Earth Syst. Dynam. Discuss.,
https://doi.org/10.5194/esd-2020-74-AC2, 2020

Earth System Dynamics Discussions

Interactive comment on "ESD Ideas: Long-period tidal forcing in geophysics – application to ENSO, QBO, and Chandler wobble" *by* Paul R. Pukite

Paul Pukite

puk@umn.edu

Received and published: 29 December 2020

Indeed, I have referenced the work of Sidorenkov as a cited paper. However, that research neither debunks the submitted idea nor does it clearly articulate the actual physical mechanism at work. For the Chandler wobble, Sidorenkov asserts that this is the predicted value for the frequency:

1/1.0 - (1/18.61 + 1/8.85) = 1/1.20 cycles per year

18.61 years is the nodal declination variation cycle of the moon while 8.85 years is the perigean cycle. According to this expression, it puts the Chandler wobble period at 438 days, which is off the generally accepted value of 433 days. That has two strikes against it – it is not very precise and has no clear conceptual basis.

What I did was much more elementary than Sidorenkov's heuristic and can be understood from introductory physics. Consider a rod rotating about its axis with ends of an attractive nature (e.g. could be magnetic, which is easy to demonstrate in the lab). As a forcing, we introduce two objects that cycle incommensurately between the two ends (i.e. nodally in earth terms). Due to the law of conservation of angular momentum, the axis of rotation will eventually precess at a rate fundamentally related to these two rates as a forced response. Next, analogize that one of the objects is the sun at a rate of 1 full nodal cycle per year, and the other is the moon at a rate of 1 full nodal cycle every 27.2122 days (the nodal or draconic lunar cycle), then the expected maximum strength conjunction cycle can be calculated via the algebra of aliasing:

(365.242/2) / (27.2122/2) - integer((365.242/2) / (27.2122/2))

which is 0.422 cycles per half-year or (365.242/2) /0.422 = 432.75 days

See Figure 1 in the submitted ESD Ideas paper for a schematic of the geometry, and Figure 1 attached for a set of calculated conjunction cycles showing the 433 day cycle.

Note that this is much more precisely aligned with the actual Chandler wobble period and because the earth is not a perfect sphere and thus has a moment of inertia, this predicted forced response cycle MUST exist in any measurements. The only question is it's strength. Since it is a forcing, it will never dissipate and any natural resonance of the earth's wobble (i.e. the original 305 day cycle predicted by Euler) may actually amplify it's strength over that bandpass regime.

The applicability of Sidorenkov's assertions to ENSO and QBO are not as relevant, as my formulation requires an analytical solution to Laplace's Tidal Equations along the equatorial topological boundary. Especially for ENSO, the tidal forcing synchronization only emerges if this is considered.

This is not to say that Sidorenkov's hypothesis provided no motivation, as his ideas were evaluated, as were the suggestions of Munk & Wunsch and Keeling & Whorf in terms of oceanic tidal forcing, and Richard Lindzen in regards to QBO, who on separate occasions claimed that “For oscillations of tidal periods the nature of the forcing is clear" [1] and “it is unlikely that lunar periods could be produced by anything other than the lunar tidal potential" [2]. The approach as described clears up how the tidal forcing is synchronized, thus allowing the climate science community to re-evaluate Lindzen’s early concerns.

References [1] RS Lindzen, Planetary waves on beta-planes, Monthly Weather Review, 1967 [2] RS Lindzen, S Hong, Effects of mean winds and horizontal temperature gradients on solar and lunar semidiurnal tides in the atmosphere, Journal of the Atmospheric Sciences, 1974

Interactive comment on Earth Syst. Dynam. Discuss., https://doi.org/10.5194/esd-2020-74, 2020.

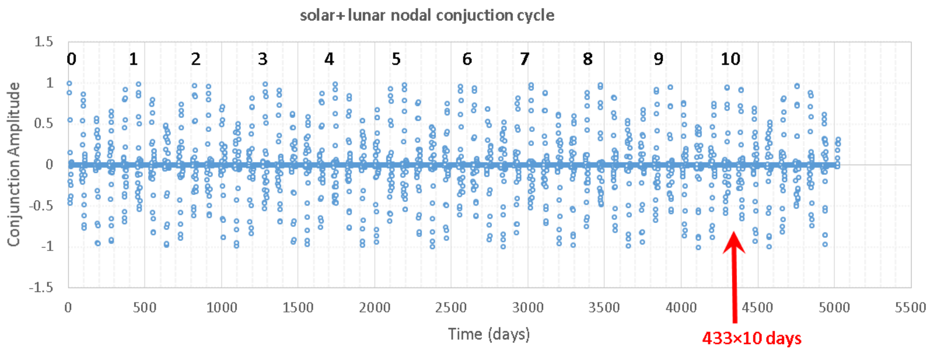

Fig. 1. Conjunction cycle of draconic fortnightly and semi-annual periods – 10 cycles in ∼4330 days