AusIMM New Leaders' Conference

Climate Change: Relative Solar and Anthropogenic Forcings

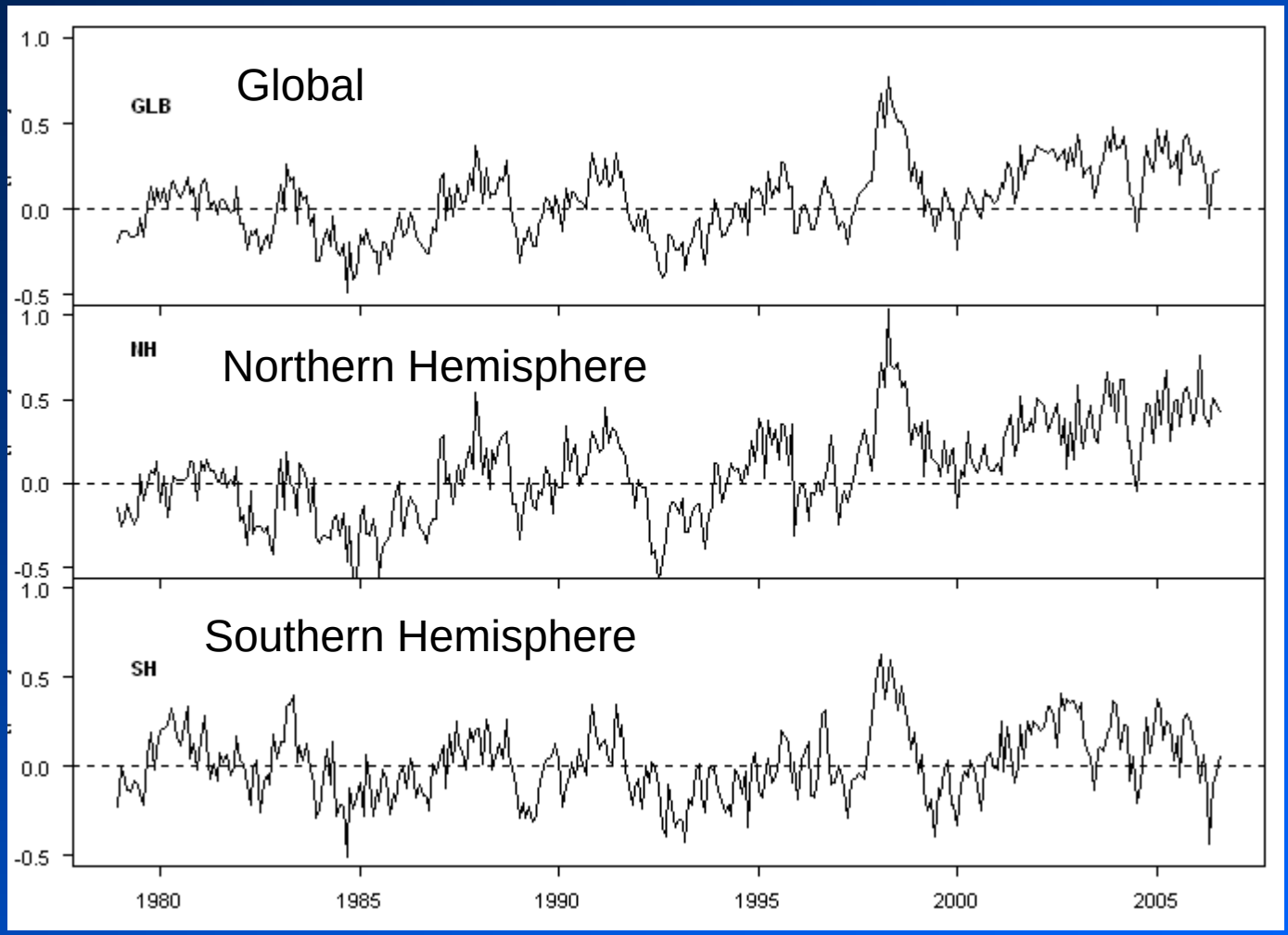
David Archibald

Brisbane, April 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: Climate Science

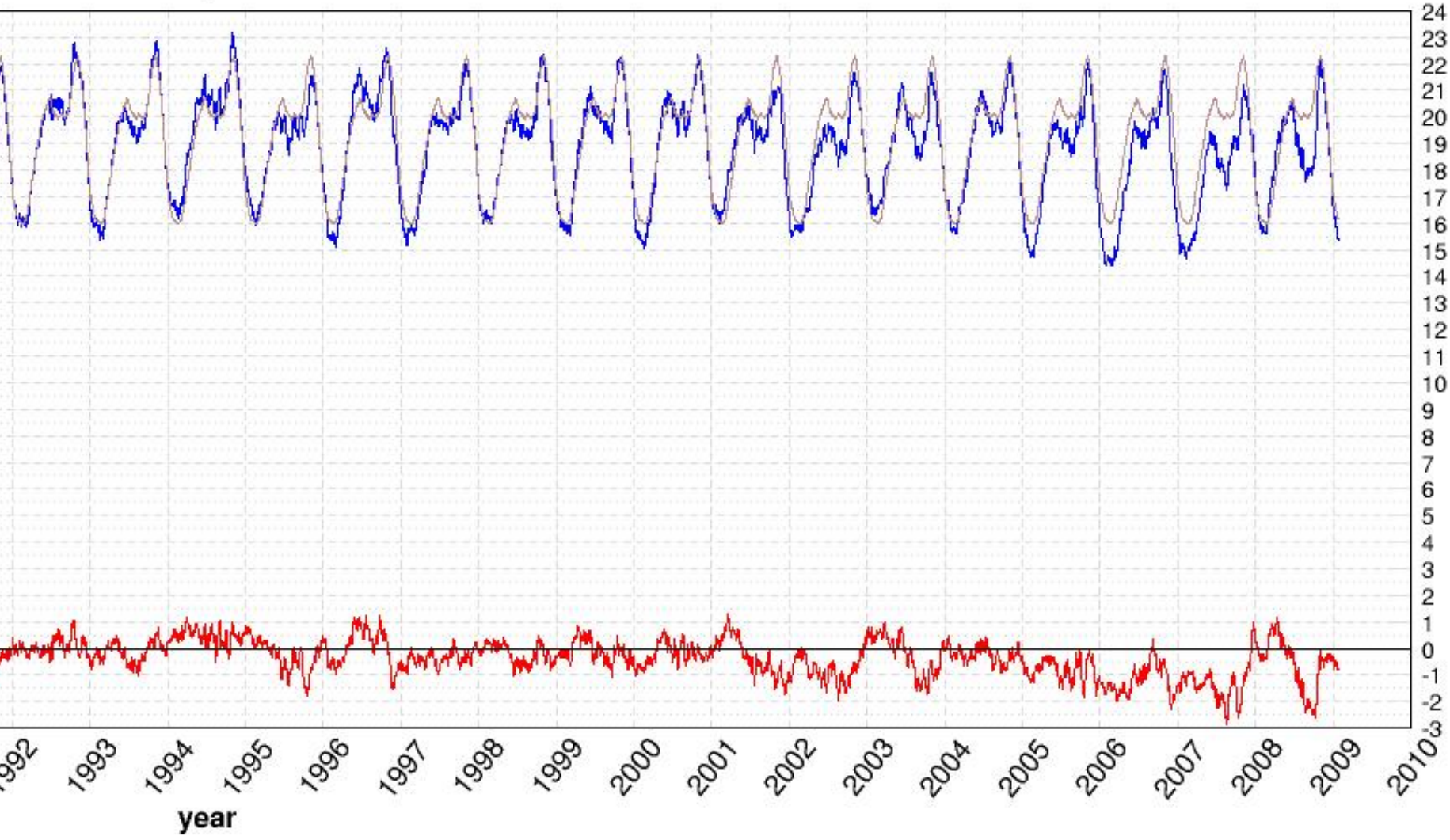


The 30 years of High Quality Satellite Data

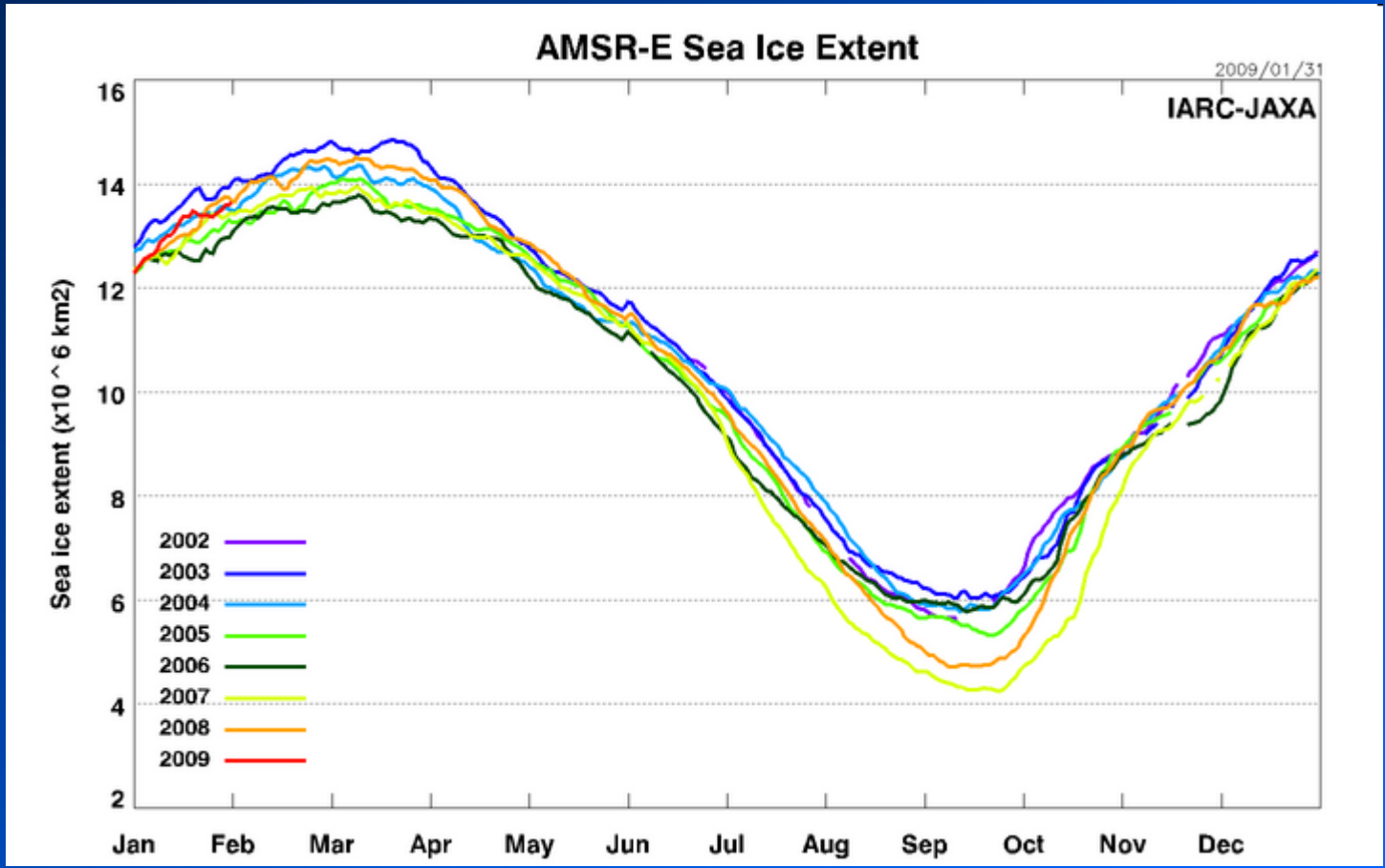
The Southern Hemisphere is the same temperature it was 28 years ago, the Northern Hemisphere has warmed slightly.

Global Sea Ice Area

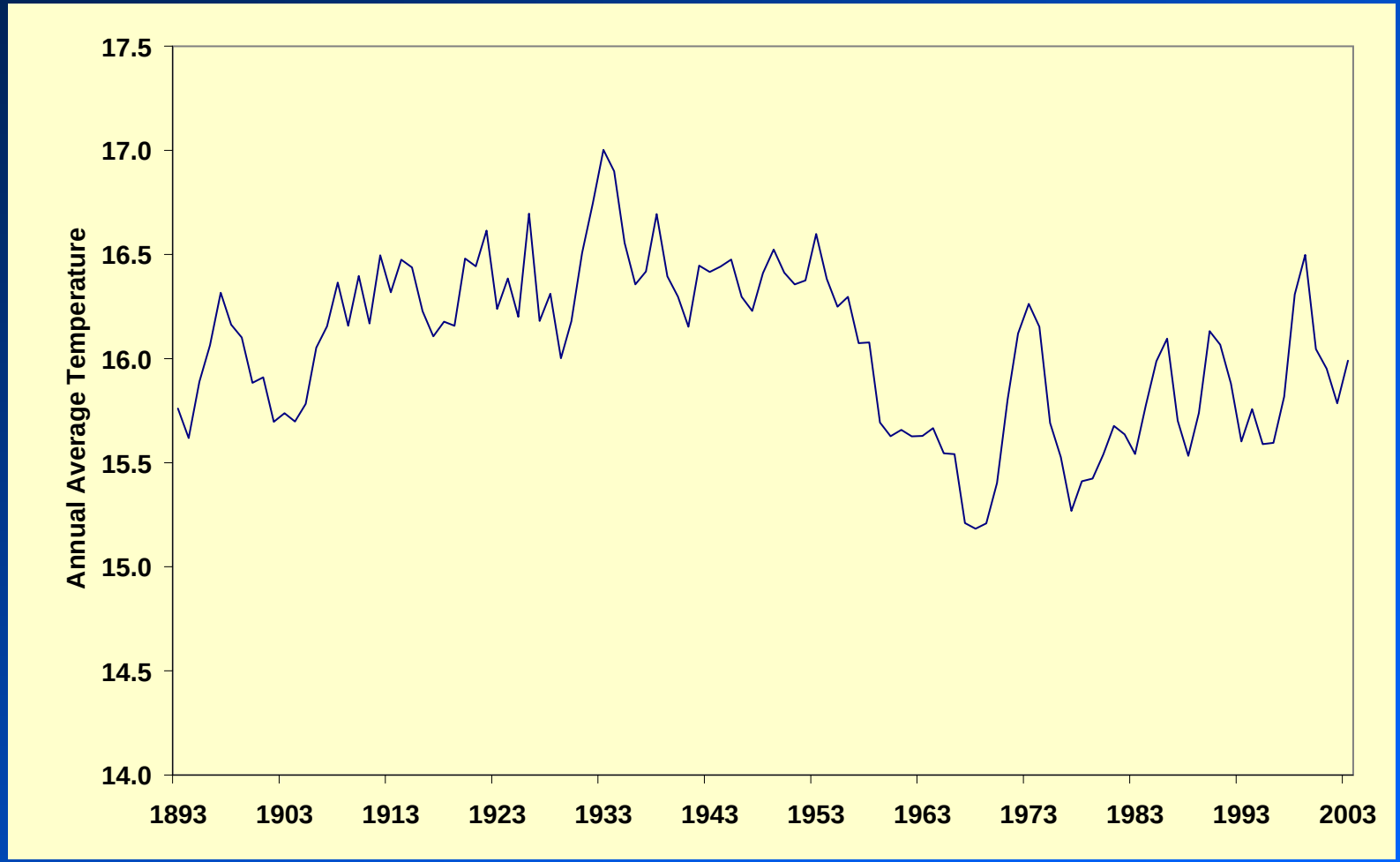
1979 - present



Sea ice extent is back to normal in winter.

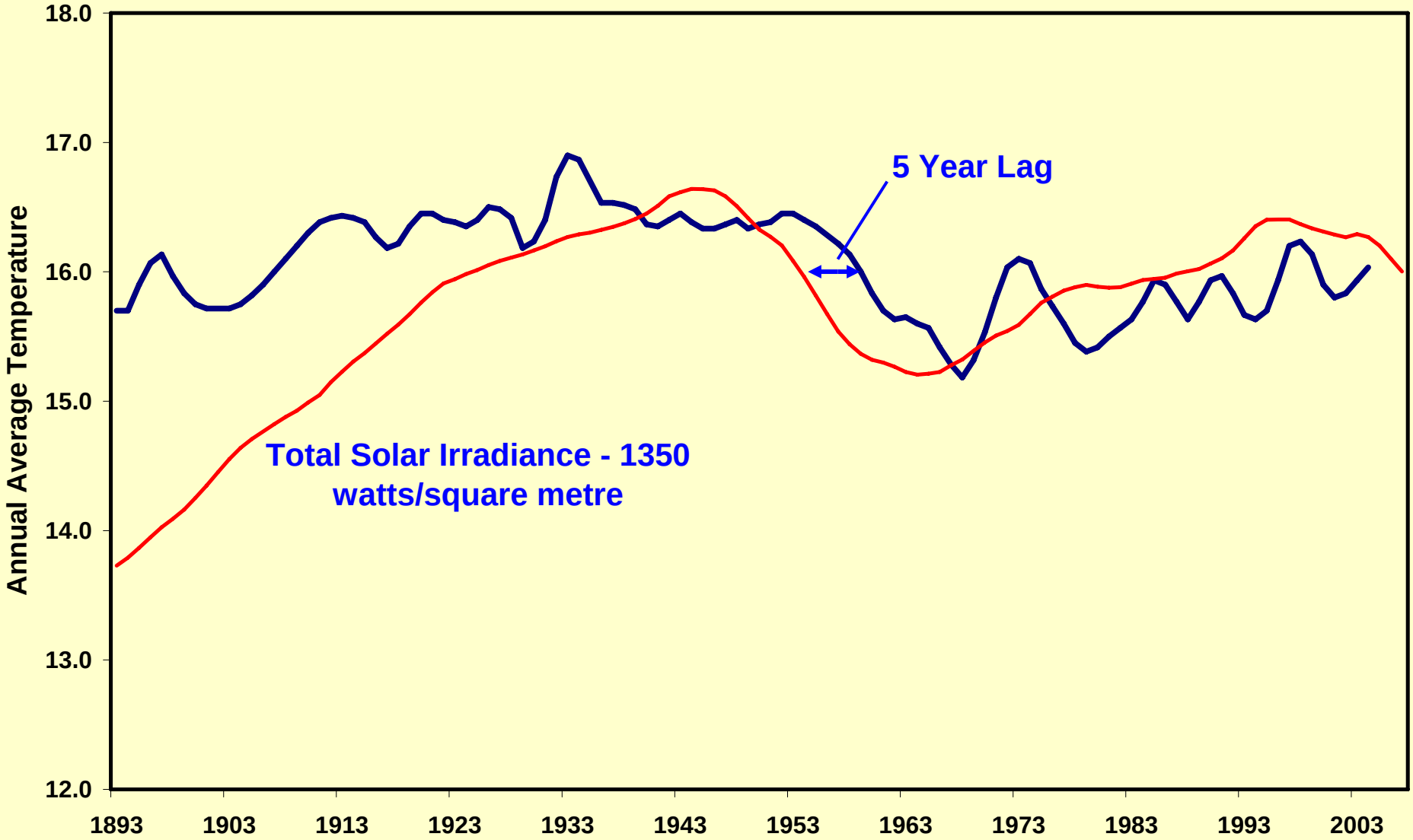


A Rural US Data Set



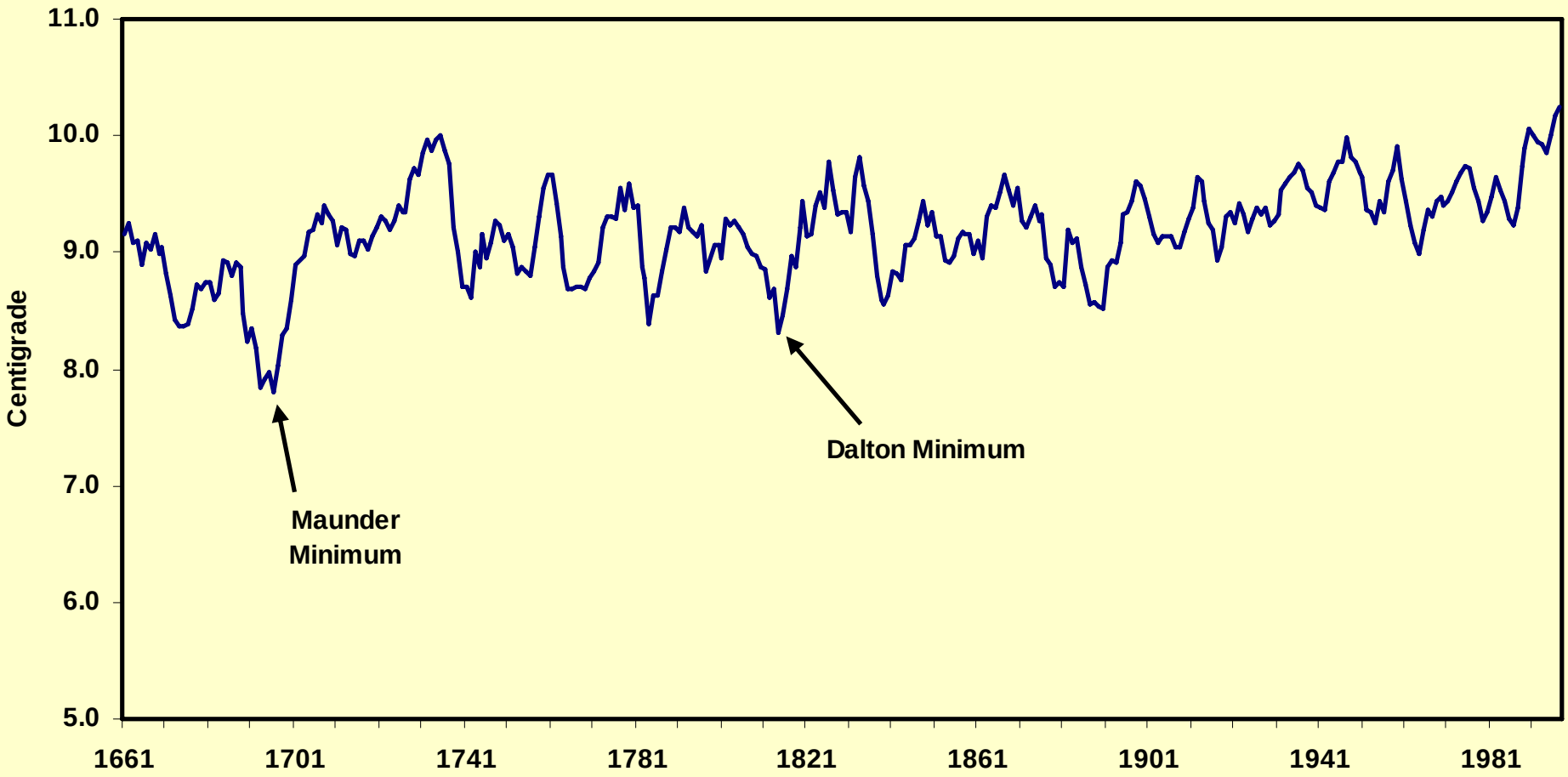
The smoothed average annual temperature of the Hawkinsville (32.3N, 83.5W), Glennville (31.3N, 89.1W), Calhoun Research Station (32.5N, 92.3W), Highlands (35.0N, 82.3W) and Talbotton (32.7N, 84.5W) stations is representative of the US temperature profile away from the urban heat island effect over the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

The Total Solar Irradiance – Temperature Correlation

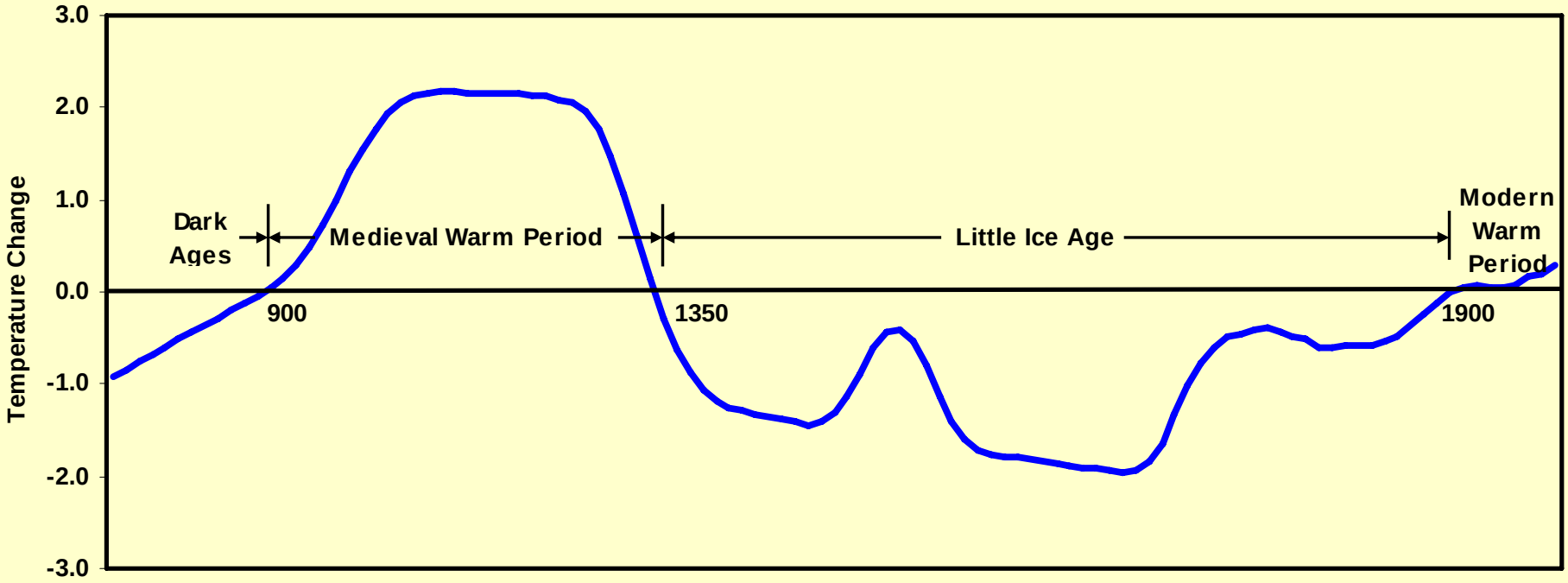


A 300 Year Thermometer Record

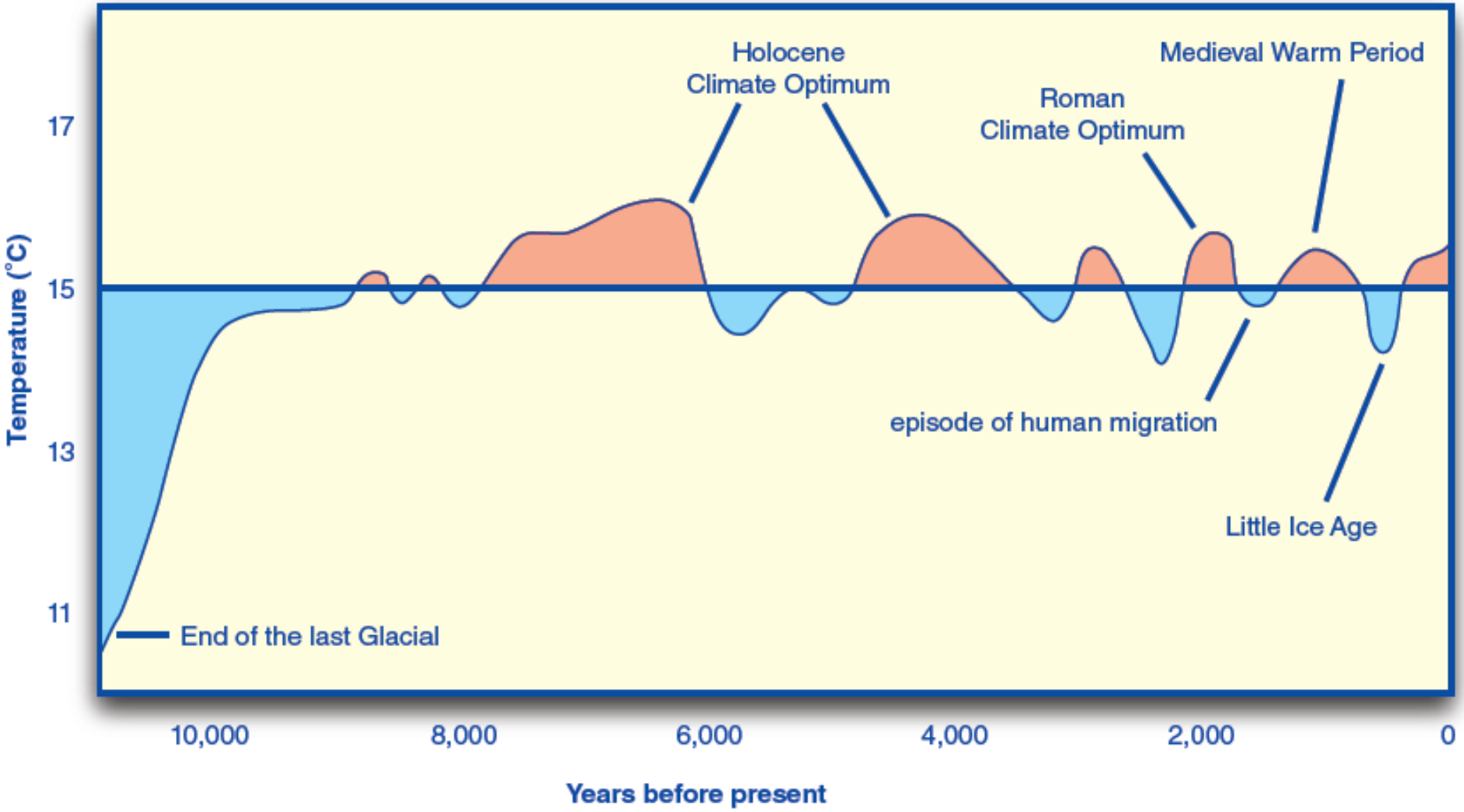
Central England Temperature



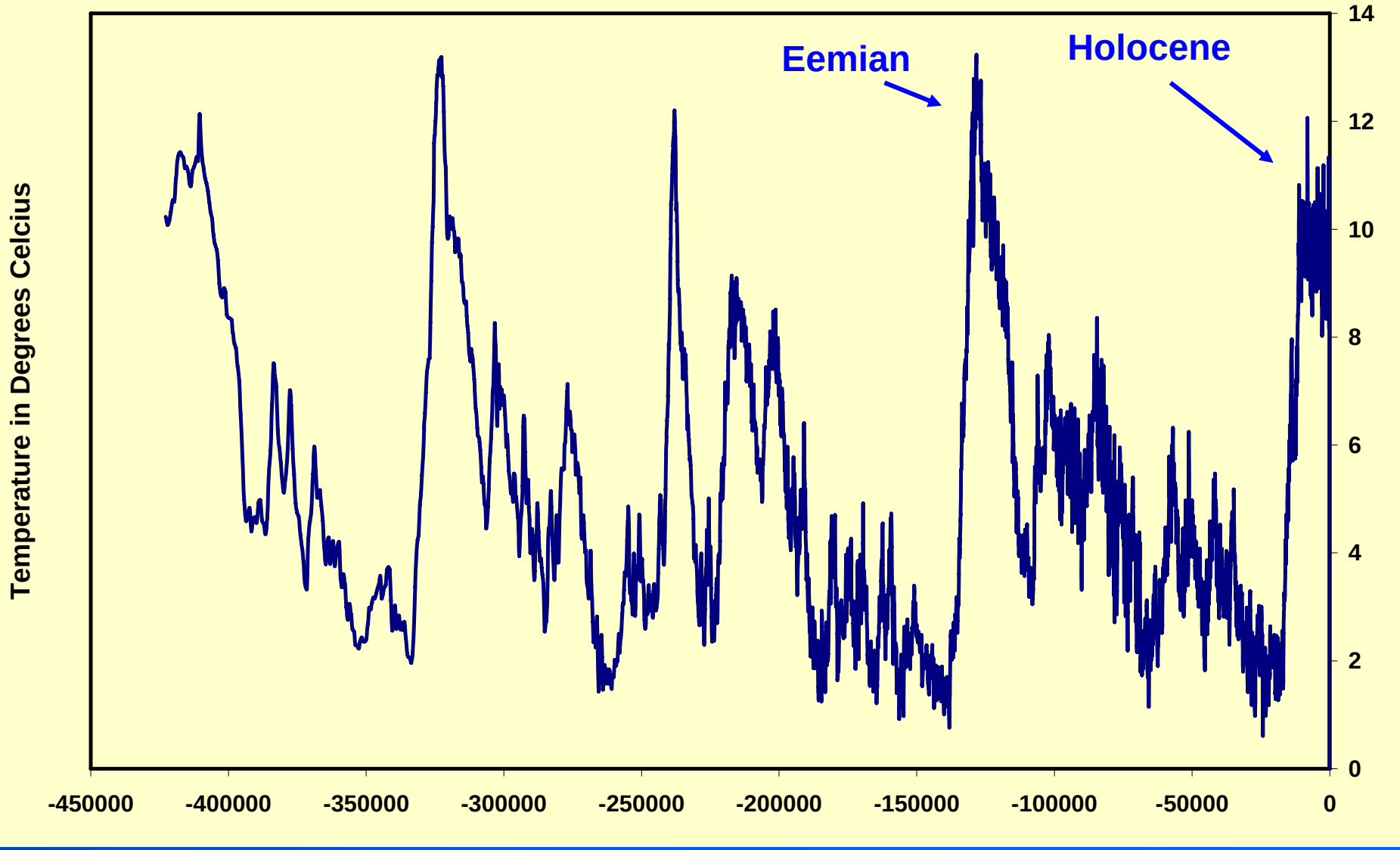
Medieval Warm Period – Little Ice Age



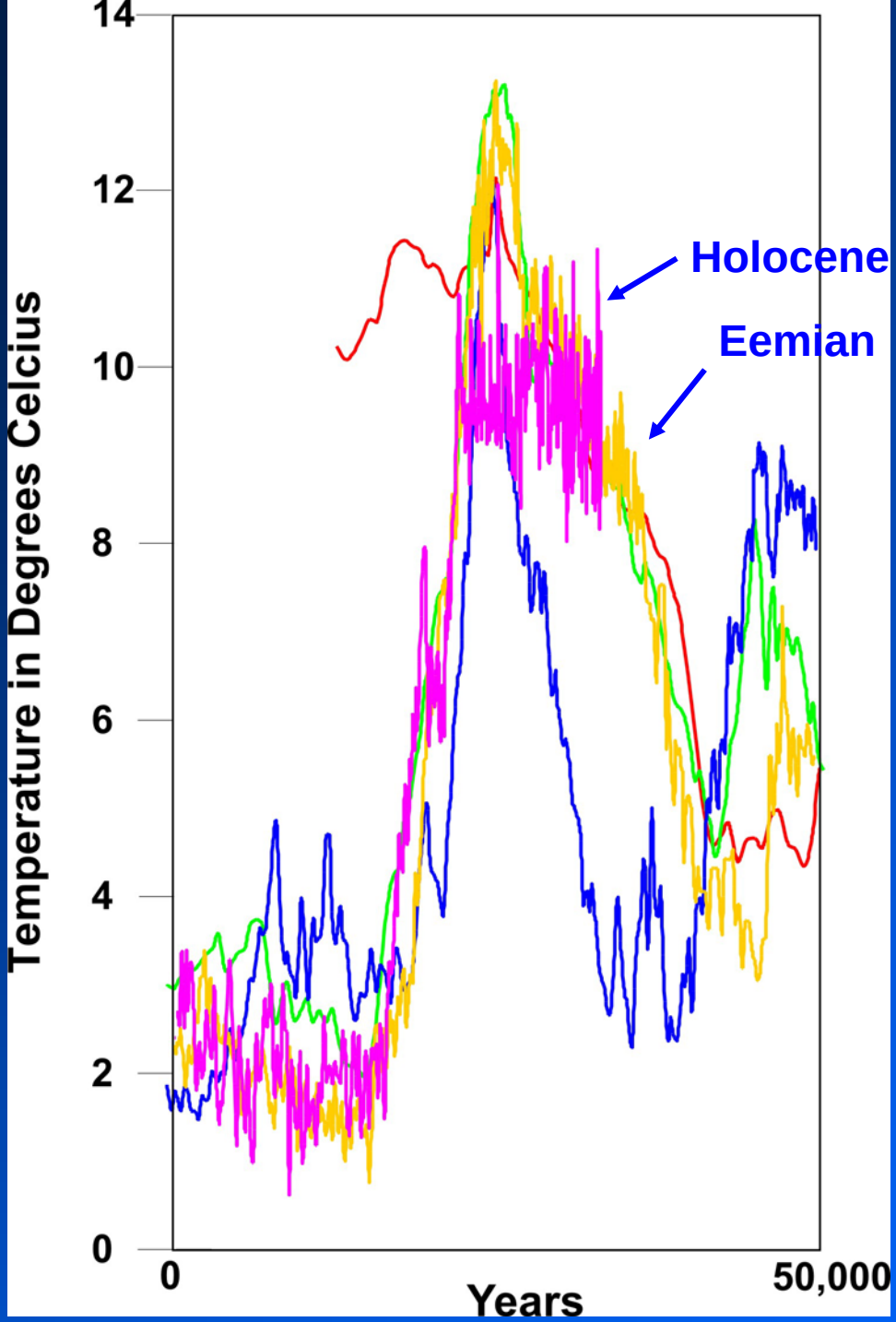
The Holocene Optimum

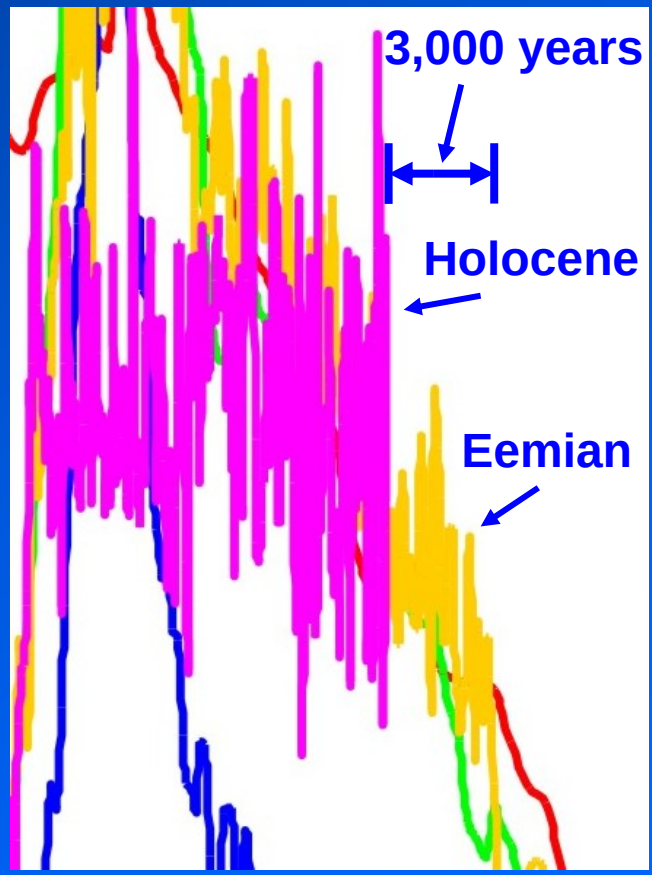


Vostok Ice Core Temperature

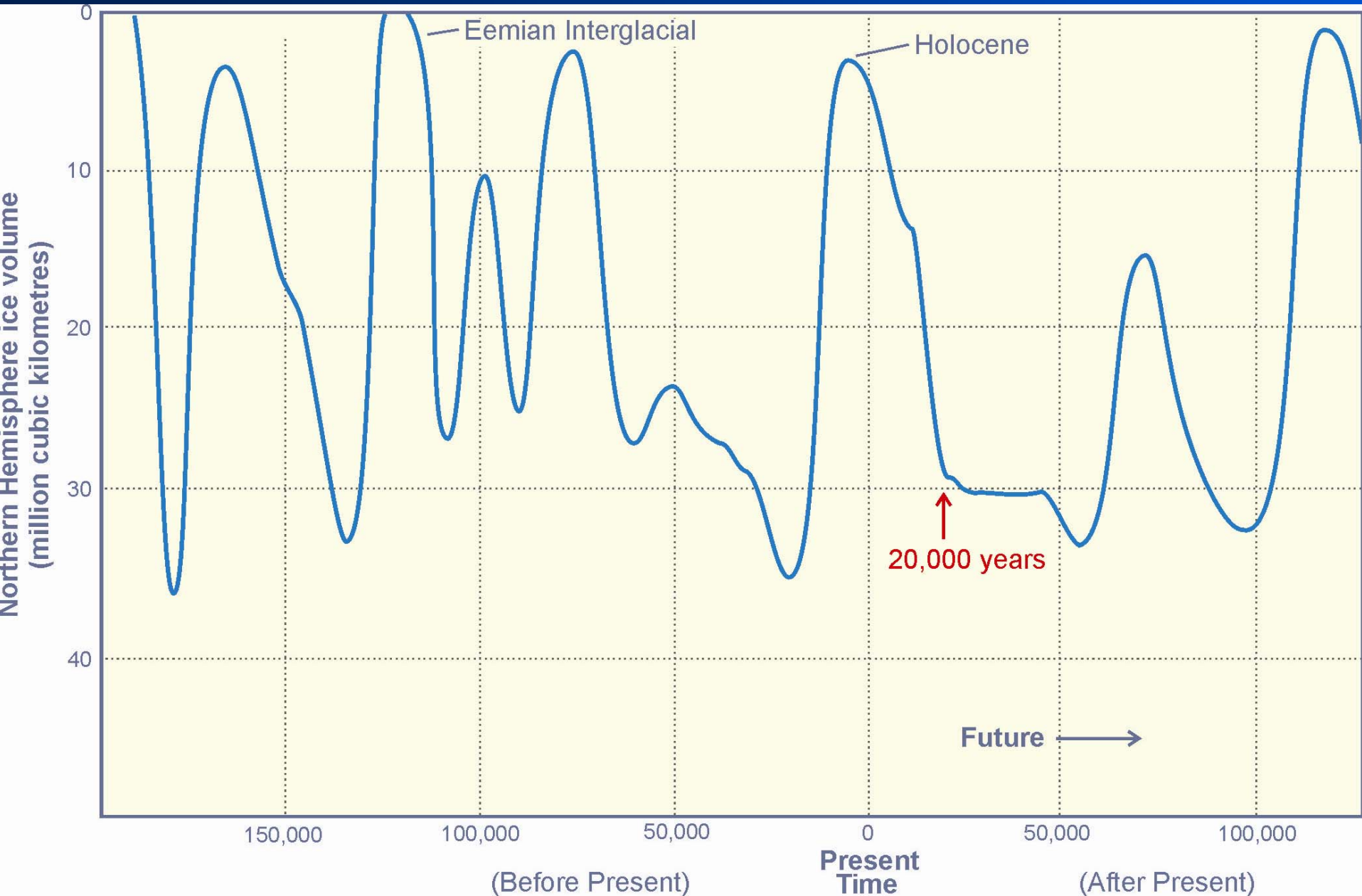


Vostok Interglacials Superimposed and aligned on Peak Temperature

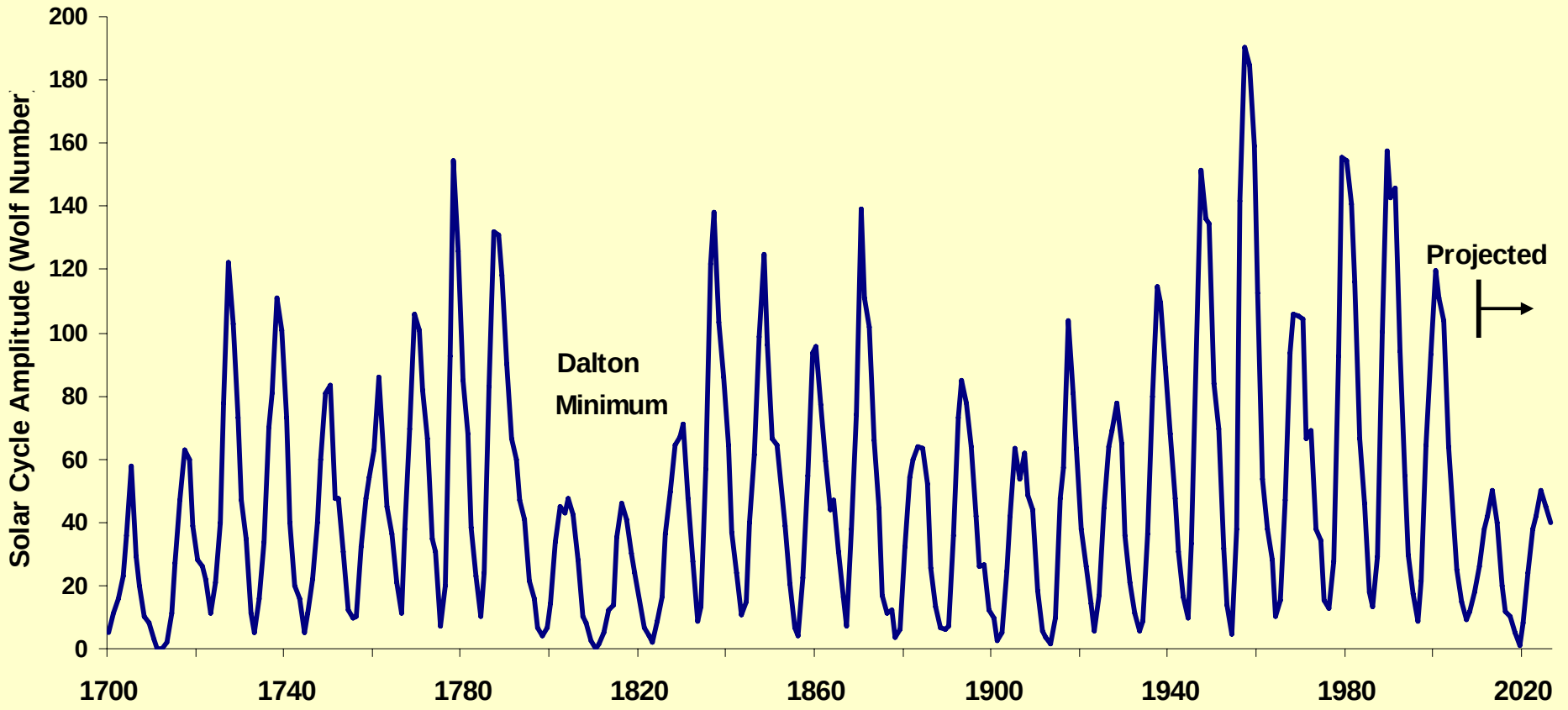




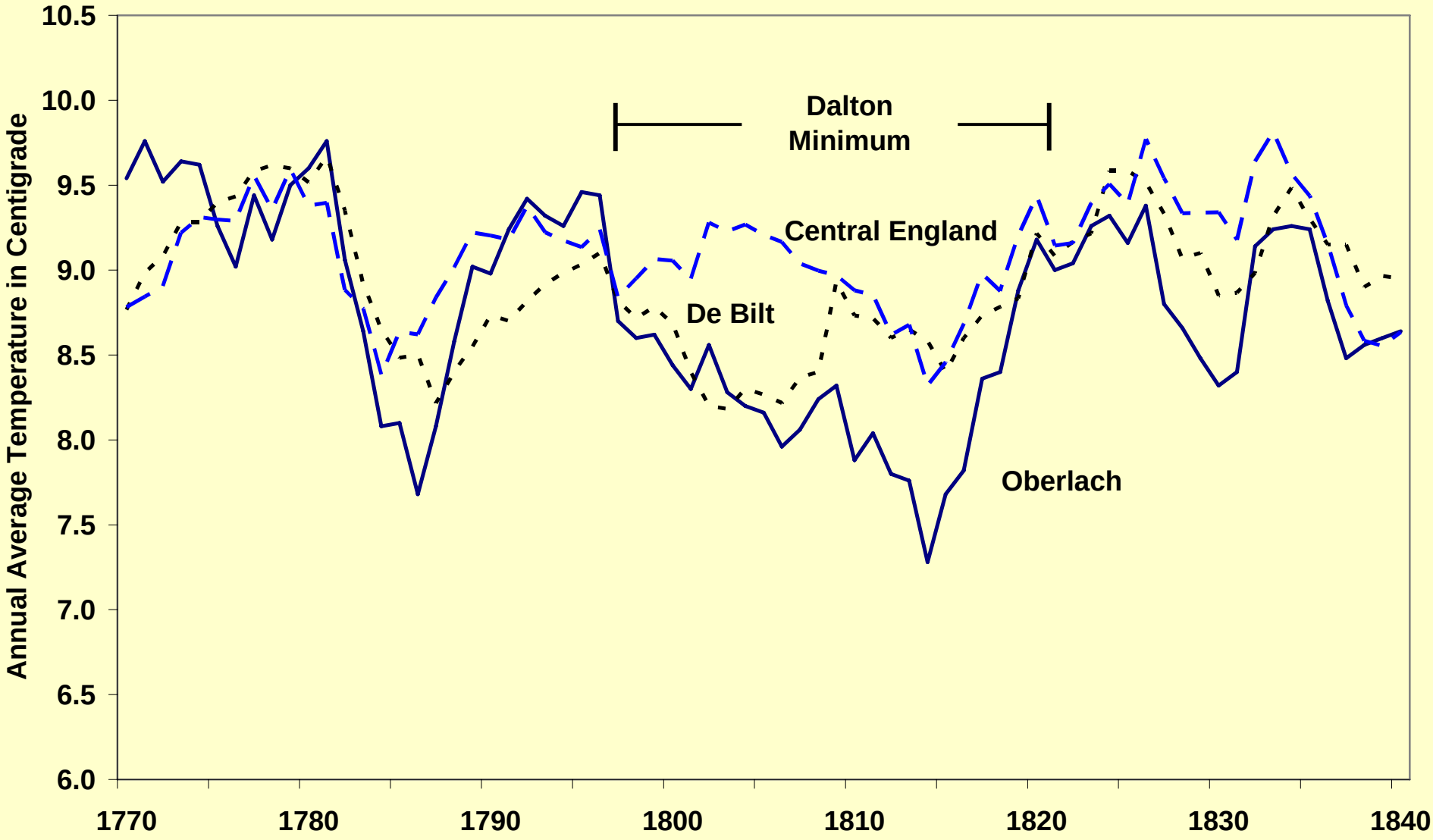
Time is up for our interglacial.



The Solar Driver

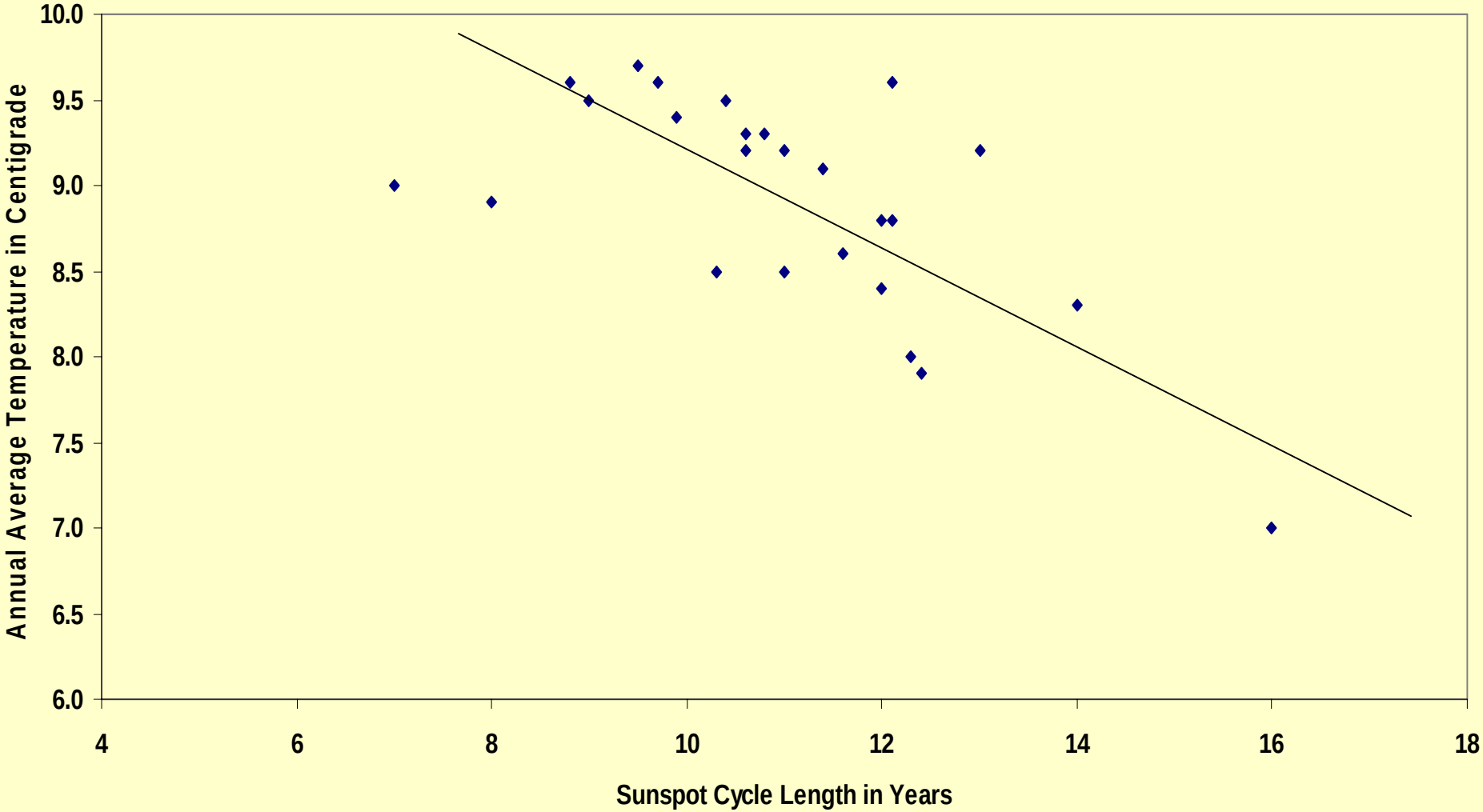


The Dalton Minimum at Three European Stations 1770 to 1840



Sunspot Cycle Length Relative to Temperature

De Bilt, Netherlands 1705 - 2000



Sunspot Cycle Length Relative to Temperature

Armagh, Northern Ireland 1796 – 1992

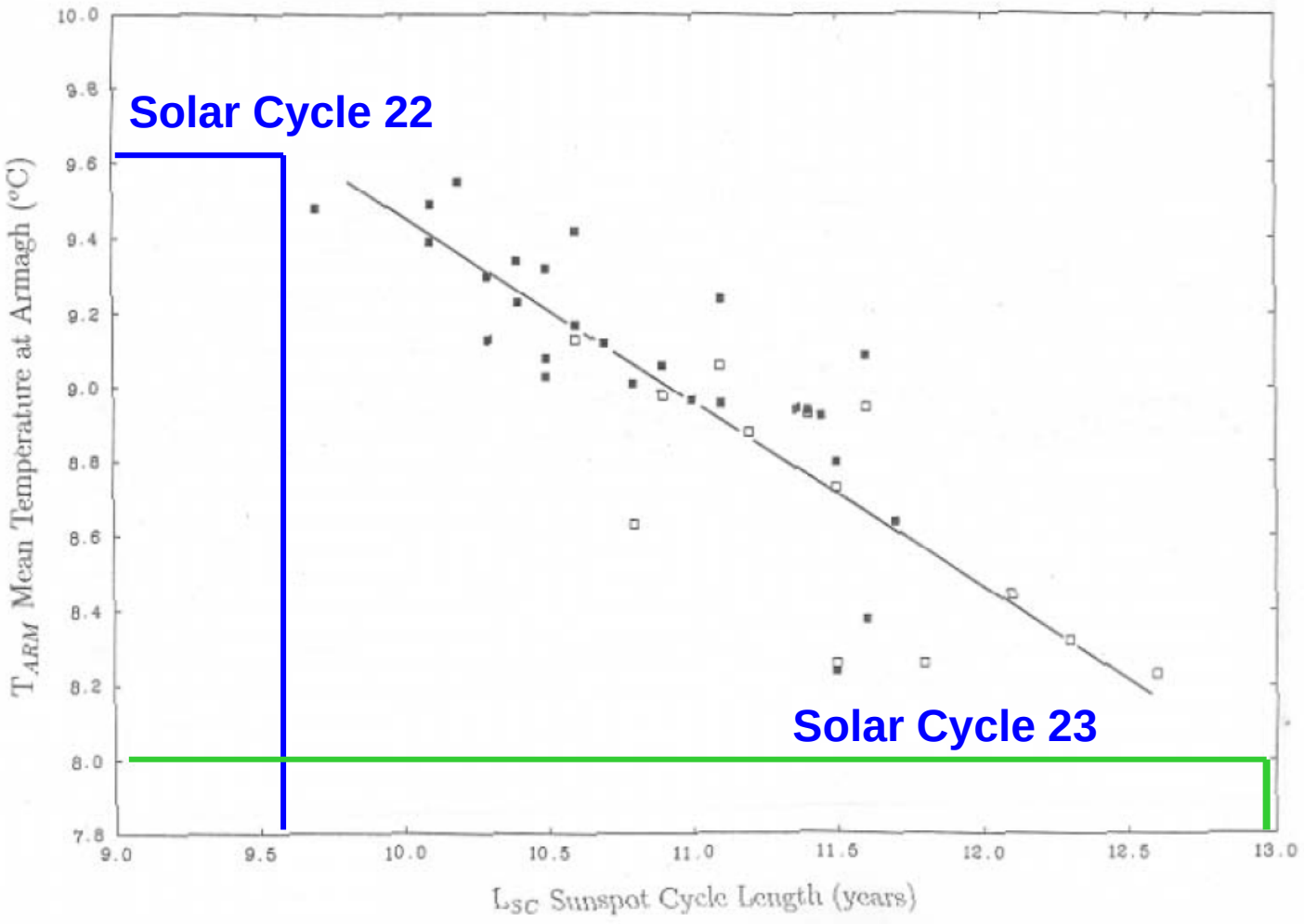
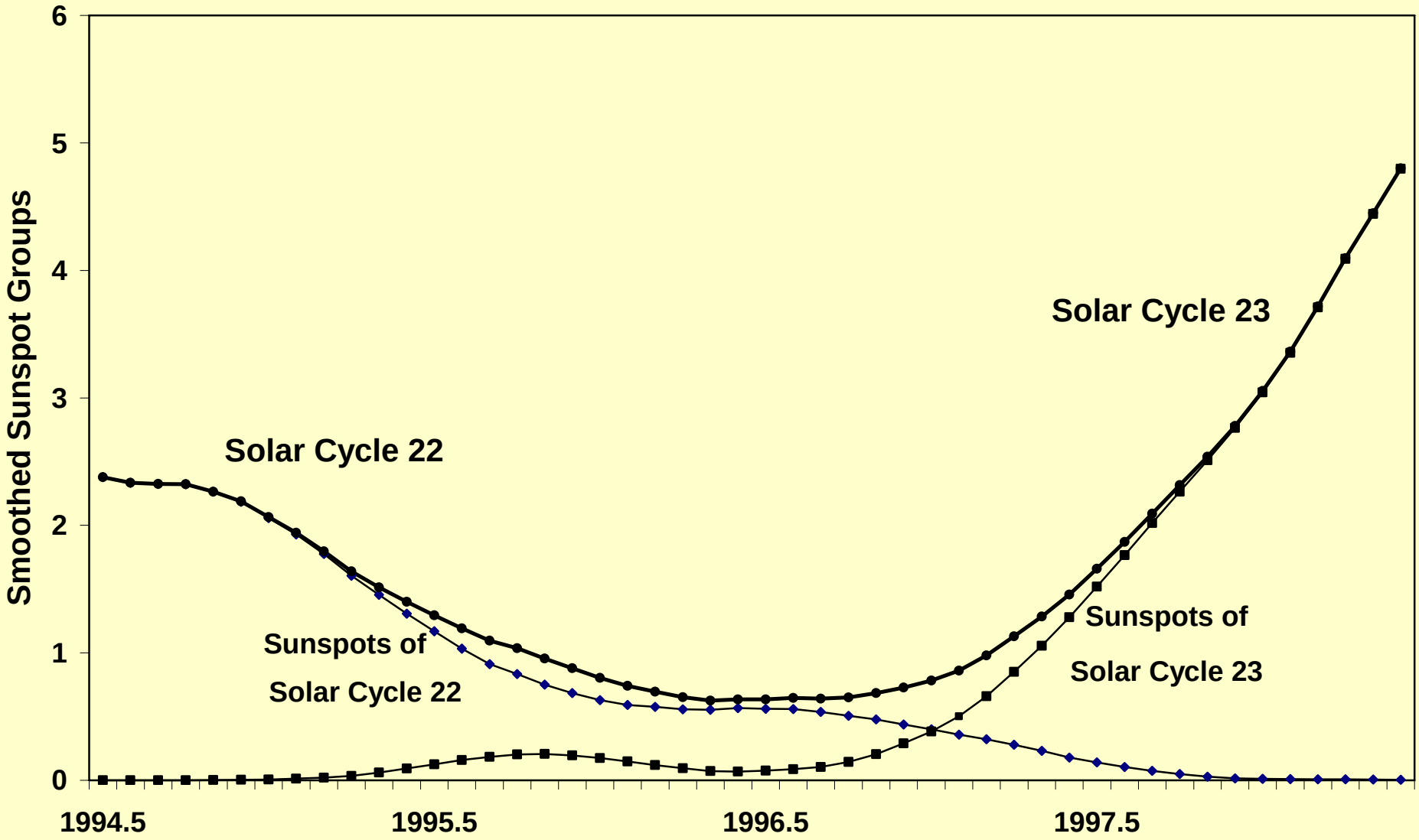
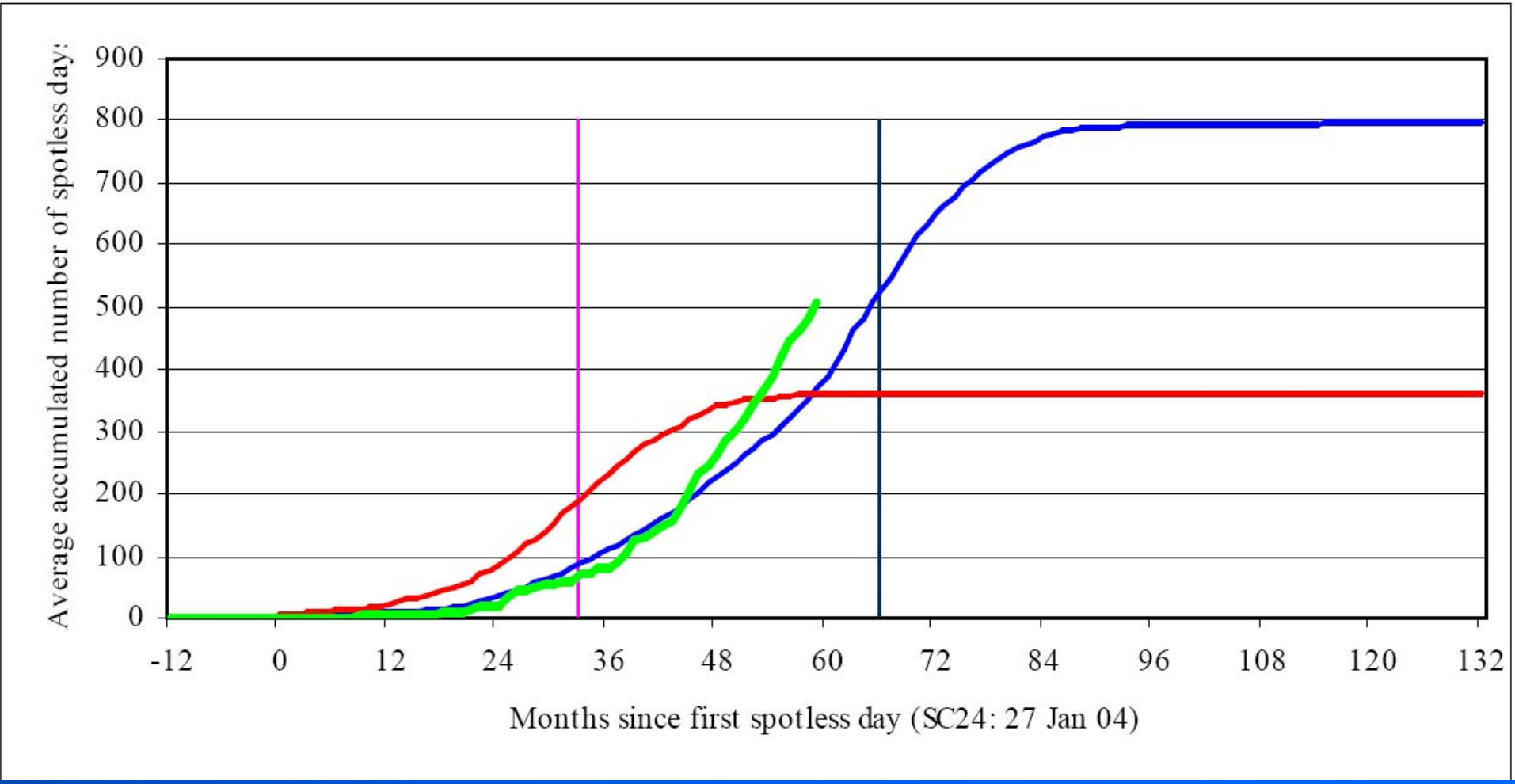


Figure 5. The mean temperature at Armagh for 11 year intervals, centred on years of sunspot maximum and minimum, plotted against the sunspot cycle length. Symbols: open squares - Series I, filled squares - Series II. The mean regression line is shown.

The Transition from Solar Cycle 22 to Solar Cycle 23



Accumulated Number of Spotless Days – Solar Cycles 10 to 15 compared to Solar Cycles 16 to 23



Source: Jan Janssens, Belgian Solar Section

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

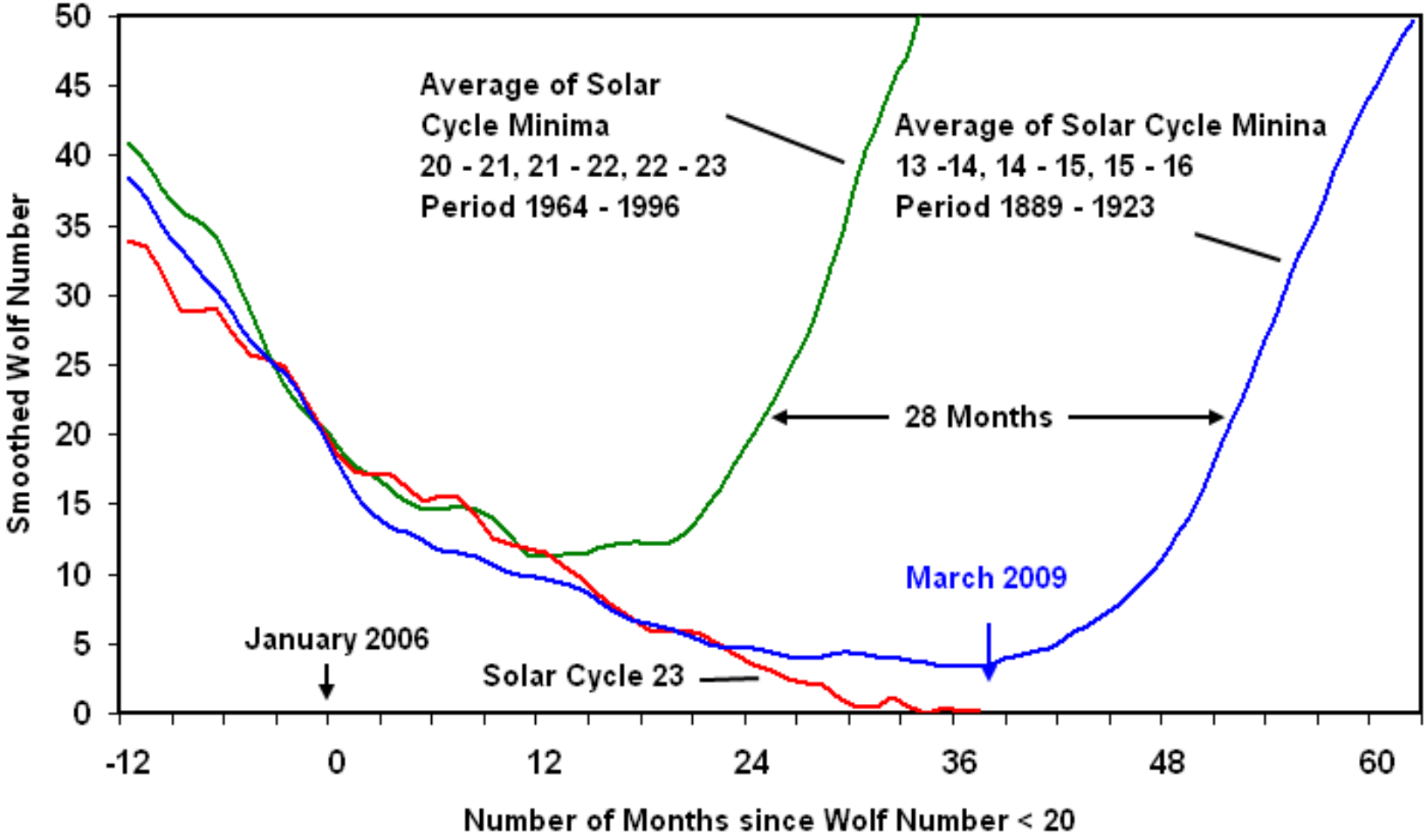
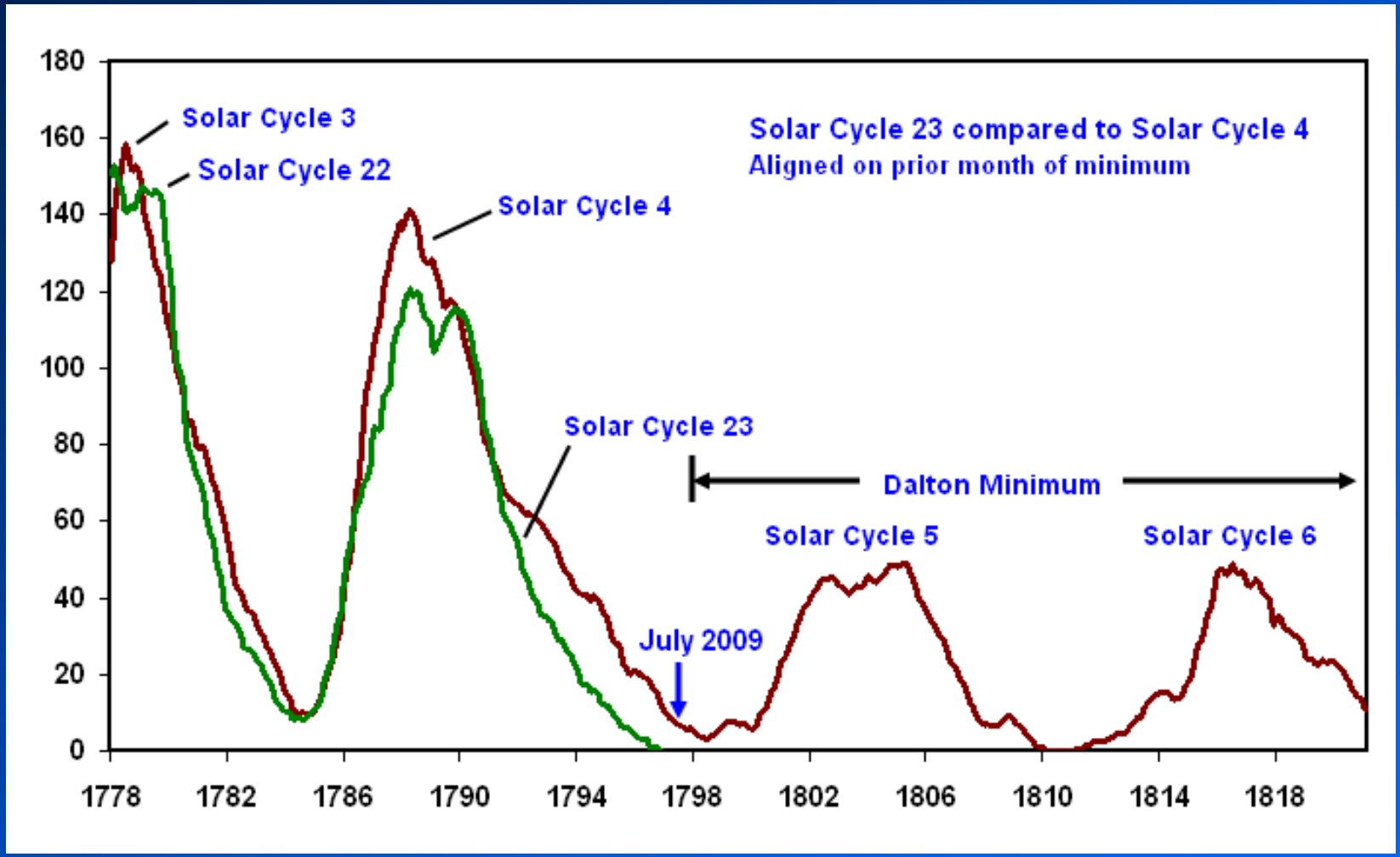


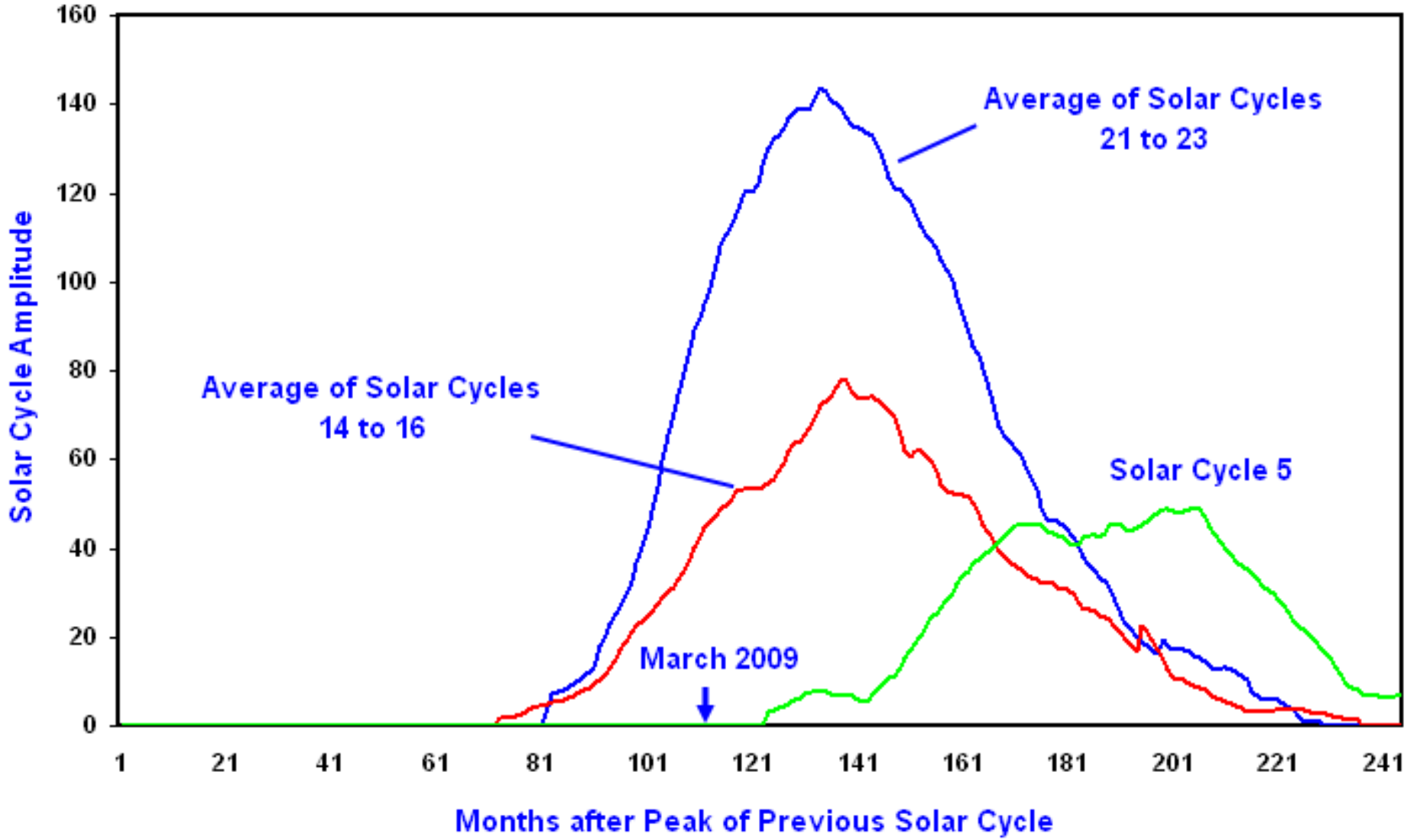
Figure source: Jan Janssens, annotated by David Archibald

Dalton Minimum Repeat?

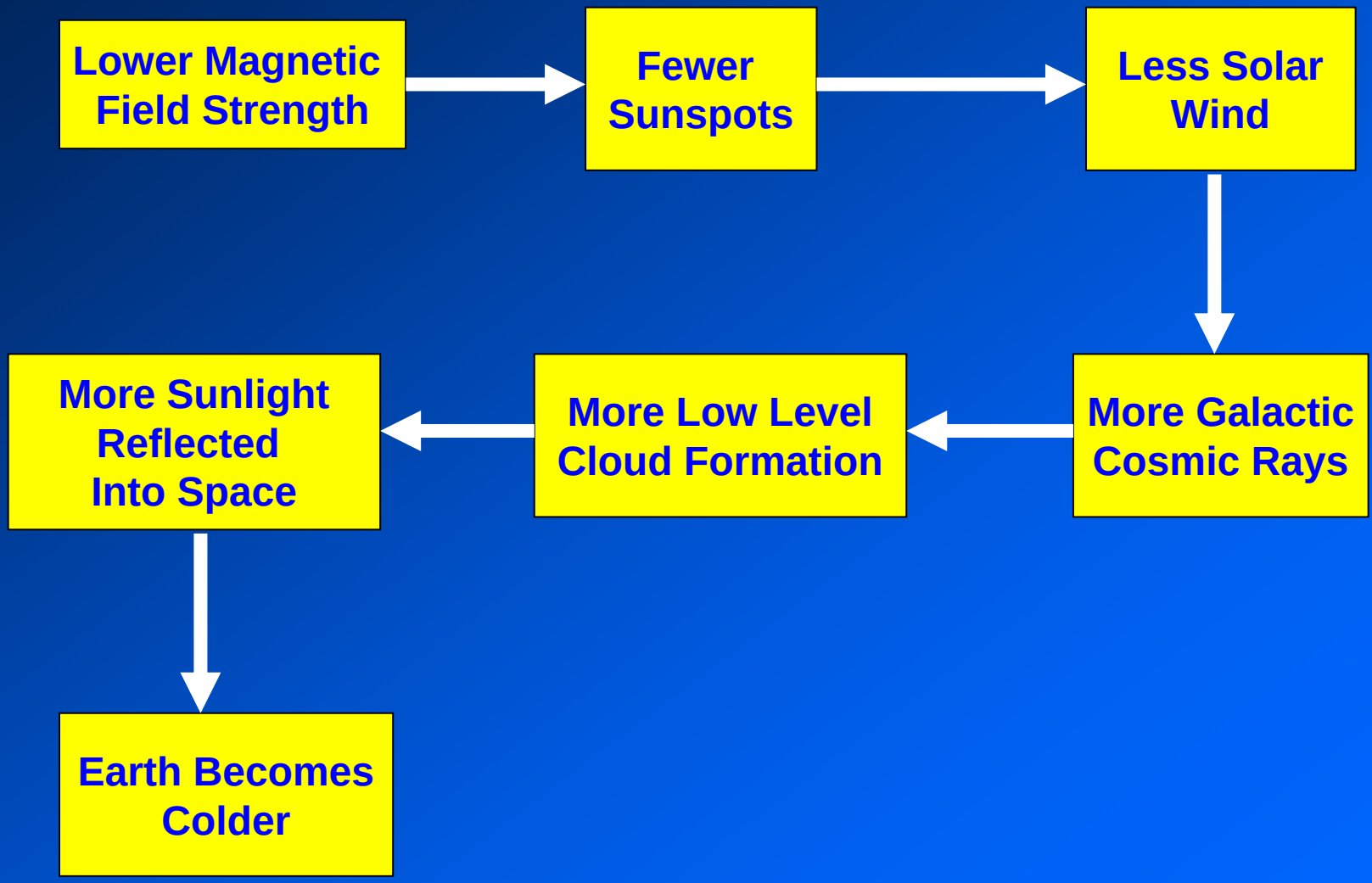


A repeat of the Dalton Minimum is not precluded by the data to date. July 2009 equates to a 13 year long Solar Cycle 23.

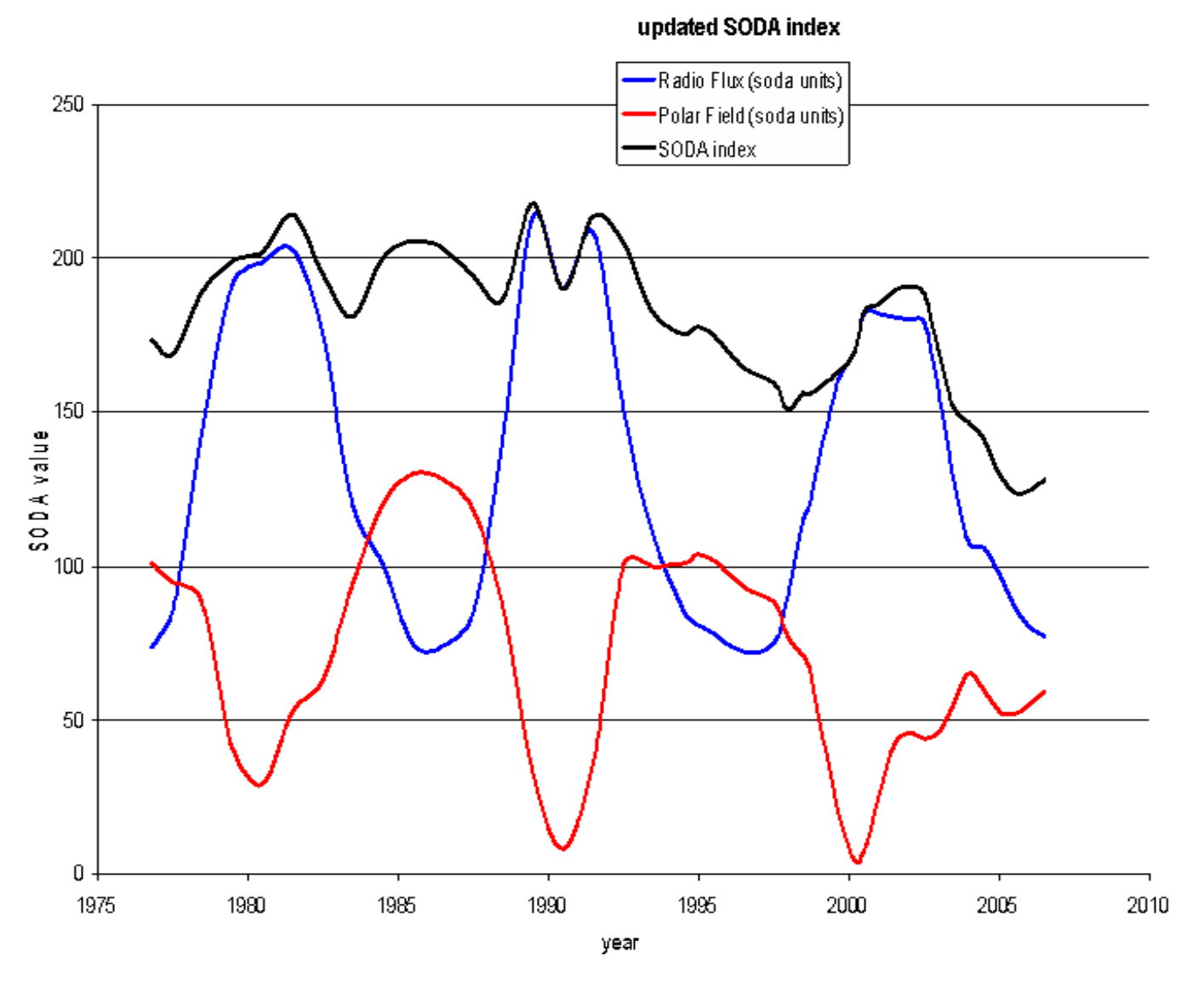
Late 20th Century Solar Cycles compared to Late 19th Century Solar Cycles



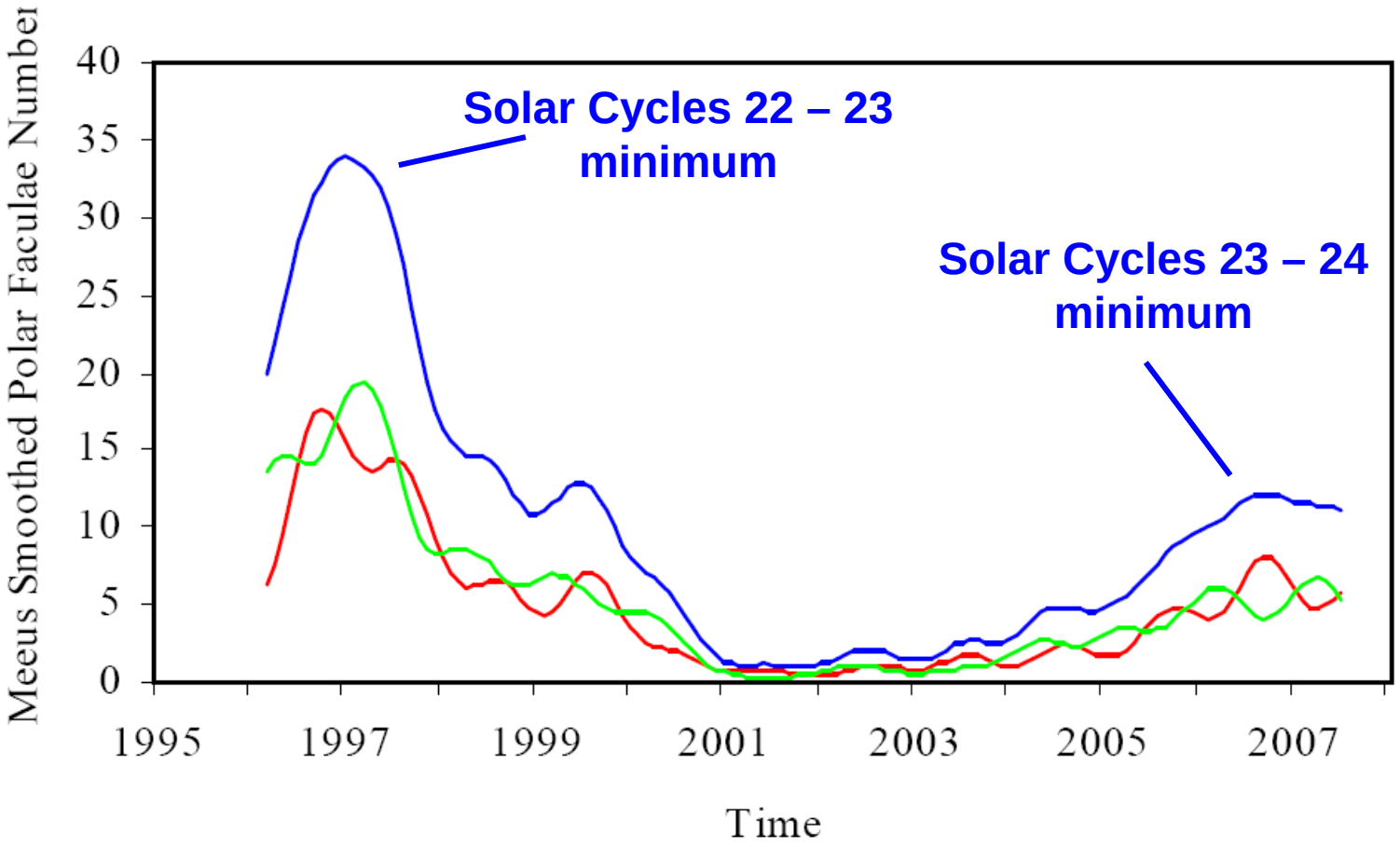
The Solar – Climate Relationship



The Solar Dynamo Index

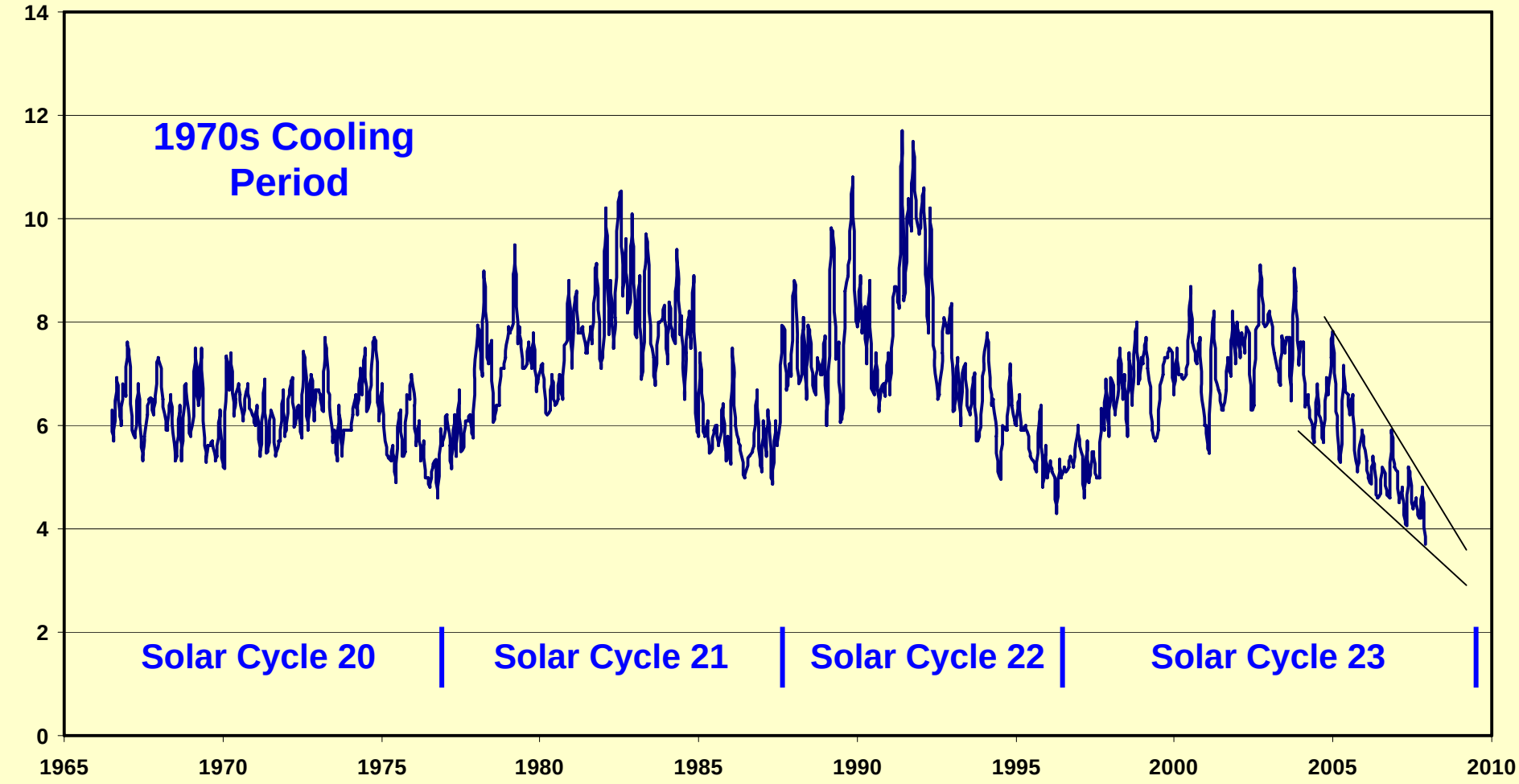


Polar Faculae

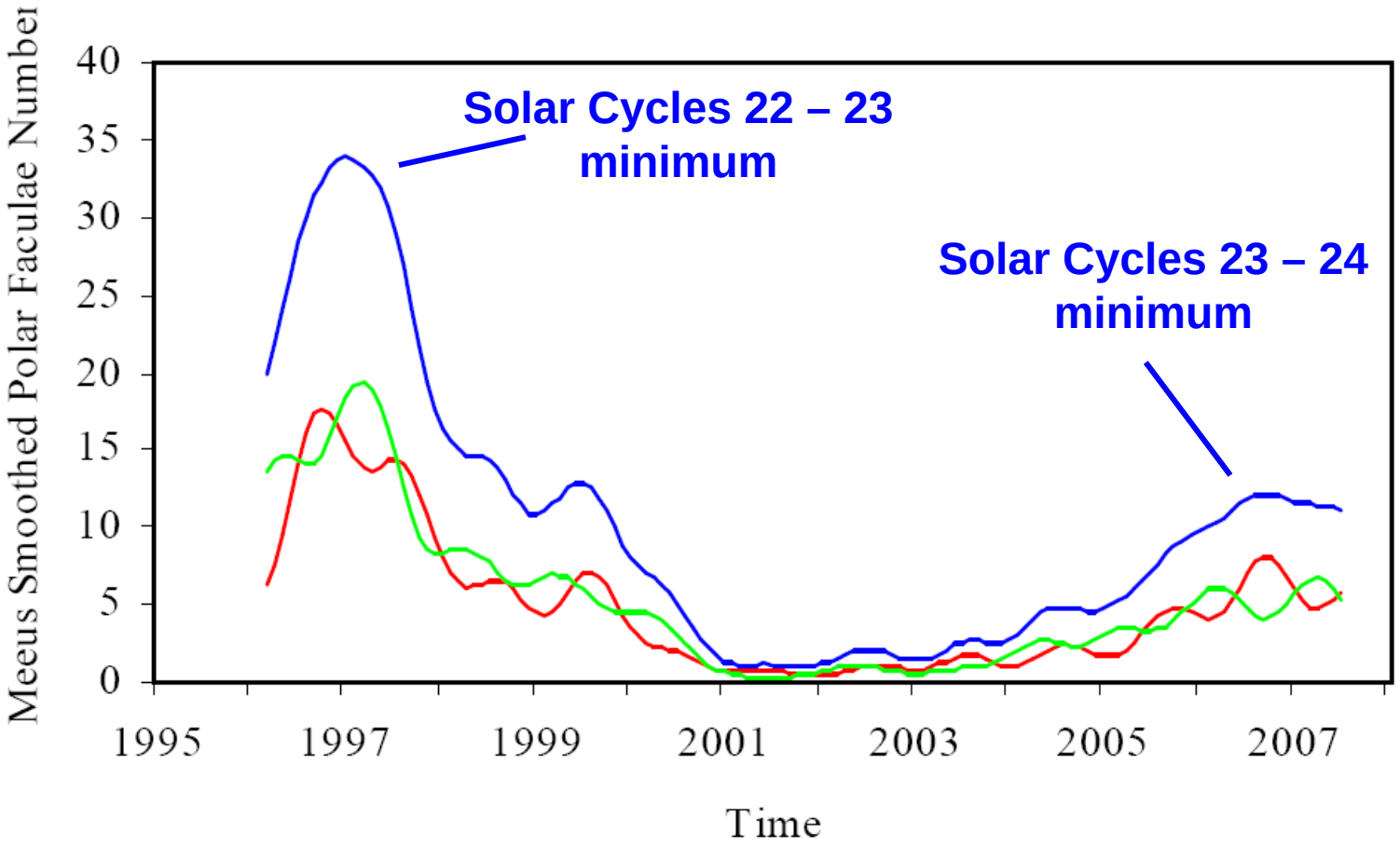


Source: Jan Janssens, Belgian Solar Section

Interplanetary Magnetic Field

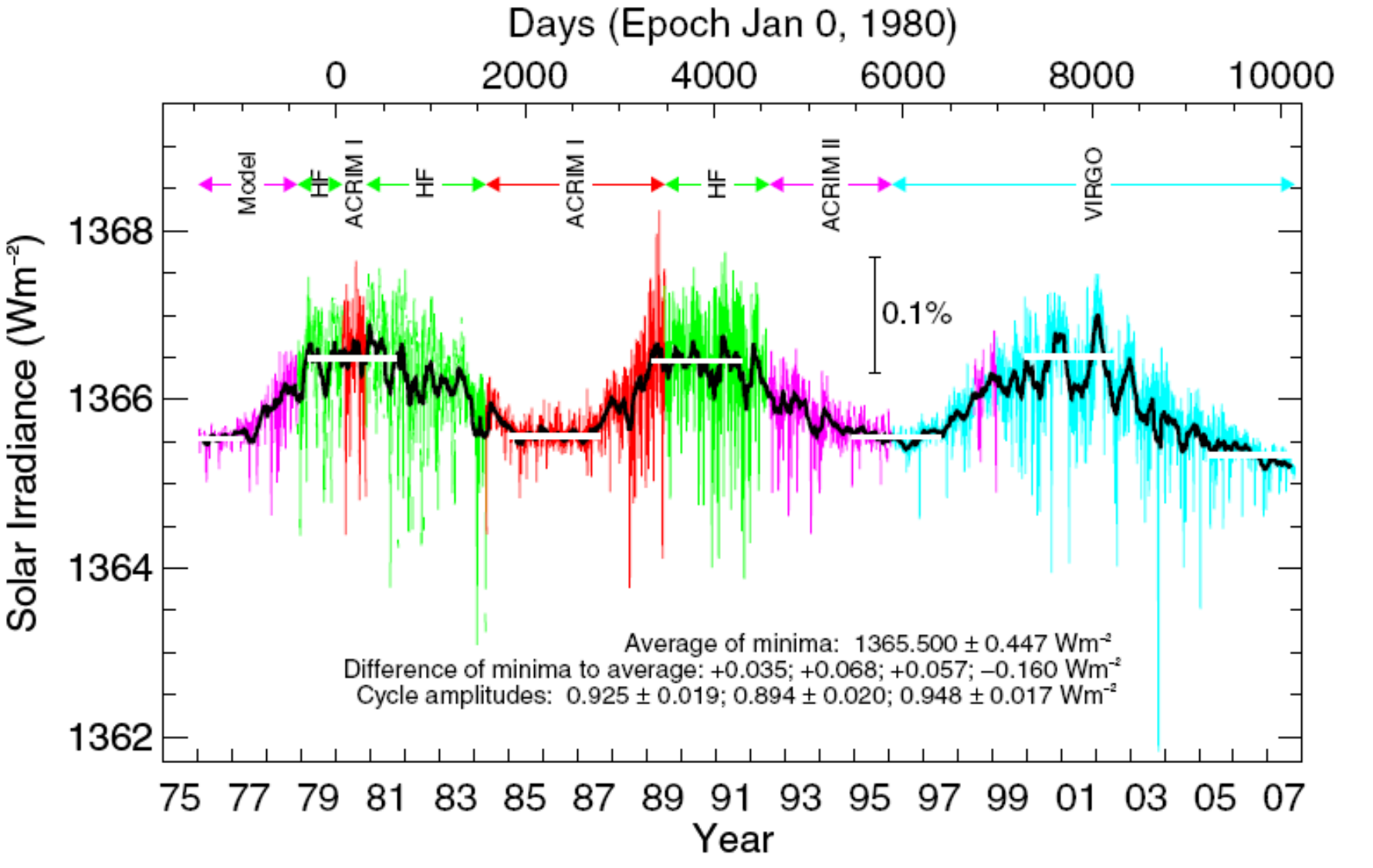


Polar Faculae

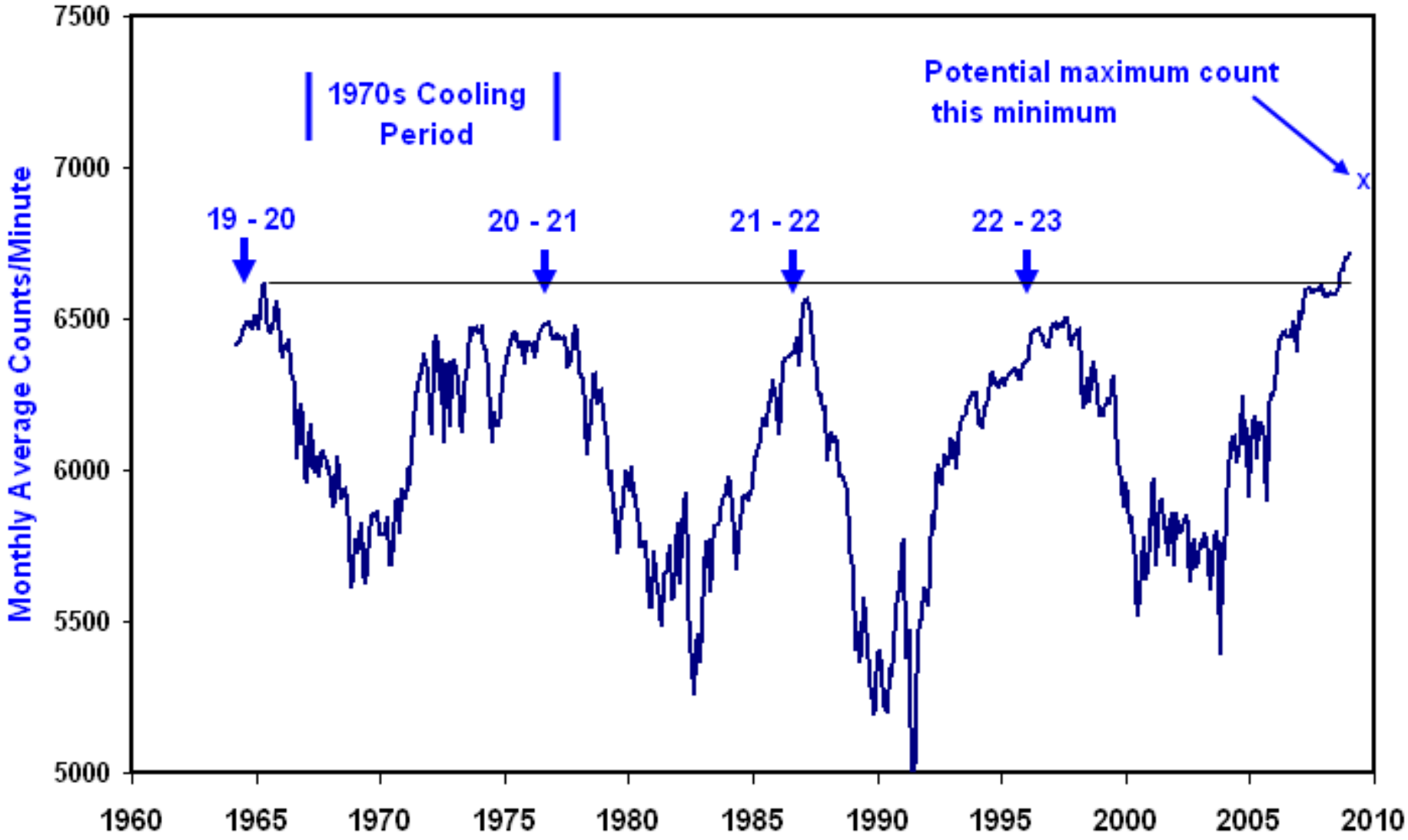


Source: Jan Janssens, Belgian Solar Section

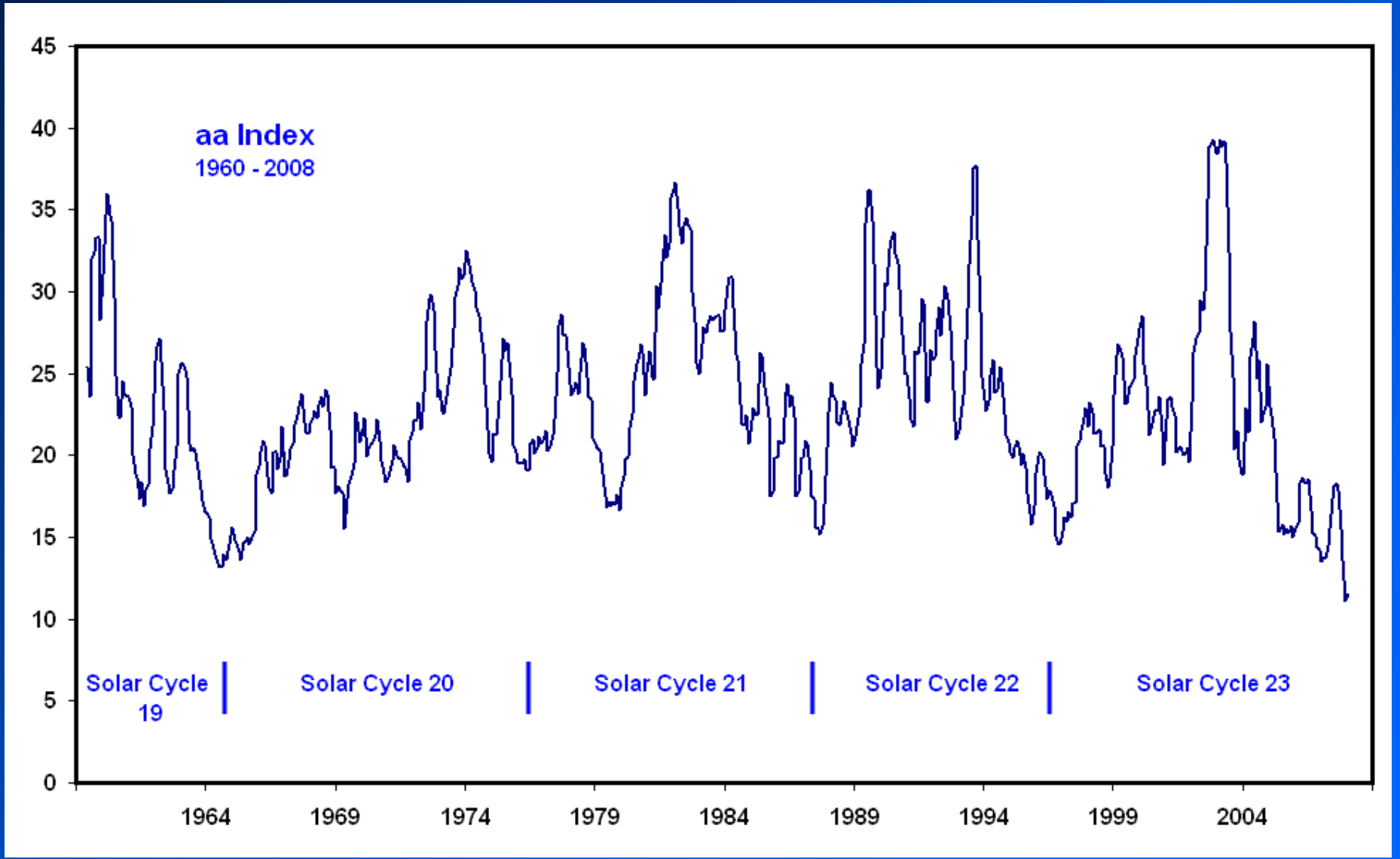
Total Solar Irradiance



Oulu, Finland Neutron Monitor Count
1960 - 2010

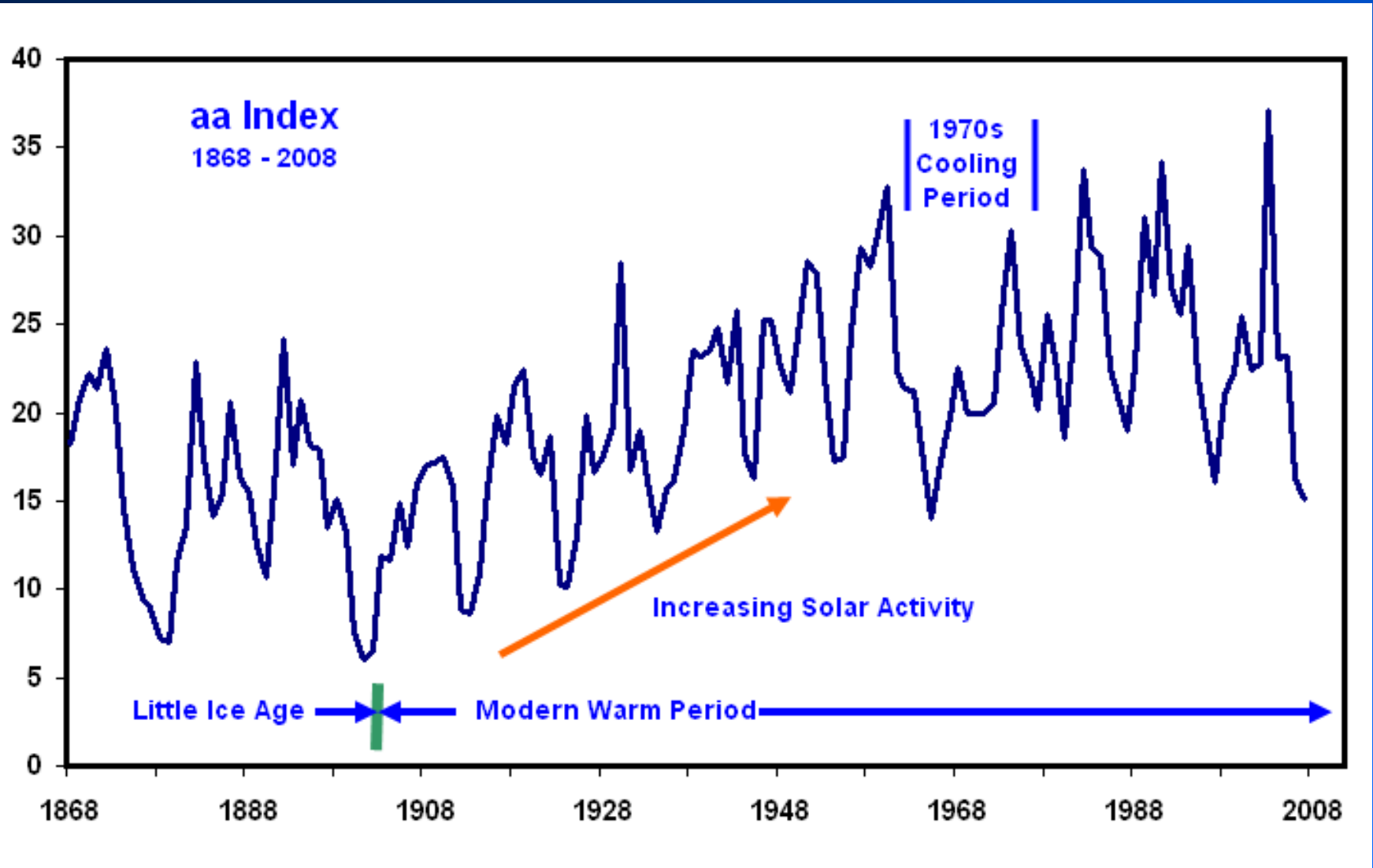


Monthly aa Index 1960 - 2008



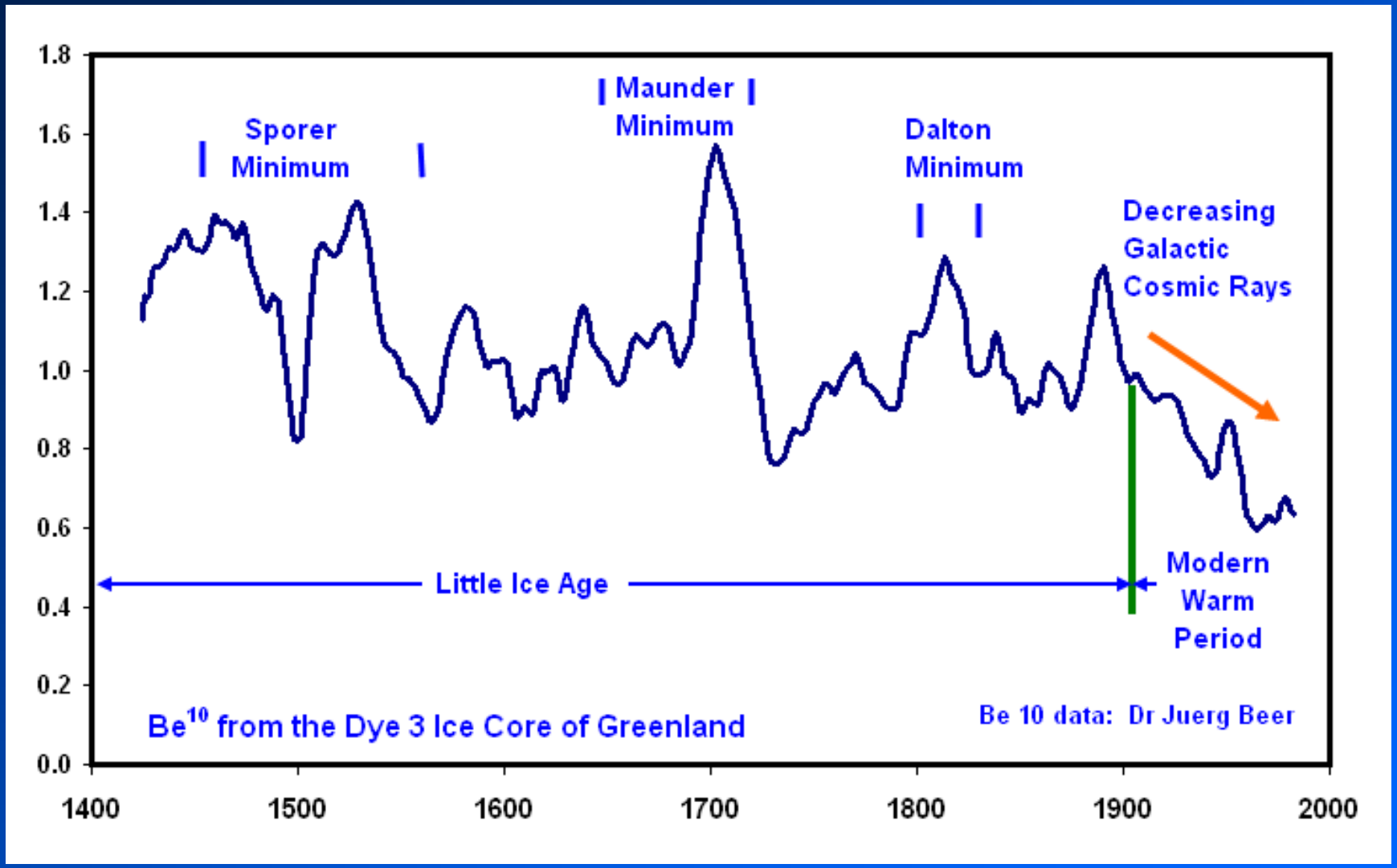
The aa Index is now weaker than it has been for 48 years.

aa Index 1868 - 2008



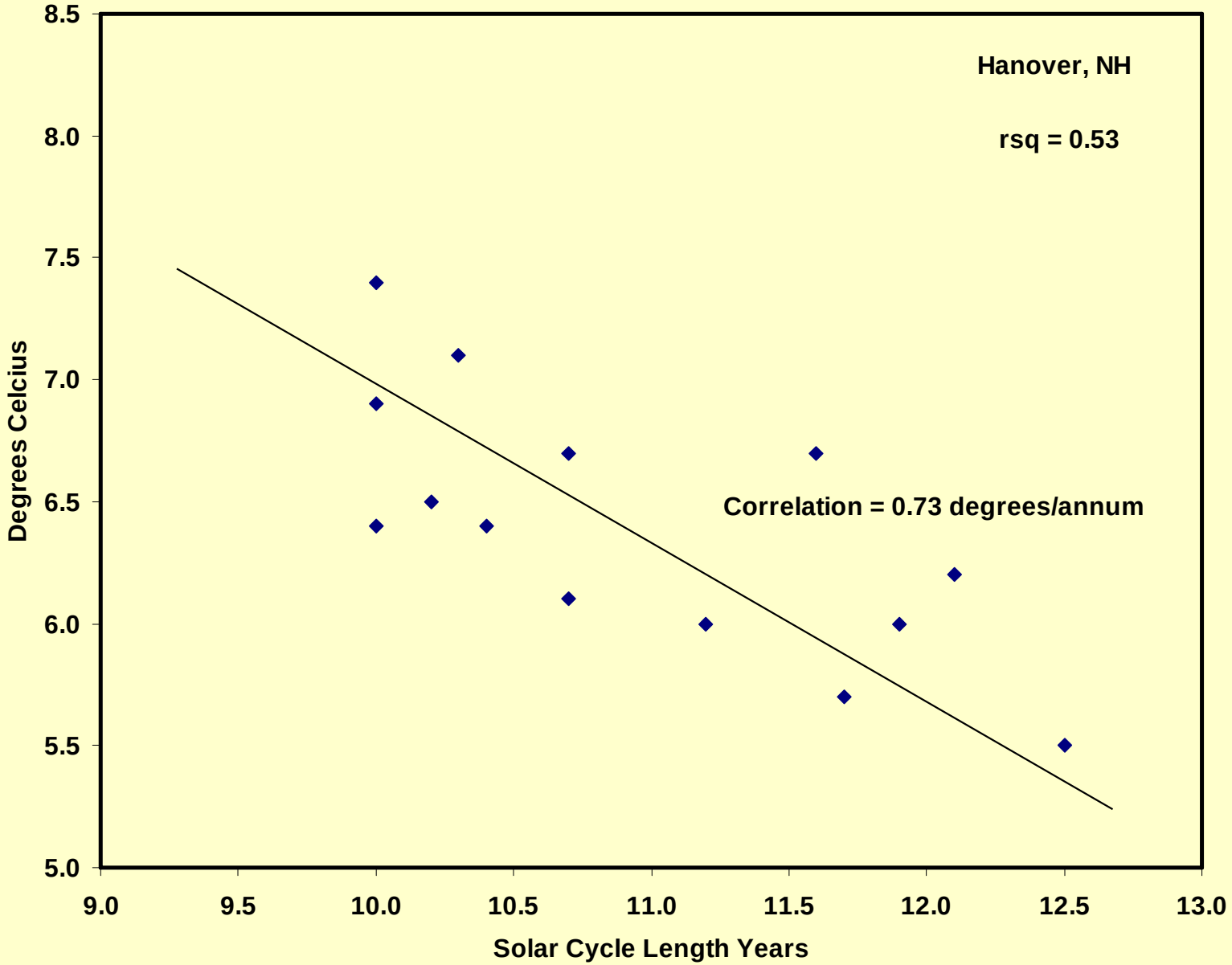
The aa Index was much weaker during the colder climate of the 19th century.

The Be^{10} Record

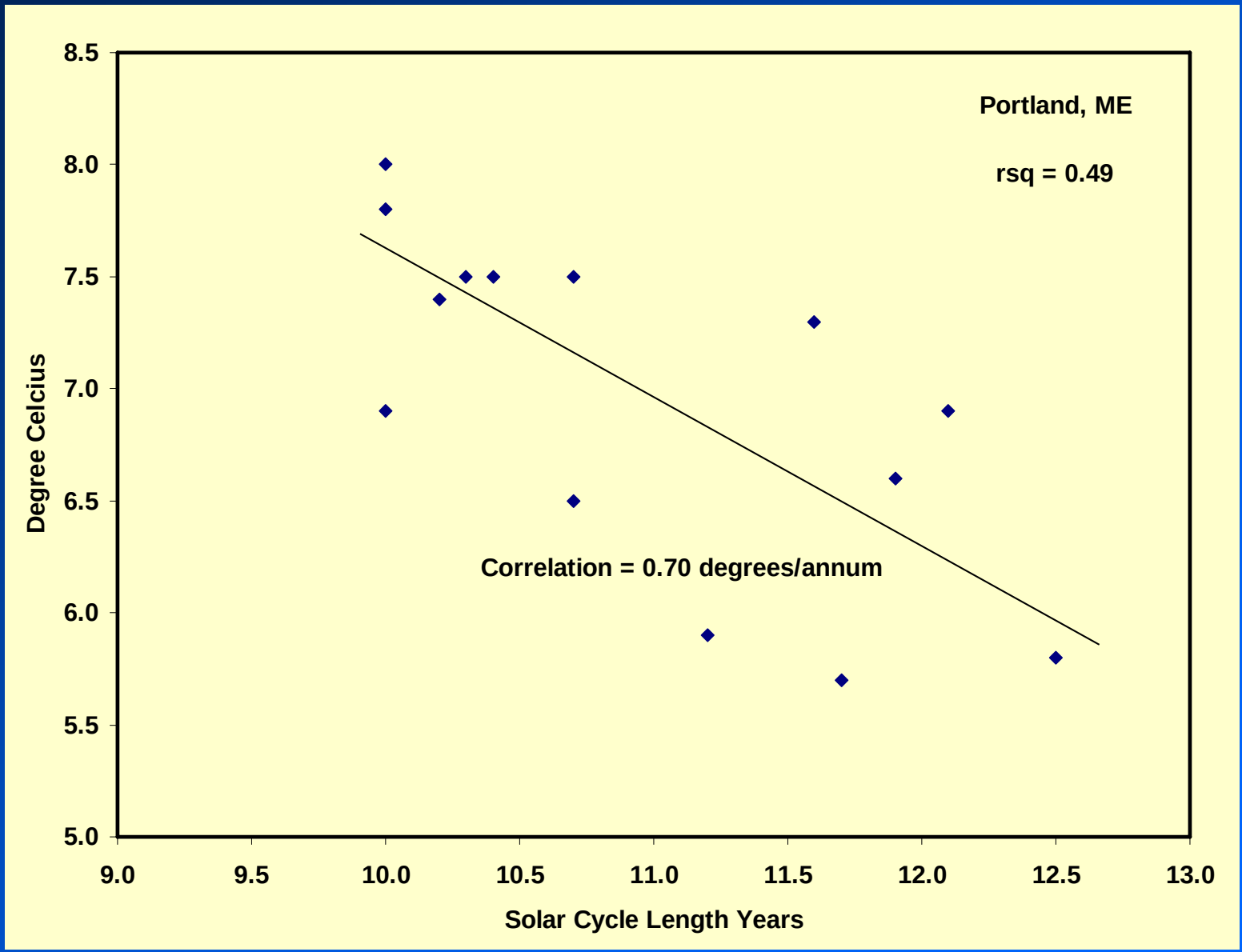


Every cold period shows up in the Be^{10} record, including the late 19th century one. The modern warm period is evident also. The Be10 record is incontrovertible, and good support for Svensmark's theory.

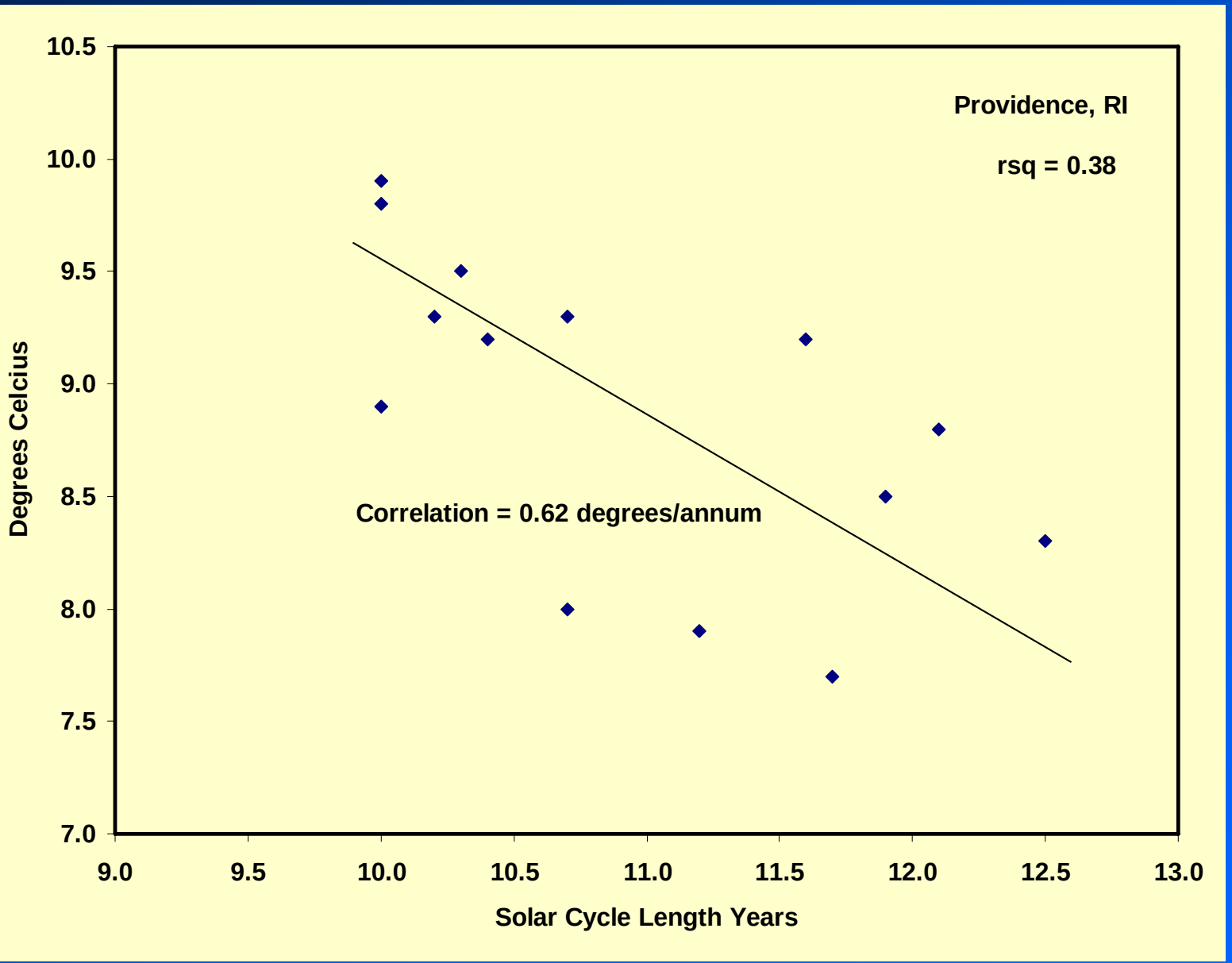
Hanover, NH


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

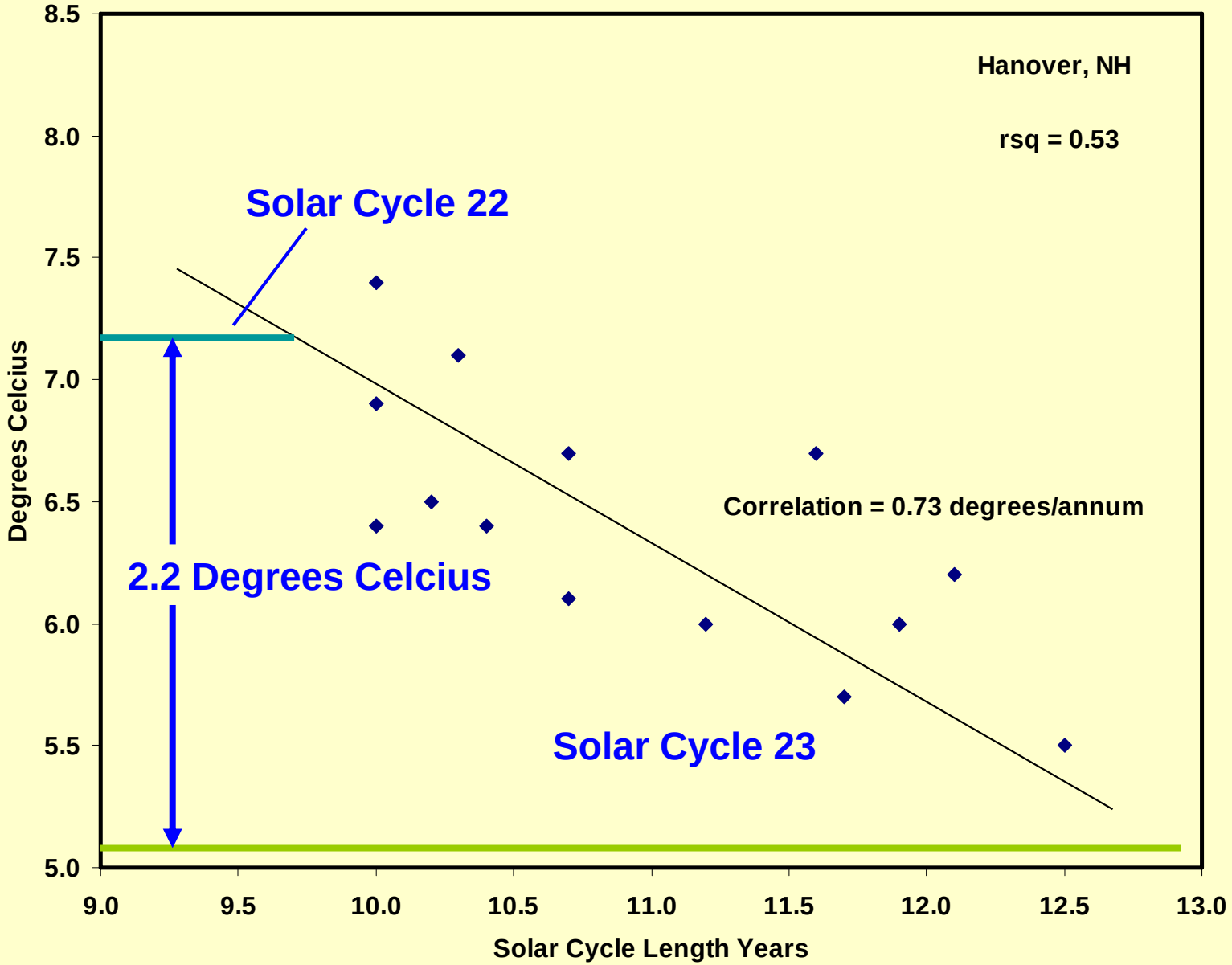
Portland, ME


Portland, ME
rsq = 0.49
Correlation = 0.70 degrees/annum
Degree Celcius
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
Solar Cycle Length Years

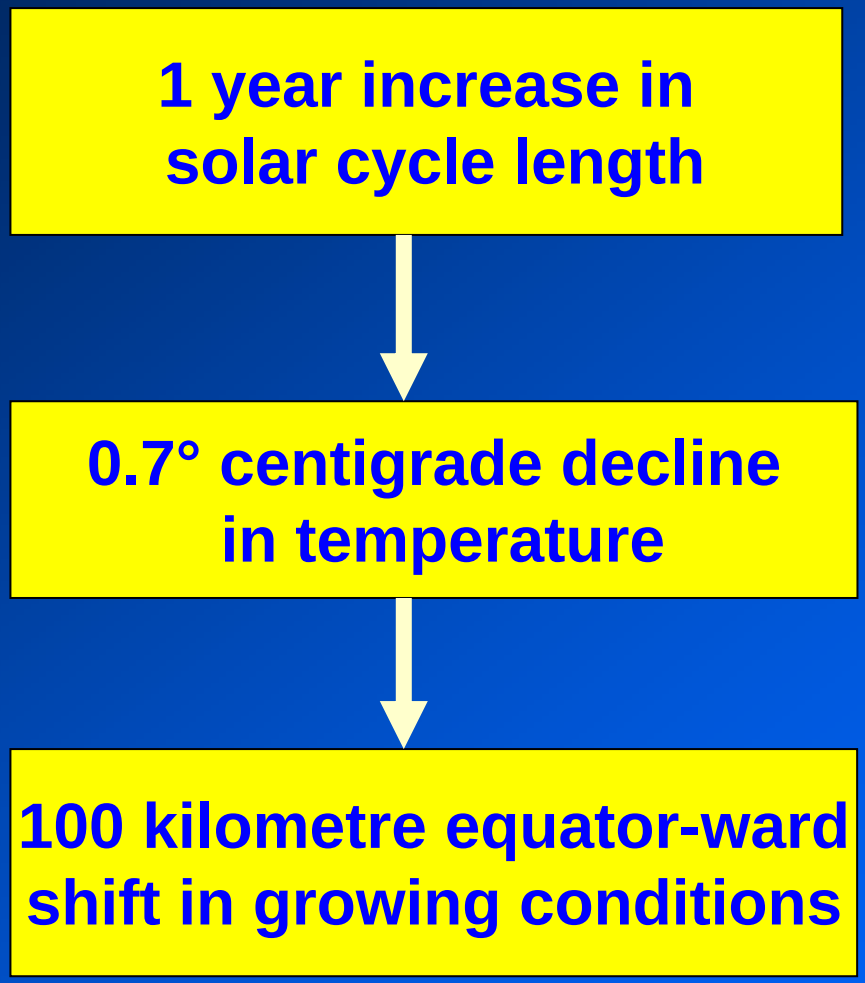
Providence, RI



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

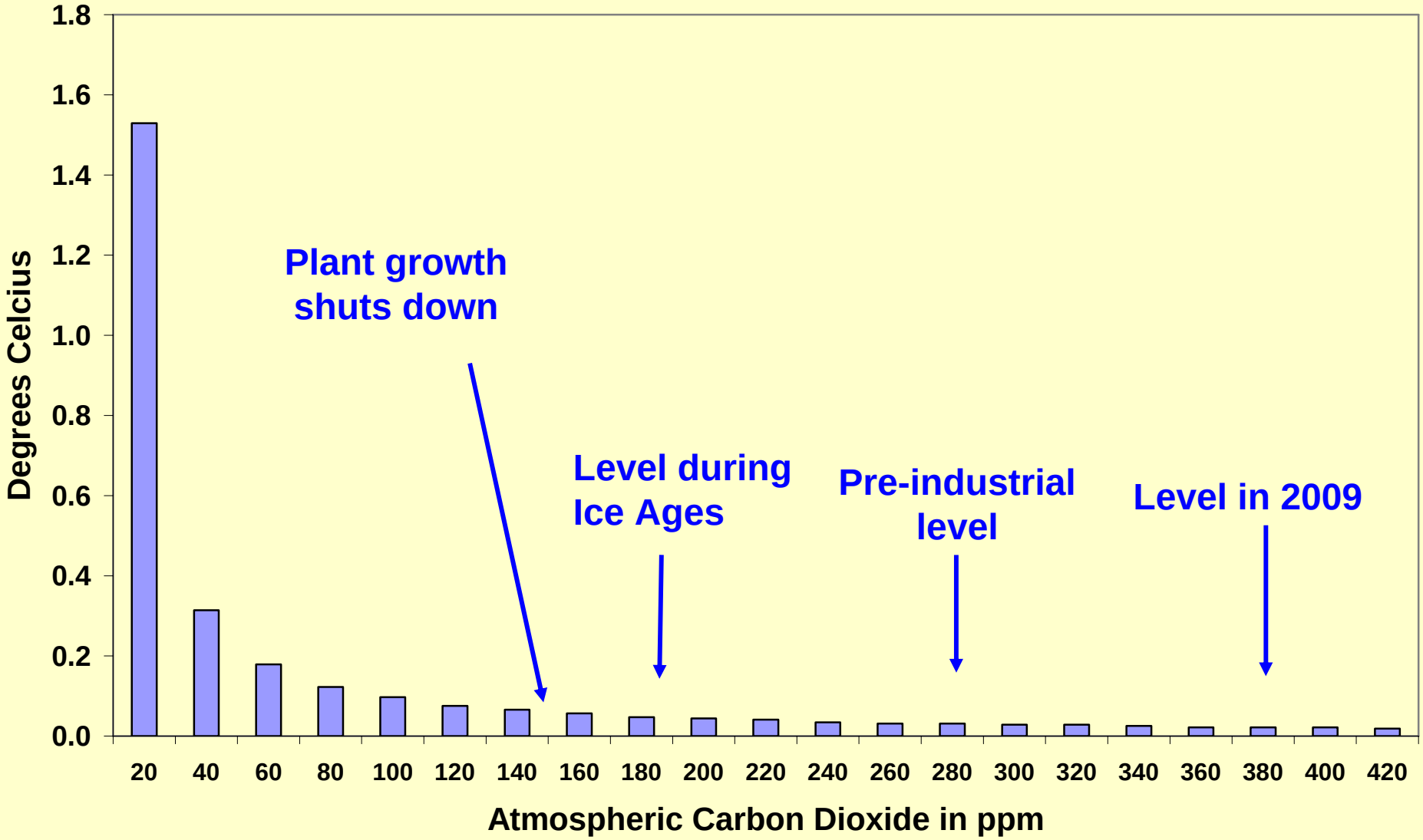


Another Dalton Minimum, or Worse?

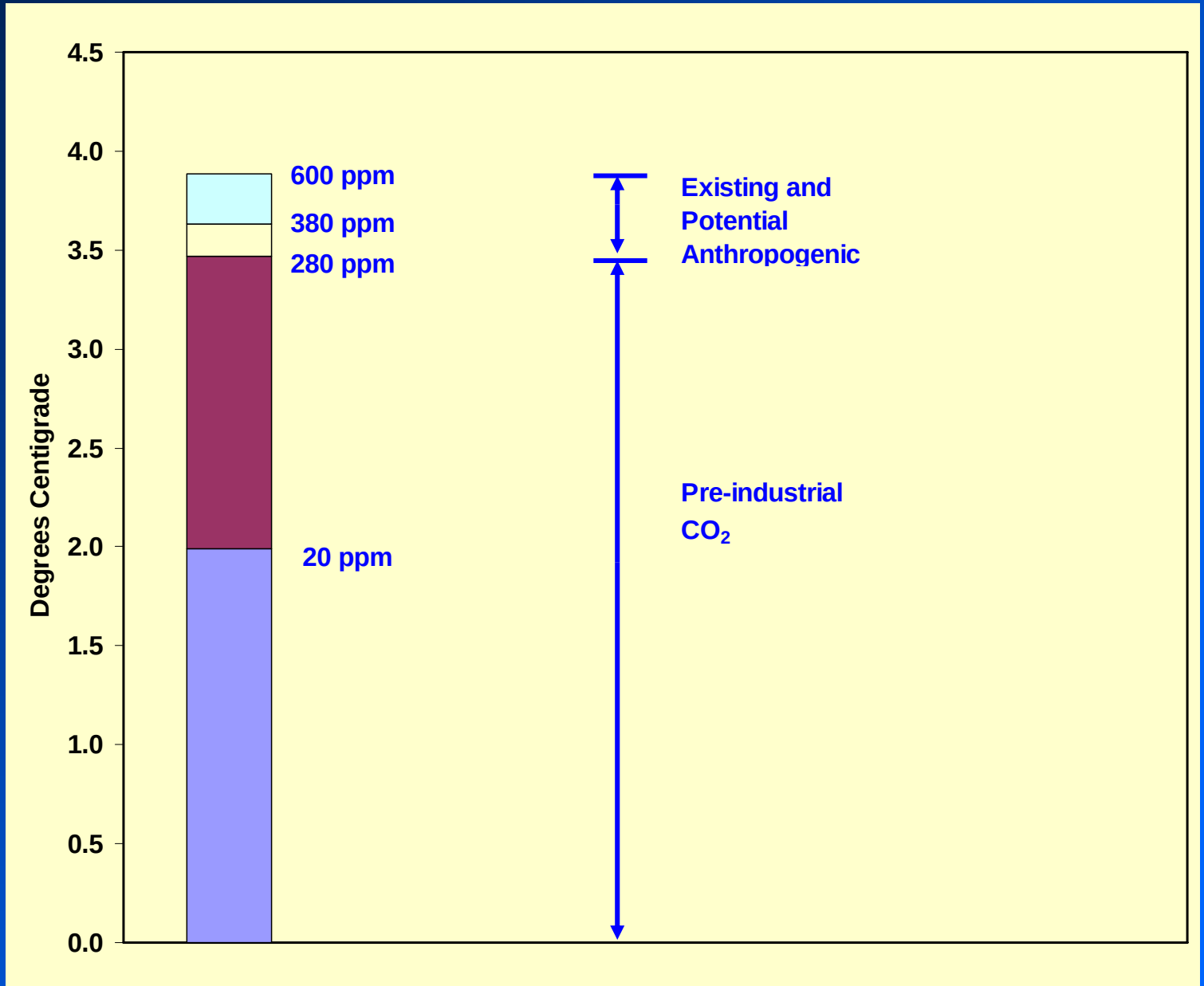
“The surprising result of these long-range predictions is a rapid decline in solar activity, starting with cycle #24. If this trend continues, we may see the Sun heading towards a “Maunder” type of solar activity minimum - an extensive period of reduced levels of solar activity.”

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

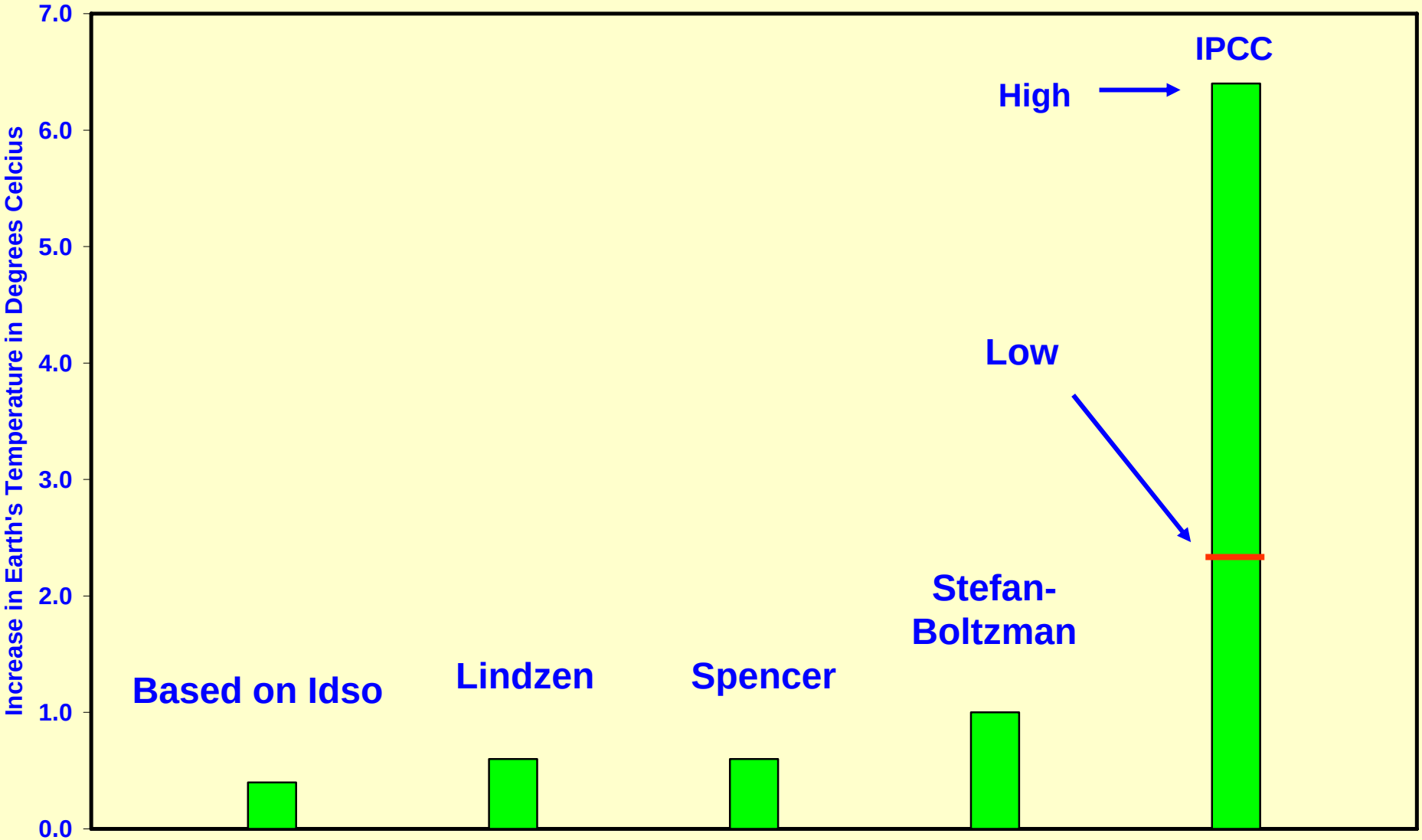
The Warming Effect of Atmospheric Carbon Dioxide



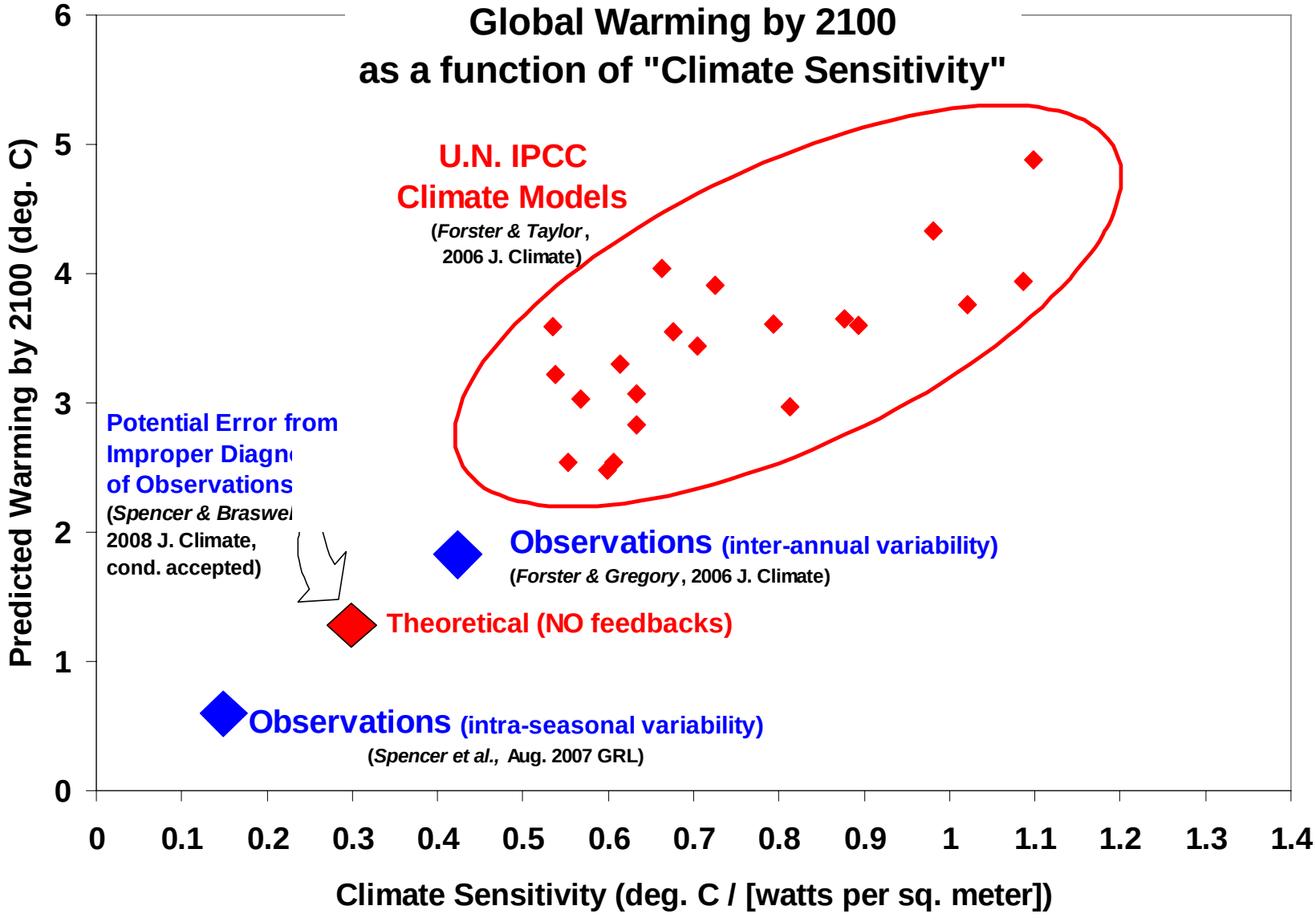
Relative Contributions of Pre-Industrial and Anthropogenic CO2



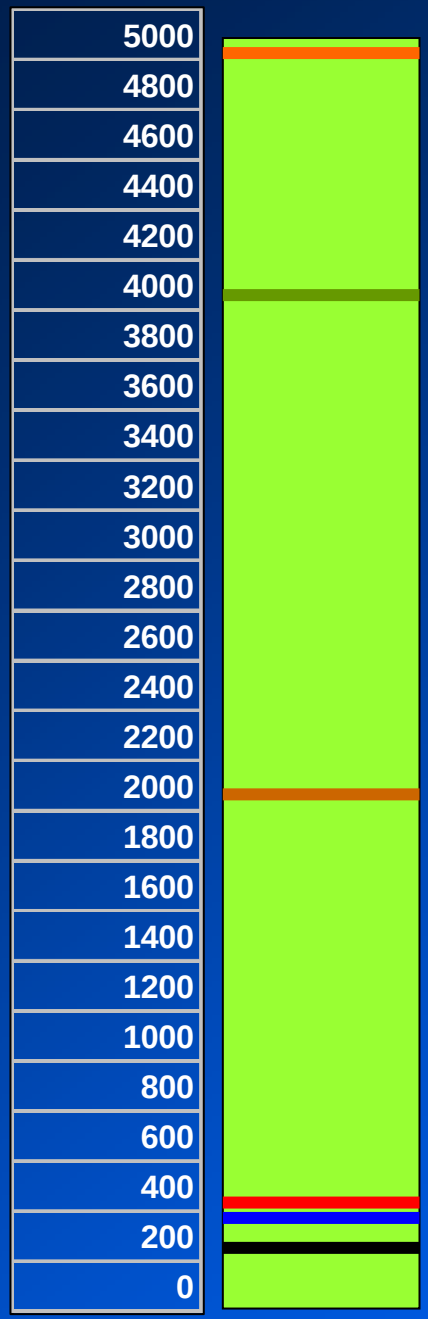
Comparison of Climate Sensitivity Estimates
280 ppm to 560 ppm of CO_2



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

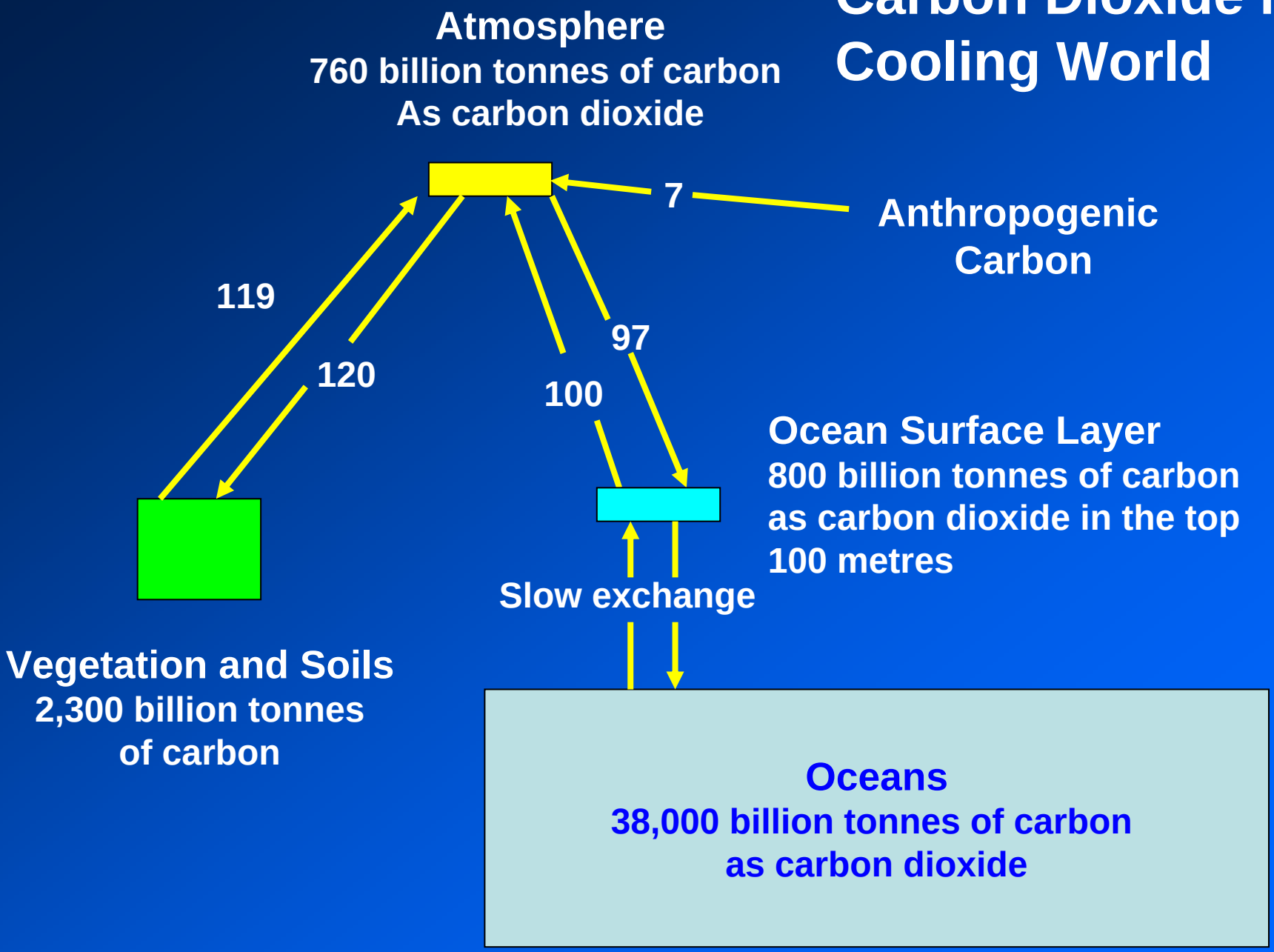
"the safe upper limit for atmospheric CO2 is no more than 350 ppm"
– Dr Hansen of NASA, American Geophysical Union meeting, San Francisco, December 2007

Dr Hansen's safe upper limit

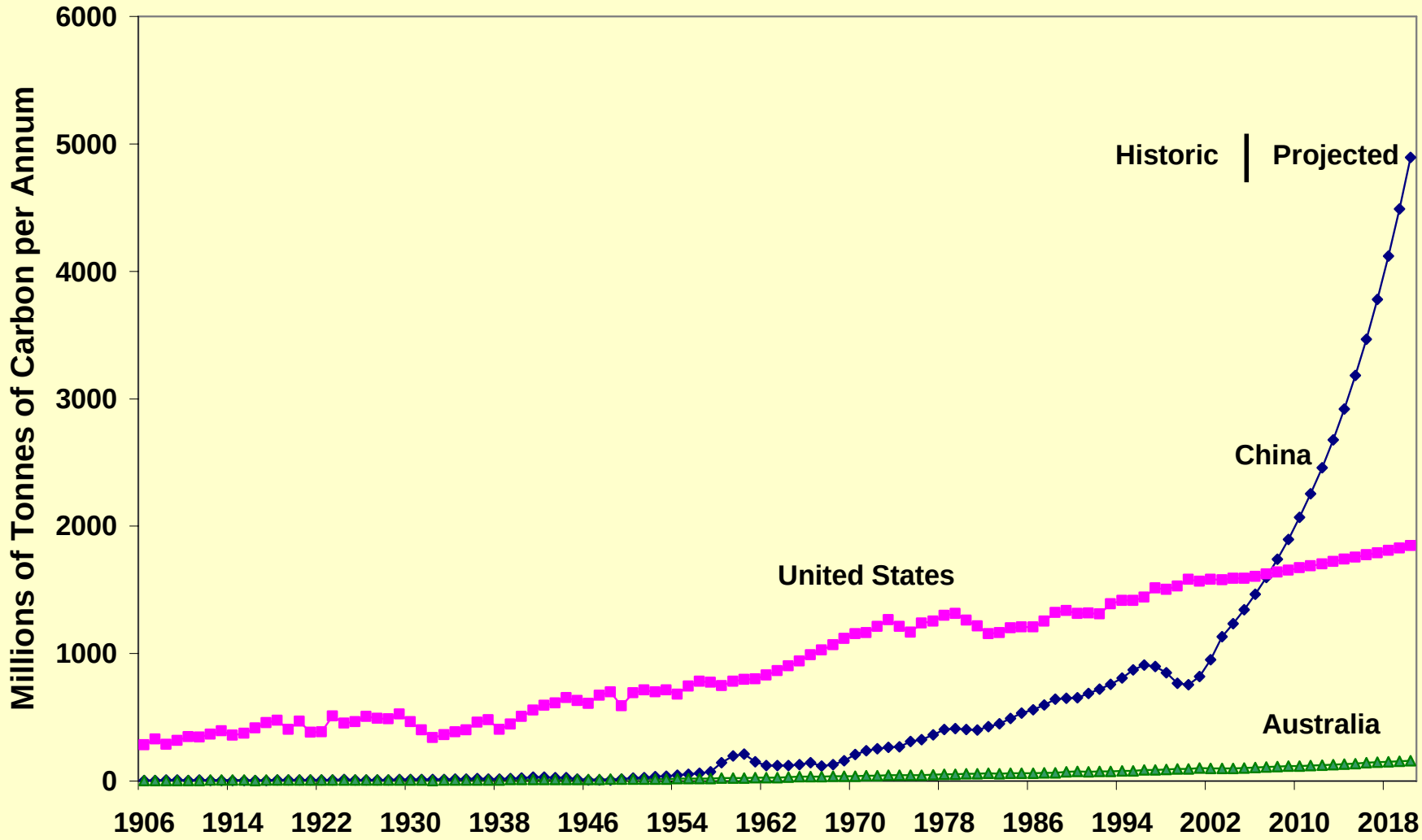
Pre-industrial level of 280 ppm

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

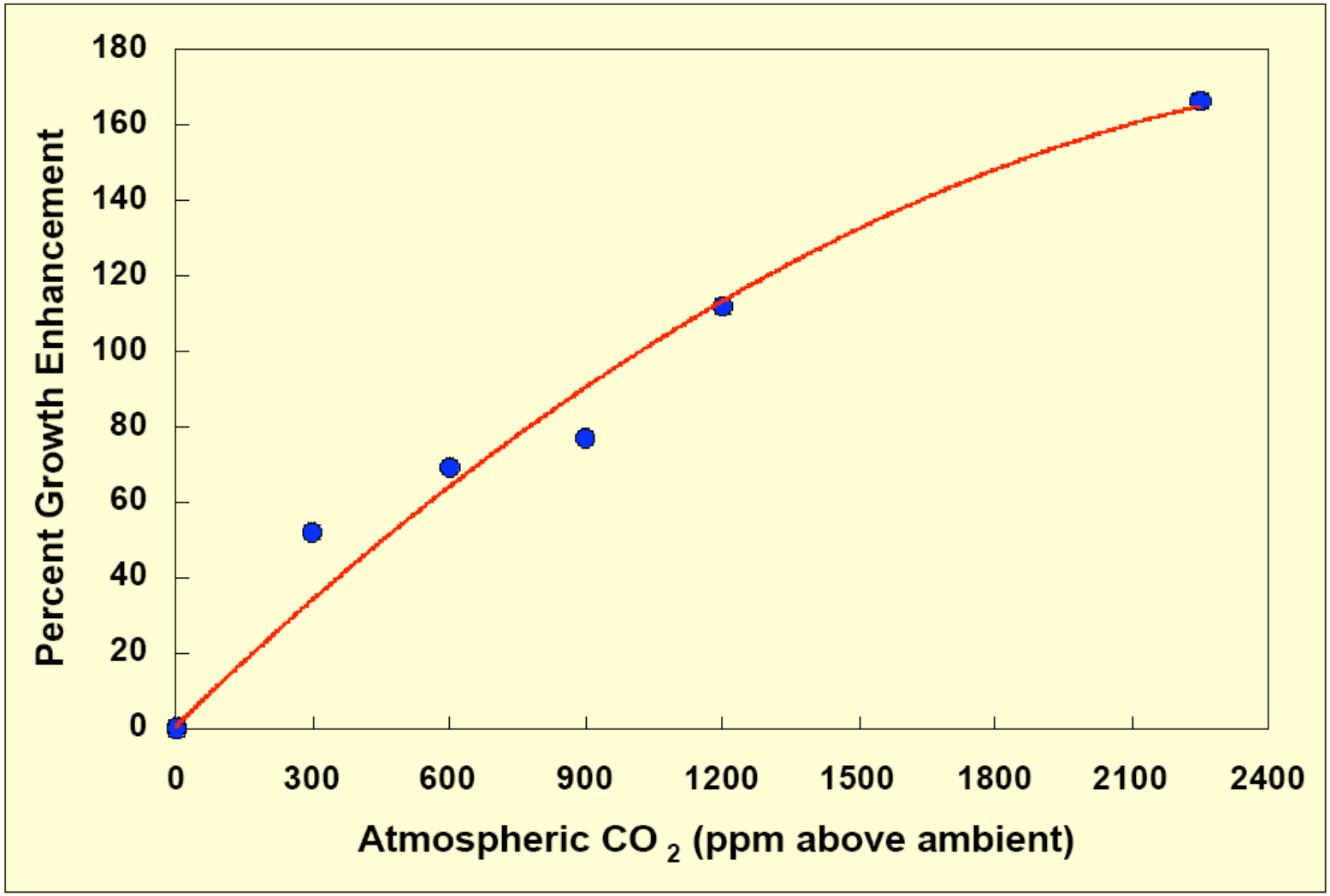
Carbon Dioxide in a Cooling World



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



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

AGW Proponents 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

How will the Global Warming hoax play out for the Mining Industry?

1. 50% to 100% increase in transport and processing costs
2. Shift of energy-intensive processing to China
   - goodbye to the aluminium industry
3. Turmoil until carbon-based taxes are unwound
4. Low process cost – transport cost operators will lose less, therefore mines will be high graded
5. Processing will go offshore

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.**
- **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.**