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Response to Comment on "Tidally Synchronized Solar Dynamo: a Rebuttal"

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Abstract
The core of my article (Nataf, 2022) was about a flaw in the reasoning used by Stefani, Giesecke, and Weier (2019) to demonstrate that the ∼ 11-year Schwabe cycle is "clocked". To give some background and point out other difficulties, I displayed tidal signals built from a very simple four-planets model. Nicola Scafetta criticizes this simplified tidal model, because it assumes circular orbits. This is correct. It seems that he did not notice that I refered to the article of Okal and Anderson (1975), who were the first to construct a tidal model that takes into account the actual orbits of these four planets. His comment gives me the opportunity to be more explicit on this question. The main conclusion of my original article does not change: no support for a planetary influence on solar cycles.

Keywords: Solar Cycle, Models; Solar Cycle, Observations

In my article entitled "Tidally synchronized Solar Dynamo: a rebuttal" (Nataf, 2022), I stressed four points:

1. Tides exerted by planets on the Sun are extremely small.
2. The $\simeq$ 11.2 years period inferred from the 'weak deviations from Jupiter–Venus–Earth syzygies" is an artificial construction that has no signature in the complete tidal signal.
3. The demonstration by Stefani, Giesecke, and Weier (2019) of a clocked behaviour for solar cycles is invalid because the 1000-years-long time series they use (Schove, 1955) is clocked by construction.
4. Magnetohydrodynamic instabilities can produce quasi-periodic fluctuations that appear as almost clocked.

These four points taken together led me to conclude "The astrological quest for a link between solar cycles and planetary tides remains as unfounded as ever".

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The core of my article was about points 3 and 4, since there is already ample literature on points 1 and 2.

In his comment, Nicola Scafetta focuses on point 2 and criticizes the content of Appendix A of my article. He rightly notes that equation 4 of that Appendix assumes circular orbits, and regrets that I did not include Saturn.

My motivations for the illustration given in Appendix A were the following:

- Show how small the tidal signals are.
- Illustrate how short-period variations largely dominate over whatever trend there would be at a period around 11 years.

I did not include Saturn because the amplitude of the tide it produces is about 20 times smaller than that of Jupiter (as can be seen in Figure 2a of Scafetta, 2023), and because it was not considered in the index of Okhlopkov (2016) used by Stefani, Giesecke, and Weier (2019).

Of course I know that the orbits of planets are elliptical rather than circular. I am also aware of the effect it can have on the tidal signal. This is why I referred to the article of Okal and Anderson (1975) who do consider real planetary positions. This article is almost never cited by tenants of the "Planetary Theory". Nicola Scafetta is an exception since he cites it in all three papers of his 2012 trilogy. I believe that Okal and Anderson (1975) were the first to compute Sun's tides "taking into account the complete orbital elements [of Mercury, Venus, Earth, and Jupiter], including eccentricity, inclination and their variation with time" over a period of 1800 years, as I recall in the last paragraph of Appendix A. They note that they find no evidence for the 11.08 year tidal period claimed by Wood (1972). Because of the eccentricity of Jupiter, they do find a small spectral peak at the orbital period of Jupiter (their Figures 3 and 4), as I mention.

However, as pointed out by Scafetta and Bianchini (2022): "[The] orbital period ($\sim$ 11.86 years) [of Jupiter] is too long to fit the Schwabe 11-year solar cycle." Hence the need for another ingredient. Saturn seems to be the favorite of Scafetta (2023). It adds an even smaller peak. But Scafetta and Bianchini (2022) do not give up the "Venus–Earth–Jupiter Model", noting that these three planets align every 22.14 years.

Despite its limitations, the simplified model of Appendix A of Nataf (2022) can help testing this idea (I recall that the small MATLAB® scripts I use are given in the supplementary material of Nataf, 2022). Figure 1a shows the envelope of the tidal signal produced by Venus, Earth, and Jupiter on the Sun. All three planets and the Sun are aligned at $t = 0$. The record covers 9000 days, spanning a bit more than two orbital periods of Jupiter (red vertical lines). Four peaks are marked. The highest one occurs at day 8176 (22.38 years). It does correspond to an alignment of all planets, as shown by Figure 1e. But there are lots of peaks almost as high, corresponding to an almost perfect alignment as well, at days 592, 3792, and 4384 for example (Figures 1b,c,d). The heights of these four peaks differ by less than 2‰.

Adding other planets and considering actual elliptical orbits slightly modifies the amplitudes of these "secondary" peaks and the time interval between them, as illustrated in Figure 2b of Scafetta (2023), but it does not change the big picture. Hence the question: how does our star decide which peak to obey? I am afraid the answer is: it doesn't have to decide because it doesn't care...

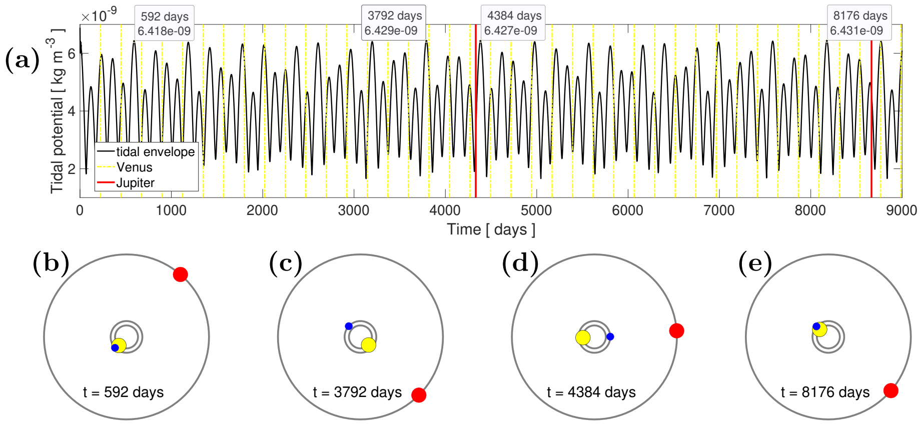

Figure 1. **(a)** Envelope of the tidal potential produced by Venus, Earth, and Jupiter on the Sun, assuming circular orbits, as in Appendix A of Nataf (2022). All planets and the Sun are aligned at $t = 0$. The orbital periods of Venus and Jupiter are indicated by yellow and red vertical lines, respectively. Four highest peaks are marked. **(b-e)** Positions of Venus (yellow), Earth (blue), and Jupiter (red) at the times corresponding to the four marked peaks in (a). Note the quasi-perfect alignment of Venus, Earth, and Jupiter at these times.

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Materials Availability The MATLAB® scripts I used to produce Figure 1 of this article are available in the supplementary material of Nataf (2022).

Conflict of interest The author declares that he has no conflicts of interest.

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