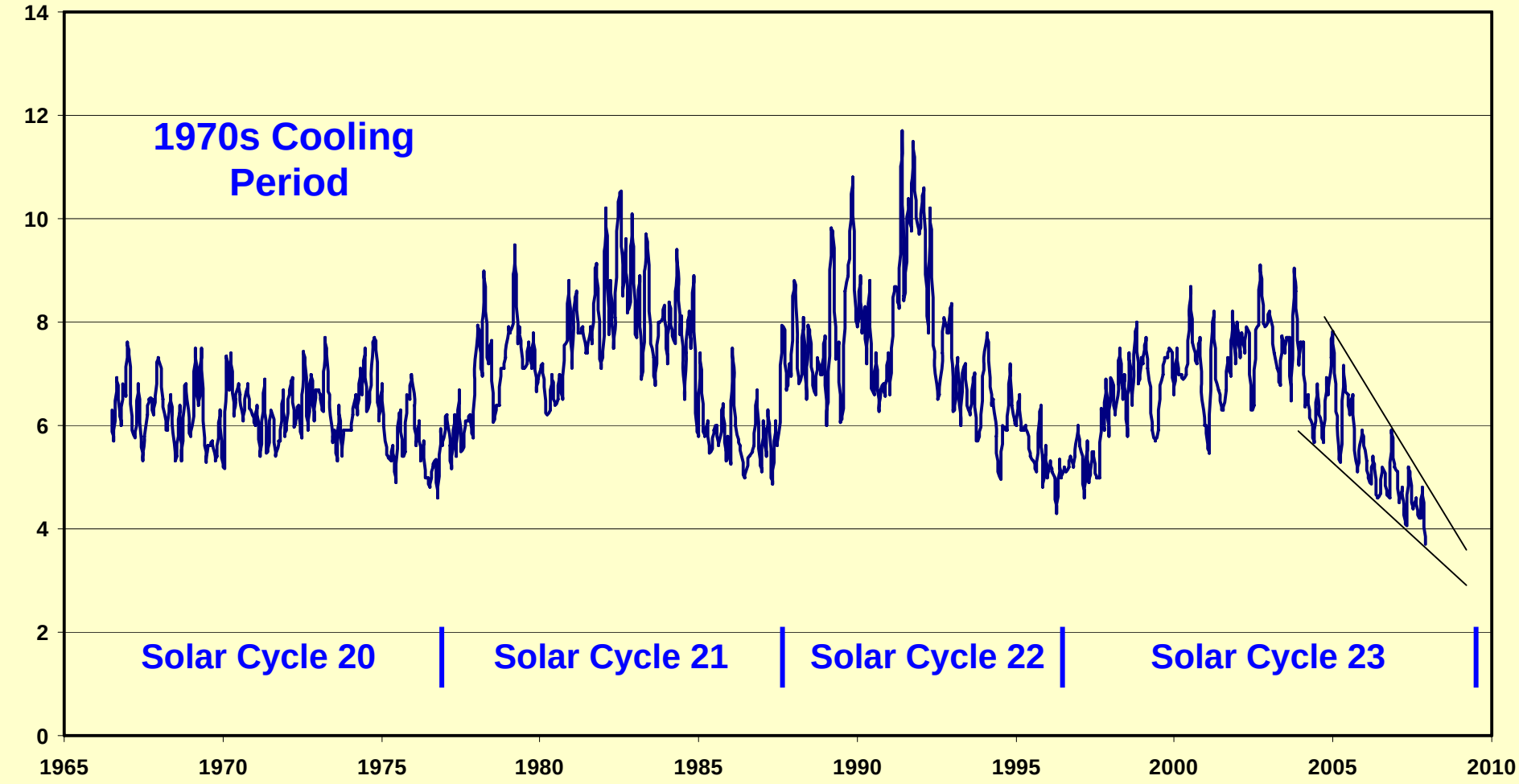


Solar power peak capacity factor dropped 25%.
World temperature dropped by 0.5° C.

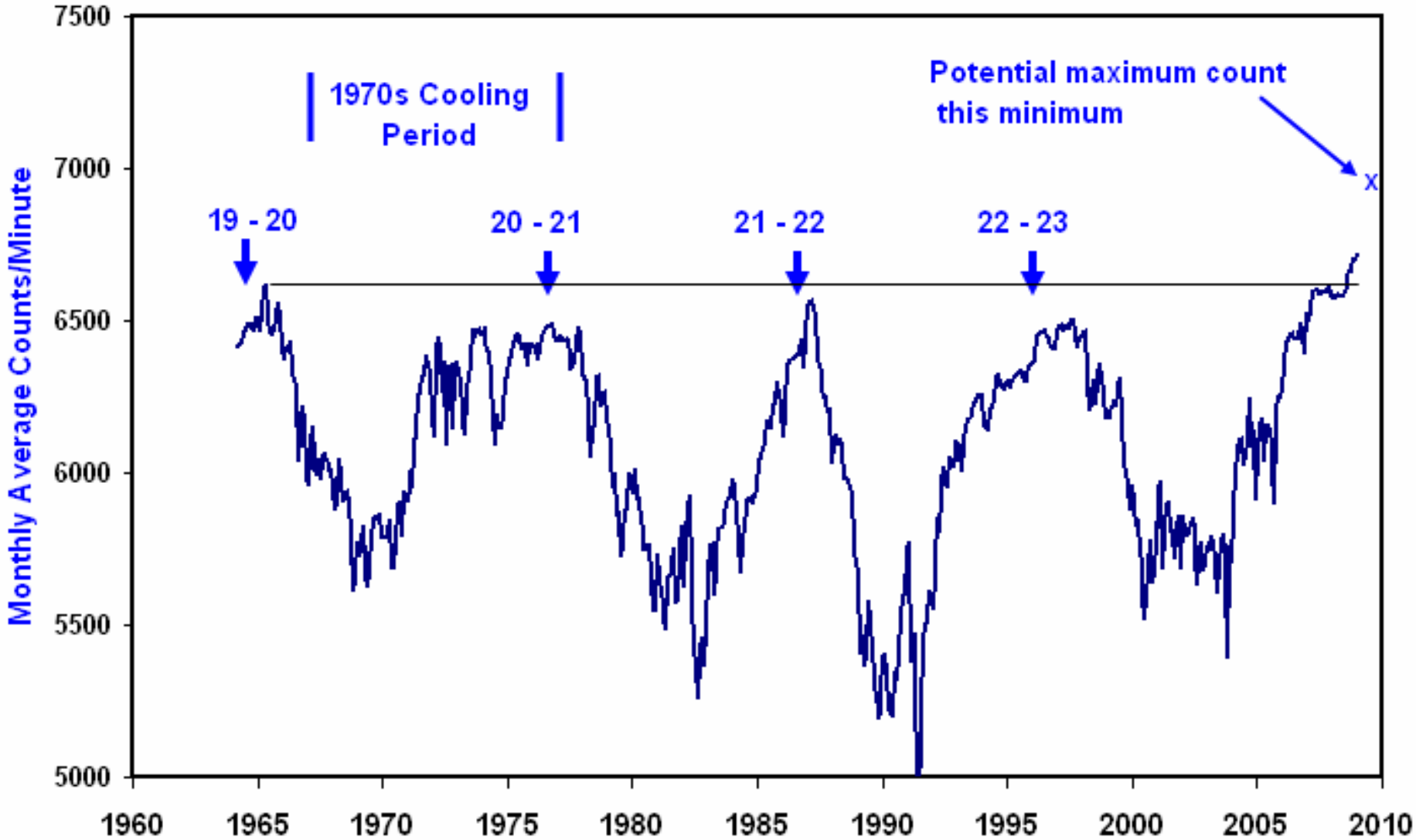
The Solar Dynamo Index



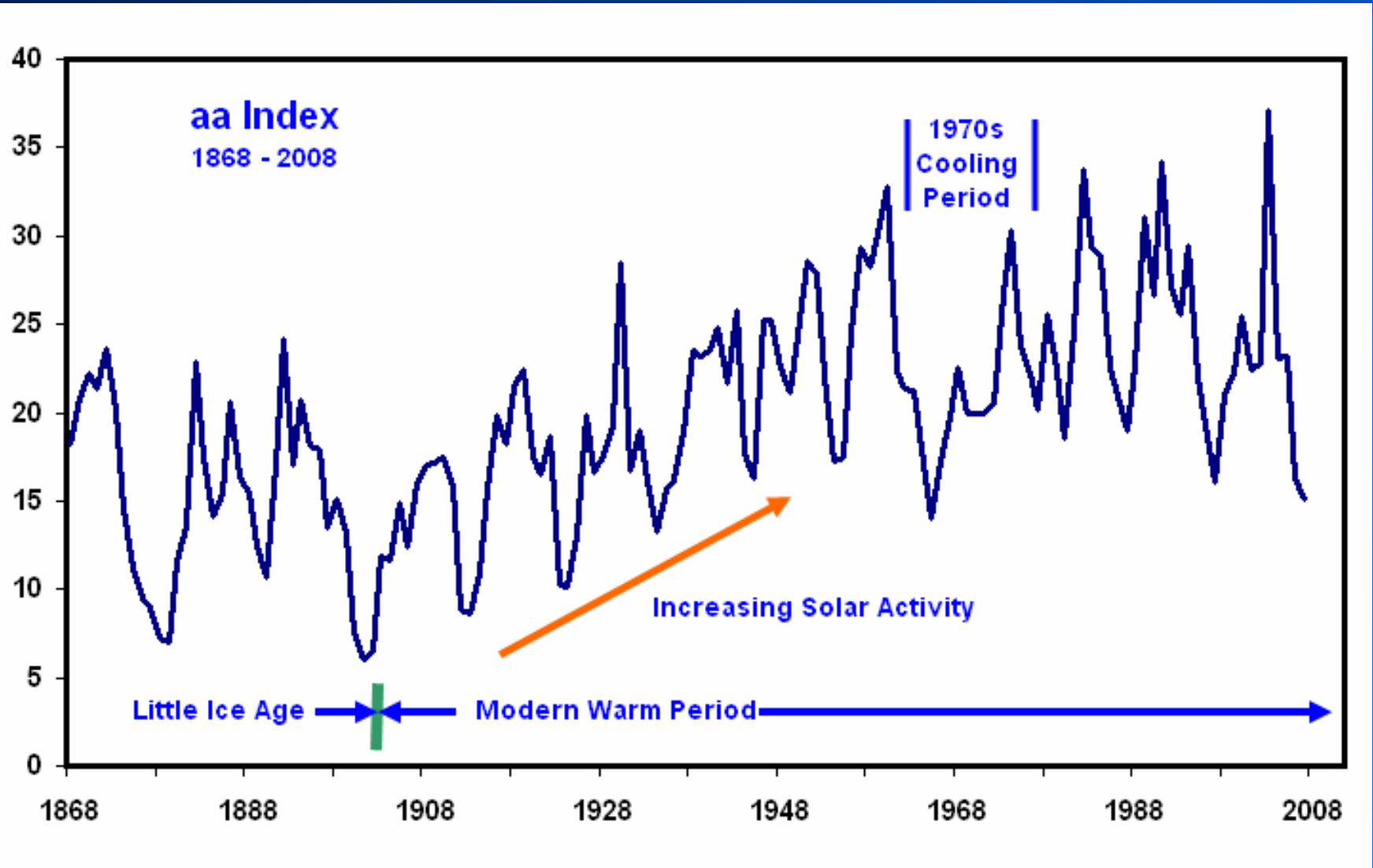
Interplanetary Magnetic Field



Oulu, Finland Neutron Monitor Count
1960 - 2010

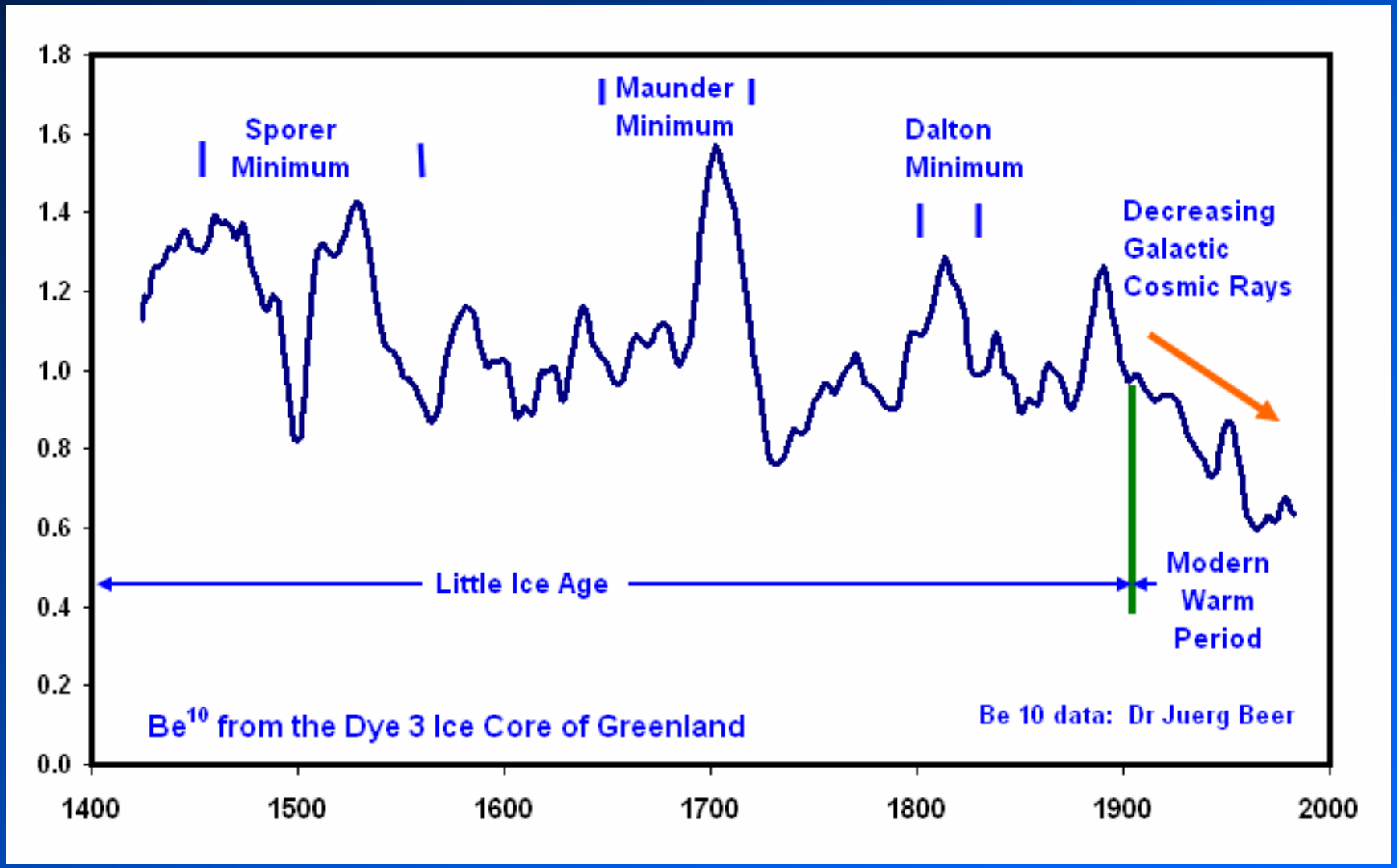


aa Index 1868 - 2008



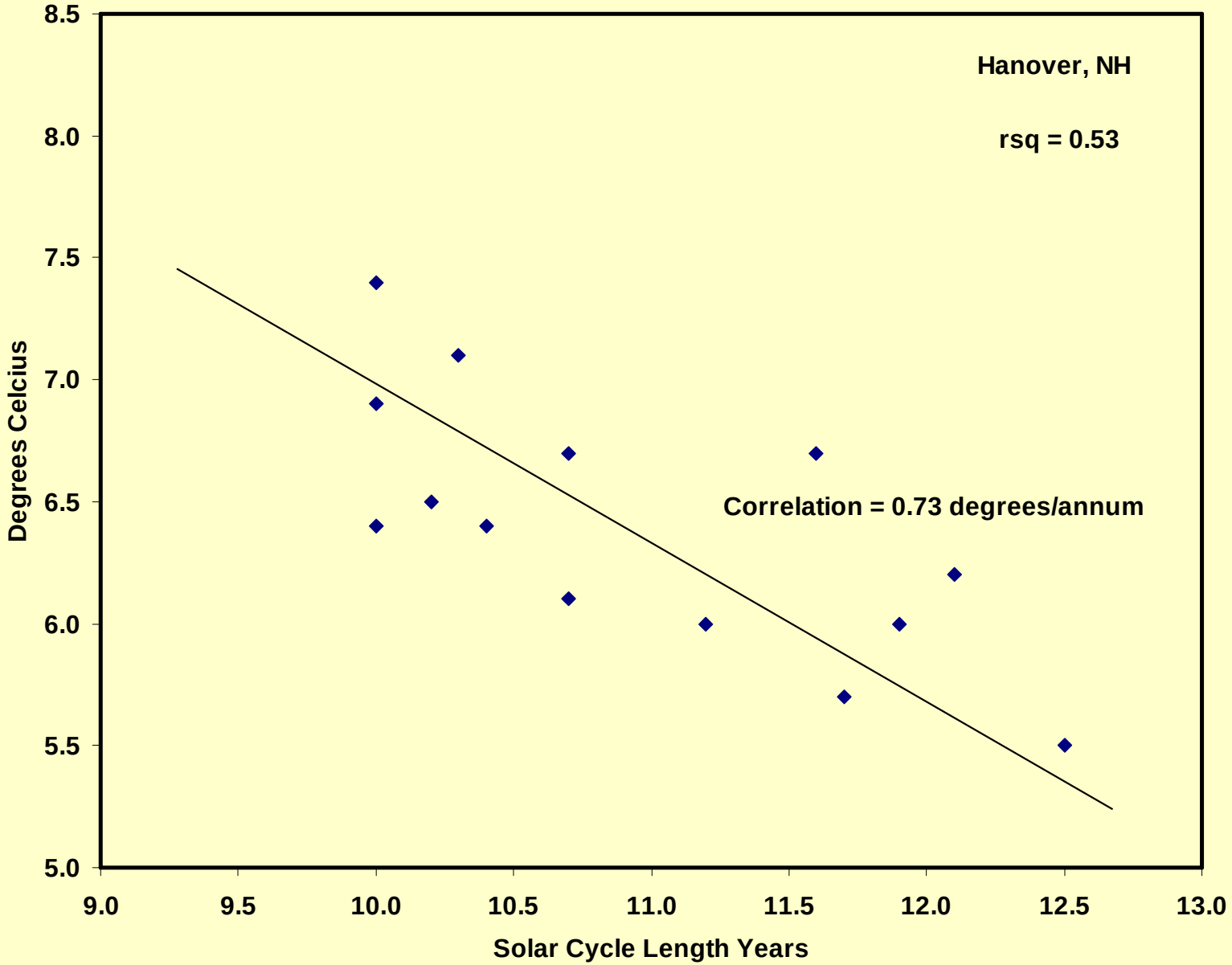
The aa Index was much weaker during the colder climate of the 19th century.

The Be^{10} Record

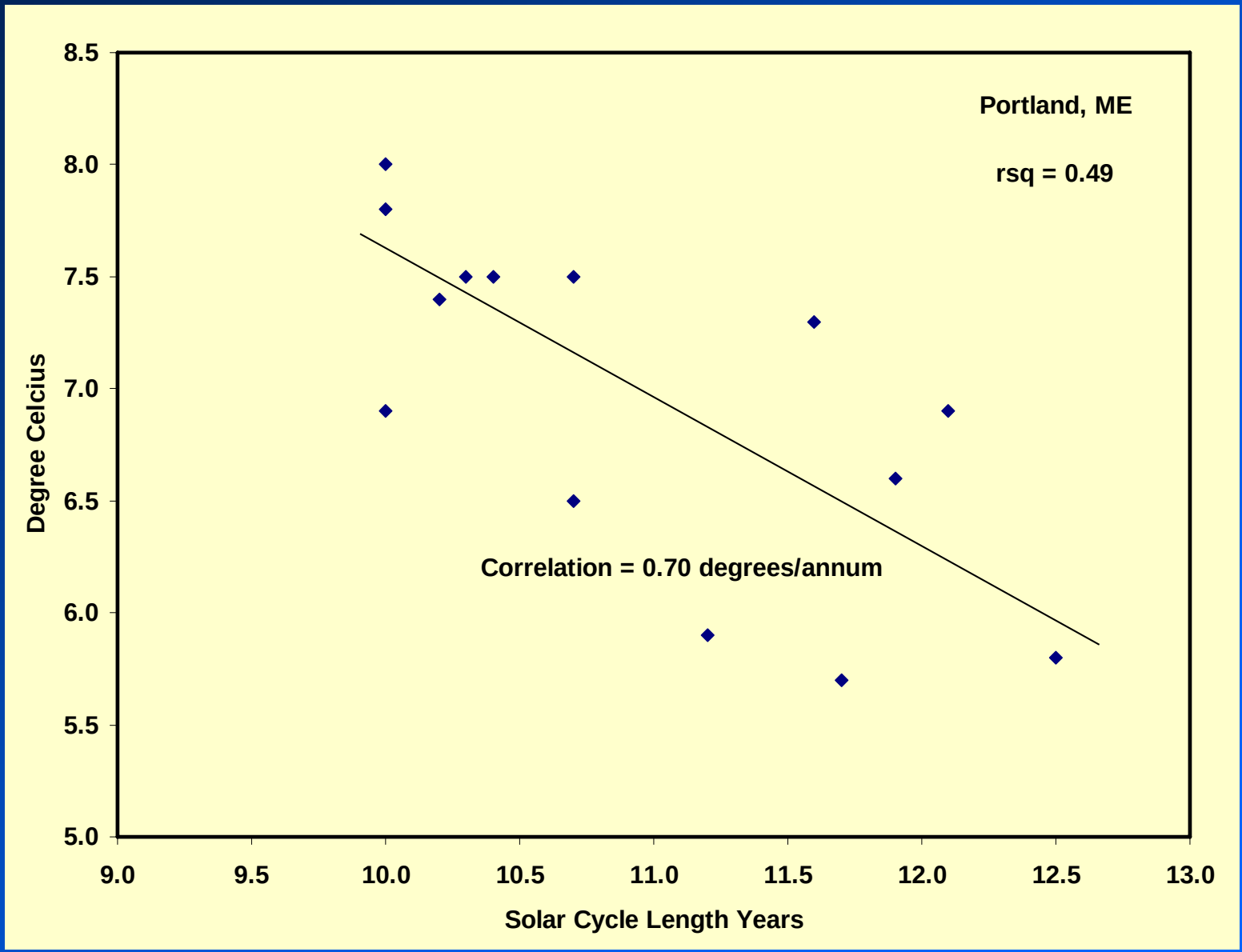


Every cold period shows up in the Be^{10} record, including the late 19th century one. The modern warm period is evident also. The Be10 record is incontrovertible, and good support for Svensmark's theory.

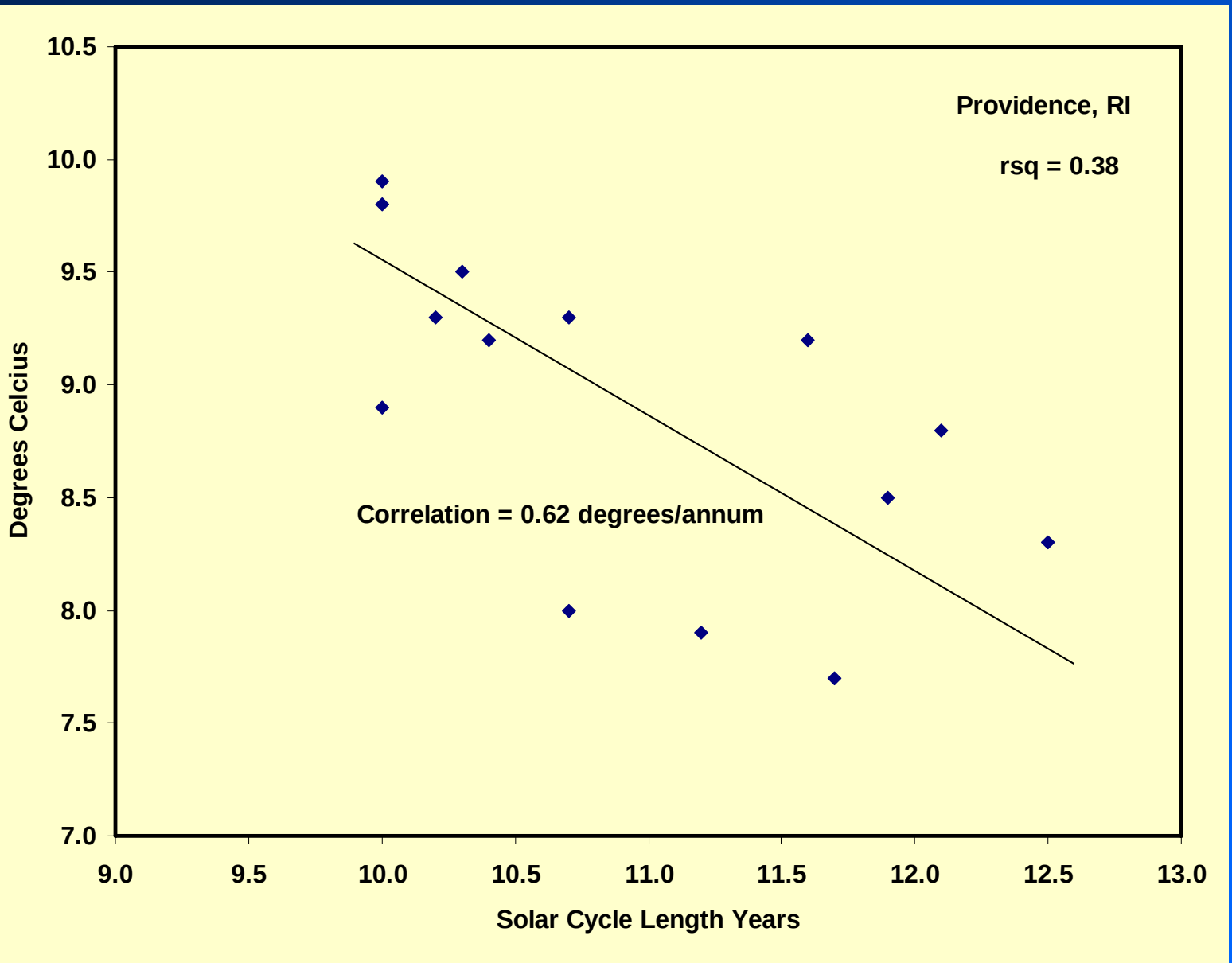
Hanover, NH


Hanover, NH
rsq = 0.53
Correlation = 0.73 degrees/annum
Degrees Celcius
Solar Cycle Length Years
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
9.0
9.5
10.0
10.5
11.0
11.5
12.0
12.5
13.0

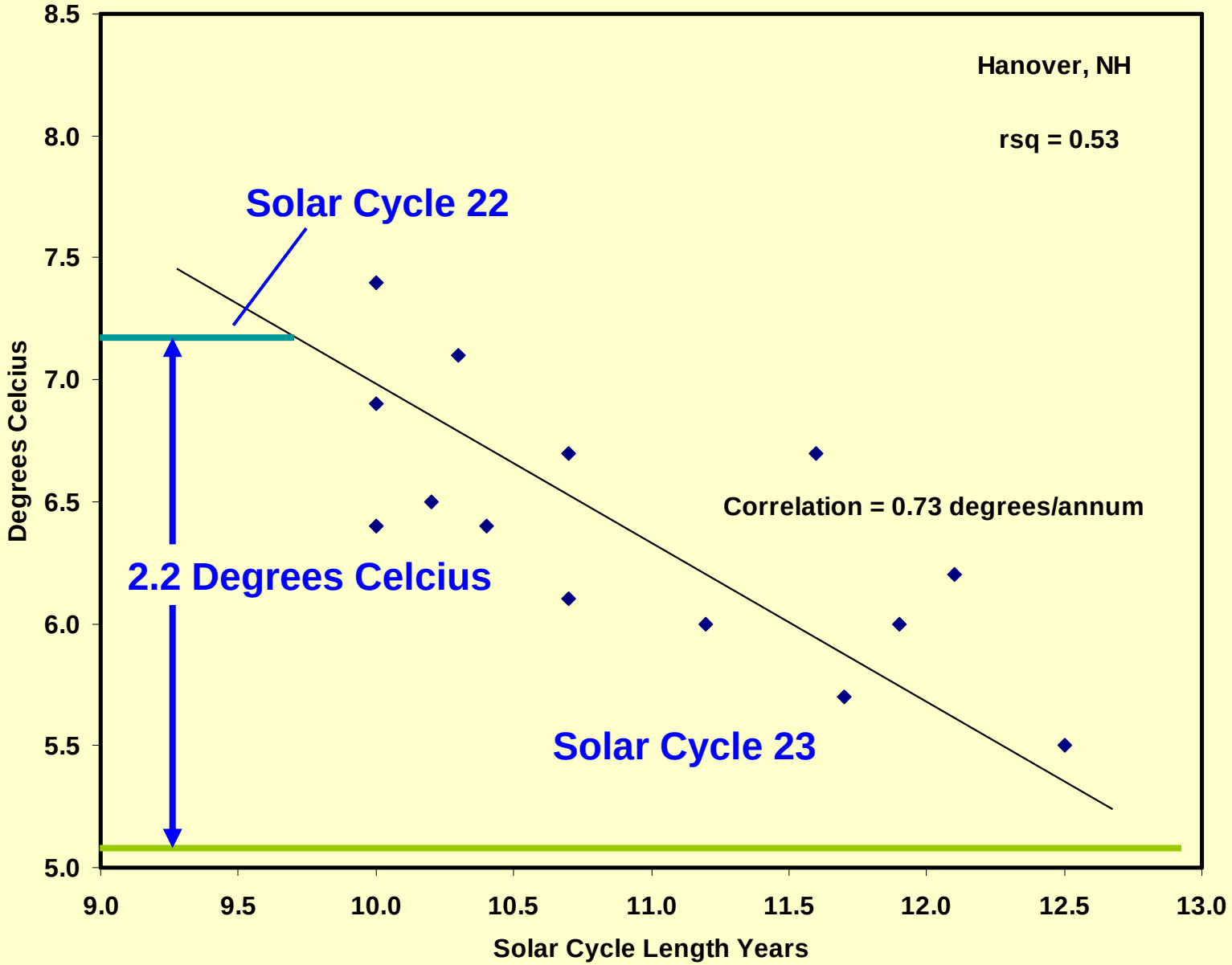
Portland, ME


Portland, ME
rsq = 0.49
Correlation = 0.70 degrees/annum
Degree Celcius
Solar Cycle Length Years
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
9.0
9.5
10.0
10.5
11.0
11.5
12.0
12.5
13.0

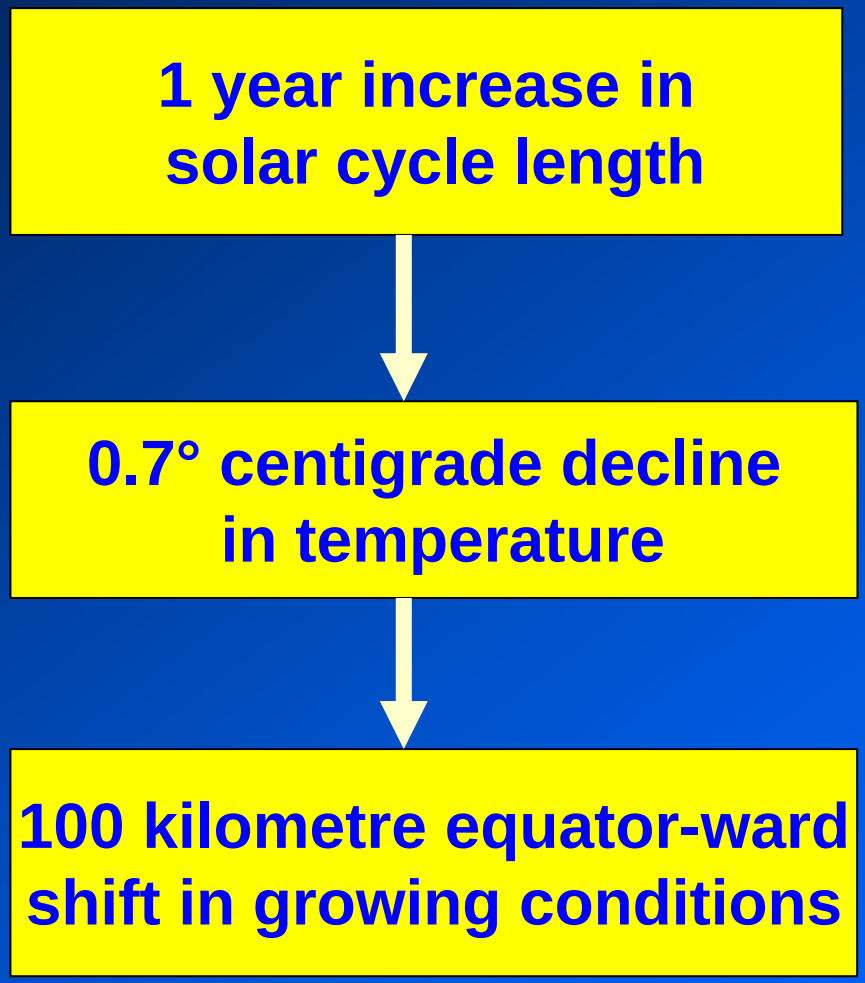
Providence, RI



Hanover, NH


Hanover, NH
rsq = 0.53
Solar Cycle 22
Correlation = 0.73 degrees/annum
2.2 Degrees Celcius
Solar Cycle 23
Degrees Celcius
Solar Cycle Length Years
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
9.0
9.5
10.0
10.5
11.0
11.5
12.0
12.5
13.0

The Consequential Climate Shift

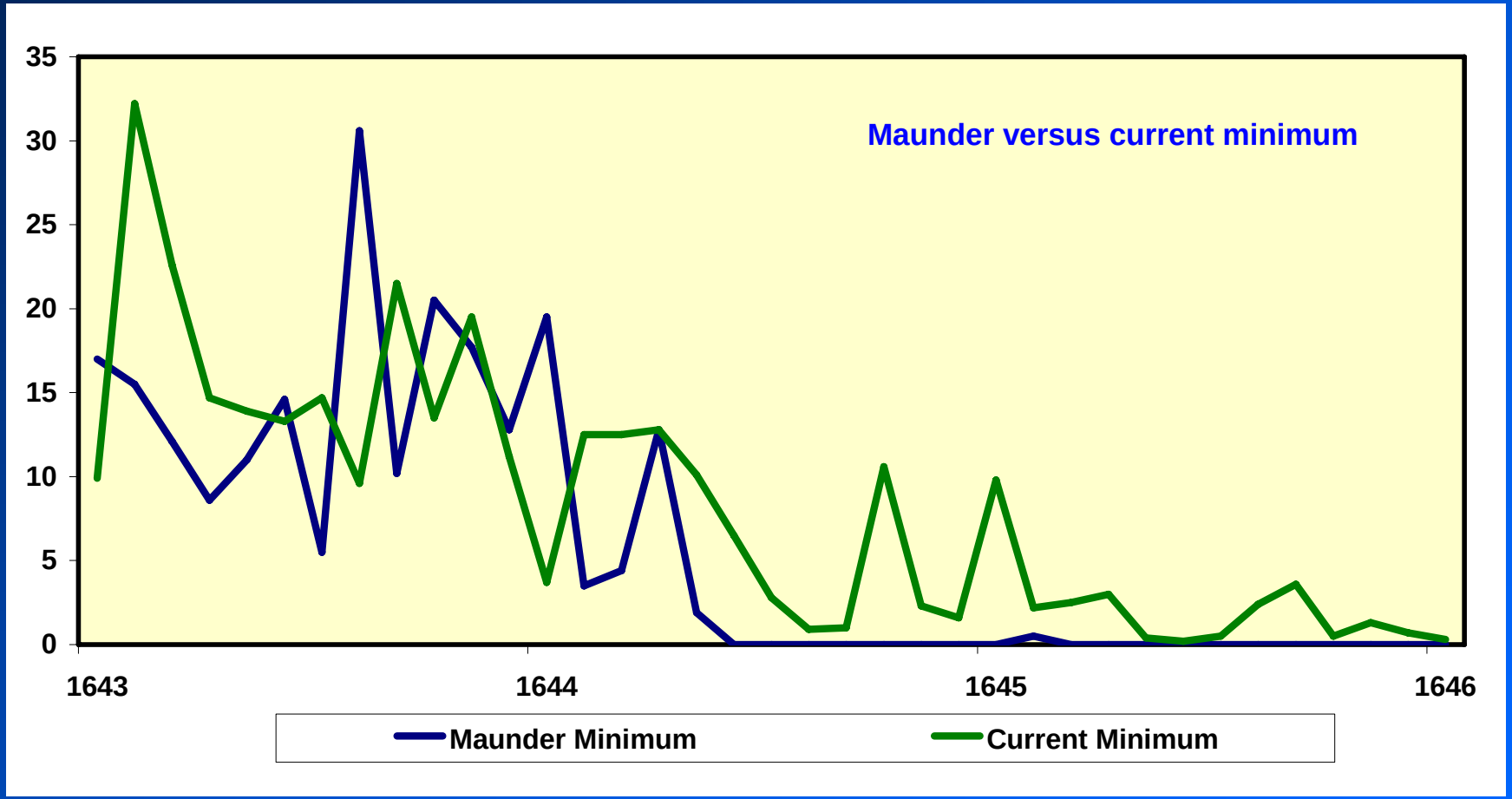


Another Dalton Minimum, or Worse?

“The surprising result of these long-range predictions is a rapid decline in solar activity, starting with cycle #24. If this trend continues, we may see the Sun heading towards a “Maunder” type of solar activity minimum - an extensive period of reduced levels of solar activity.”

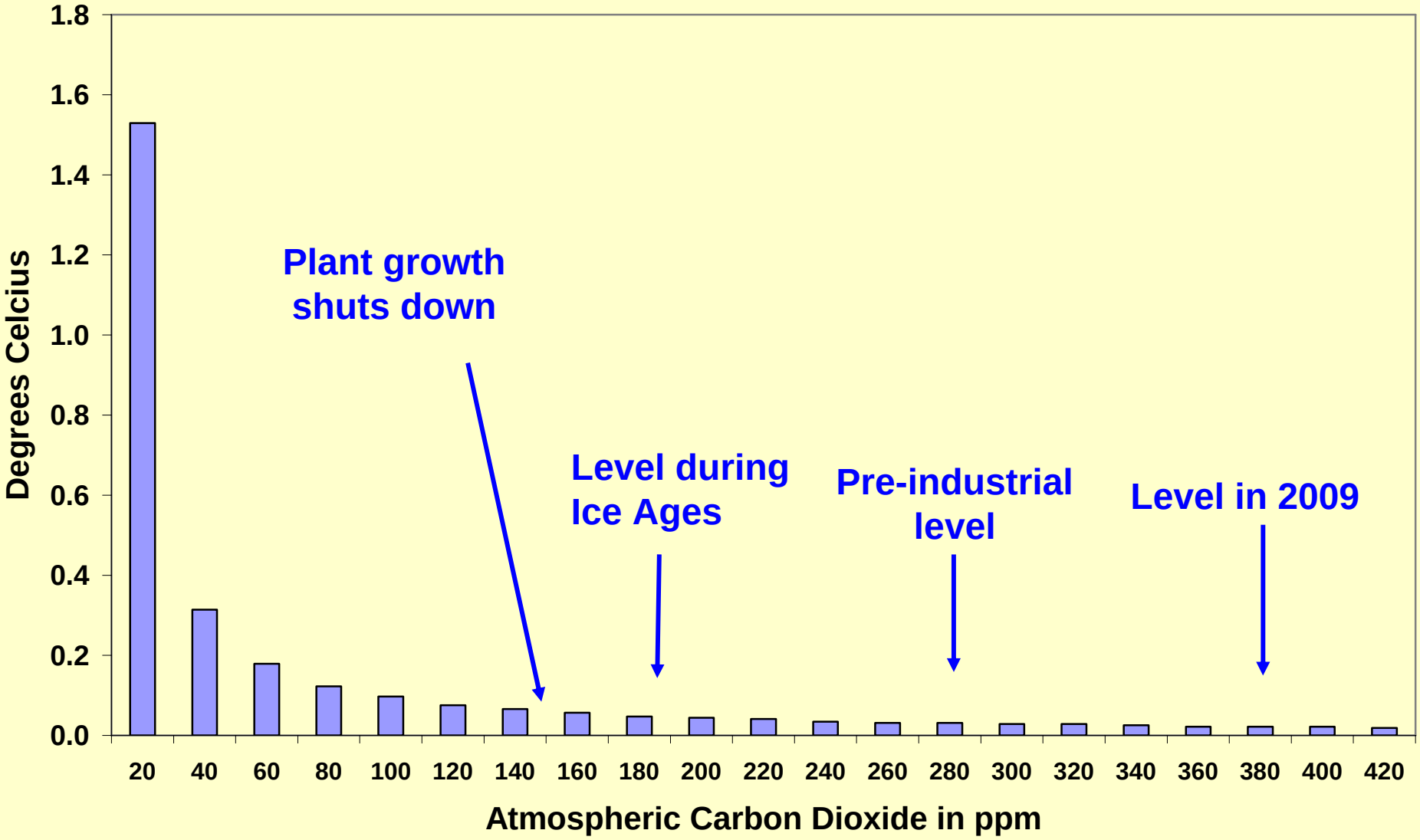
K.H.Schatten and W.K.Tobiska, 34th Solar Physics Division Meeting, June 2003, American Astronomical Society

The start of the Maunder Minimum plotted against the current minimum.

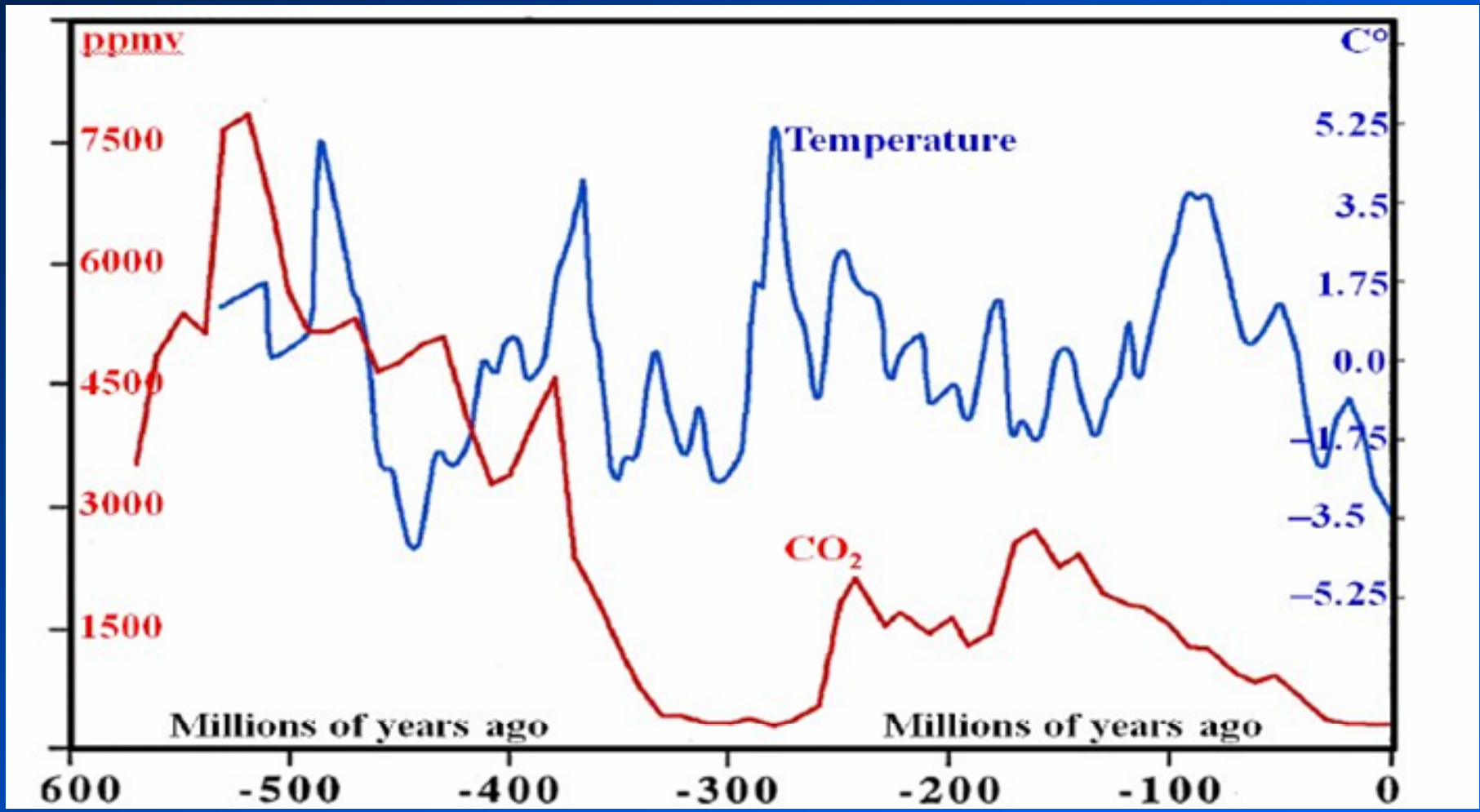


The match is good given that we are counting a lot of tiny spots now.

Section 3: The Contribution of Carbon Dioxide

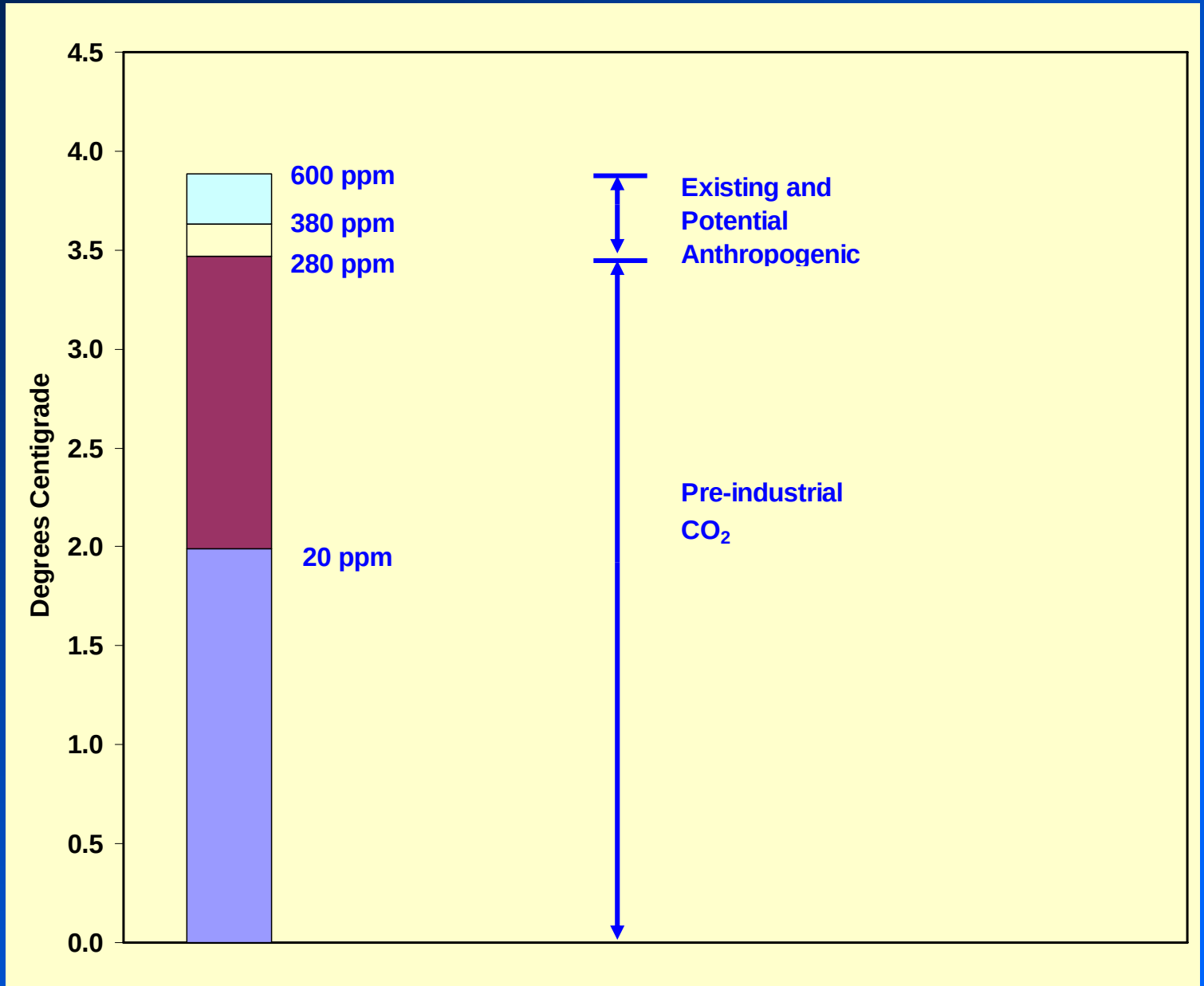


600 Million Years of Temperature and Carbon Dioxide

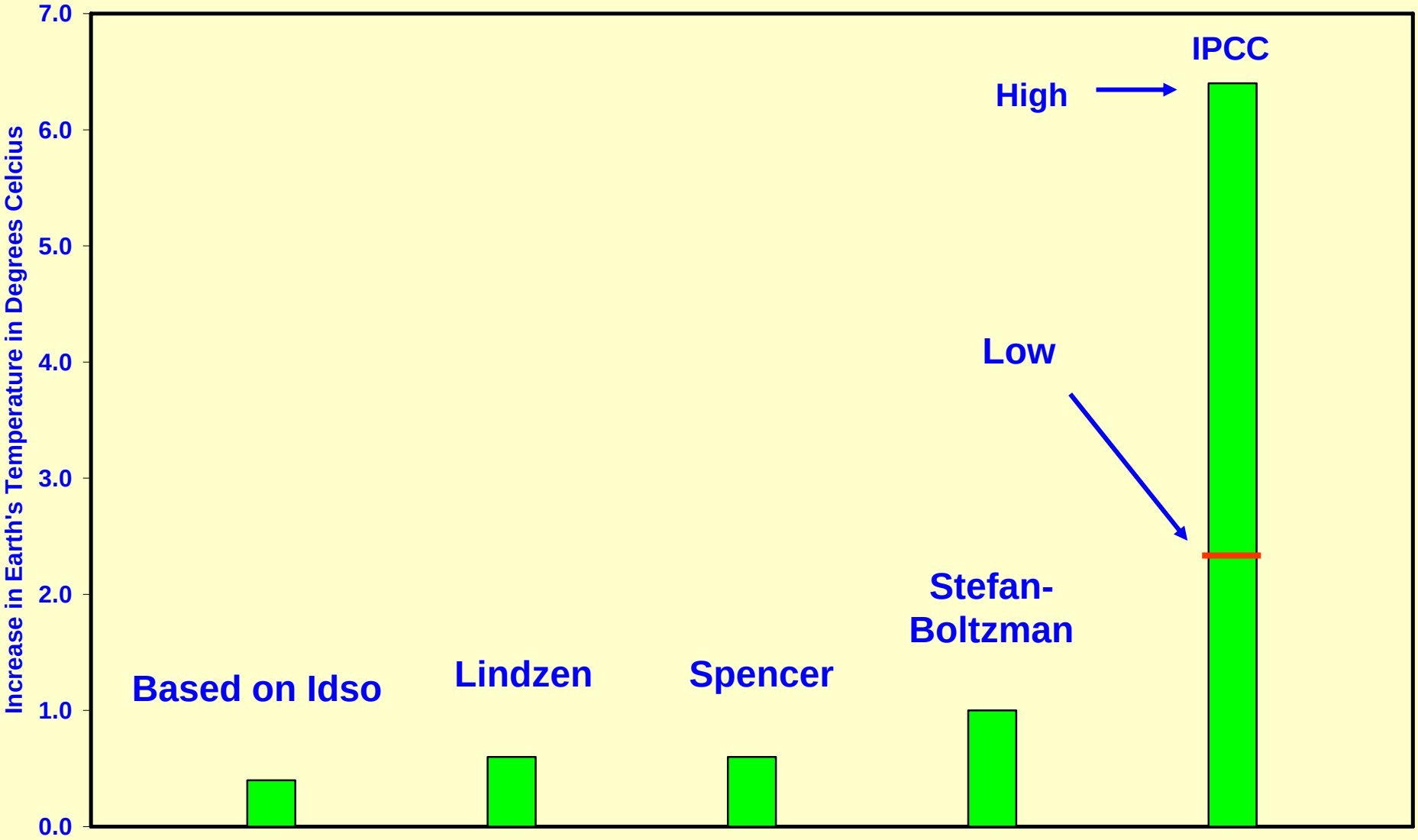


Over the last 150 million years, geological processes have taken 90% of the carbon dioxide out of the atmosphere.

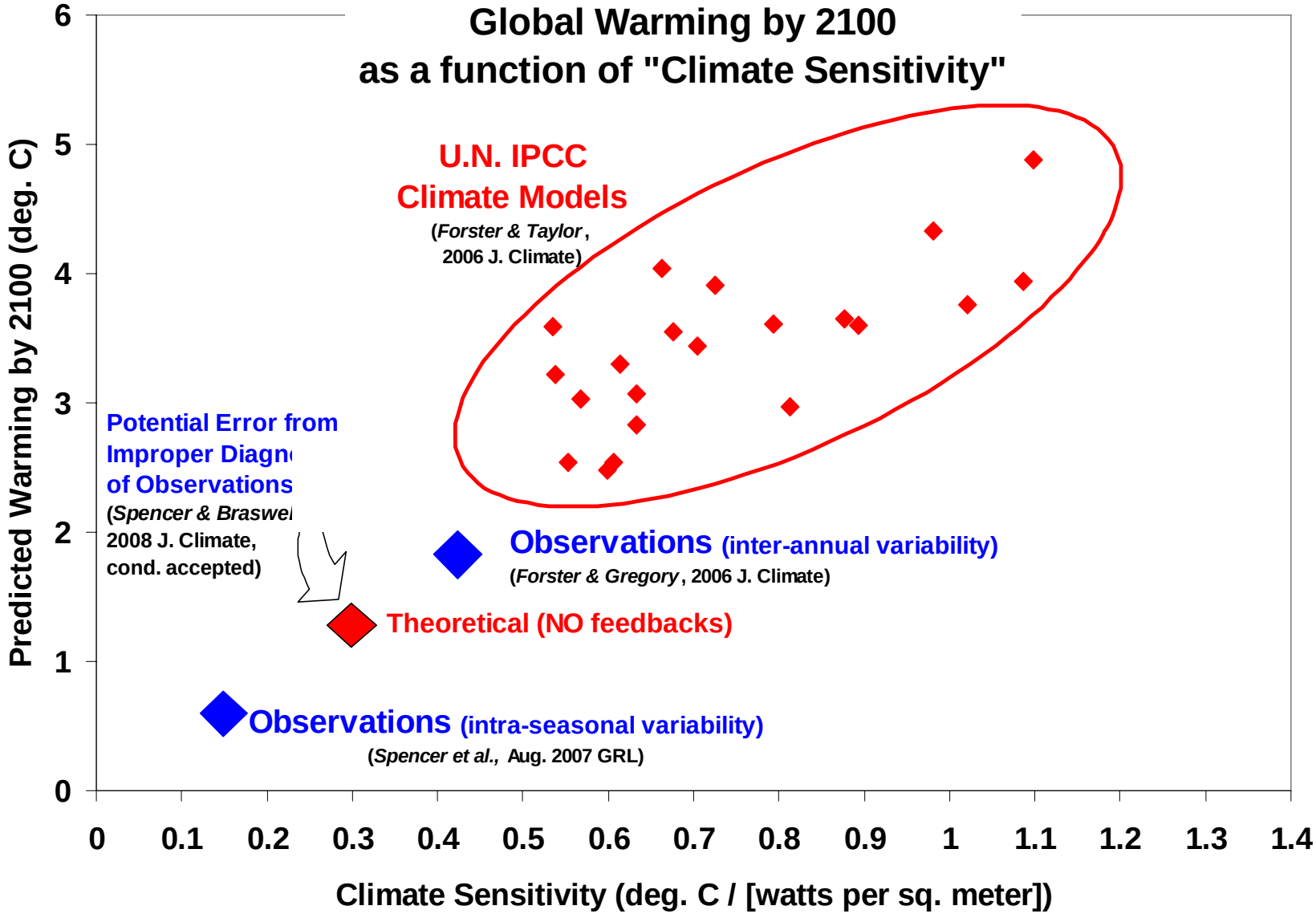
Relative Contributions of Pre-Industrial and Anthropogenic CO2



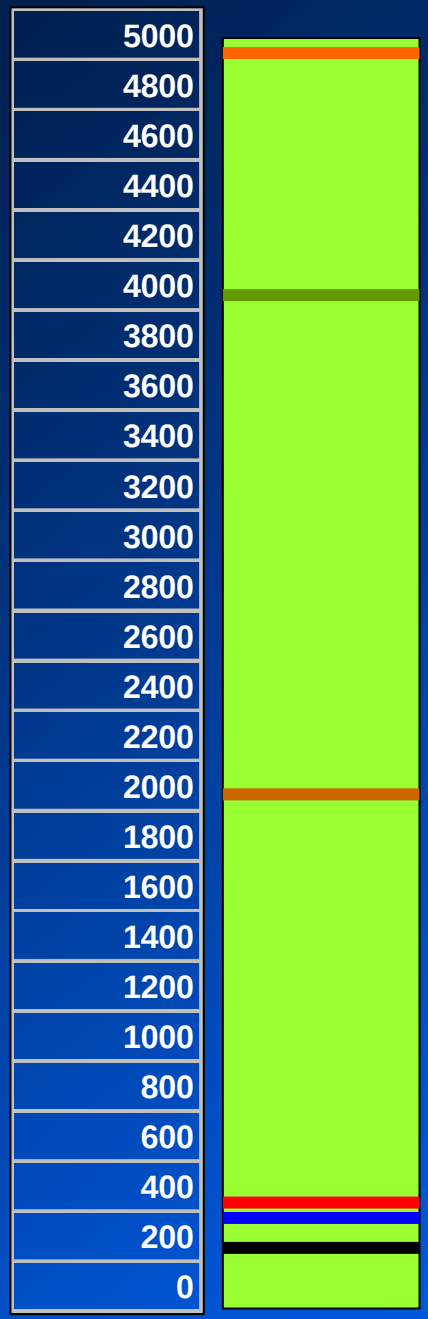
Comparison of Climate Sensitivity Estimates
280 ppm to 560 ppm of CO_2



How Do the Observational Estimates of Feedback Compare to Climate Models?



Correct Safe Limit



500 million years ago

400 million years ago

150 million years ago

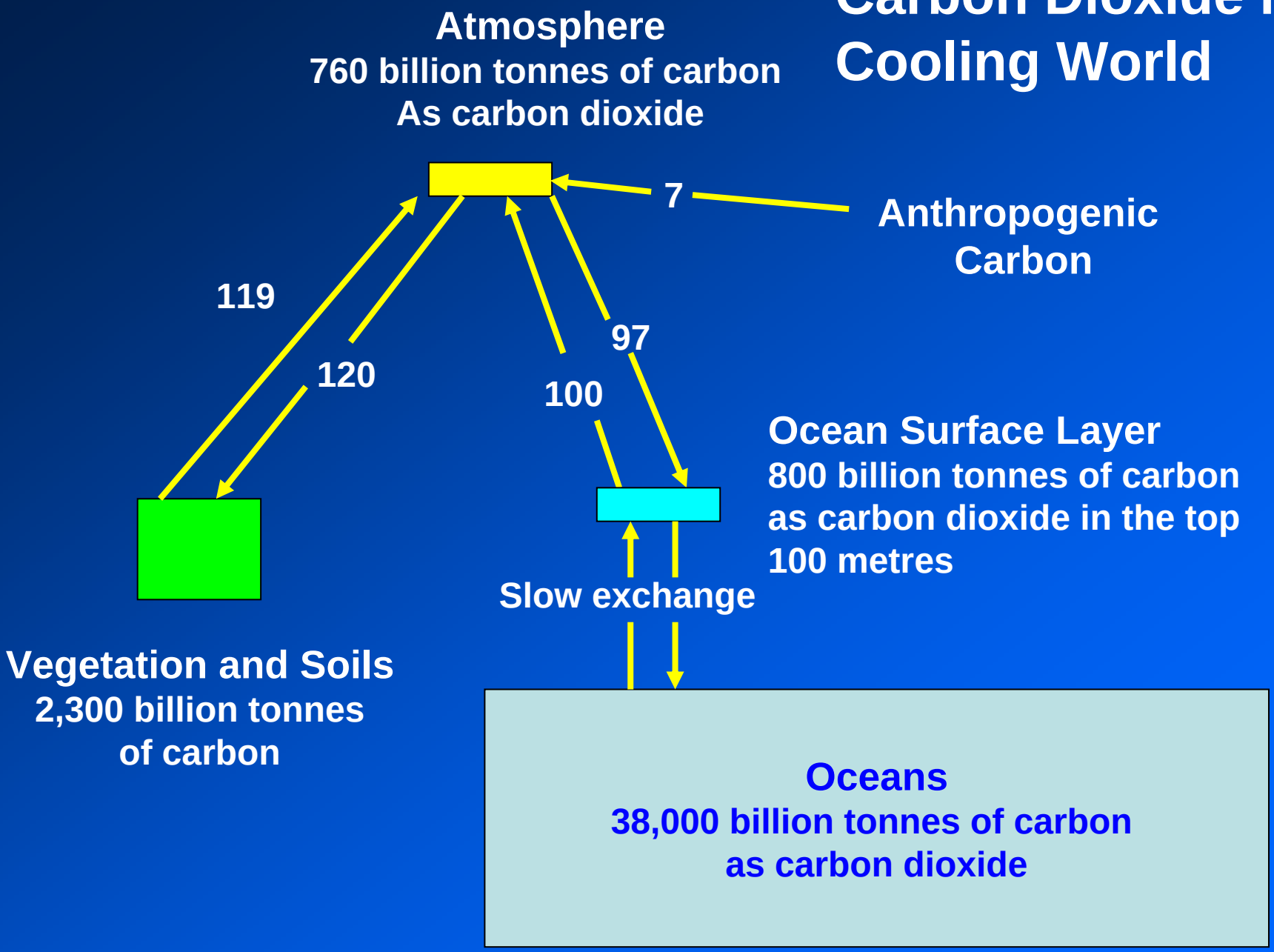
"the safe upper limit for atmospheric CO2 is no more than 350 ppm"
– Dr Hansen of NASA, American Geophysical Union meeting, San Francisco, December 2007

Dr Hansen's safe upper limit

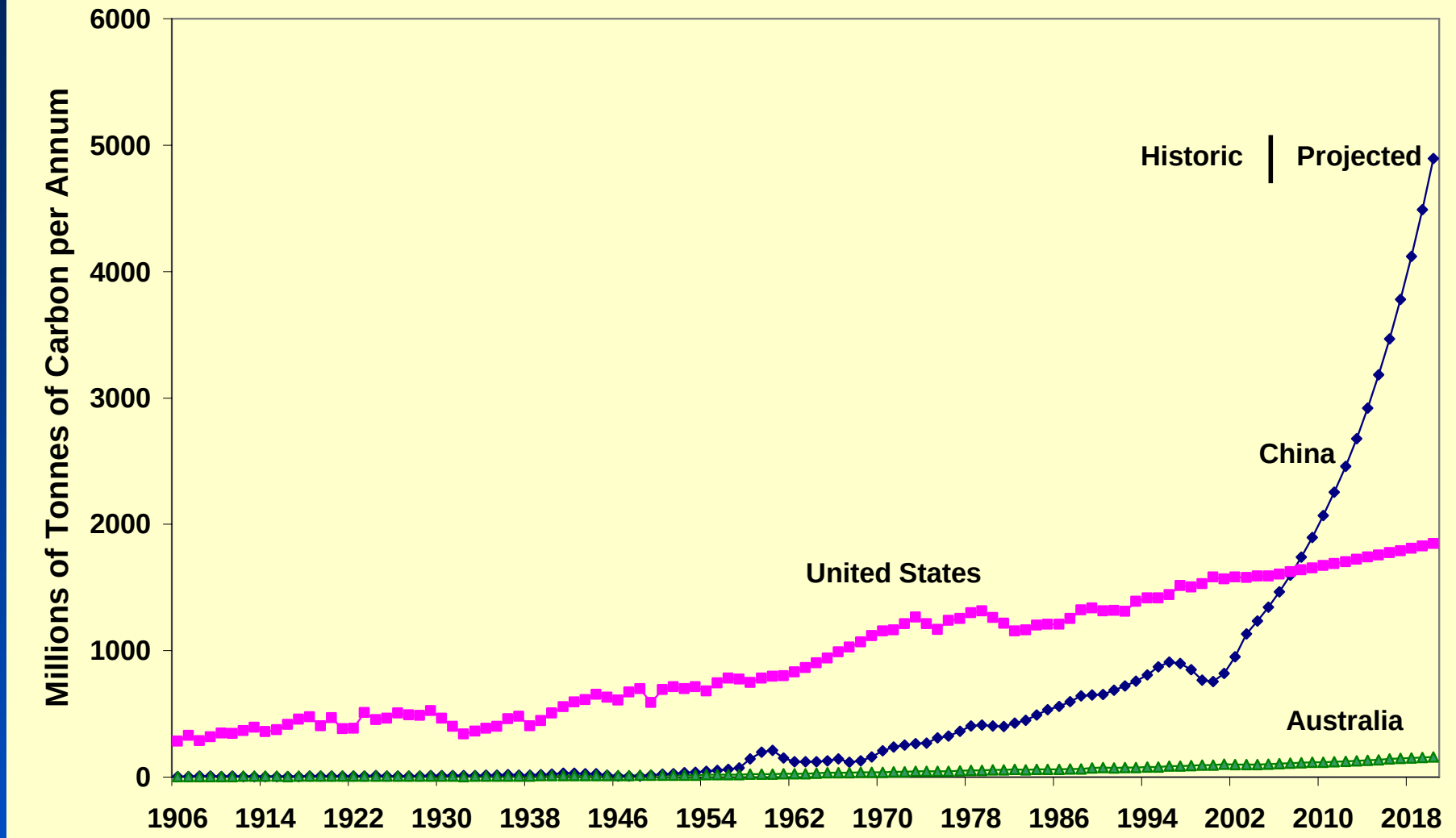
Pre-industrial level of 280 ppm

Level reached during interglacials, level below which plant growth shuts down

Carbon Dioxide in a Cooling World

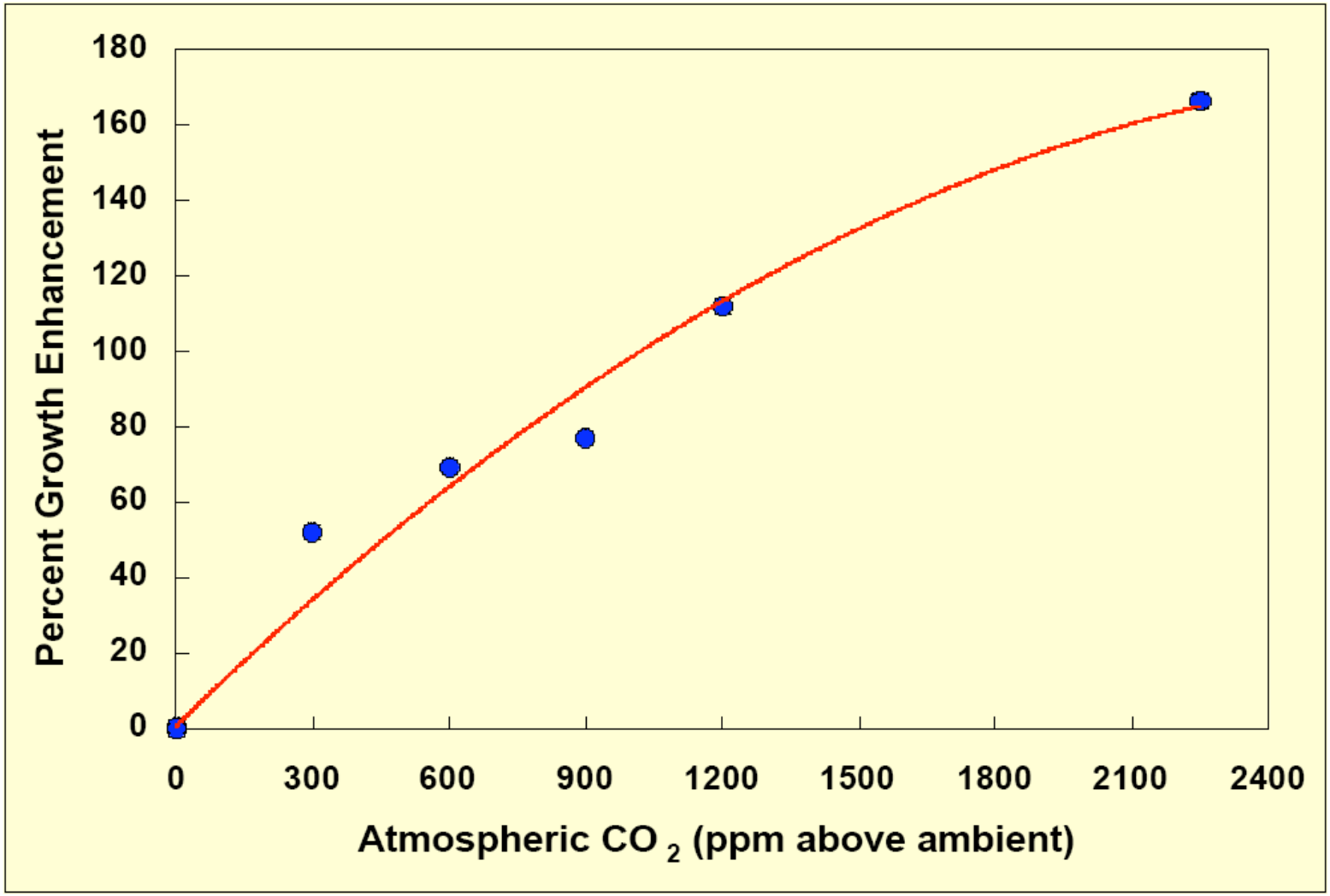


Historic and Projected Atmospheric Carbon Contributions by the United States, China and Australia



Section 4: The Benefit to Plant Growth

Can Carbon Dioxide be even a little bit bad?



Average Growth Enhancement due to a 300 ppm increase in atmospheric carbon dioxide

C_3 Cereals	49%
C_4 Cereals	20%
Fruits and Melons	24%
Legumes	44%
Roots and Tubers	48%
Vegetables	37%

Source: Idso May 2007

Global Warming Alarmists are Exactly Wrong.

1. The Earth is getting colder and this will accelerate.
2. Carbon dioxide has a minuscule warming effect.
3. Increased atmospheric carbon dioxide will increase agricultural productivity.
4. The ideal atmospheric carbon dioxide level is a minimum of 1,000 ppm

Why not give the economy the benefit of the doubt?

The Carbon Tax will:

1. **Close all seven oil refineries in Australia.**
2. **Shift of energy-intensive processing to China - goodbye to the aluminium industry**
3. **Close most cement plants in Australia.**
4. **Reduce mining by one third.**
5. **Take us back to the 1930s in terms of standard of living.**

Carbon capture is idiotic.

Source	Projected Increase in Cost of Electricity from Addition of CCS
Duke Energy Indiana[10]	68%
MIT Future of Coal Report[11]	61%
Edison Electric Institute[12]	75%
National Energy Technology Laboratory[13]	81%

The cost of power would go up 80%
-putting a lot of people out of work
- we would burn through our coal reserves 80% faster.

What is sustainable about that?

- The South Australian ban on plastic shopping bags will save 400 million bags per annum.
- At 7 grams per bag, that is 2,800 tonnes – equivalent to 33,000 tonnes nationally.
- We burn 120 million tonnes of coal per annum to make electricity.
- Carbon capture at 80% would require us to burn another 100 million tonnes per annum.

Institutional Failure

- **Normally the CSIRO and the universities are gatekeepers protecting the public from carpetbaggers and rent-seekers.**
- **In this instance they have sold out (CSIRO has 500 staff devoted to global warming with a budget of $120 million).**
- **It is now a question of how angry the public will get when they realise that their lives have been severely disrupted for no good reason.**

Solar Cycle 24 – The Book