Does the Sun work as a nuclear fusion amplifier of planetary tidal forcing?

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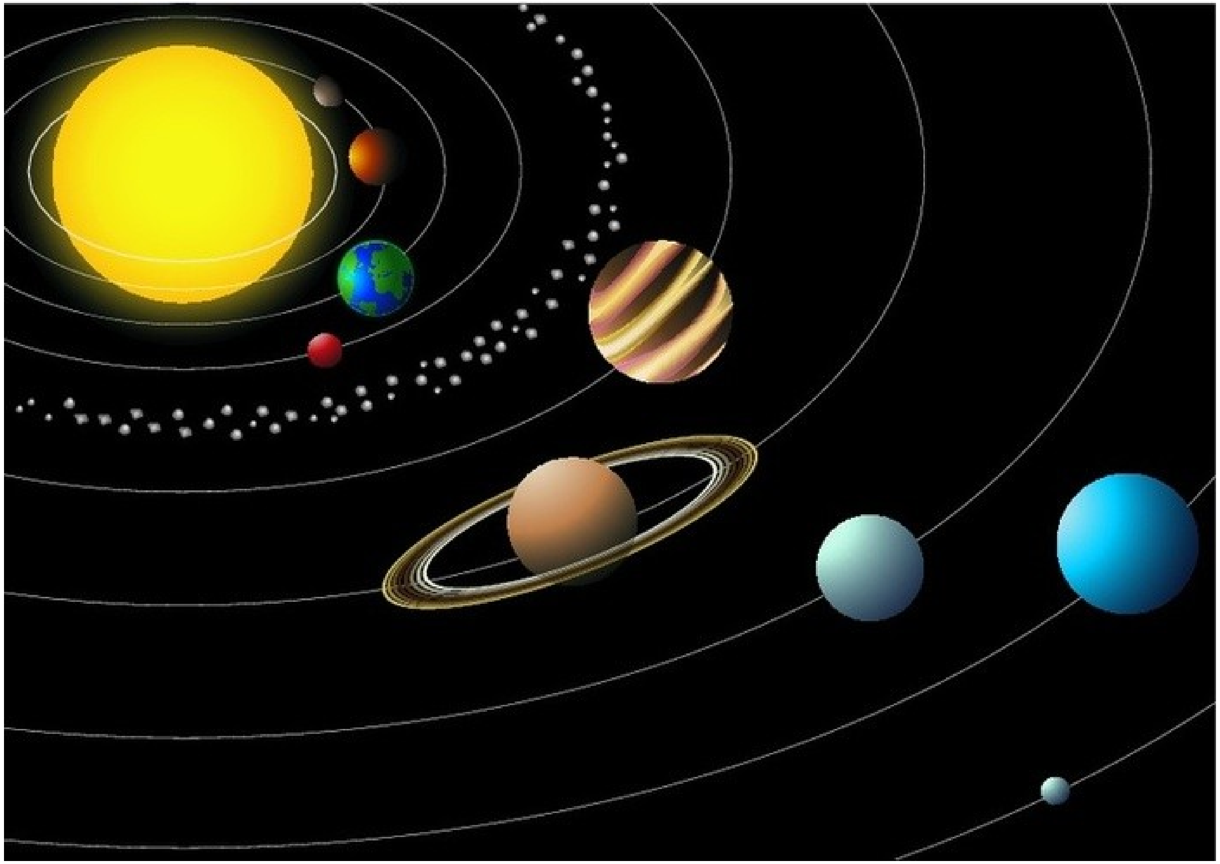
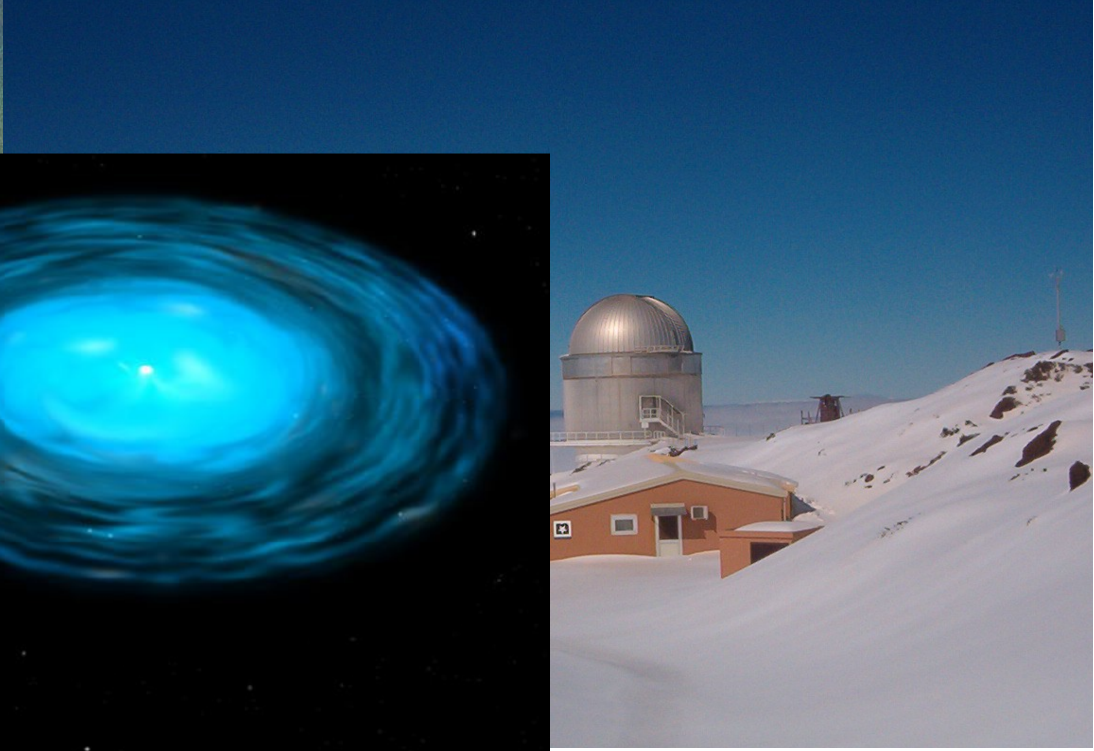
We are living in a **solar system**

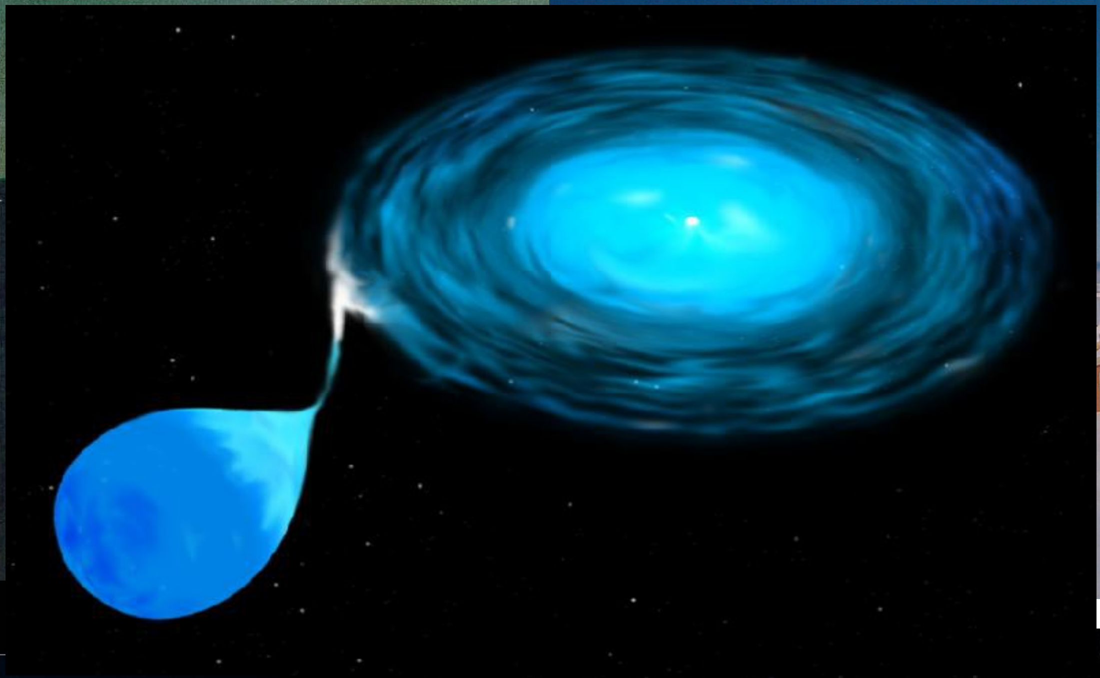
- The solar system oscillates because of planetary motion

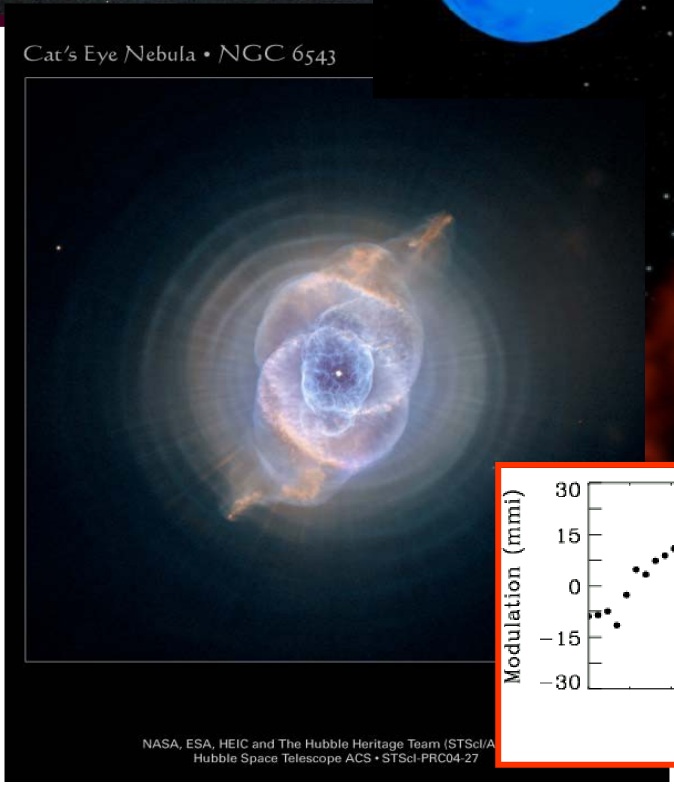
- The Sun is likely very sensitive to these oscillations and synchronizes to them

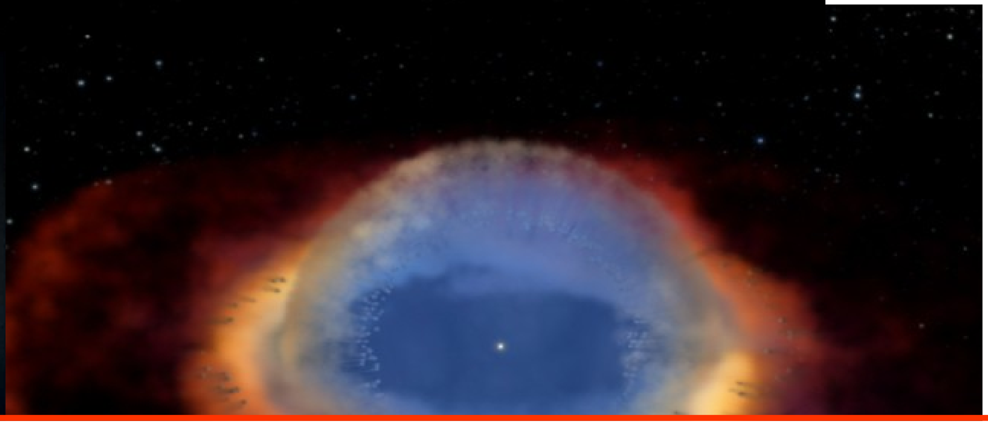
- The Earth's climate system oscillates with the same oscillations by synchronizing to them

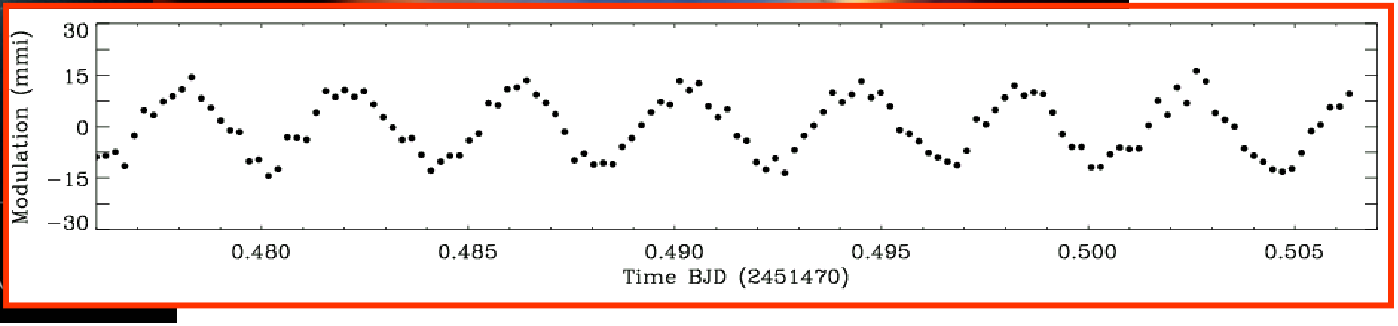




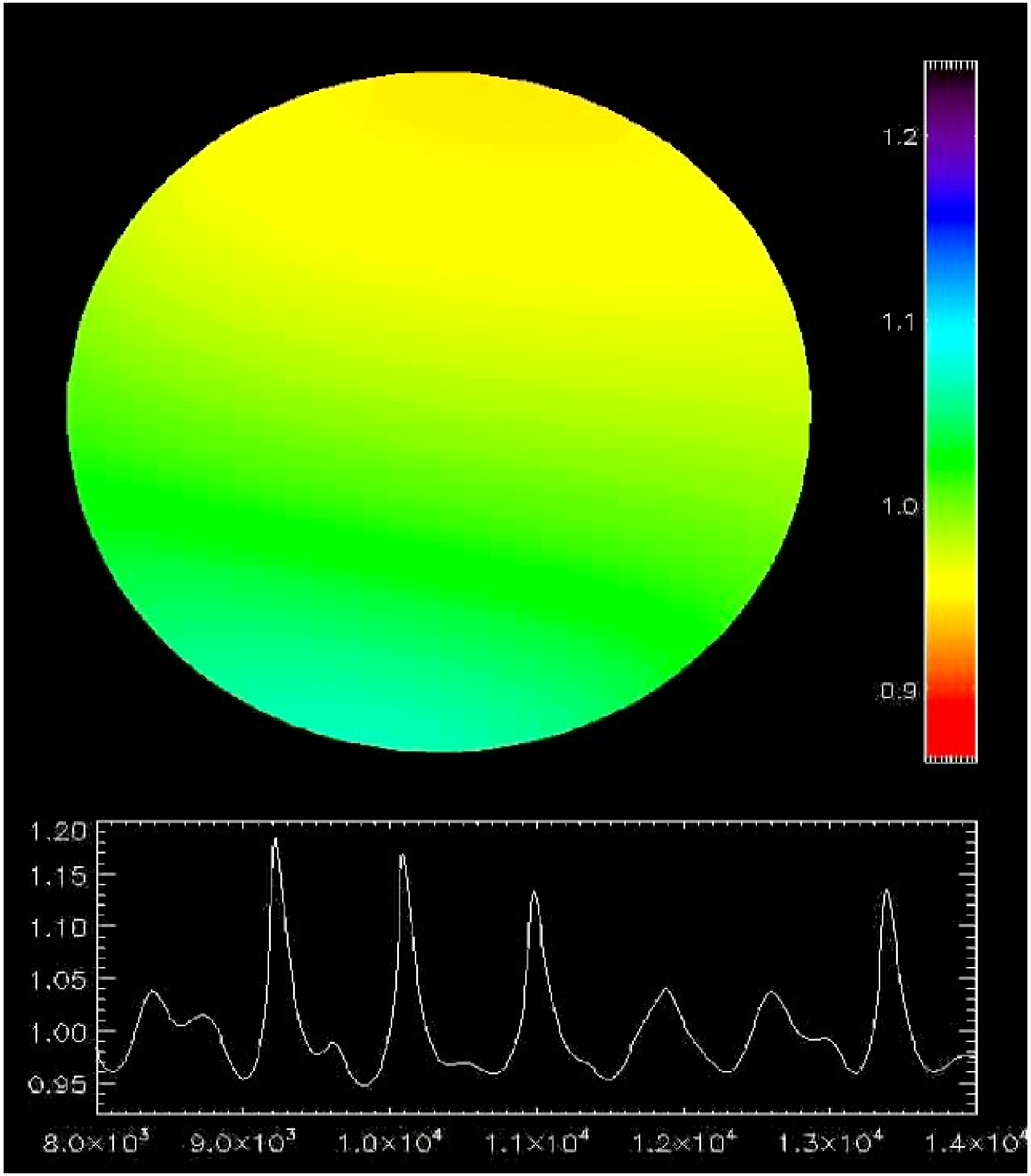



Cat's Eye Nebula • NGC 6543
NASA, ESA, HEIC and The Hubble Heritage Team
Hubble Space Telescope ACS • STScI-PRC04-27



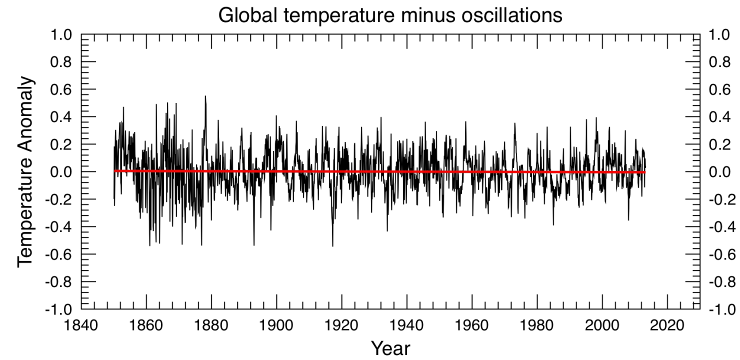

Modulation (mmi)
30
15
0
−15
−30
0.480
0.485
0.490
0.495
0.500
0.505
Time BJD (2451470)

Model of a pulsating star



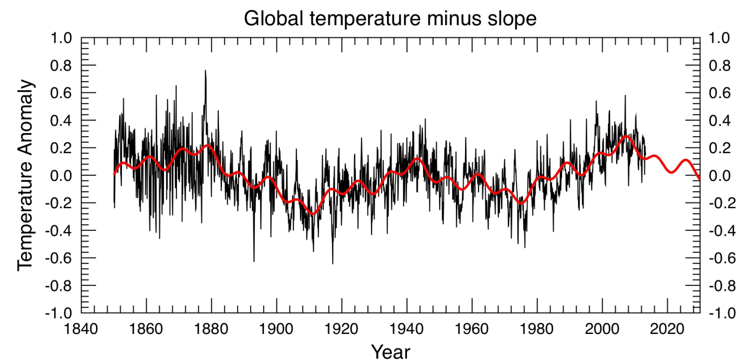
The global temperature

Trend + 3 periods removed

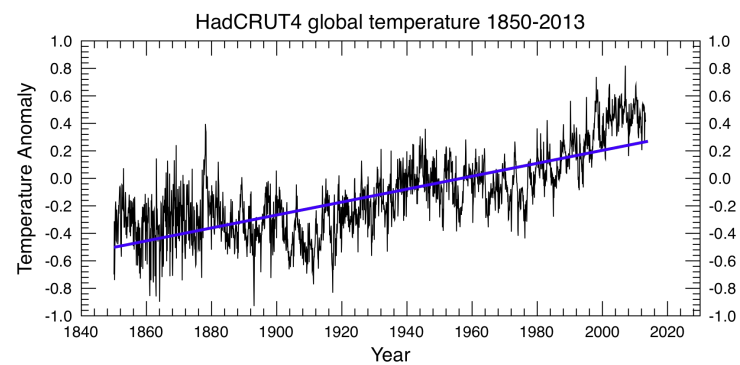


Detrendet + fit of 3 periods

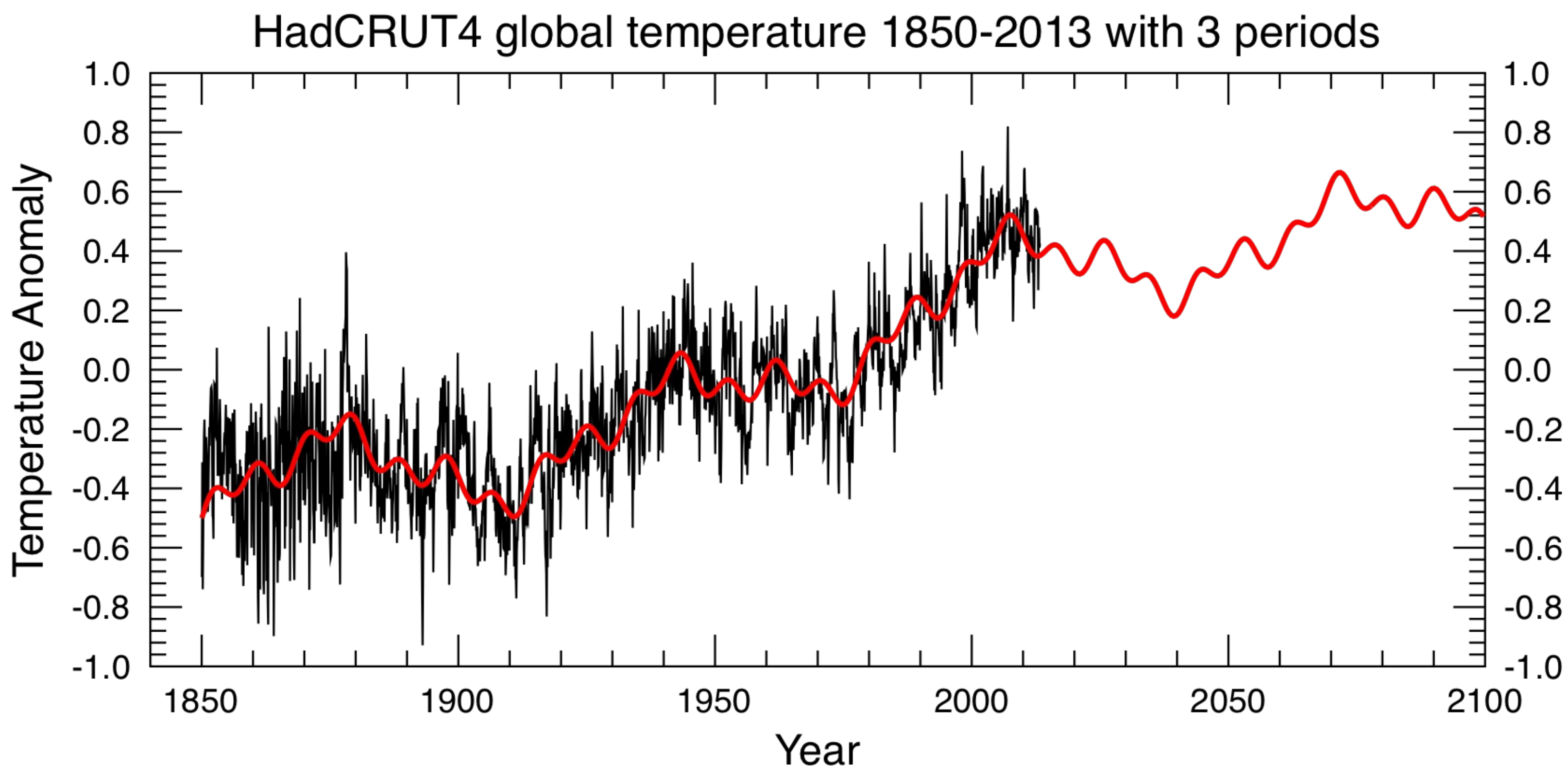
P= 66, 22, and 9.2 yrs



Trend: 0.47 ^{o}C/ 100 yrs



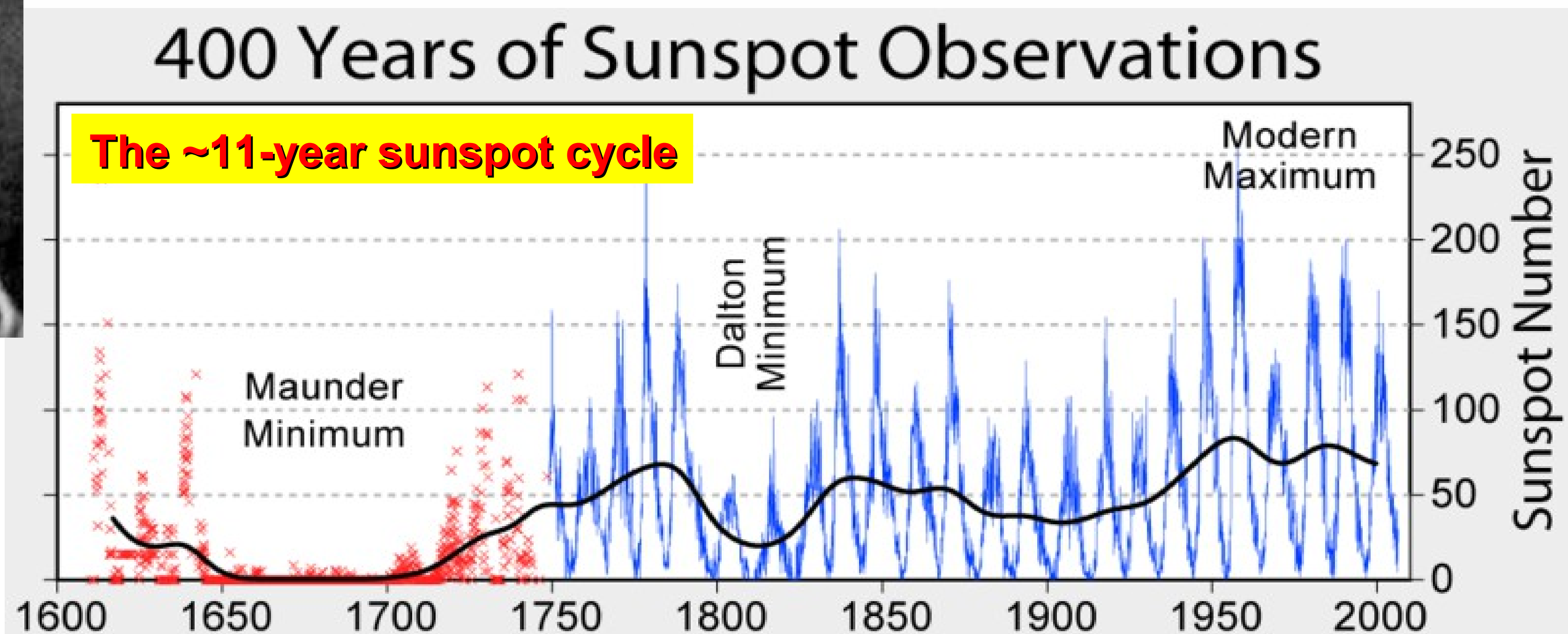
Why do we have climate cycles?
What if the cyclic climate continues?
Maybe: Sun and planets?



The theory of a planetary modulation of solar activity

Extract of a Letter from Prof. R. Wolf, of Zurich, to Mr. Carrington, dated Jan. 12, 1859.

(*Translation.*)



the same planets, the conclusion seems to be inevitable, that my conjecture that the variations of spot-frequency depend on the influences of *Venus, Earth, Jupiter, and Saturn*, will not prove to be wholly unfounded. The preponderating planet

Critique to the theory of a planetary modulation of solar and climate activity

- **Planets seem too far from the Sun and from the Earth**
- **Planetary cycles seem to be uncorrelated to solar variability**
- **Claiming a planetary influence appears "astrology"**

Planetary tides during the Maunder Sunspot Minimum, CHARLES M. SMYTHE & JOHN A. EDDY Nature 266, 434 - 435 (31 March 1977);

We reconstruct here Sun-centred planetary conjunctions and tidal potentials for the AD 1645–1715 period of sunspot absence (the Maunder Minimum). These are found to be effectively indistinguishable from patterns of conjunctions and power spectra of tidal potential in the modern era of a well-established 11-yr sunspot cycle. This places a new and difficult constraint on any tidal theory of sunspot formation.

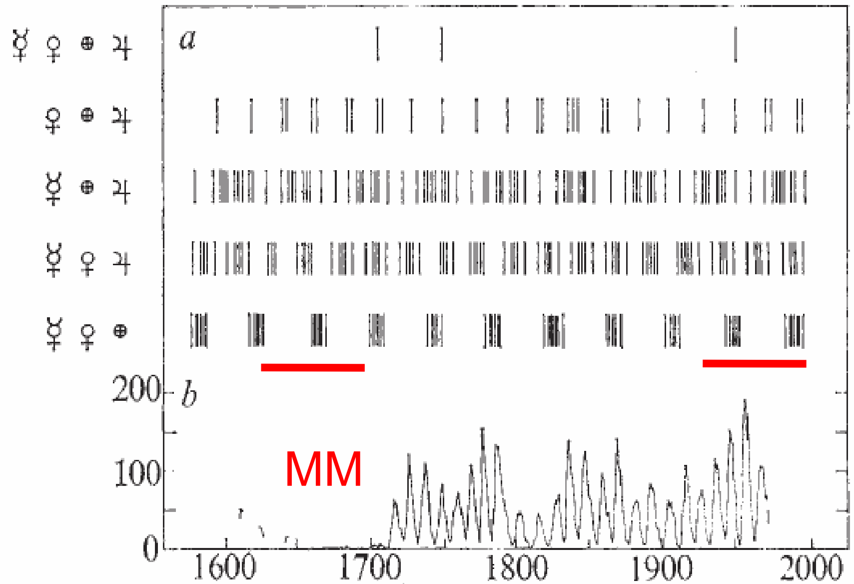


Fig. 1 *a*, Multiple planetary conjunctions (alignment within 0.15 rad) AD 1575–2000. *b*, Mean sunspot number[6].

The inconvenient truths

● **Current solar science claims that the Sun is an isolated system regulated by an internal solar dynamo**

However, current solar dynamo models fail to explain

1) 11-year solar cycle
2) 60-120 yr cycles (Gleissberg solar cycles)
3) 150-250 yr cycle (de Vries solar cycles)
4) 800-1100 yr cycle (Eddy solar cycles)
5) etc......

● **Current climate science claims that astronomical forcings have a very small influence on the Earth's climate**

However, there is a synchronicity between solar and climate records that remains unexplained, and the ultimate origin of multiple climate oscillations remains mysterious as well.

The 11-year sunspot cycle appears regulated by Venus-Earth-Jupiter-Saturn

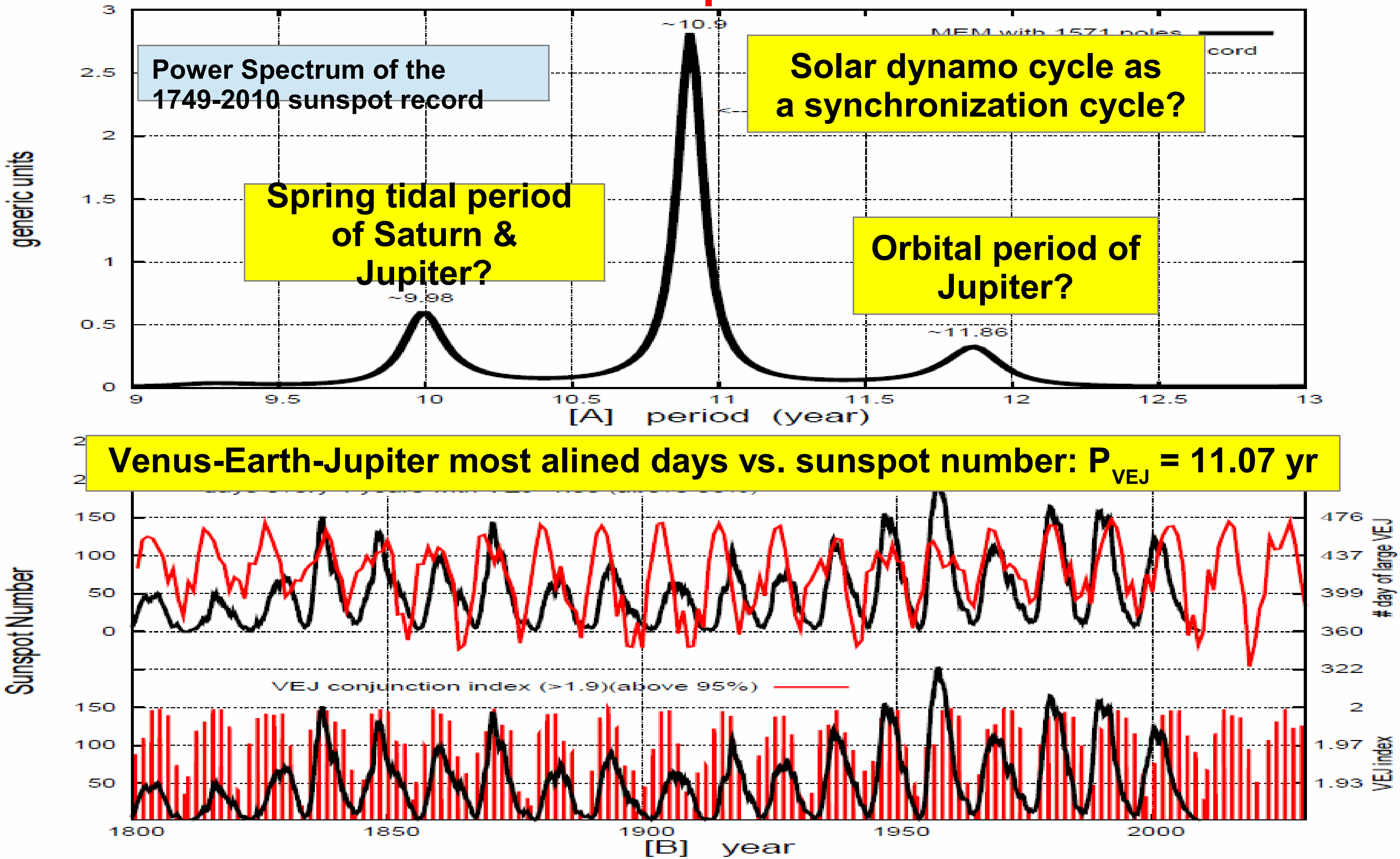
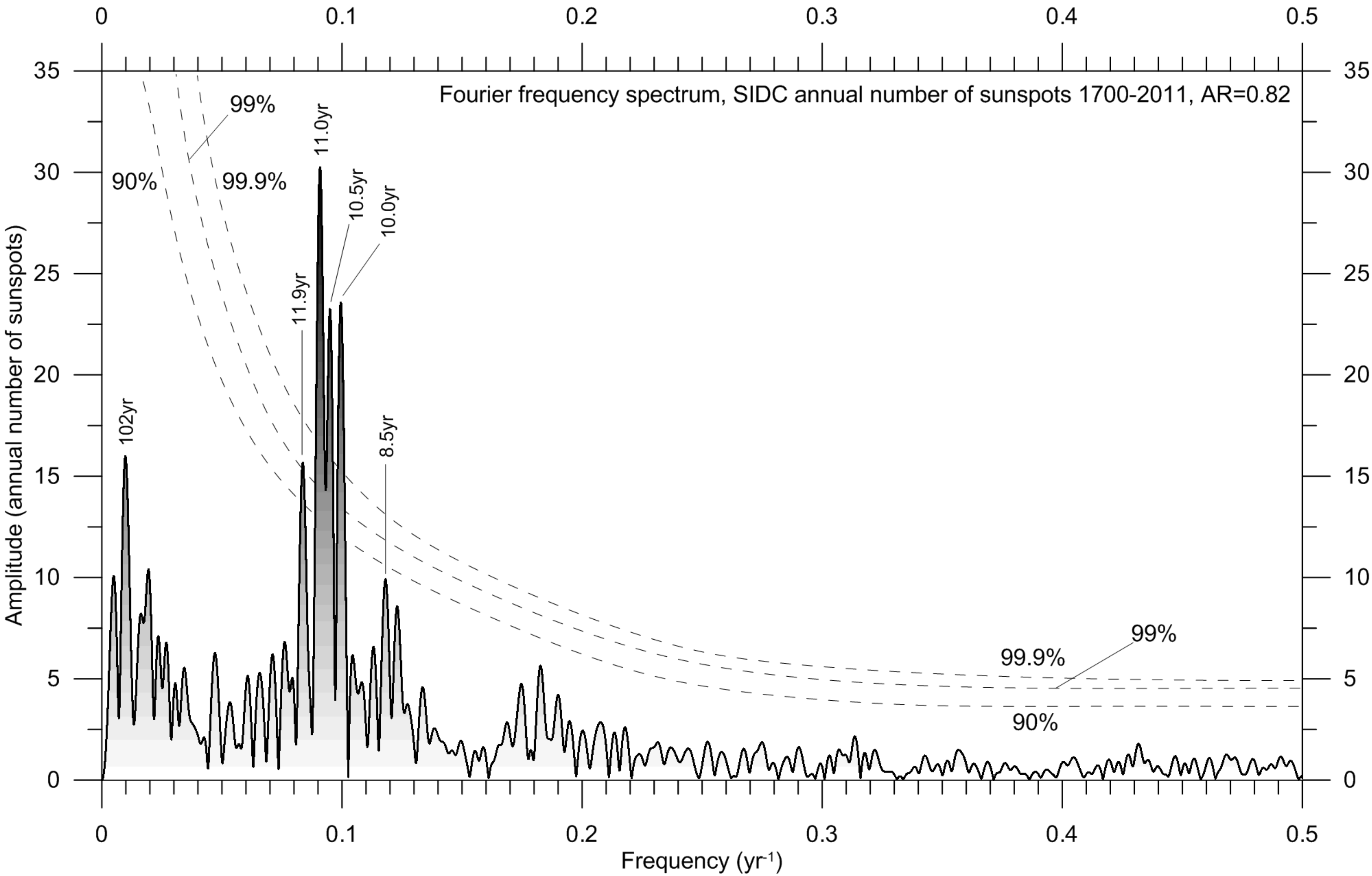
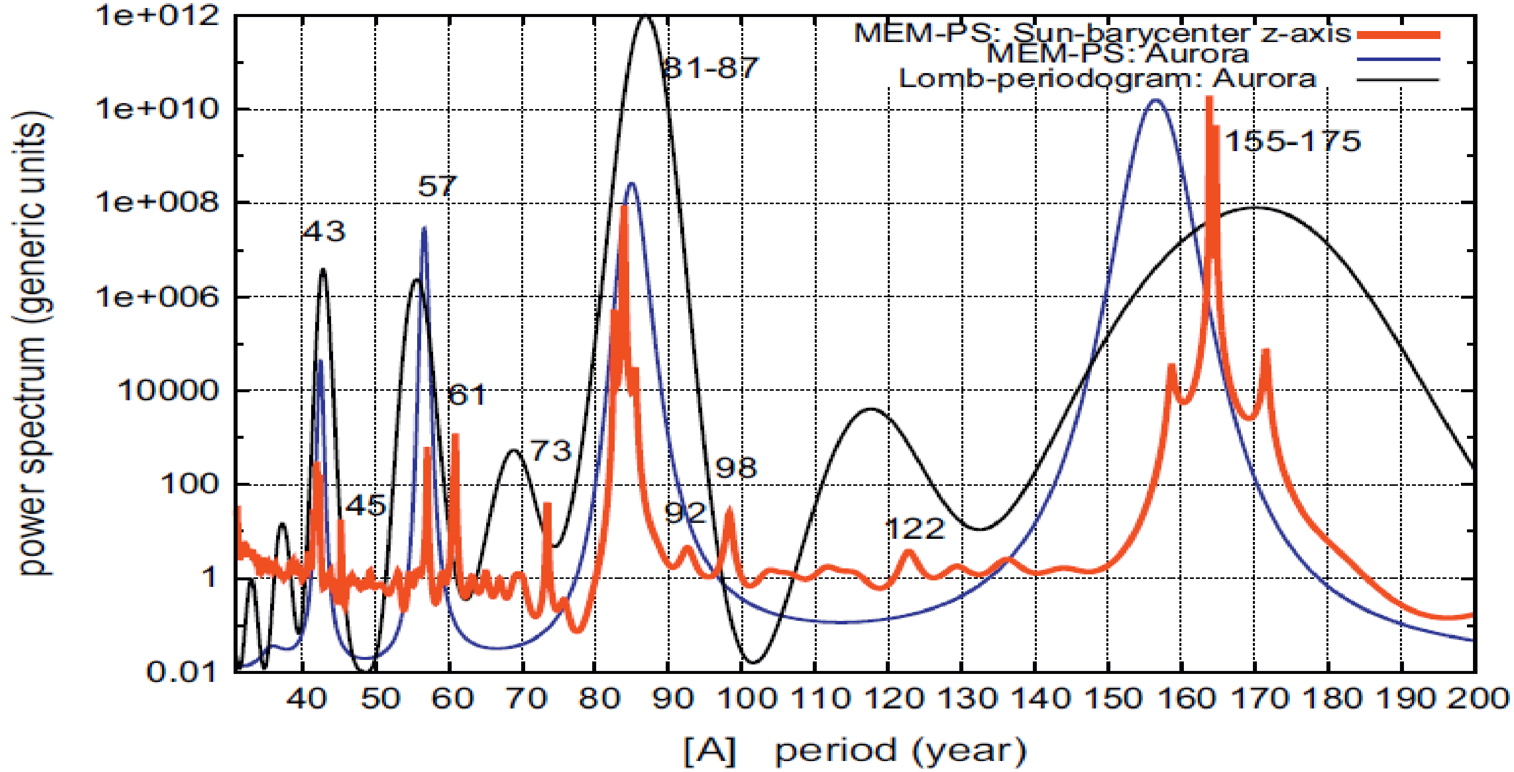
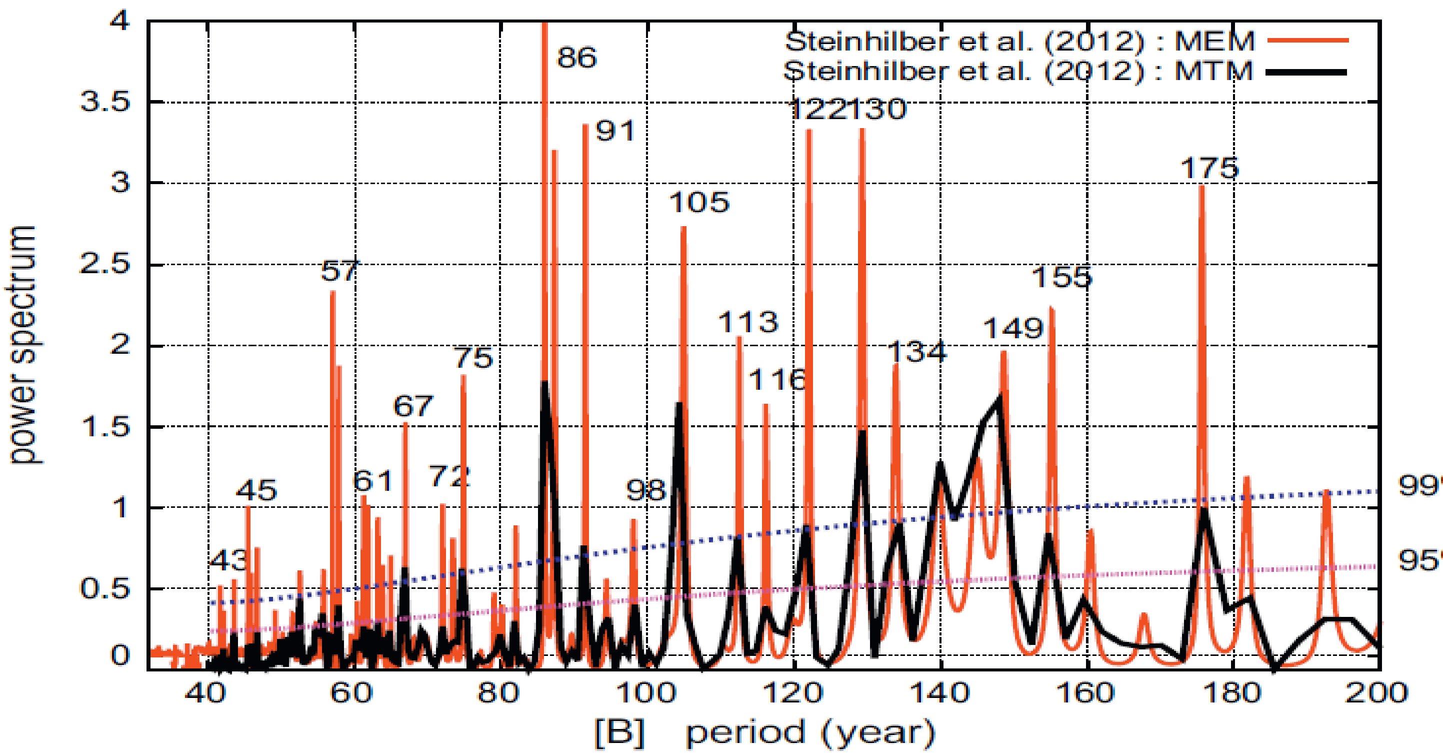


Figure 12: [A] Power spectrum of the sunspot record from 1749 to 2010 highlighting three peaks within the Schwabe frequency band (period 9-13 years) including the two major tides of Jupiter and Saturn. [B] Comparison between the sunspot record (black) and a particular tidal pattern configuration (red) made using Venus, Earth and Jupiter that reproduces on average the solar cycle length of 11.08 yr.


Fourier frequency spectrum, SIDC annual number of sunspots 1700-2011, AR=0.82
Amplitude (annual number of sunspots)
Frequency (yr-1)
102yr
11.9yr
11.0yr
10.5yr
10.0yr
8.5yr
90%
99%
99.9%
0
0.1
0.2
0.3
0.4
0.5
0
5
10
15
20
25
30
35

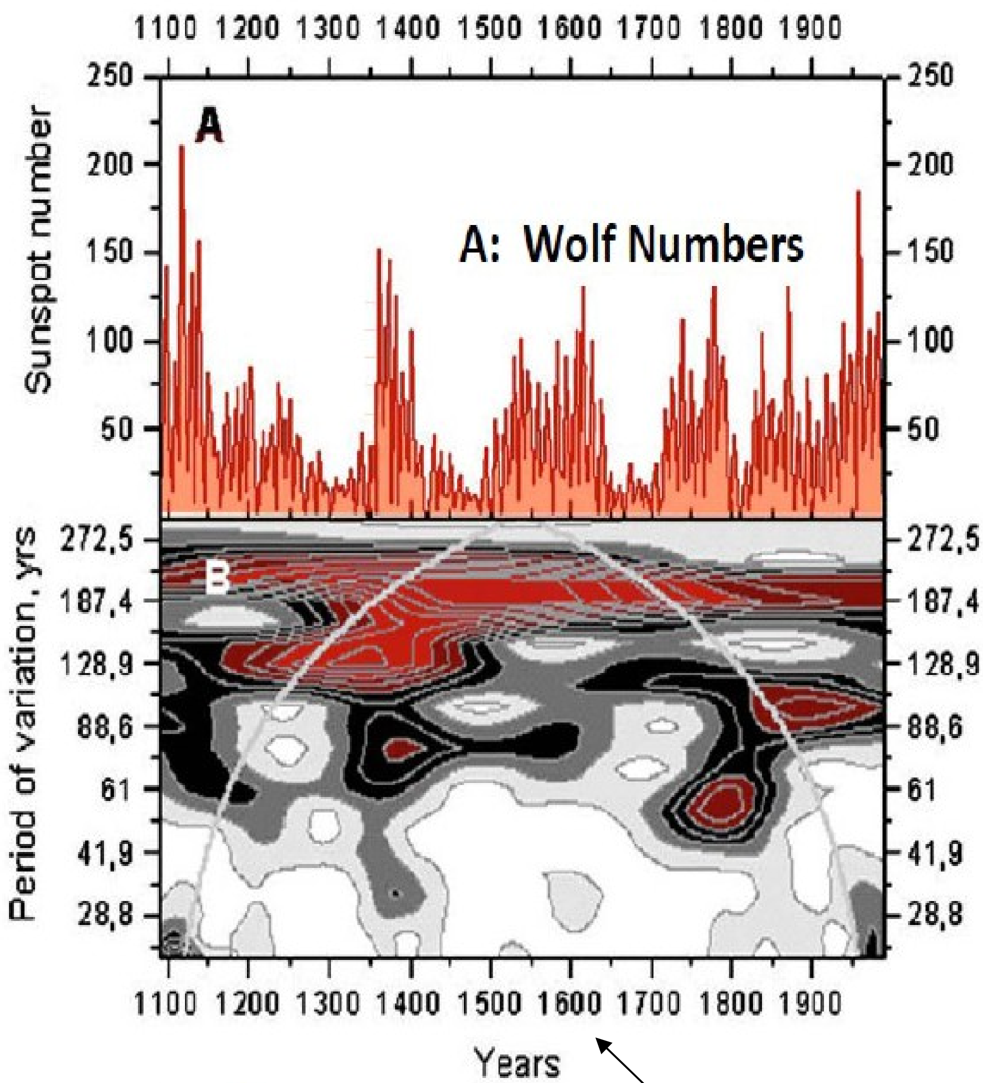


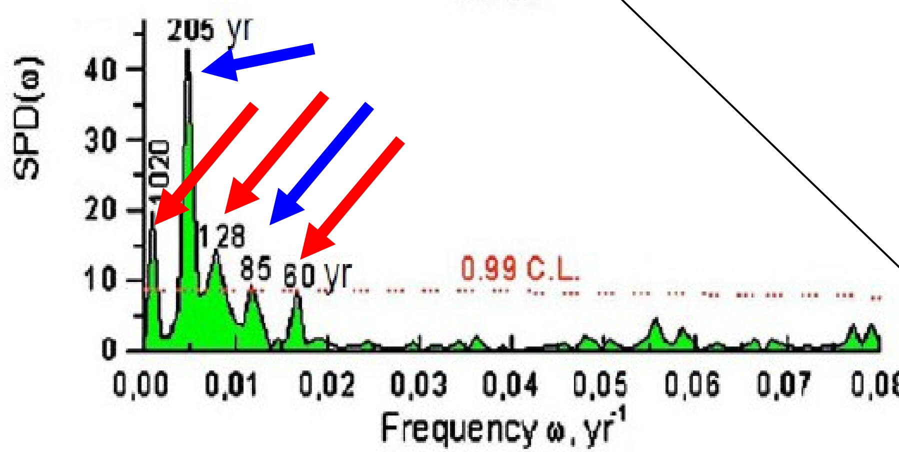
(A) Power spectrum comparison between the z-axis coordinate of the Sun about the center of mass of the solar system (red) and the Hungarian auroral record (1530-1960) (black, blue).

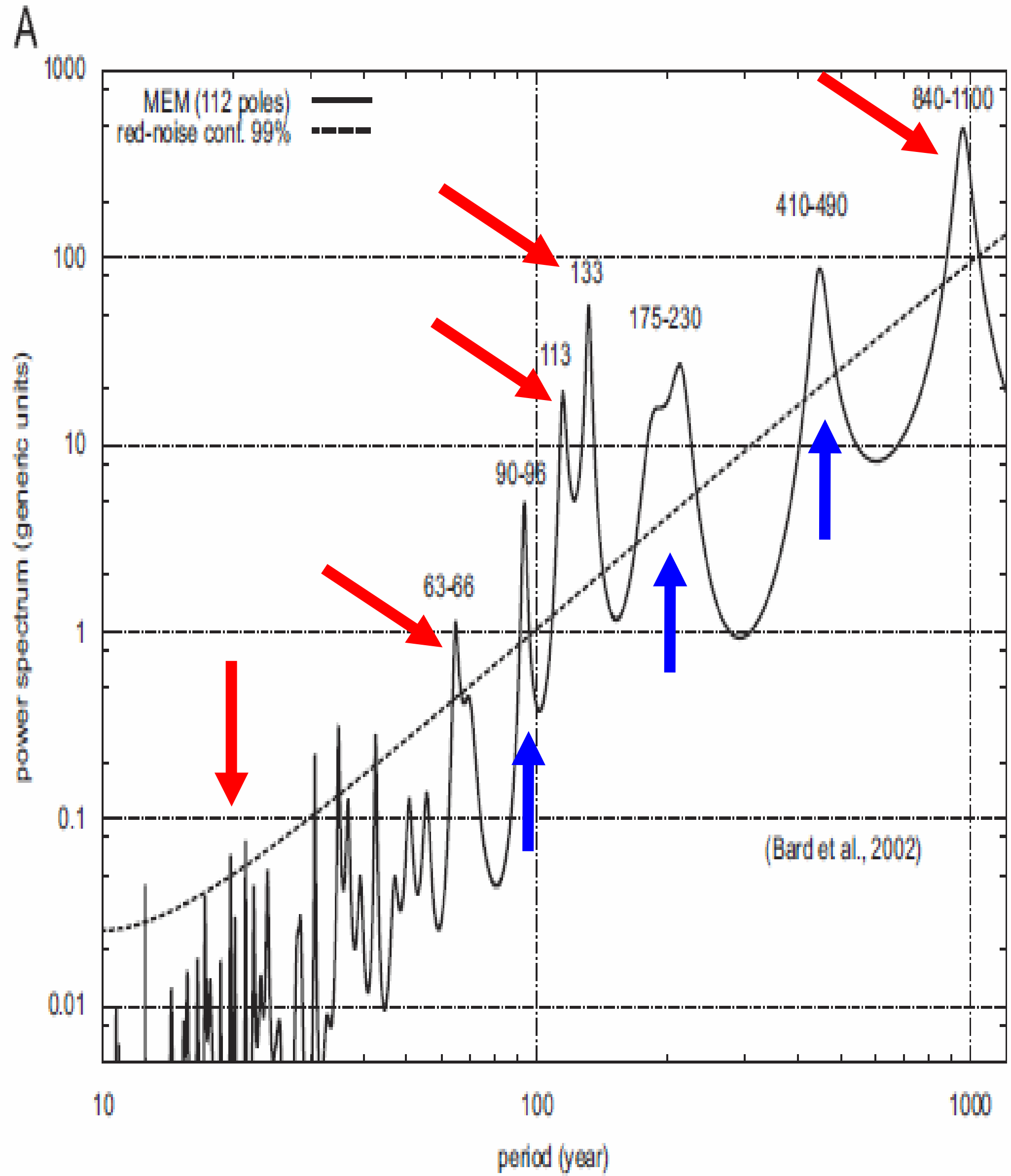


(B) Power spectrum evaluations using MEM and the multi taper method (MTM) of the cosmogenic records by Steinhilber et al., (2012) covering 9400 years of the Holocene

Power spectrum evaluations of solar records Find ~20, ~60, ~85, ~115, ~130, ~210, ~500 and ~1000 year cycles among others



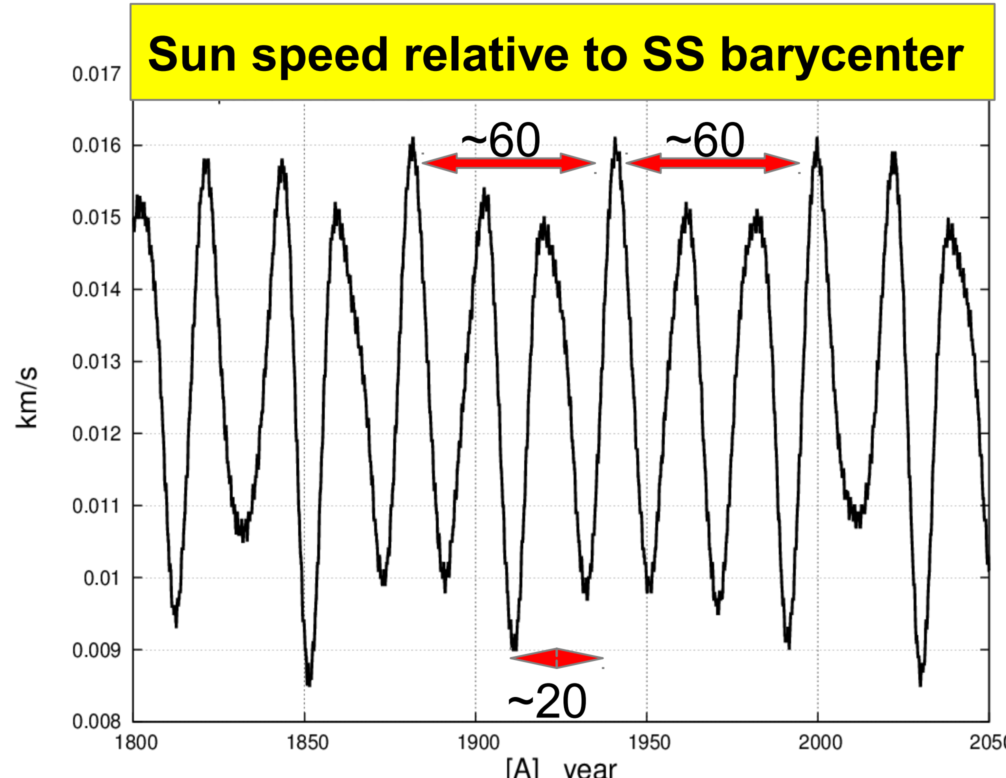


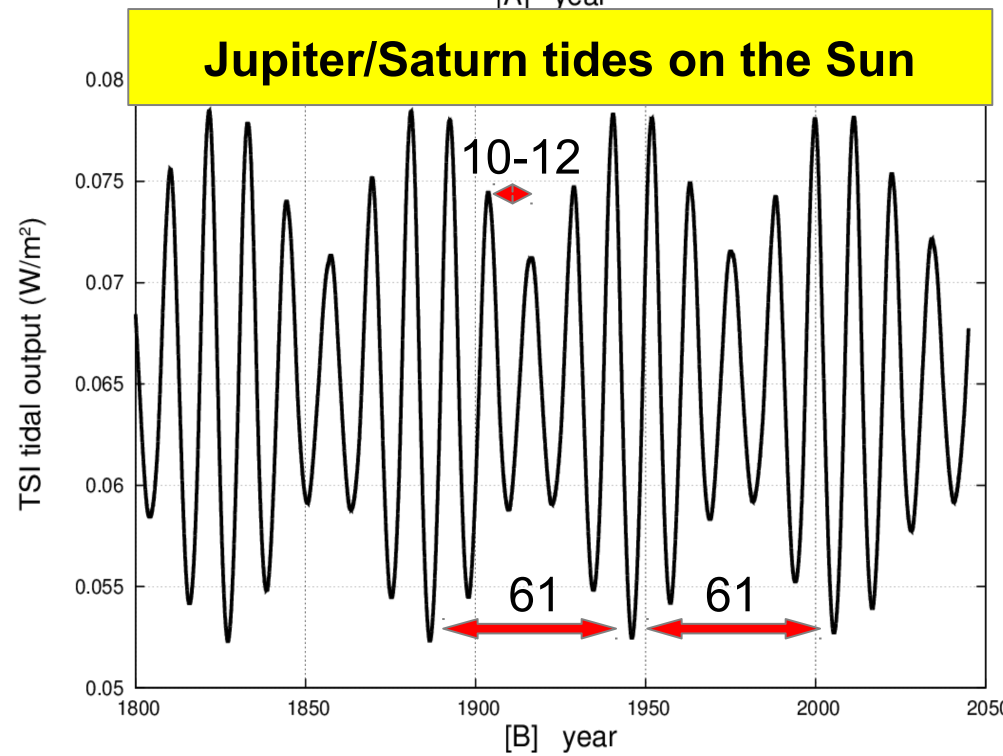


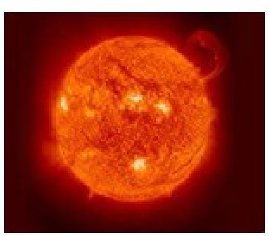
Ogurtsov, M.G., Y.A. Nagovitsyn, G.E. Kocharov, and H. Jungner (2002). Long-period cycles of the Sun's activity recorded in direct solar data and proxies Solar Phys. 211, 371-394.

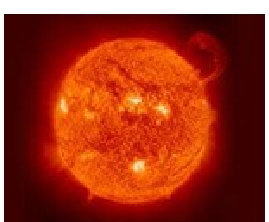
Jupiter & Saturn

- ~10-12 year cycle
- ~20 year cycle
- ~60-61 year cycle







$$h_1(t) = 0.83\cos\left(2\pi\frac{t-2000.475}{9.929656}\right), \tag{10}$$

Jupiter/Saturn spring tide

$$h_2(t) = 1.0\cos\left(2\pi\frac{t-2002.364}{10.87}\right), \tag{11}$$

Solar Dynamo cycle

$$h_3(t) = 0.55\cos\left(2\pi\frac{t-1999.381}{11.862242}\right), \tag{12}$$

Jupiter tide

Beat Cycles

$$b_{12}(t) = 0.60\cos\left(2\pi\frac{t-1980.528}{114.783}\right), \tag{15}$$

$P_{Ju\text{-}Sa}$ & P_{Sc}

$$b_{13}(t) = 0.40\cos\left(2\pi\frac{t-2067.044}{60.9484}\right), \tag{16}$$

P_{Ju} & $P_{Ju\text{-}Sa}$

$$b_{23}(t) = 0.45\cos\left(2\pi\frac{t-2035.043}{129.951}\right), \tag{17}$$

P_{Sc} & P_{Ju}

$$g_m(t) = A\cos\left(2\pi\frac{t-2059.686}{983.401}\right) + B. \tag{19}$$

$P_{Ju\text{-}Sa}$ & P_{Sc} & P_{Ju}

The three -frequency Jupiter/Saturn solar harmonic model

Here we summarize the functions used for constructing the planetary/solar harmonic model in generic relative units.

The three basic proposed harmonics are

$$h_1(t) = 0.83\cos\left(2\pi\frac{t-2000.475}{9.929656}\right), \quad (10)$$

Jupiter/Saturn spring tide

$$h_2(t) = 1.0\cos\left(2\pi\frac{t-2002.364}{10.87}\right), \quad (11)$$

Solar dynamo cycle

$$h_3(t) = 0.55\cos\left(2\pi\frac{t-1999.381}{11.862242}\right), \quad (12)$$

Jupiter orbital tide

$$h_{123}(t) = h_1(t)+h_2(t)+h_3(t), \quad (13)$$

$$f_{123}(t) = \begin{cases} h_{123}(t) & \text{if } h_{123}(t) \geq 0, \\ 0 & \text{if } h_{123}(t) < 0, \end{cases} \quad (14)$$

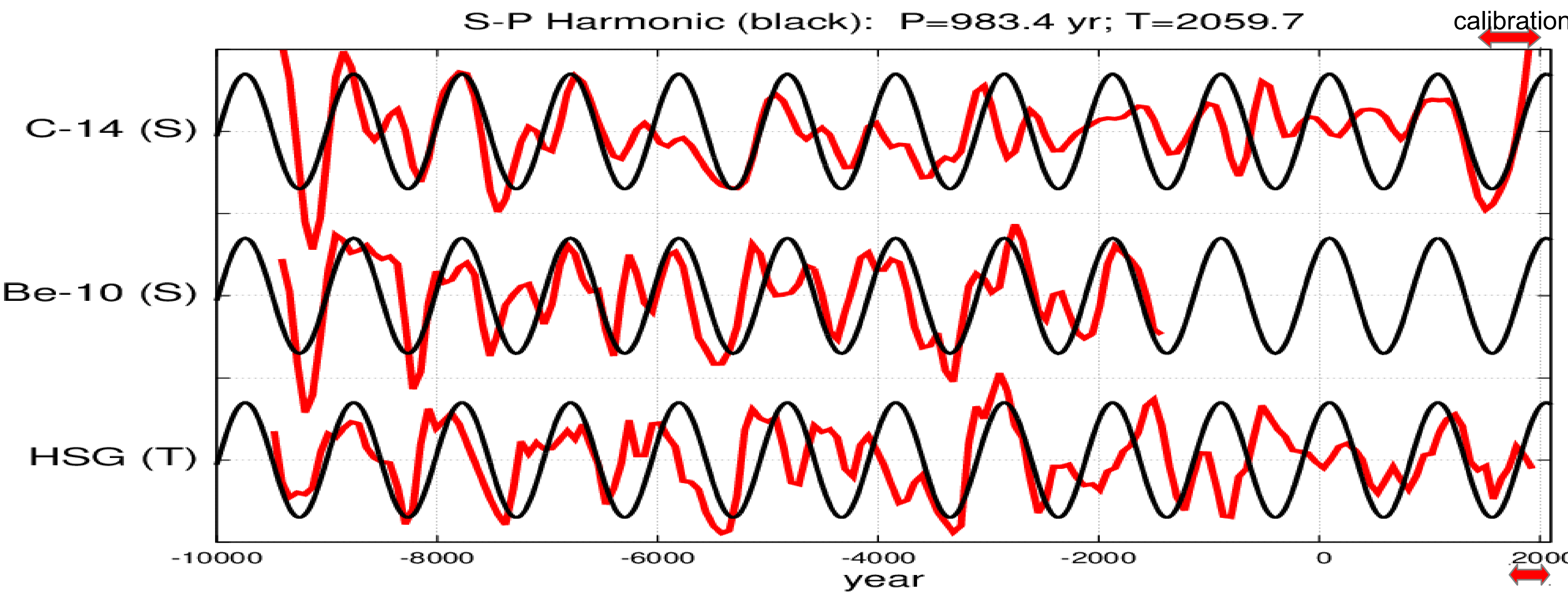
$$g_m(t) = A\cos\left(2\pi\frac{t-2059.686}{983.401}\right)+B. \quad (19)$$

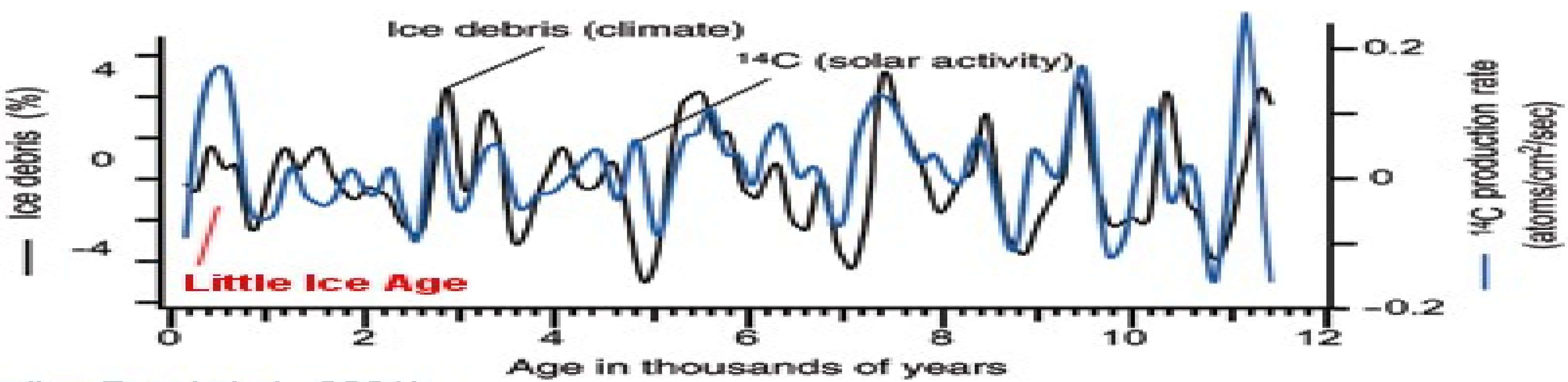
Let us sum

the three oscillations

$$F_{123}(t) = g_m(t)^* f_{123}(t)$$

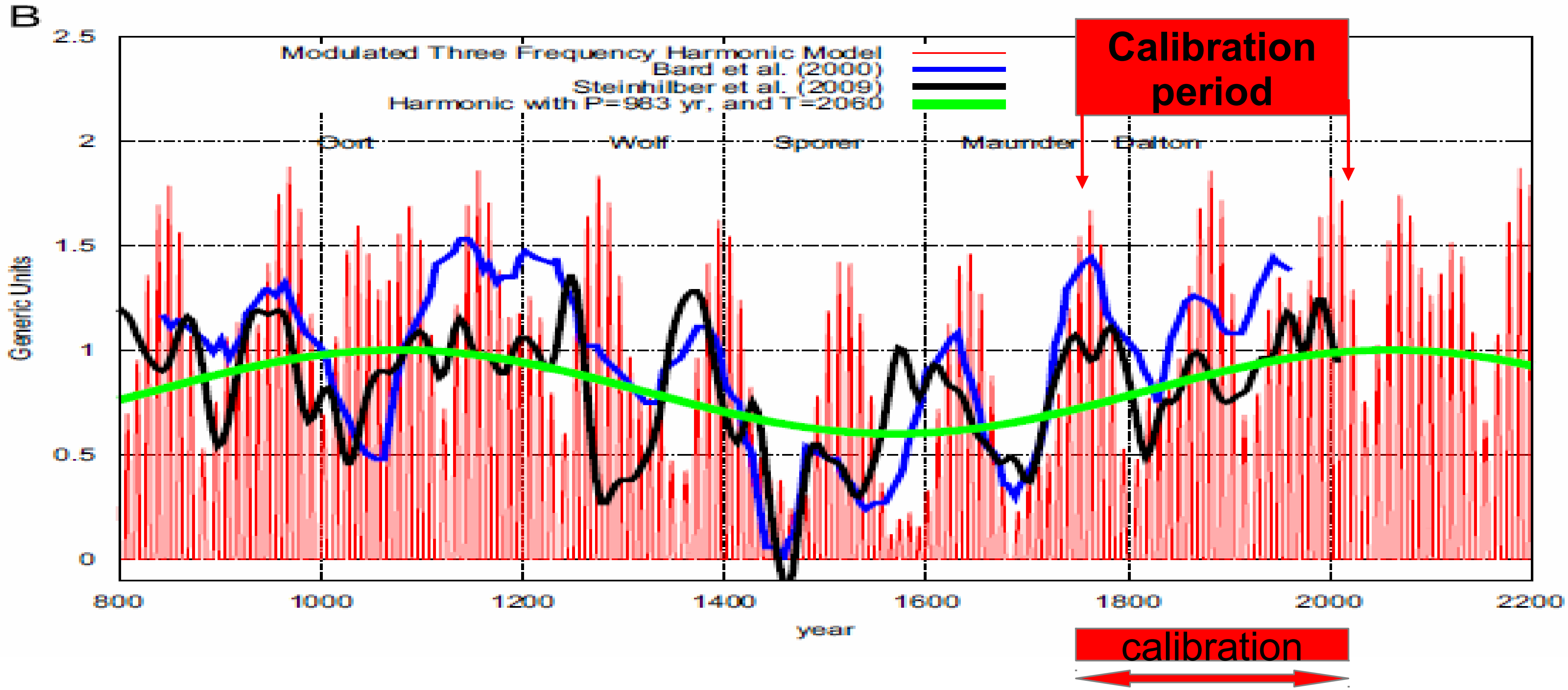
Three-frequency solar model for solar and millennial climate cyclical variation throughout the Holocene (~983 yr cycle)



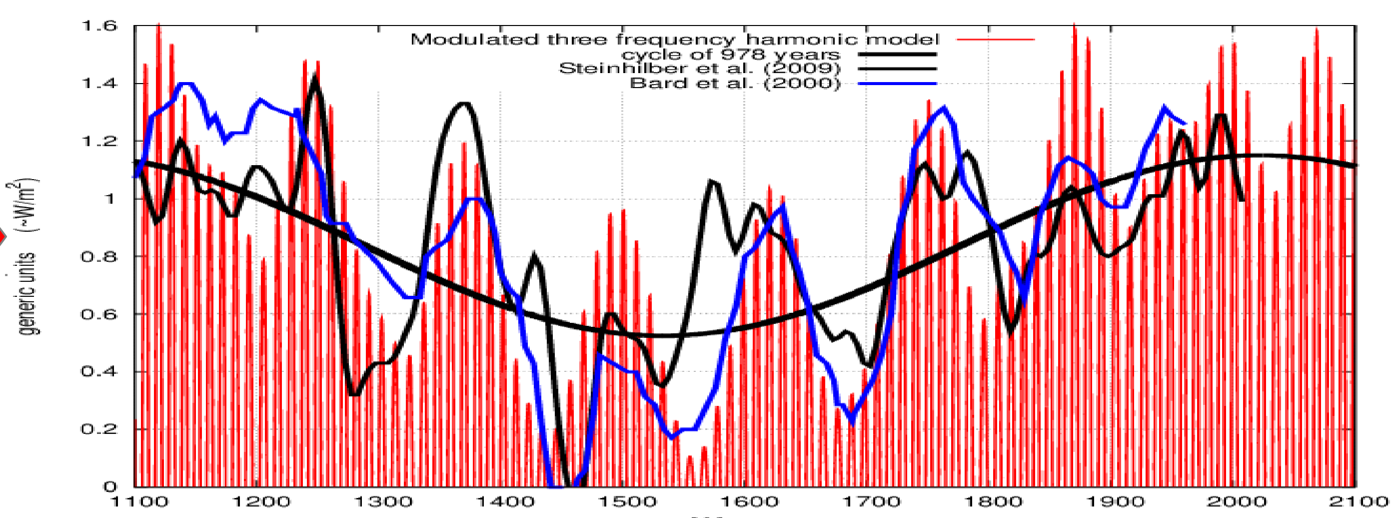


G. Bond, S. Hoffmann, R. Lotti-Bond, J. Beer, R. Muscheler, M. Evans, B. Kromer, W. Showers, I. Hajdes, G. Bonani, Persistent Solar Influence on North Atlantic Climate During the Holocene, Science (Nov, 2001)
R. Kerr, A variable sun paces millennial climate, Science, Vol. 294, p. 1442-1443, (Nov, 2001)

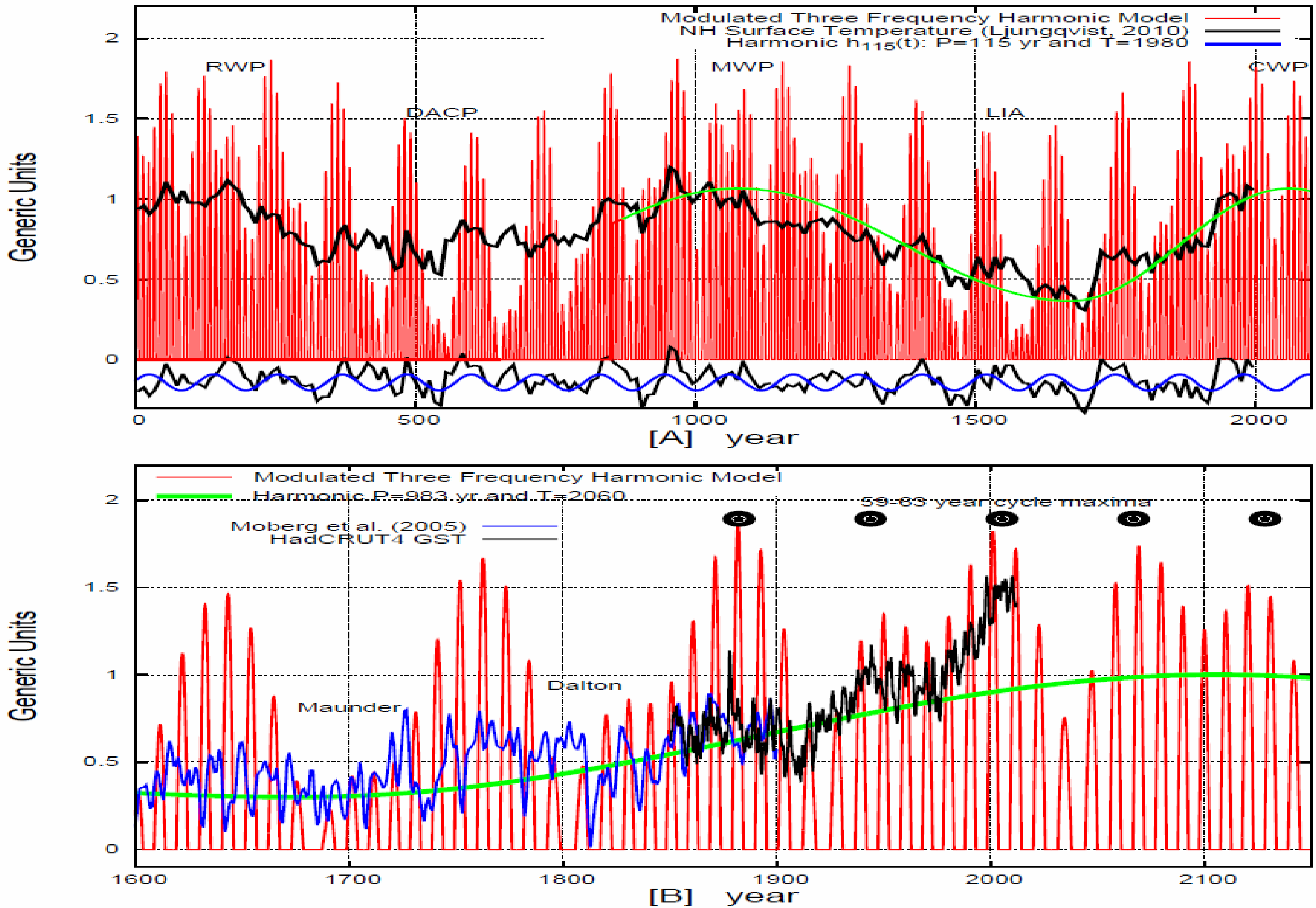
Three-frequency solar harmonic model vs. ^{10}Be and ^{14}C solar proxy reconstructions



Same model with very small corrections

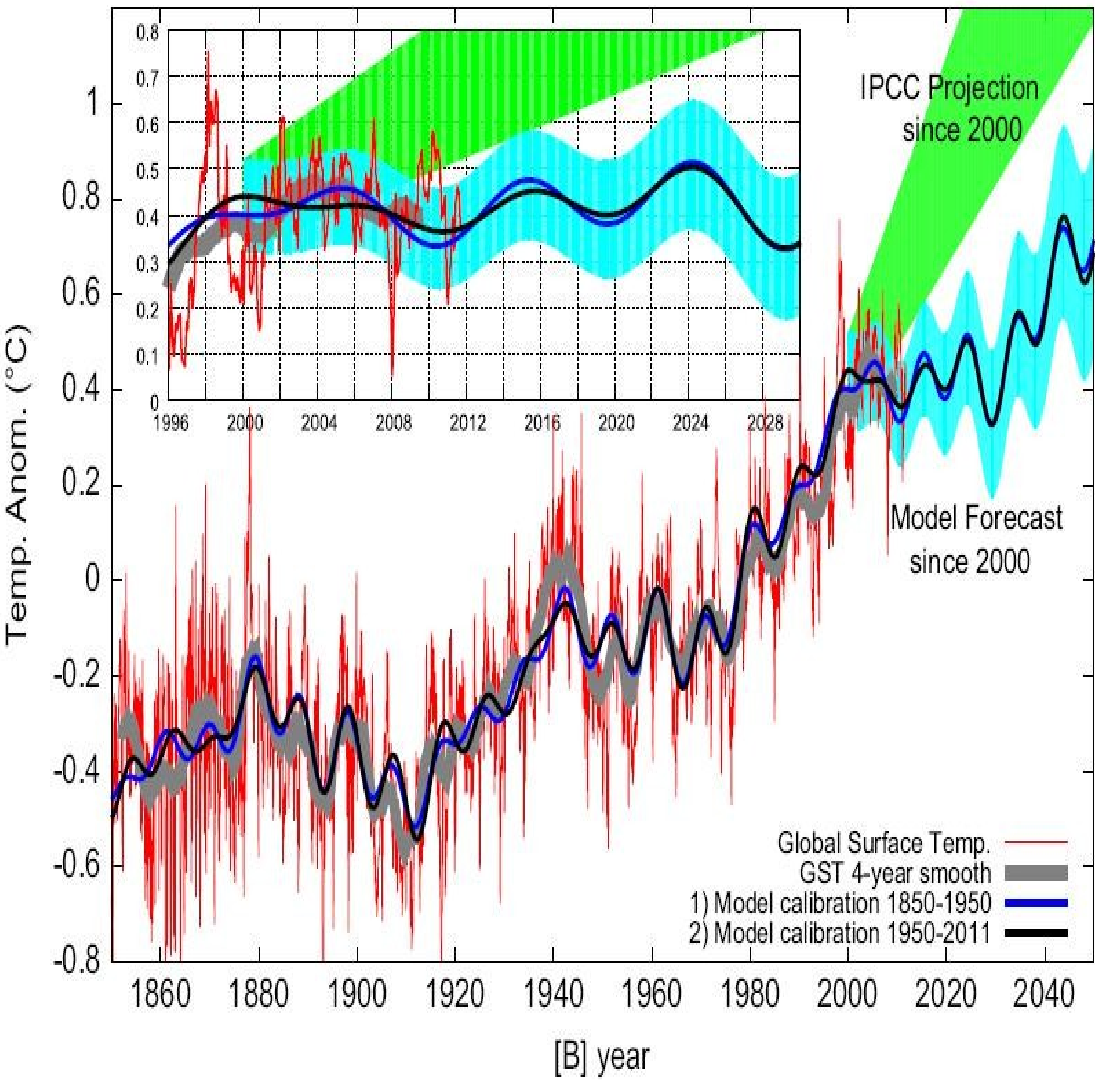


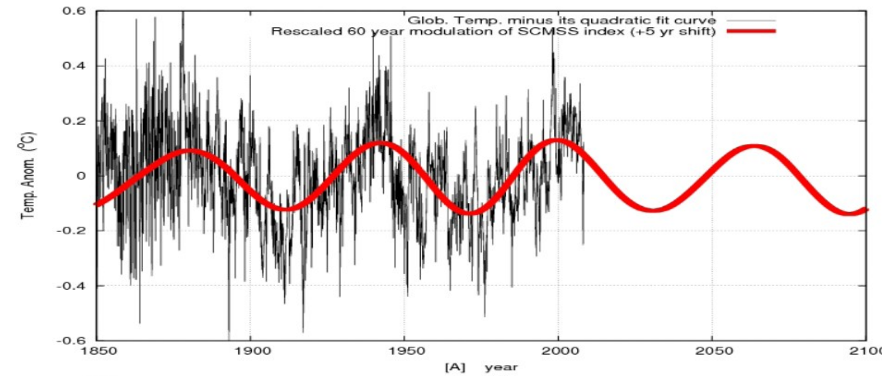
Three-frequency solar harmonic model vs. temperature reconstructions (~61 yr, ~115 yr, ~980 yr cycles)

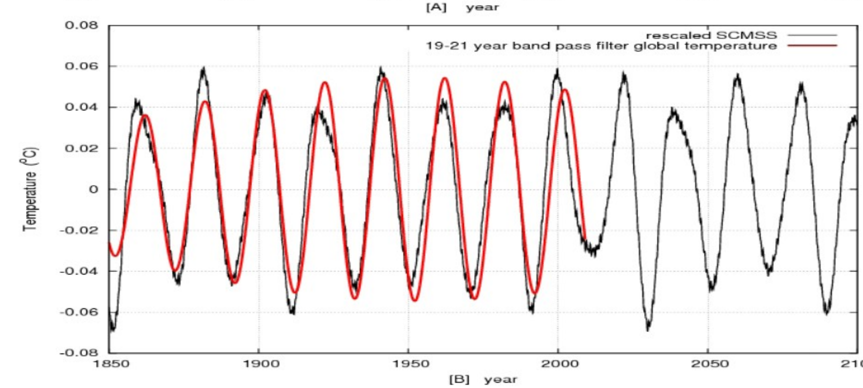


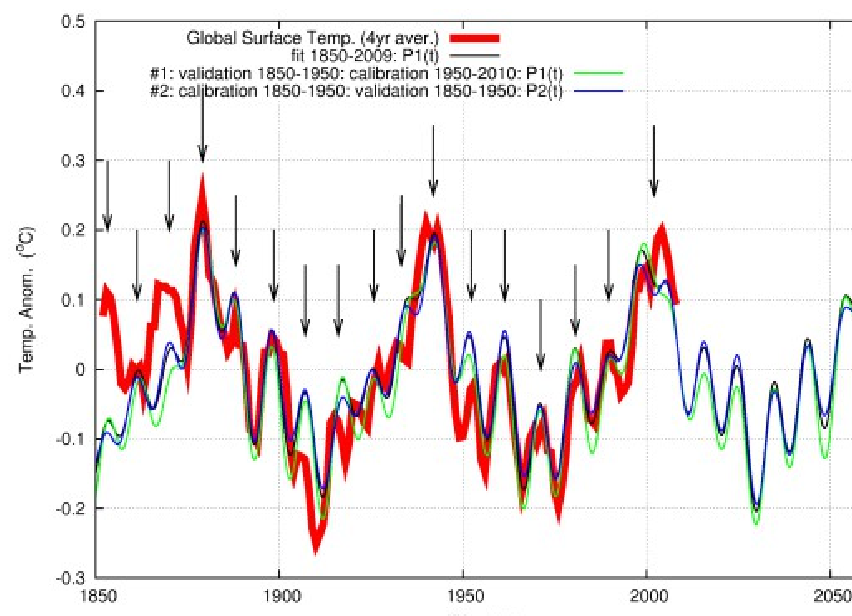
Hindcasting climate variations with specific astronomically cycles

Using four specific decadal and multidecadal astronomical oscillations (~9.1, 10-11, 20, 60 yr), it is possible to hindcast decadal GST variations



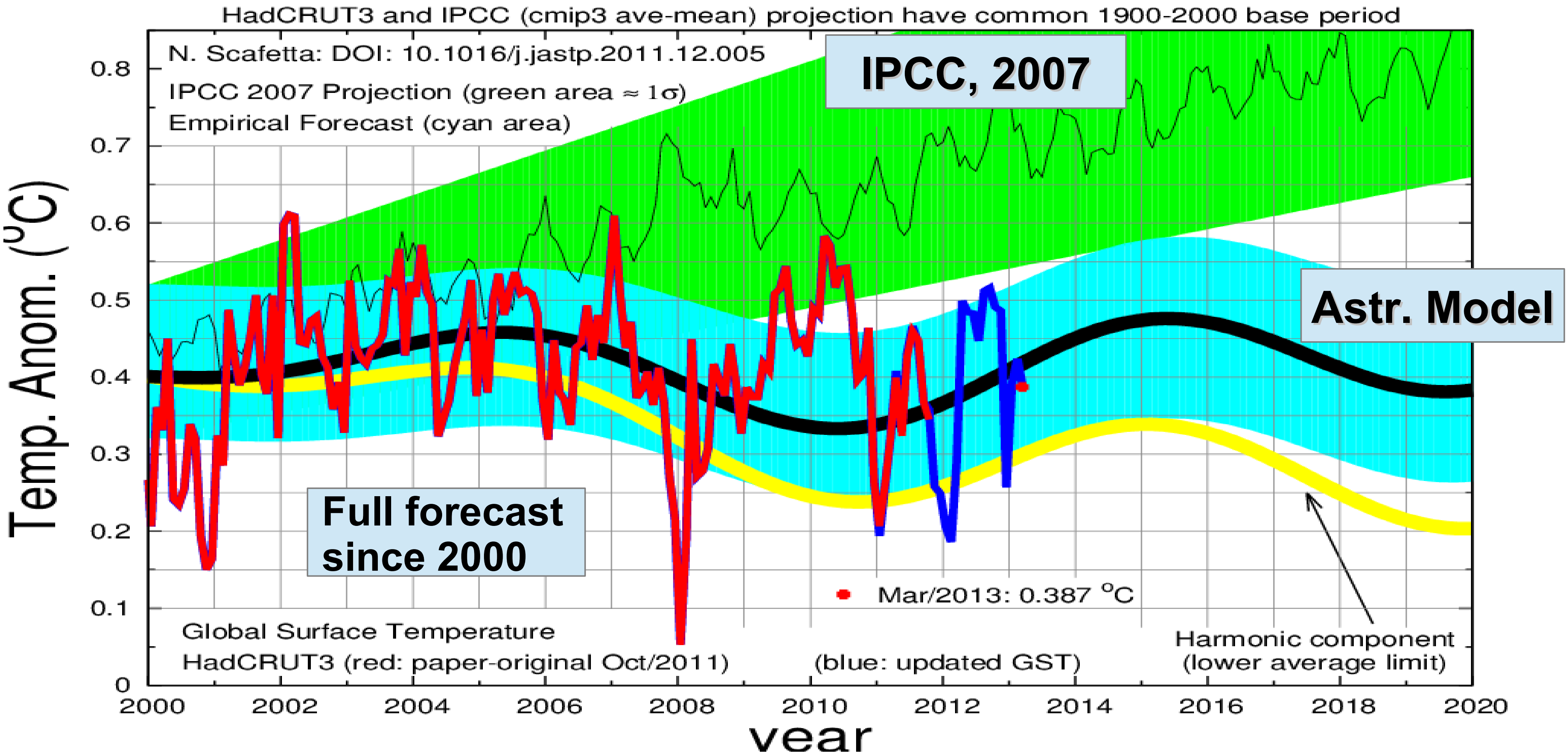






Astronomical Climate model forecast vs. CMIP3 GCM (IPCC 2007)

Visit http://people.duke.edu/~ns2002/



Global surface temperature (HadCRUT3): original global surface temperature record **(red)** published in Scafetta (2012b); and updated global surface temperature **(blue)**.

The **black** curve within the **cyan area** is the full astronomical harmonic model forecast since 2000 that clearly outperforms the IPCC general circulation model projections **(green area)**.

The yellow curve is the harmonic component alone without the anthropogenic component.

Table 2

Average theoretical tidal elongation at the solar surface, due to the eight planets of the solar system (Eq. (14)). For the Sun we use $M_S = 1.99E30$ kg and $R_S = 6.96E8$ m. The 'diff tidal elongation' refers to the difference of the tidal elongations calculated at the perihelion and the aphelion, respectively. The last column reports the solar rotation as seen from each planet using a sidereal solar rotation of 26.5 days: longer values imply slower vertical tidal movement and less tidal work in unit of time. The tidal elongations are calculated with the Love numbers 3/2 and 15/4, the latter in parentheses.

Planet	Mass (kg)	Tidal elong. (m)	Diff. tidal elong. (m)	S. rot. (days)
Me	3.30E23	3.0E−4 (7.5E−4)	4.3E−4 (1.1E−3)	37.92
Ve	4.87E24	6.8E−4 (1.7E−3)	2.6E−5 (6.6E−5)	30.04
Ea	5.97E24	3.2E−4 (7.9E−4)	3.2E−5 (7.9E−5)	28.57
Ma	6.42E23	9.6E−6 (2.4E−5)	5.5E−6 (1.4E−5)	27.56
Ju	1.90E27	7.1E−4 (1.8E−3)	2.1E−4 (5.2E−4)	26.66
Sa	5.69E26	3.4E−5 (8.5E−5)	1.2E−5 (2.9E−5)	26.57
Ur	8.68E25	6.4E−7 (1.6E−6)	1.7E−7 (4.3E−7)	26.52
Ne	1.02E26	2.0E−7 (5.0E−7)	1.3E−8 (3.3E−8)	26.51

Planetary tides are small !

Solving the problem

Only if the Sun works as an amplifier, planetary tides may matter.

The Sun can work as an amplifier of gravitational disturbances because it is a generator of energy controlled by gravity.

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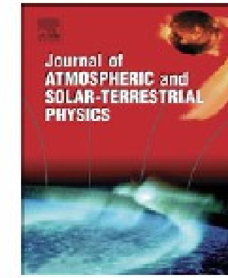
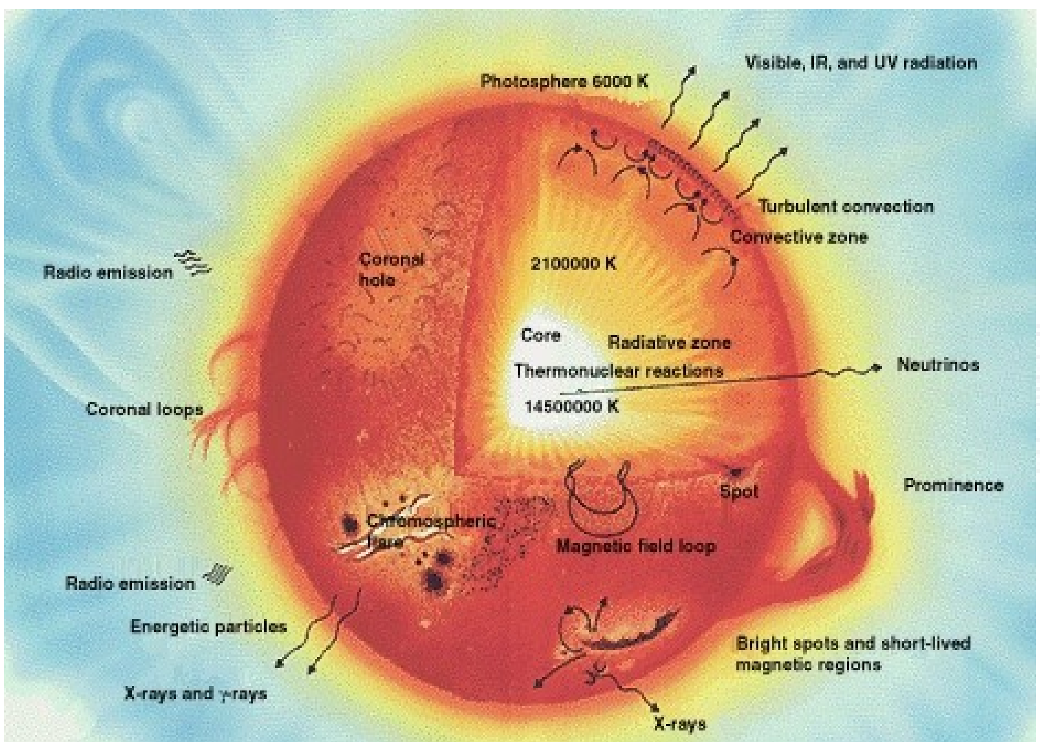
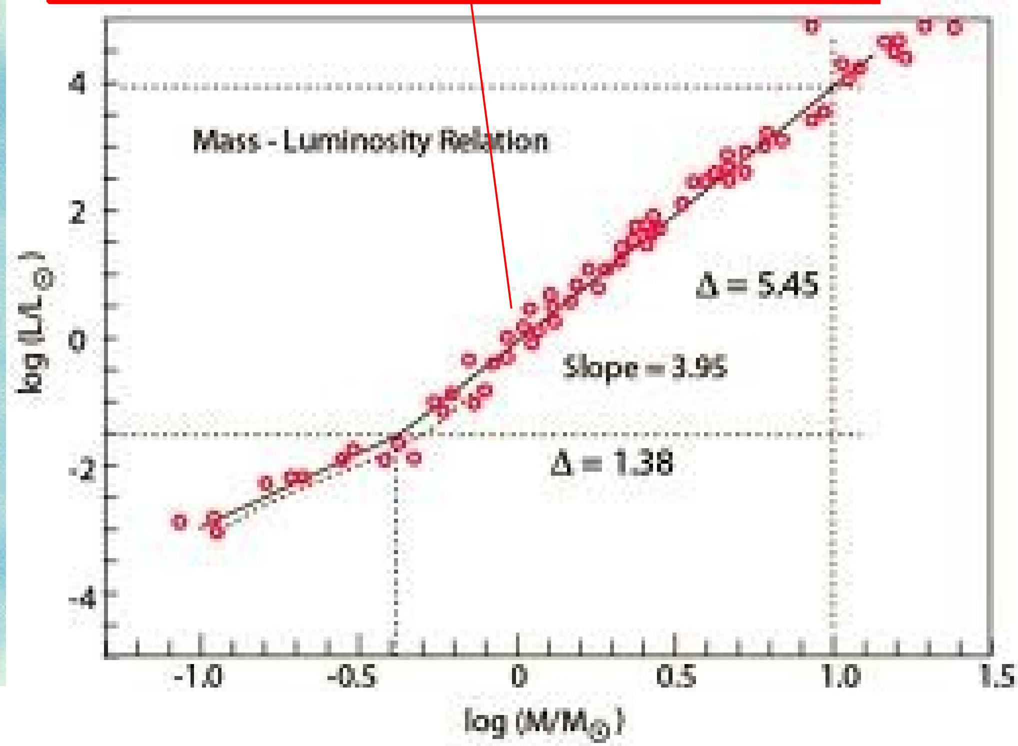


Does the Sun work as a nuclear fusion amplifier of planetary tidal forcing? A proposal for a physical mechanism based on the mass-luminosity relation

Nicola Scafetta *

$$\boxed{\frac{L}{L_S} \approx \left(\frac{M}{M_S}\right)^4 \approx 1 + \frac{4\Delta M}{M_S},}$$





Luminosity production associated to tidal energy dissipated in the Sun

$$\frac{L}{L_S} \approx \left(\frac{M}{M_S}\right)^4 \approx 1 + \frac{4\Delta M}{M_S},$$

rewriting it

$$L(t) \approx L_S + 4L_S \frac{\dot{U}_{tidal}(t)}{\dot{U}_{Sun}} = L_S + A \cdot \dot{U}_{tidal}(t),$$

amplification factor used in $K(\chi)$

Solar luminosity L_s=4x10^{26} W

Equation to convert gravitational energy released by the tides into luminosity anomaly

$$I_P(t) = \frac{3\,G\,R_S^5}{2\,Q\,\Delta t}\int_0^1 K(\chi)\,\chi^4\rho(\chi)\,d\chi\,\cdot$$

$$\int_{\theta=0}^{\pi}\int_{\phi=0}^{2\pi}\left|\sum_{P=1}^{8} m_P\frac{\cos^2(\alpha_{P,t})-\frac{1}{3}}{R_{SP}^3(t)} - m_P\frac{\cos^2(\alpha_{P,t-\Delta t})-\frac{1}{3}}{R_{SP}^3(t-\Delta t)}\right|\sin(\theta)\,d\theta\,d\phi,$$

$K(\chi)$ is the amplification function

$$\dot{U}_{Sun} = -\dot{U}_{fusion} = \frac{1}{2}G\int_0^{R_S} m_S(r)\frac{d\dot{m}(r)}{dr}\frac{1}{r}\,dr = 3.6\times10^{20}W,$$

$$\frac{d\dot{m}(r)}{dr} = \frac{1}{c^2}\frac{dL(r)}{dr},$$

$$\boxed{A = \frac{4L_S}{\dot{U}_{Sun}} \approx 4.25\times10^6.}$$

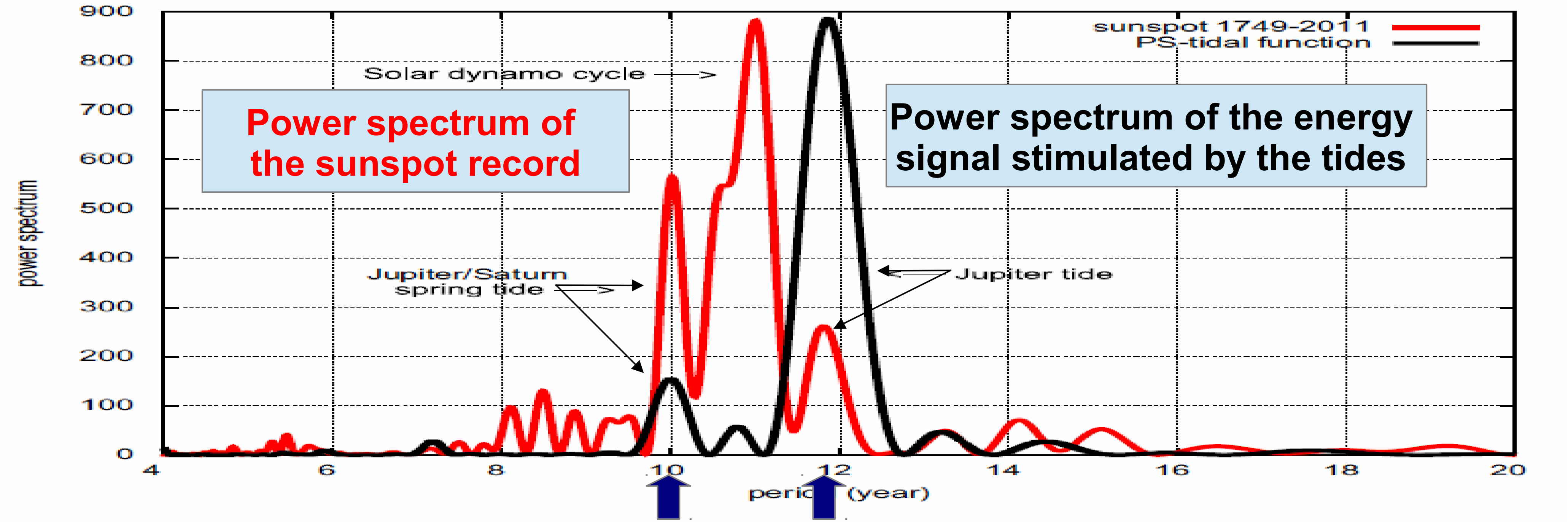
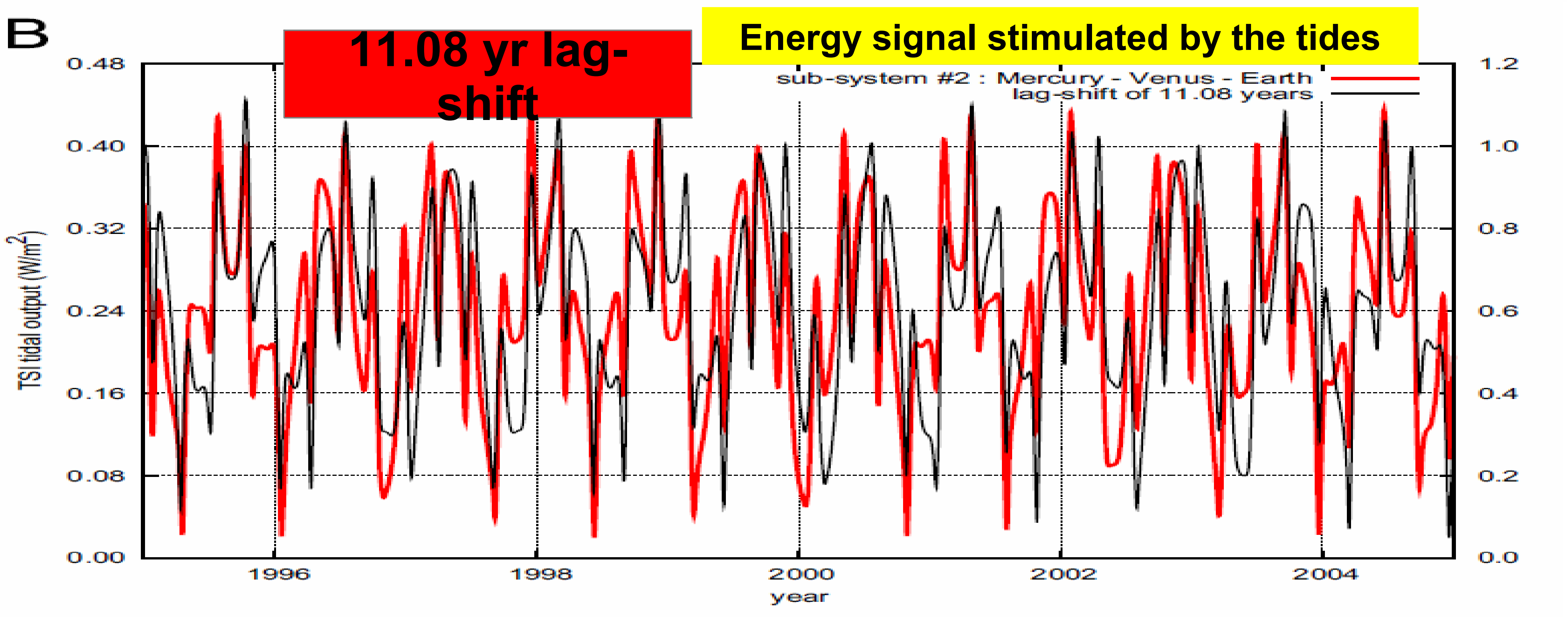
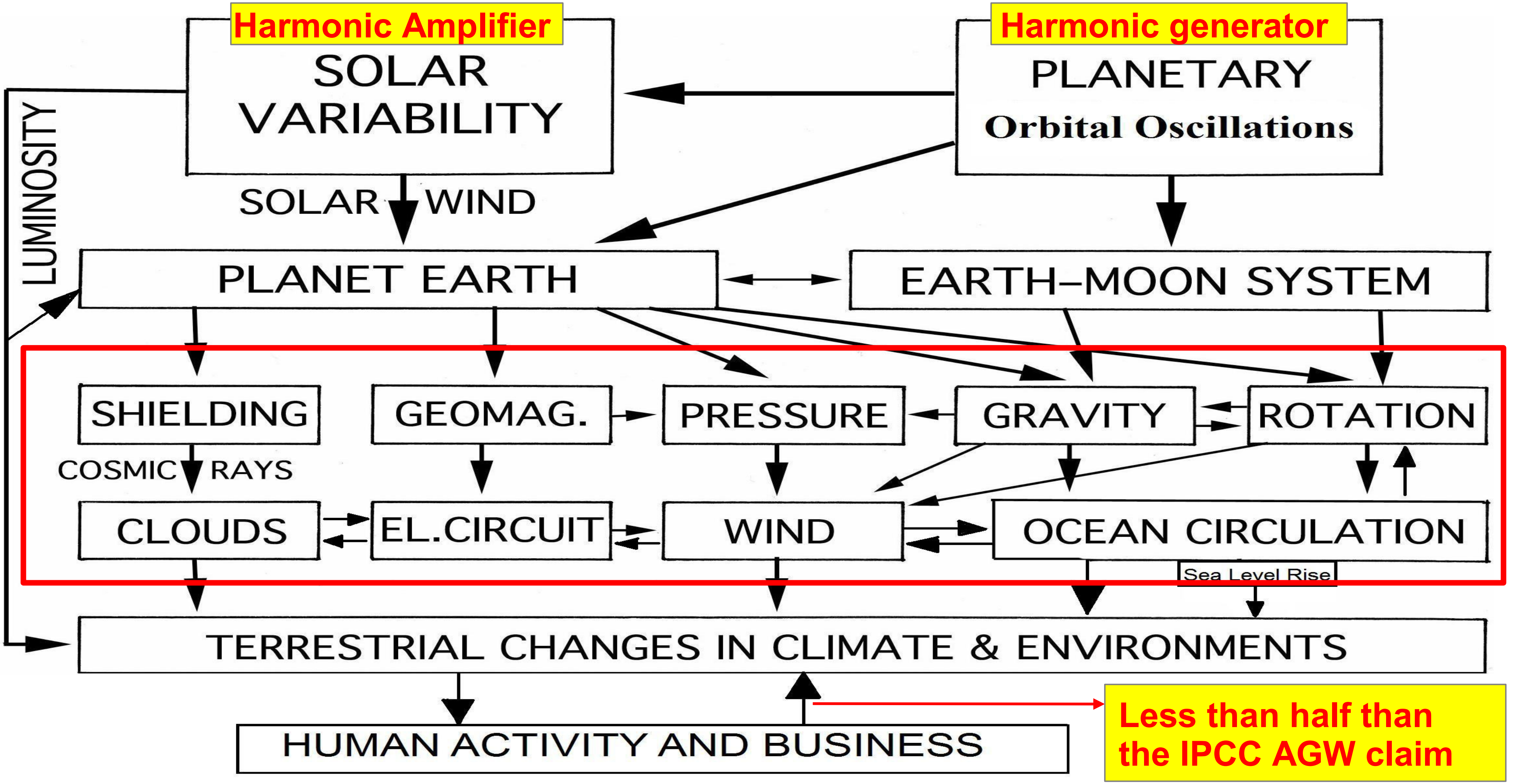


Fig. 13. Lomb-periodogram spectral analysis of the sunspot number record and of the total tidal function record depicted in Fig. 10. Note that the two side



Conclusion



- Solar and climate dynamics are coupled and synchronized with astronomical harmonics
- The Sun likely works as a strong amplifier of the gravitational oscillations of the solar system
- Solar/Lunar tidal (multi-)decadal harmonics are present in the climate system
- Current climate general circulation models (CMIP3 and CMIP5 GCMs) are seriously flawed.
- Natural cyclical variability has contributed at least 50% - 60% of the 20th century warming

References:

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