Natural Cycles

Dai Davies
brindabella.id.au
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Ocean currents have quasi-millennial timing of around 800 to 1000 years. Along with climate optima, they are probably best seen as geographical events that are influenced by weak external drivers that have a more regular cyclic pattern. What might those driver be?

Some people find it difficult to consider that cycles in sunspot numbers and associated solar flares could have an impact on the Earth's climate, and that these, in turn, are driven by planetary motions. To the modern mind it smacks a bit too much of astrology, but bear with me. I'm not talking about meeting the love of your life on the bus tomorrow morning.

I find the idea intriguing, and not at all surprising if you consider that the solar system evolved from a swirling cloud of dust and gas into a highly synchronised cyclic system interconnected by gravitational and electric fields. The Golden Mean harmonies of planetary orbits – 'the music of the spheres' – were noted centuries ago. Modern measurements are showing more and more resonant structures in the motions of moons and even in the braided banded disks of the ringed planets.

The motions of the planets shake the sun about by a distance greater than its diameter. The tidal forces the planets exert on the sun are small, but they have been acting through the full evolution of the solar system. This is likely to be influencing, if not dominating, the sun's roiling internal dynamics that produce sunspot and flare activity at the chaotic boundaries, which influences the Earth's magnetic field that deflects cosmic rays toward the poles forming the shimmering light curtains of the auroras, or, when it's weak, let more through.

The huge showers of secondary particles that cosmic rays create in our atmosphere play a part in seeding clouds, which play a vital role in our water thermostat. Variations of a few percent in cloud cover are all that's needed to account for the small recent temperature changes.

My small excursion into climate modelling consisted of looking at published models of sunspot cycles and adjusting them to fit surface temperature data for the southern oceans – initially, a few hours work with a spreadsheet. The accuracy and simplicity of the result spurred me on to explore further. The model already fitted the data far better than the supercomputer models used by the IPCC.

The choice of this data set was not arbitrary. It can be taken as the rectal temperature of the Earth since there is more ocean down here, and southern climates and ocean currents are simpler than up north.

Figure 4 shows the output of a model using 820, 193, 60 and 32 year cycles. Temperature data is the large black circles. The best fit is the blue line, with others showing 10% parameter variations as part of a sensitivity analysis not error bands. A significant 11 year cycle and other shorter ones help the fit but have been omitted in this model for simplicity sake, and the 32 year cycle is not critical. The mean error (root mean square, rmse) is 0.03ºC.

How various cycles found in sunspots and Earth systems data can be related to planetary orbits is discussed in detail by Nicola Scafetta (1) whose sunspot models inspired my effort. From my own analysis, temperatures follow a clear, but unstable, 11 year cycle – a Jovian year. The 60 year cycle can be clearly seen as 30 year steps in any representation of temperature for the last century. Longer cycles exist, but their periods are disputed. A 210 year Suess cycle is seen in radiocarbon and sunspot data.

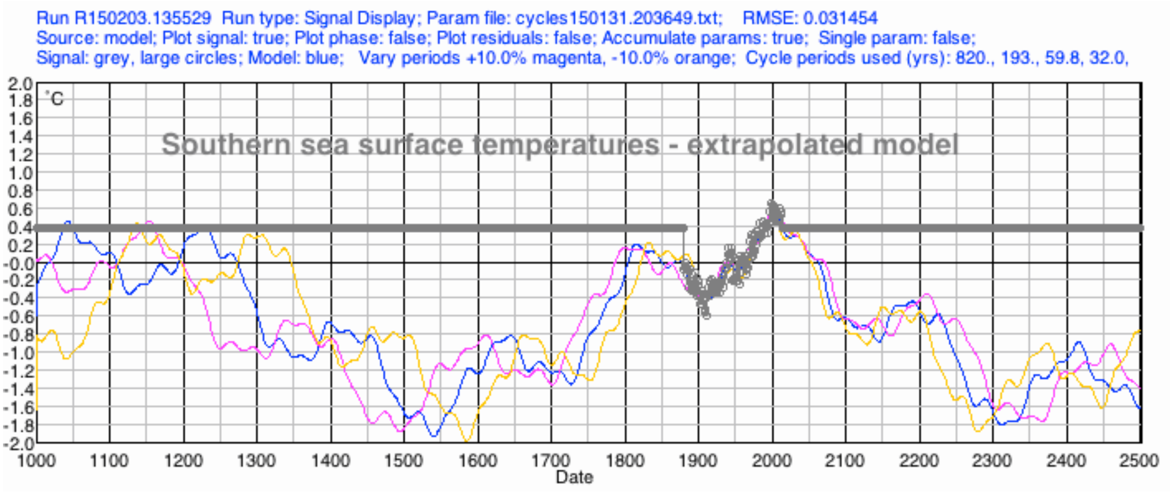

Figure 4

For temperatures, we don't have long enough, or accurate enough, records to pin long cycles down precisely. The 820 (perhaps 800 to 950) year cycle in this model roughly matches the 800 year alignments of Jupiter and Saturn, when they act in concert. There's a limit to how well it can be determined from 135 years of data, but the fact that we're at its peak means the curvature is at a maximum, which helps.

Missing from this model is a long term cooling trend as we slowly descend towards the next major ice age. Historical records suggest that the millennial peaks are weakening.

The value of a model is not how well it fits the data, but whether it can answer questions about our world. Is the rise in temperature over the last century part of an ongoing upward trend caused by increasing atmospheric CO2, or is it part of a natural cycle?

The full model I'm using here exhaustively optimises the fit to data given the specified initial constraints – in the illustrated case, four cycles of unconstrained period. Replacing the millennial cycle with an upward sloping straight line that might represent the influence of rising CO2 levels, then letting the model relax to an optimum, reduces accuracy relative to the cycle.

Can a combination of straight line and long cycle improve the fit? Optimising with both present, but fixing the straight line at increasing slopes for successive optimisations, provides a maximum slope for the line of about 0.3 C° per century before it doubles the error and the data starts screaming for mercy. An upward turning line would be worse. The data demands a long term cycle in ocean temperatures. There is no significant role for CO2.

Copernicus offended sensibilities by suggesting that we were not the centre of the universe. The current turn of the Copernican revolution involves the recognition that we are a tiny part (0.001%) of the Earth's biosphere, and all our industrial activity has added just 1% to its carbon cycle.

The model has been extrapolated to show the last millennial peak, the Little Ice Age, and future trends. I was motivated by a desire to know what conditions might be like in the year 2200 – a time I escape to whenever I can – a time when we understand our planet and our solar system much better – when we confront the next turn of the Copernican revolution and start heading out across the vast expanse of our galaxy.

References:

1. Scafetta, N., 2010, *Empirical evidence for a celestial origin of the climate oscillations and its implications*, Journal of Atmospheric and Solar-Terrestrial Physics