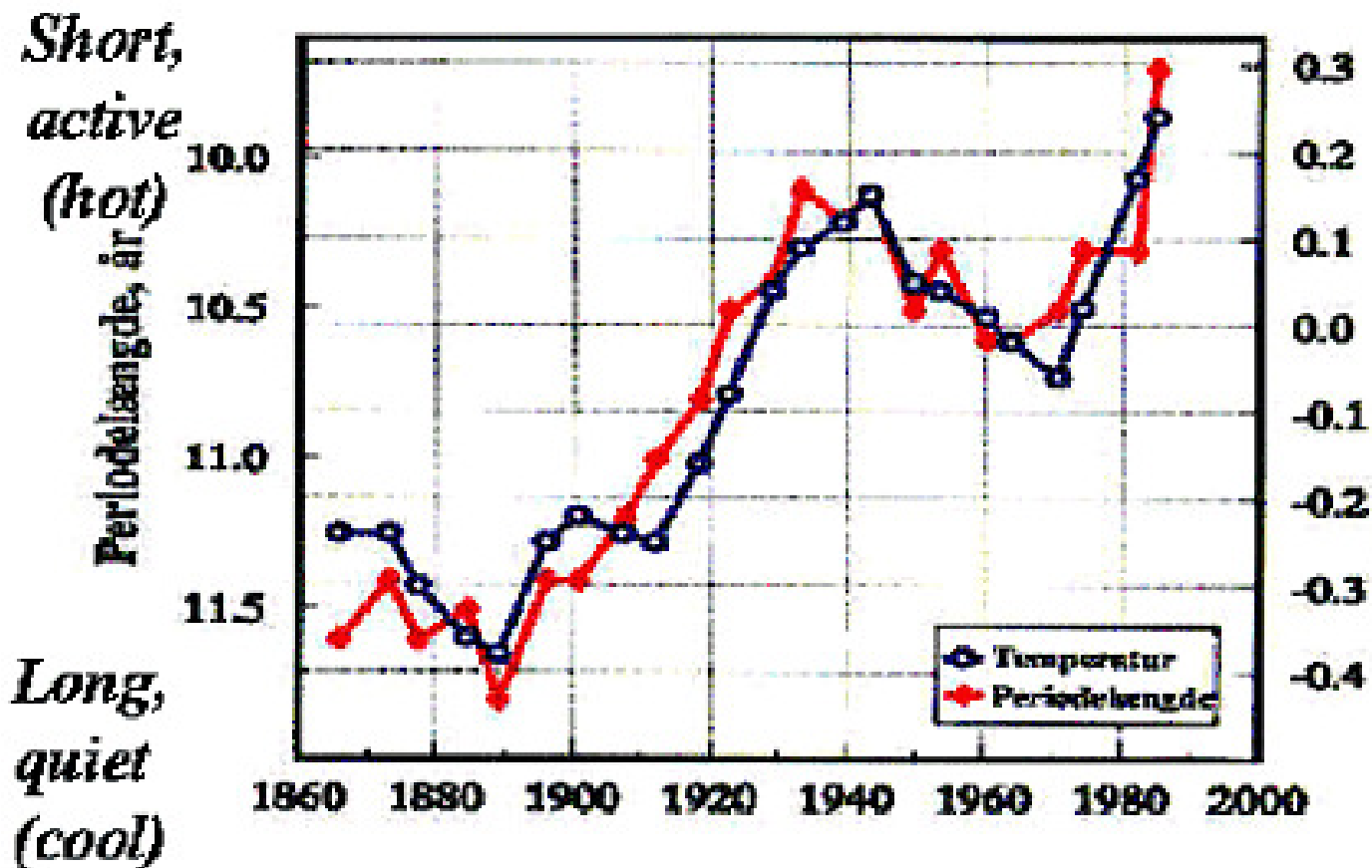


## SOLAR CYCLE LENGTH, SUNSPOT NUMBERS AND TEMPERATURES

In an important paper in 1991, Friis-Christensen et.al. compared the average temperature in the northern hemisphere with the average solar activity defined through the interval between successive sunspot maxima. The more active the sun - the shorter the interval: the solar cycle runs more intense. Their results are displayed in the figure below:

# Global Mean Temperatures and Sunspot Cycle Length

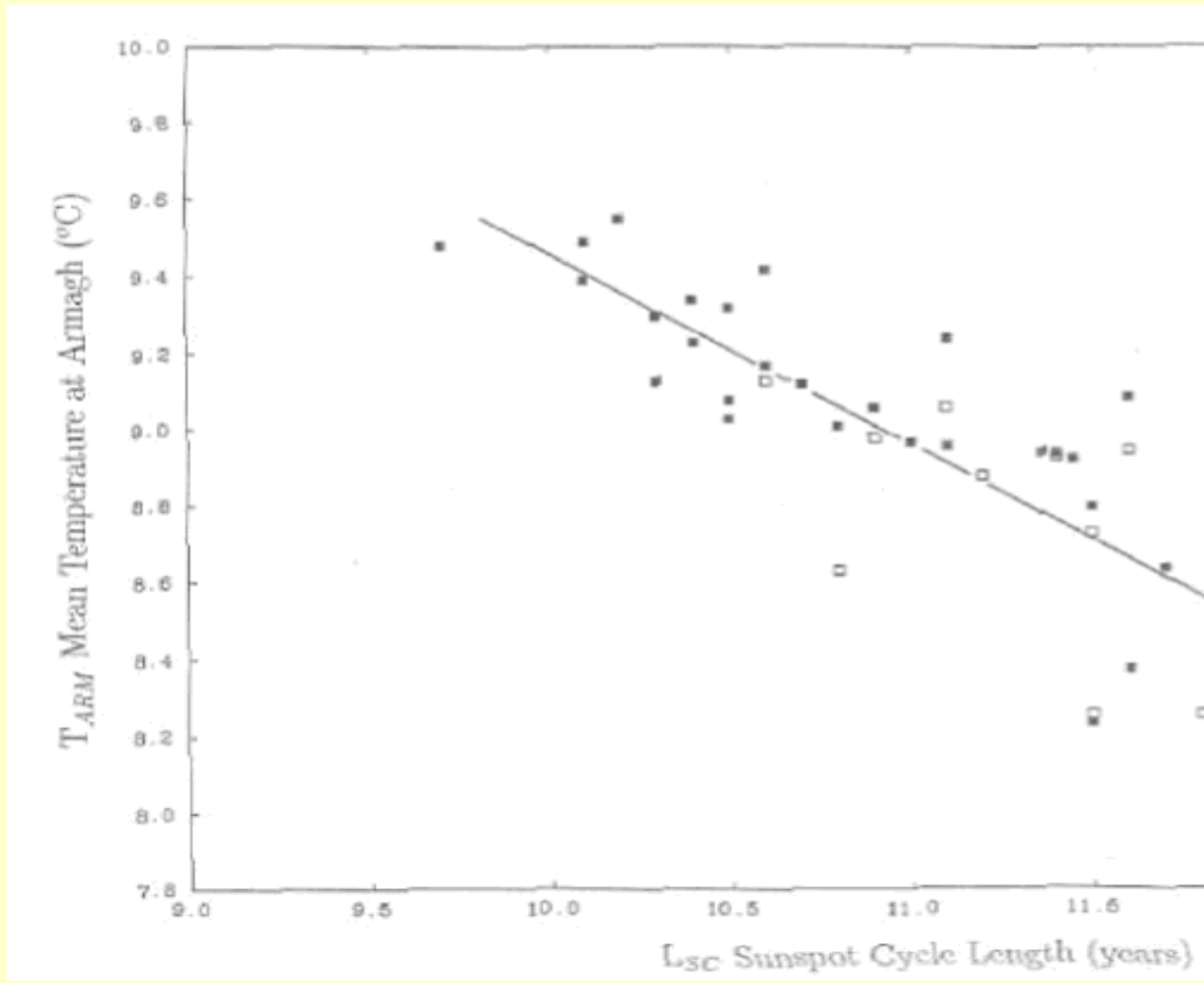


The red curve illustrates the solar activity, which is generally increasing through an interval of 100 years, since the cycle length has decreased from around 11.5 years to less than 10 years. Within the same interval the Earth's average temperature as indicated by the blue curve has increased by approximately 0.7 degree C. Even the finer structures in the two curves have similar appearances. (Reference: Friis-Christensen, E., and K. Lassen, Length of the solar cycle: An indicator of solar activity closely associated with Climate Science, 254, 698-700, 1991).

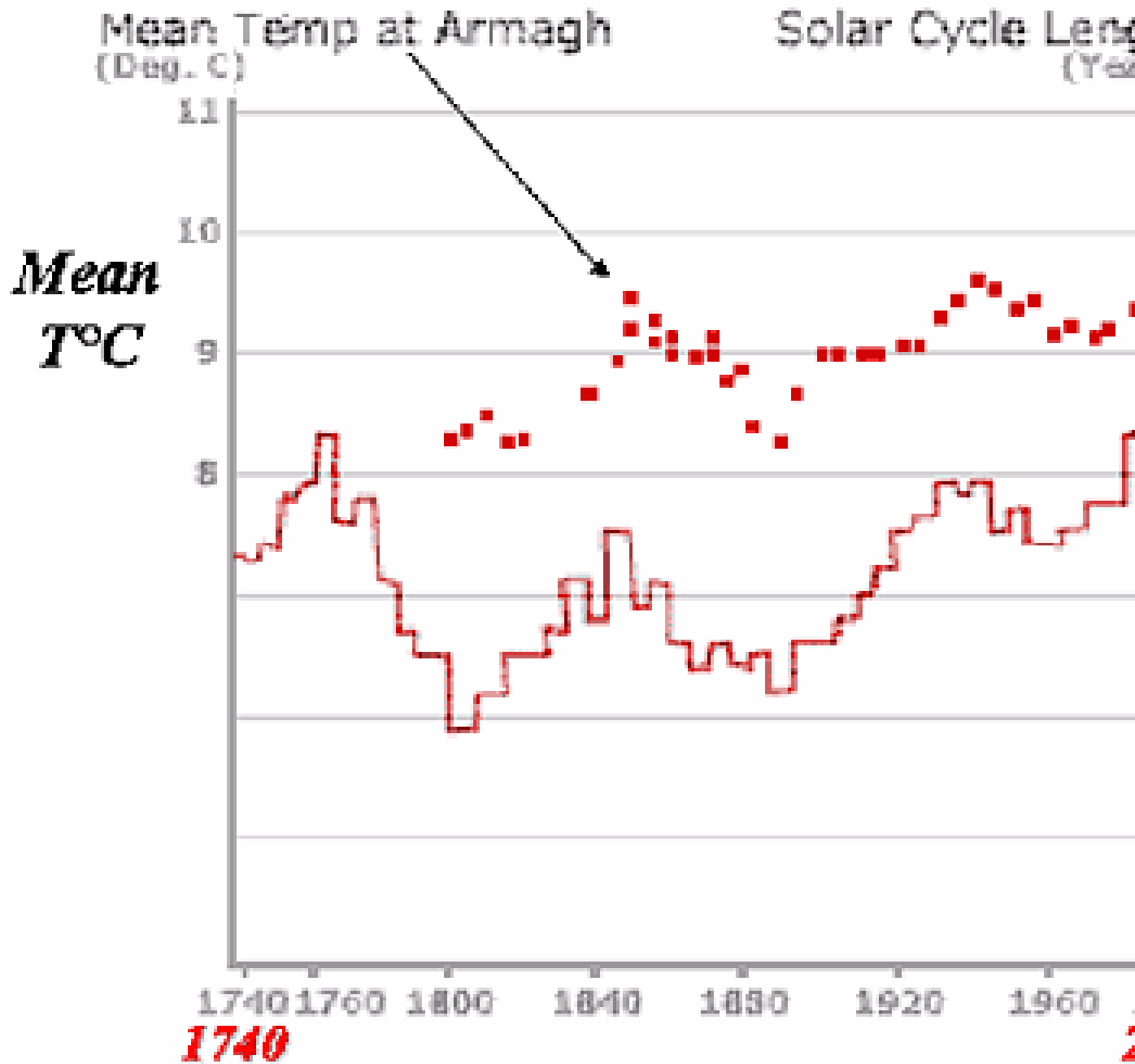
The long standing observation site at Armagh in Northern Ireland shows similar results (this one courtesy of Archibald). Shorter cycles are warmer and longer colder.

## Sunspot Cycle Length Relative to $T_{ARM}$

Armagh, Northern Ireland 1796 – 1996

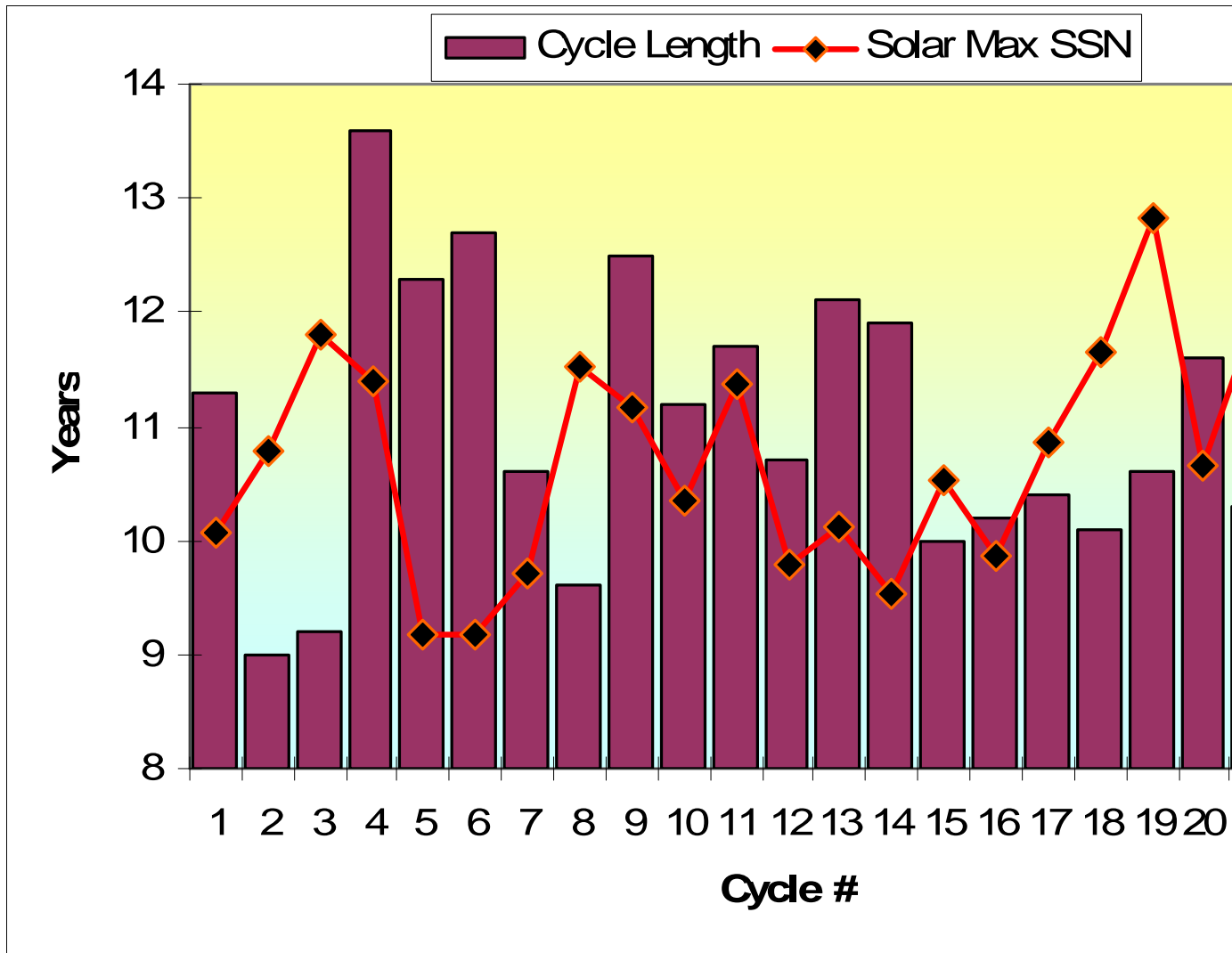


## Recently reported by the BBC - Armagh Ob

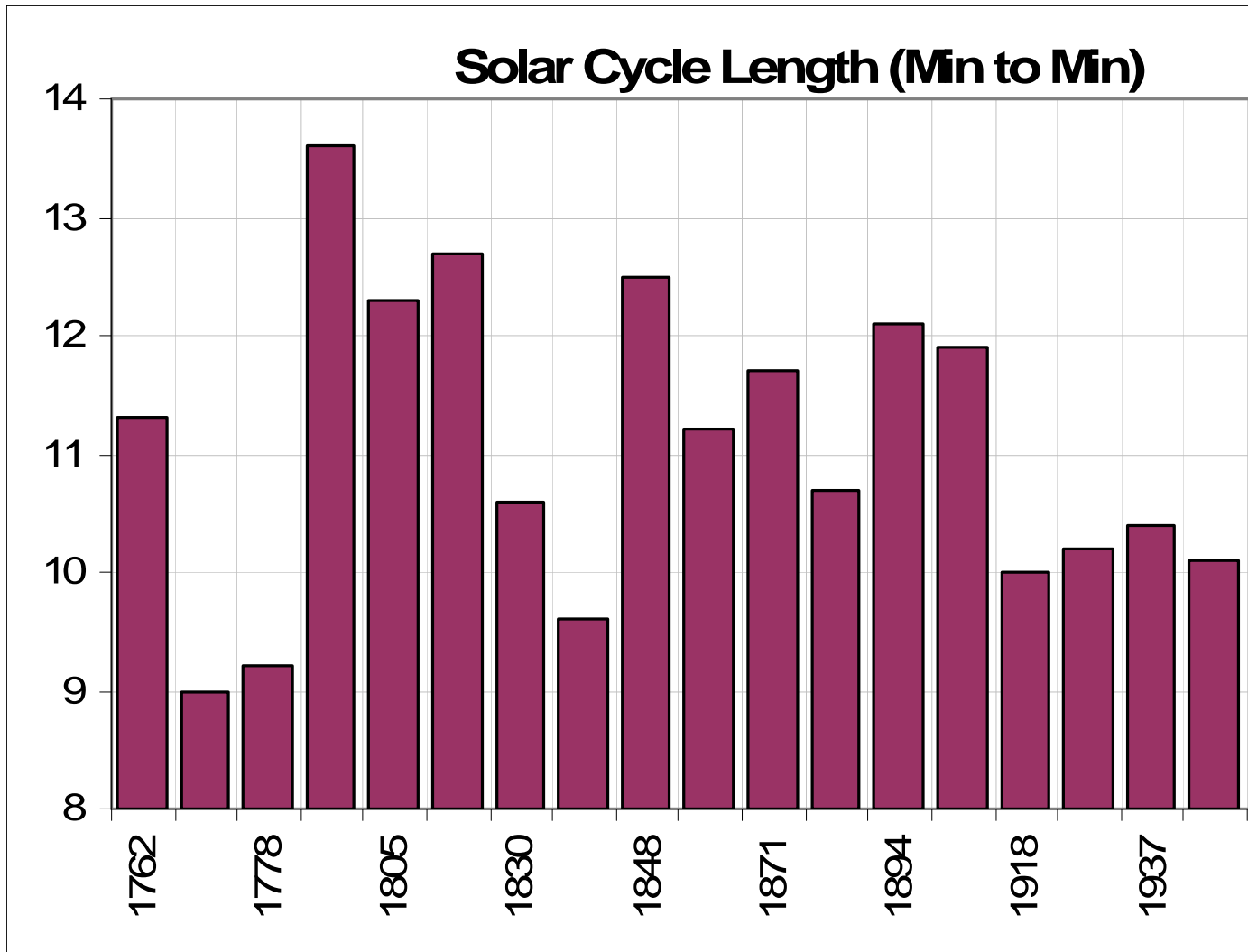


See [http://news.bbc.co.uk/1/hi/english/sci/tech/newsid\\_1045000/1045327.stm](http://news.bbc.co.uk/1/hi/english/sci/tech/newsid_1045000/1045327.stm).

In general the longer cycles are also associated with diminished sunspot activity. I have plotted solar cycle length (columns and sunspot numbers since sunspot cycles were first numbered back in the middle 1700s.



Next to give you a better perspective of dates I repeated the length graph with a plot of the solar max years for the cycles.



The Armagh plot goes back to cycle 4, Friis Christensen around cycle 10.

You can see the long cycles around the Dalton Minimum in the early 1800s and again in the late 1800s to early 1900s. The decreasing length and increasing SSNs accompanied a rise in temperatures in the first half of the 1900s and again late in the century. Note the longer cycle 20 that accompanied the cooling in the 1960s into the 1970s. The current cycle length is still TBD but is likely to be at least close to 12 years. Landscheidt suggested a lag in temperatures to changes in solar input (I believe I recall 8 years). Wigley suggests a 5 year lag to irradiance. This would imply the cooling that appears to have started in 1998/99 or 2001/02 depending in data set used is real and will continue/accelerate.