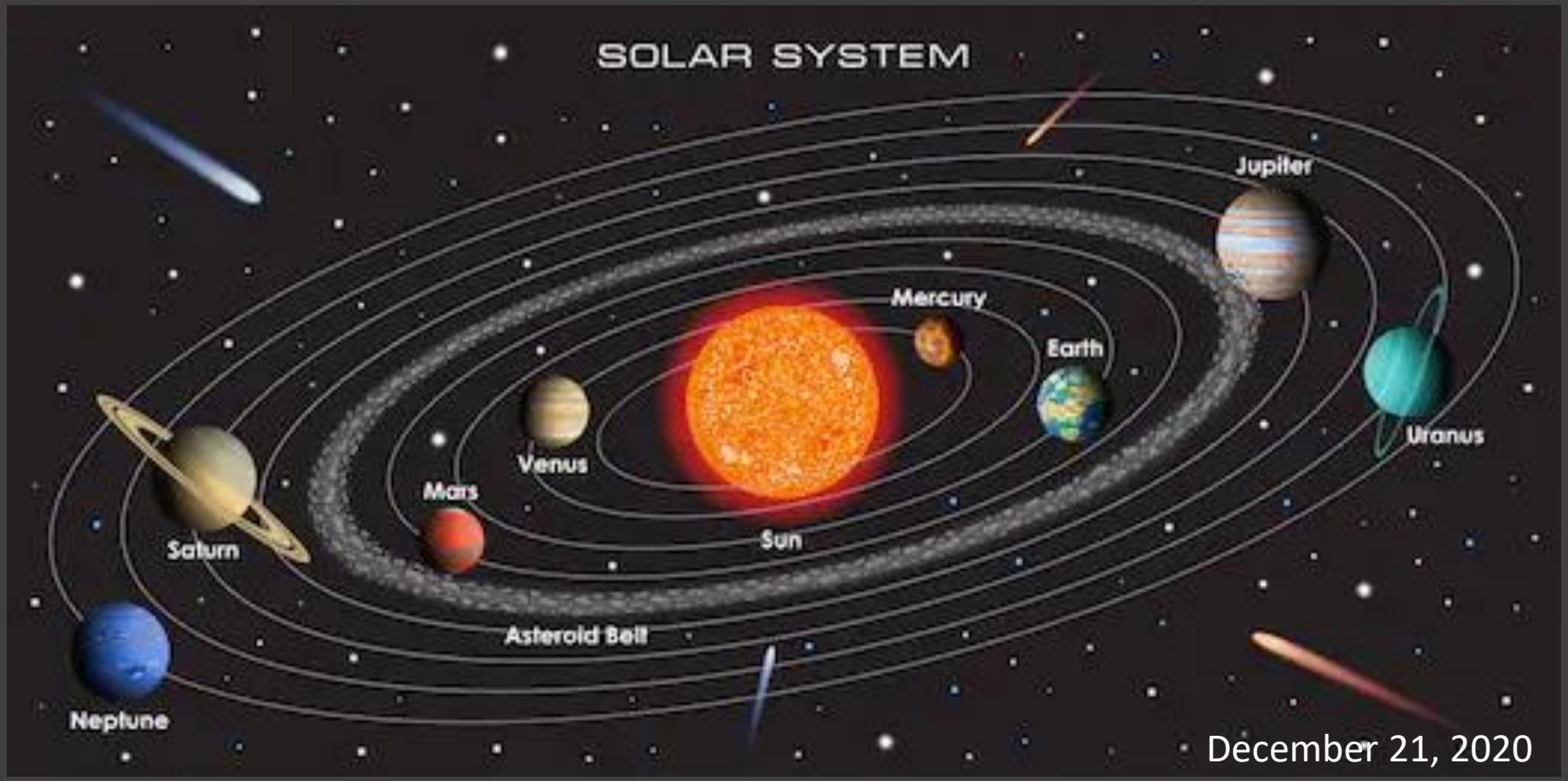
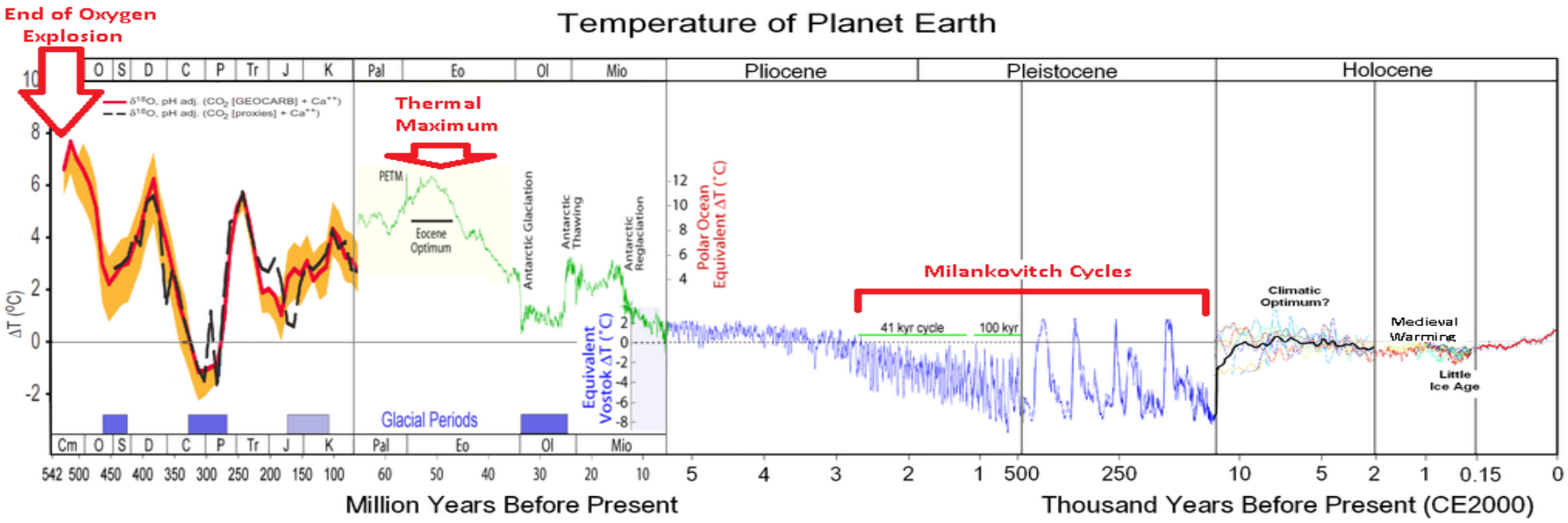
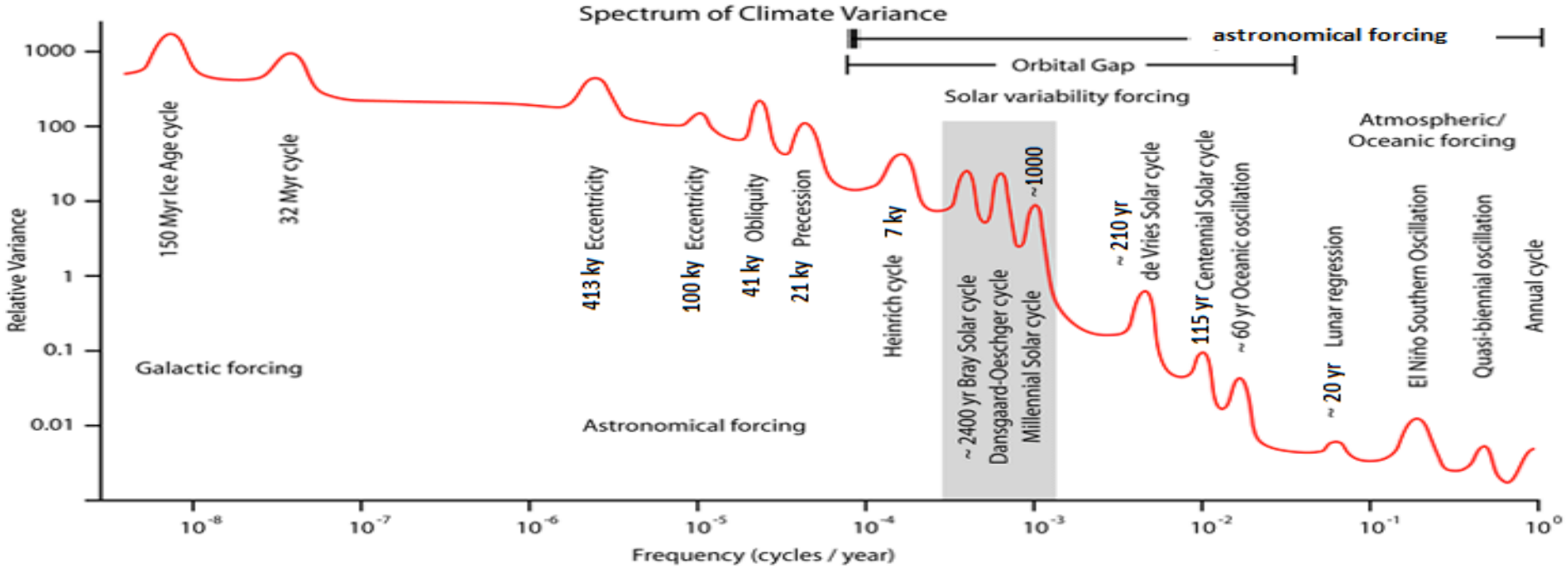


Planetary conjunctions, Invariant inequalities and the solar-climate oscillations

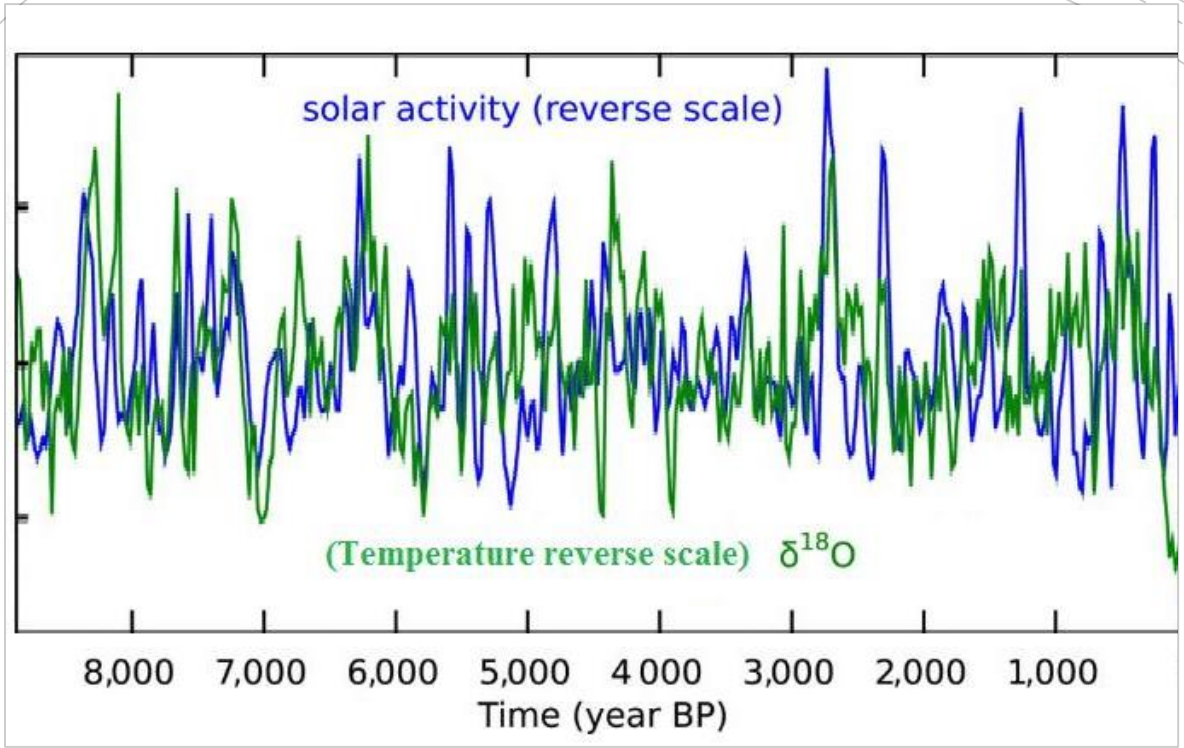
- **Prof. Nicola Scafetta**
- *Dipartimento di Scienze della Terra,*
- *dell'Ambiente e delle Risorse*
- **Università degli Studi di Napoli**
- **Federico II**

Natural Climate Oscillations



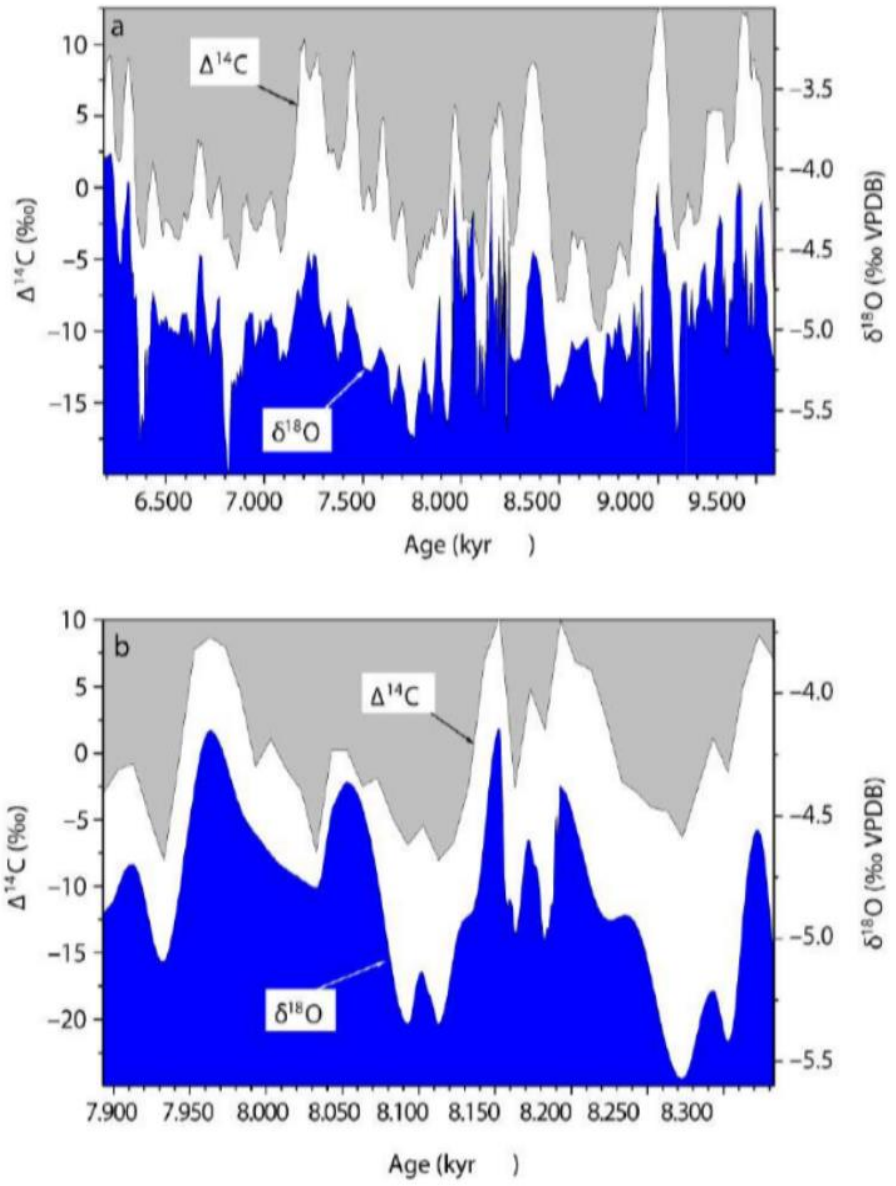


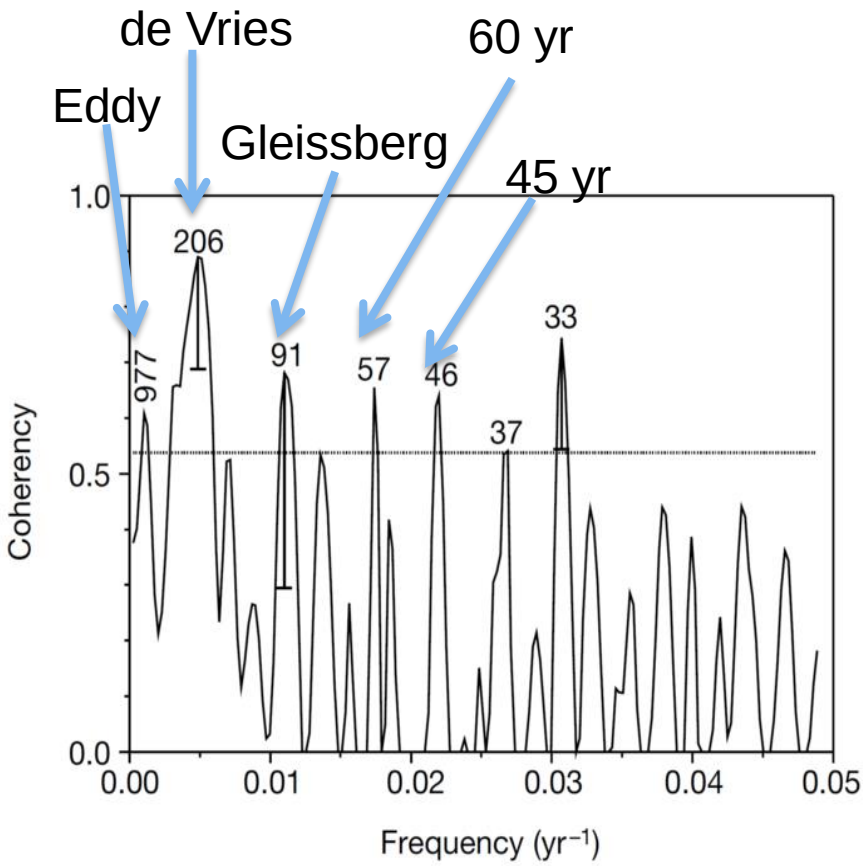
Solar Variability is correlated with climatic records for millennia



- Comparison between a solar activity record (blue) based on cosmic ray flux and a climatic record from Dongge cave, China, (green) representing changes of the Asian climate. From Steinhilber et al. (2012).

Strong coherence between solar variability and the monsoon in Oman between 9 and 6 kyr ago



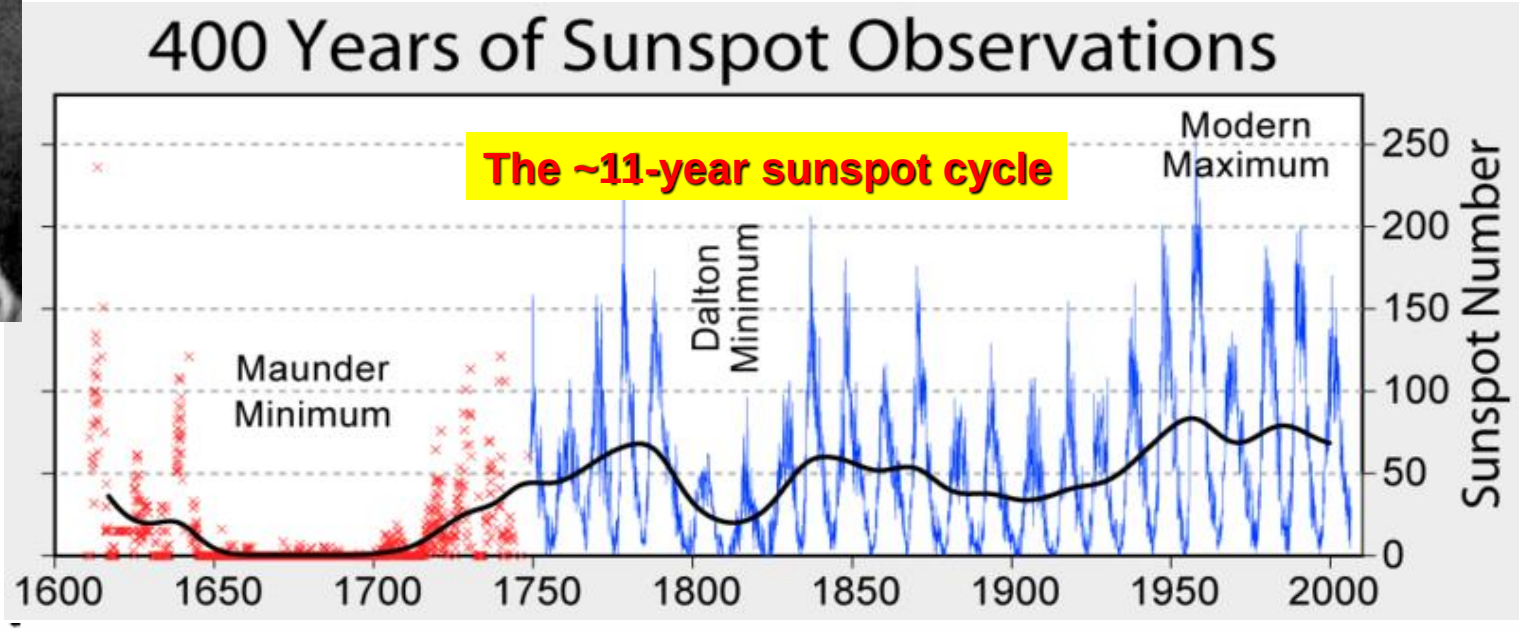


U. Neff et al., Nature 411, 290 - 293 (2001)

A Planetary theory of solar variations

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

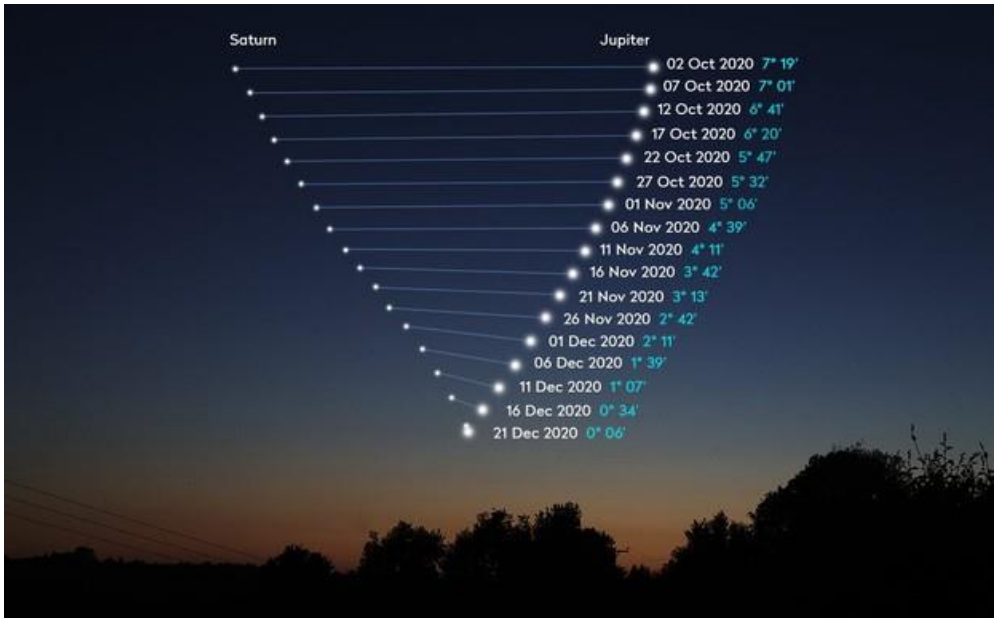
(*Translation.*)

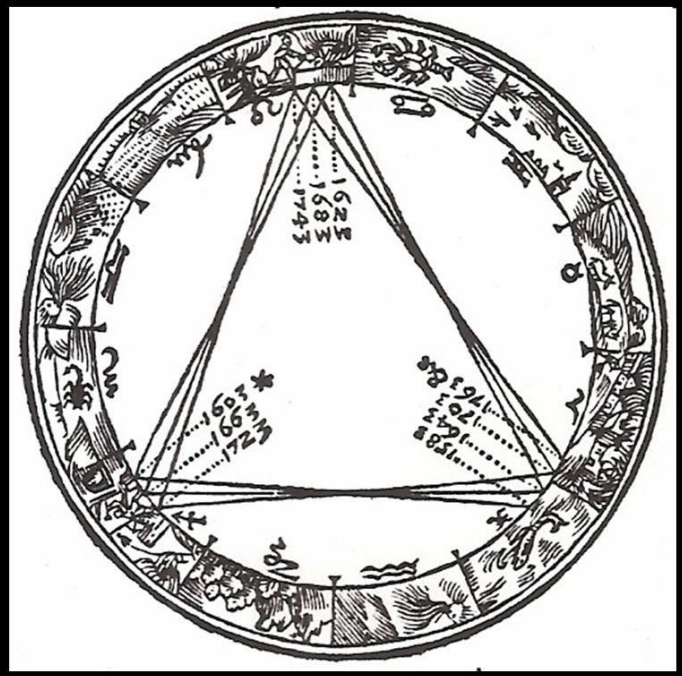


the same planets, the conclusion seems to be inevitable, that my conjecture that the variations of spot-frequency depend on the influences of *Venus, Earth, Jupiter, and Saturn,* will not prove to be wholly unfounded. The preponderating planet

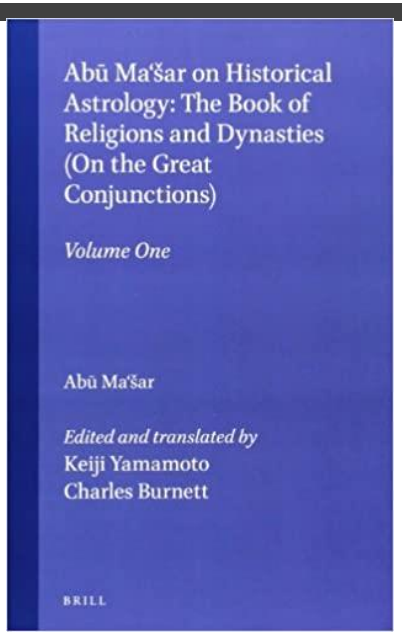
Table 1. Heliocentric synodic mean periods, orbital invariant inequality and heliocentric longitude and date of planetary conjunctions nearest to 2000 AD.

	Orb. Inv. Ineq.	Period (yr)	Julian Date	Long.
Jup-Sat	(1,-1,0,0)	19.8593	2451718.4	52° 01′
Jup-Ura	(1,0,-1,0)	13.8125	2450535.8	305° 22′
Jup-Nep	(1,0,0,-1)	12.7823	2450442.1	297° 21′
Sat-Ura	(0,1,-1,0)	45.3636	2447322.1	269° 05′
Sat-Nep	(0,1,0,-1)	35.8697	2447725.6	281° 14′
Ura-Nep	(0,0,1,-1)	171.393	2449098.1	289° 22′



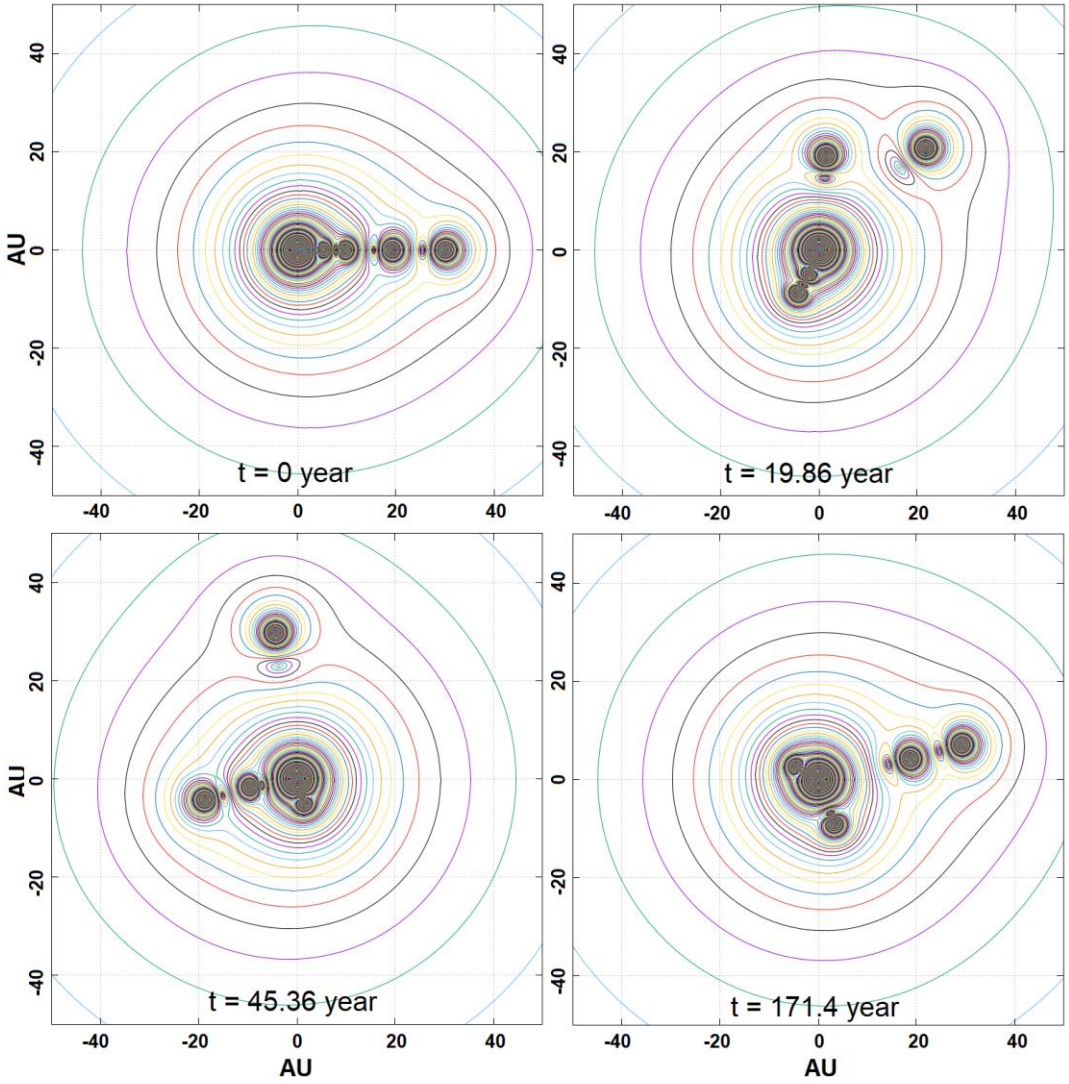


The Trigon formed by Great Conjunctions, which occur every 20 years and return to the same stellar background every sixty (ie the same sign). Kepler, 1606..



Gravitational symmetries related to the conjunction periods among four Jovian planets

Examples of gravitational field configurations produced by a toy-model of the solar system made of four equal masses orbiting a 10 times more massive central point.



The resonances of the solar system and its invariant inequalities

---

Invariant Inequalities

=

beats among the conjunction periods

$$f = \frac{1}{T} = \left| \sum_{i=1}^{n} \frac{a_i}{T_i} \right|,$$

$$\sum_{i=1}^{n} a_i = 0.$$

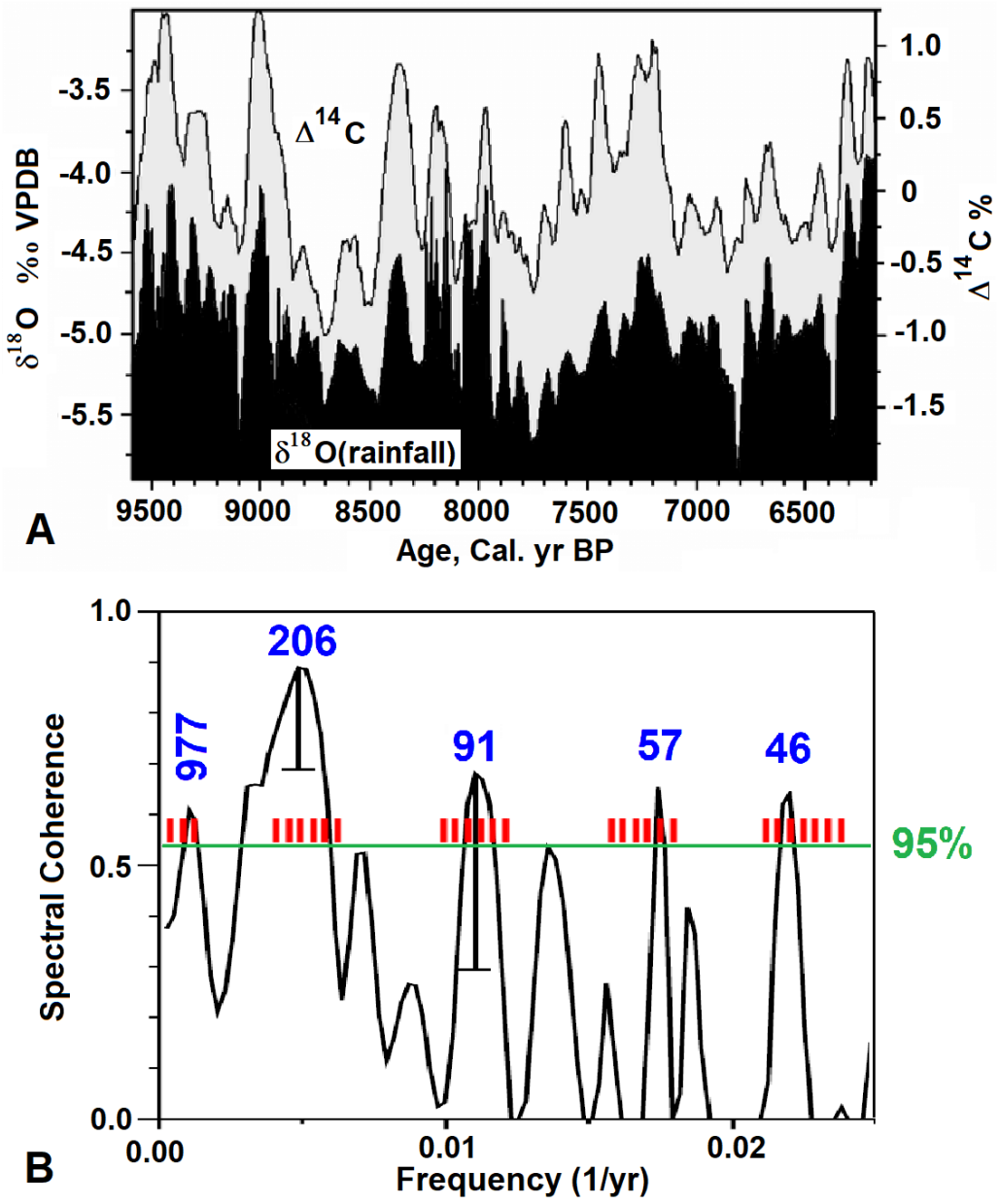
$$f_i' = \frac{1}{T_i'} = \frac{1}{T_i} - \frac{1}{P}.$$

$$f' = \frac{1}{T'} = \left| \sum_{i=1}^{n} \frac{a_i}{T_i'} \right| = \left| \sum_{i=1}^{n} \frac{a_i}{T_i} - \frac{\sum_{i=1}^{n} a_i}{P} \right|.$$

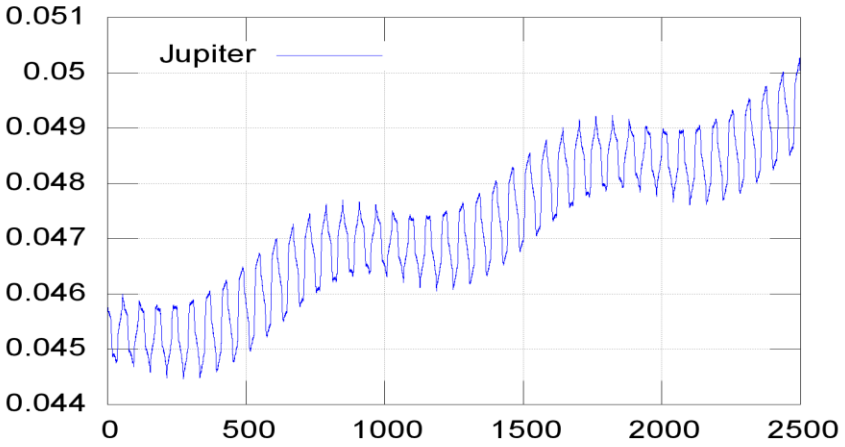
Table 2. Full list of invariant inequalities: period $T \geq 40$ yr and $1 \leq M \leq 5$. Most relevant periods according to the (M, K) classification are in bold.

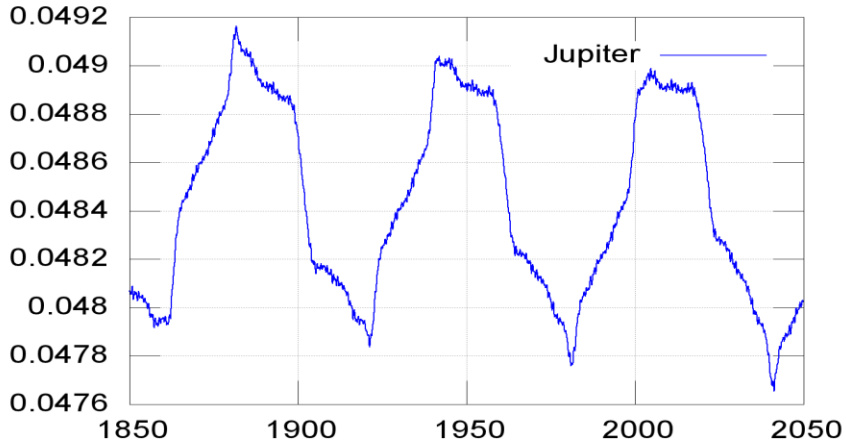
(Jup, Sat, Ura, Nep)	(M, K)	T (year)	cluster
(1, -3, 5, -3)	(5, 6)	42.1	
(0, 0, 4, -4)	(4, 4)	**42.8**	
(2, -5, 1, 2)	(5, 5)	43.7	
(1, -3, -3, 5)	(5, 6)	43.7	
(1, -2, 0, 1)	(2, 2)	**44.5**	~ 45 yr
(0, 1, -1, 0)	(1, 1)	**45.4**	
(1, -4, 2, 1)	(4, 4)	**46.3**	
(1, -1, -5, 5)	(5, 6)	47.2	
(1, -3, 4, -2)	(4, 5)	55.8	
(0, 0, 3, -3)	(3, 3)	**57.1**	
(2, -5, 0, 3)	(5, 5)	58.6	
(1, -3, -2, 4)	(4, 5)	58.6	~ 60 yr
(1, -2, -1, 2)	(2, 3)	**60.1**	
(0, 1, -2, 1)	(2, 2)	**61.7**	
(1, -4, 3, 0)	(4, 4)	**63.4**	
(1, -3, 3, -1)	(3, 4)	**82.6**	
(0, 0, 2, -2)	(2, 2)	**85.7**	
(2, -5, -1, 4)	(5, 6)	89.0	
(1, -3, -1, 3)	(3, 4)	**89.0**	Gleissberg
(1, -2, -2, 3)	(3, 4)	**92.5**	
(0, 1, -3, 2)	(3, 3)	**96.4**	
(1, -4, 4, -1)	(4, 5)	100.6	
(1, -3, 2, 0)	(3, 3)	**159.6**	
(0, 0, 1, -1)	(1, 1)	**171.4**	Jose
(2, -5, -2, 5)	(5, 7)	185.1	
(1, -3, 0, 2)	(3, 3)	**185.1**	
(1, -2, -3, 4)	(4, 5)	**201.1**	
(0, 1, -4, 3)	(4, 4)	**220.2**	Suess-de Vries
(1, -4, 5, -2)	(5, 6)	243.4	
(0, 1, -5, 4)	(5, 5)	**772.7**	Eddy
(1, -2, -4, 5)	(5, 6)	**1159**	
(1, -3,1, 1)	(3, 3)	**2318**	Bray-Hallstatt

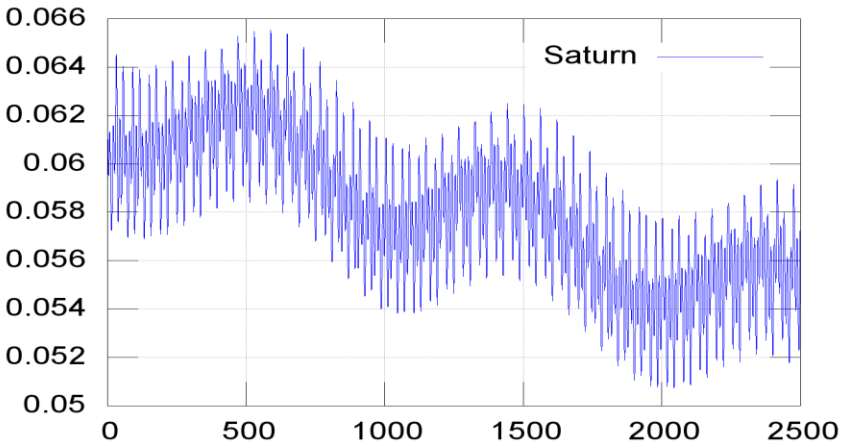
Solar and climate oscillations versus the invariant inequalities of the solar system (red)

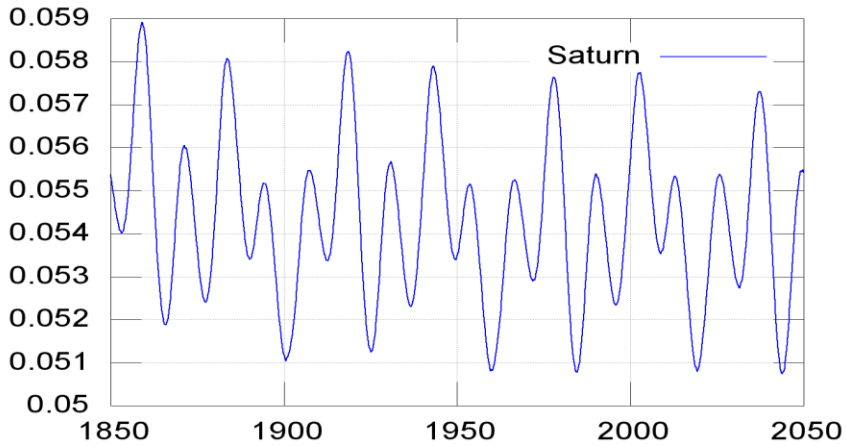


Eccentricity variation of Jupiter and Saturn (major 60- and 940-year cycles)

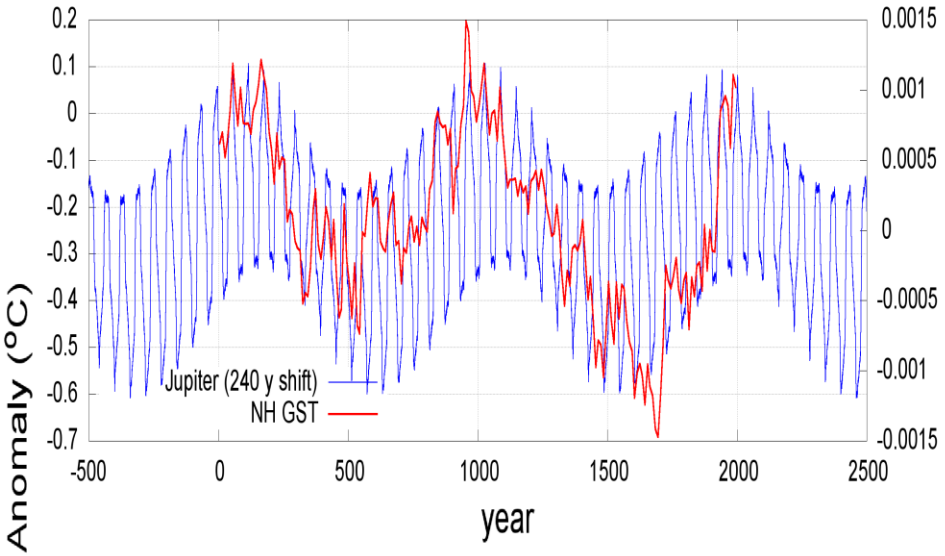


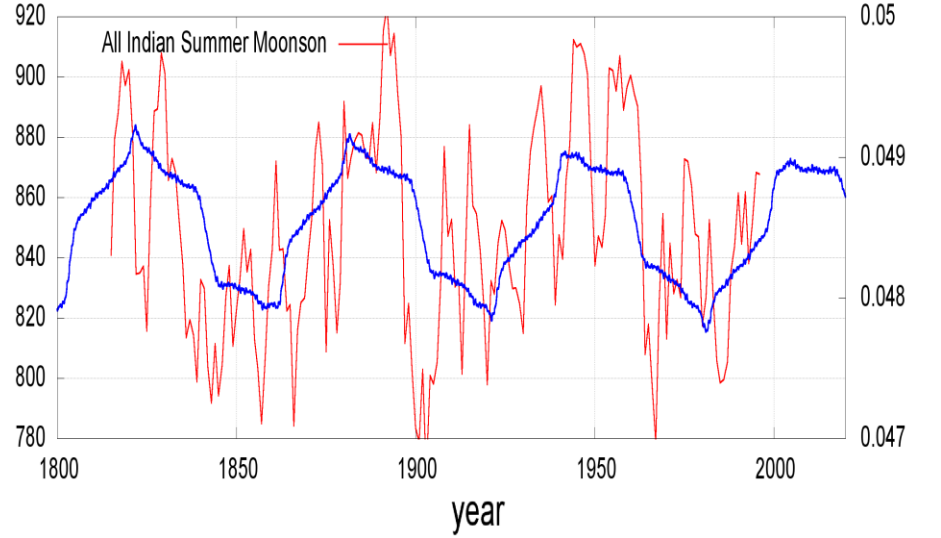


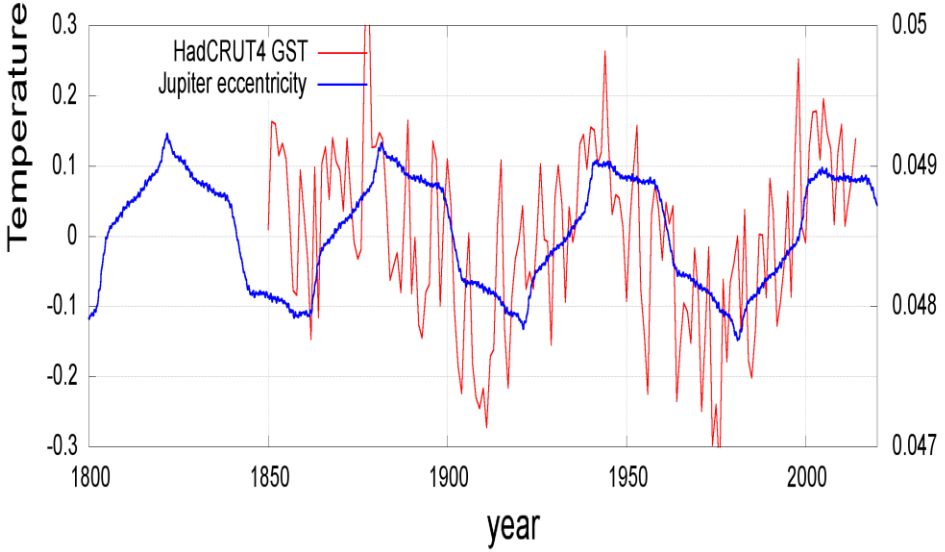


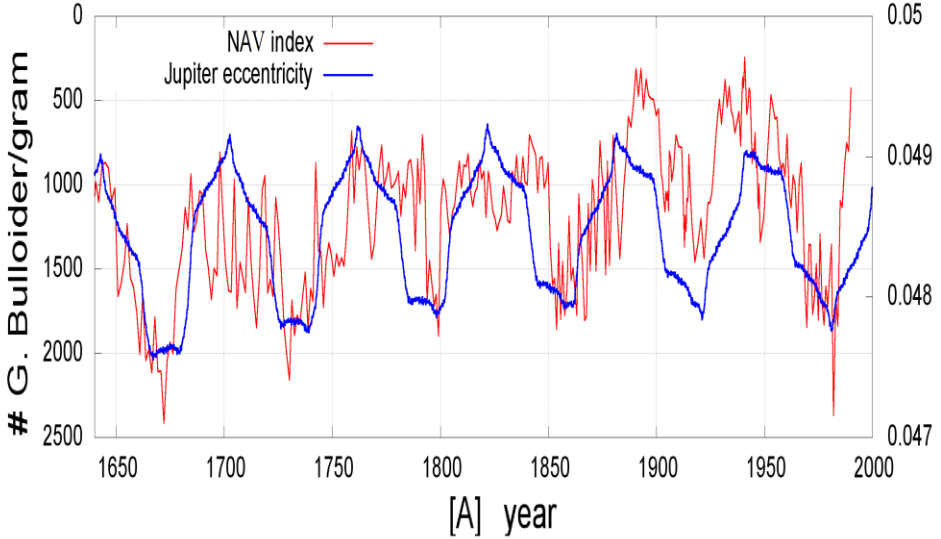


60 and 940 years cycles in the climate system

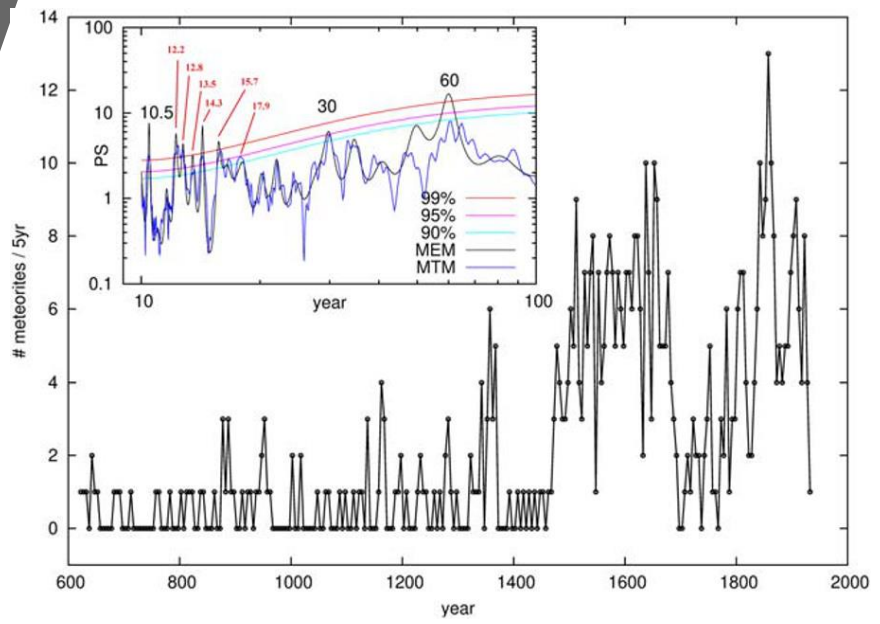


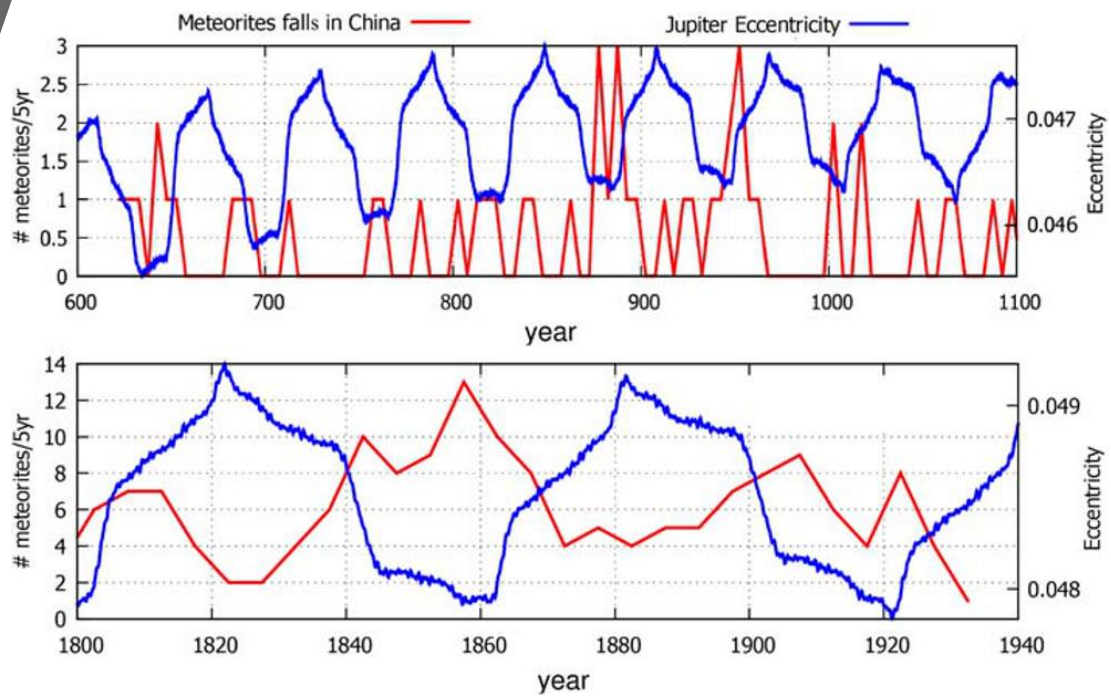






The eccentricity variation of Jupiter versus the meteorite fall frequency (60-year)





Conclusion

- Solar activity and Climate variation present similar oscillations.
- These oscillations correspond to astronomical oscillation related to the revolution of the planets of the solar system.
- It is possible that the sun synchronizes with gravitational oscillations of the solar system and/or the latter modulate the influx of cosmic dust toward the Earth.

Very recent bibliography

- Scafetta, N., Milani, F., Bianchini, A.: 2020. A 60-Year Cycle in the Meteorite Fall Frequency Suggests a Possible Interplanetary Dust Forcing of the Earth's Climate Driven by Planetary Oscillations. Geophysical Research Letters, 47(18), e2020GL089954. DOI: 10.1029/2020GL089954.

- Scafetta, N.: 2020. Le oscillazioni solari e le armoniche stabili del sistema solare. Gerbertus, 13, 73–86. ISSN: 2038-355X.

- Scafetta, N.: 2020. Solar Oscillations and the Orbital Invariant Inequalities of the Solar System. Solar Physics, 295(2), 33. DOI: 10.1007/s11207-020-01599-y