SOLAR FORCINGS ON NILE AND EARTHQUAKES

SAAD MOHAMMED AL-SHEHRI

KING Abdulaziz City of Science and Technology

ISMAIL SABBAH

Physics Department, Faculty of Science, Kwait University

SHAHINAZ MOUSTAFA YOUSEF and MAGDY Y. AMIN

Astronomy and Meteorology Department, Faculty of Science, Cairo University
habibat_arrahman@yahoo.com

Nile and earthquake periodicities are examined in the light of solar and geomagnetic periodicities in order to uncover the role of the sun in initiating such terrestrial phenomena. The Nile periodicities under considerations covers the period 622-1420 AD. 1749- 1800 and 1870-1945 and are taken from an earlier paper by Yousef and El-Rae (1995).

It is found that 11 yr and 21 yr solar periodicities affected the White Nile originating from the Equatorial plateau. On the other hand the Blue Nile arising mainly from Lake Tana in Ethiopia was affected mostly by the 3.3 yr, 2.9 yr, 2.7 yr, and the 2.52 yr periodicities. Such short periodicities are also present in cosmic rays. This is fairly true as during weak solar cycles series at the bottom of the 80-120 year Solar Wolf-Gleissberg Cycles, the level of the second to last of the weak cycles rise and fall coherently with full solar cycles with a correlation coefficient of about 0.9. Rain over Ethiopia is affected by the Monsoon precipitation which is related to the quasi biennial oscillations QBO of the equatorial zonal wind between the easterlies and the westerlies in the tropical stratosphere with a mean period of 29 months. We propose that the QBO are stimulated by the 2.52-2.48 yr solar periodicities. The 2.52 and 2.48 yr periodicity is strong in odd solar cycles 21 and 23.

Generally speaking, it looks that different solar periodicities are space-time dependant and that they affect different regimes of terrestrial responses.

In the case of earthquakes, we think that they are related to geomagnetic storms initiated by solar stimuli. Several solar periodicities are found in earthquakes. We postulate that electric currents in the ring current and in the ionosphere induce surface as well as deep electric currents in the magma thus produce motion and disturbances of the plates and the magma leading to earthquakes and volcanoes.

Introduction

The sun is the driving force of many terrestrial phenomena. Many authors have studies direct and indirect sun-earth connections in many areas. To mention a few, cosmic rays flux is anti –correlated with solar activity, their excess increase cloud cover and reduce Earth's temperature as is the present and future scenario (Svensmark (2008),Yousef (2005), 2011, Yousef et al 2011). Precipitation cycles, drought- flood hazards (Yousef 2000) and their relations to El- Nino and La Nina and teleconections, River floods and closed seas (Yousef 2004) and lakes levels variations (Yousef and Amer 2003).

Power Spectral Density PSD

The study of periodicity of spectral density (PSD) of the Galactic cosmic-ray variations, particularly their spectral characteristics, allows us to find the main features of fluctuations that existed during different phases of solar activity, as well as to look for the correlation between these fluctuations and the interplanetary and solar parameters. For this purpose we have selected two stations, where the continuous registration of Galactic Cosmic Ray (GCR's) intensity count rates recorded by the Climax

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neutron monitor station in Colorado (cut off rigidity 2.99 GV) for the time interval (1953-2006), and the Huncayo/ Haleakala, Hu/Ha neutron monitors in Peru/Hawaii (cut off rigidity 12.91 GV) for the same time makes it possible to conduct statistical studies of long-term variations and periodicities. The advantage of the Hu/Huancayo NM and the Haleakala NM is that the dataset being from the same station, there is no different rigidity response to the cosmic ray flux, so the cosmic ray intensity variation will by always the same quantitatively, where hourly averaged data are now available at http://www.nmdb.eu.

Days with large ground-level enhancements (GLEs) caused by solar flares or by Forbush decreases were eliminated from both data sets. The power spectrum in the frequency region considered, is rather complicated and affected by various transitional effects in the heliosphere and magnetosphere.

We compared the power spectral density analysis of these cosmic ray stations with that of the continuous records of the geomagnetic activity index (aa) in order to get a closer look at a possible connection between them.

The power spectral density (PSD) is calculated using the fast Fourier transform (FFT) with the rectangular window method for the wide frequency range (2.3×10^{-8} Hz– 4×10^{-7} Hz), which is corresponding to a range from ~ 2 yr to 37 yr since the frequency is c/27 days. The results were smoothed using the Hanning window function, and the smooth curve using a cubic B-spline connection is used. The spline technique is described (e.g. in de Boor [1978]) . This is necessary since most of the disturbed features completely disappear, while the significant peaks are clearly defined. Nevertheless, the particular window chosen does not shift the positions of the spectral peaks.

Figure 2 shows a comparison between the PSD for CL, Hu/Ha (NM) and the aa index during the period (1953-2006). We divided the PSD into two windows one for higher frequency and the other for low frequency, this is to show a clearer view of all frequency fluctuations. Numbers are added to assist in determining the relative locations of peaks in years. The observed significant peaks are listed in Table 1. Sunspot periodicities obtained from fig 1 and are also shown in the same table for studying solar forcing on cosmic rays and the geomagnetic index aa. Terrestrial responses given in Table 1, are based on Yousef and El Raey (1995) paper on Sun-Nile floods connections as well as (Shaltout et al. 1999) for earthquake periodicities. Both of the periodicities 2.67 and 2.52 years appear in Ethiopian water contribution to the Nile as well as in earthquakes data as evident in Table 1. The other common periodicity between sun, aa and Hu/Ha is ~4.64 years while the common periodicities between sun, aa and Climax are ~ 6.15 yr and 3.94 yr. Common periodicities between sun and aa are ~ 10 yr, 7.18 yr, 4.06 yr, 2.74 yr and 2.47 yr. Common periodicity between sun and Hu/Ha is 3.52 yr, while common periodicities between sun and Climax are 16.6 yr, ~ 4.83 yr and 3.37 yr. Two common periodicities are found between aa and climax namely; ~ 9.71 yr and 5.72 yr. The PSD of the aa index shows the three durations of solar cycles 10, 11 and 12 for very strong and weak solar cycles respectively (Nesme-Ribes et al. 1994).

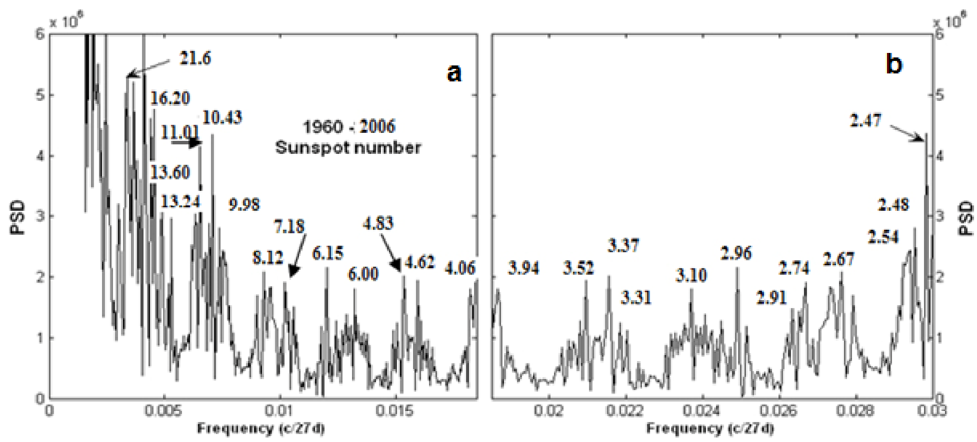

Fig 1. PSD every 27 days at (a & b) SN during (1964–2006).

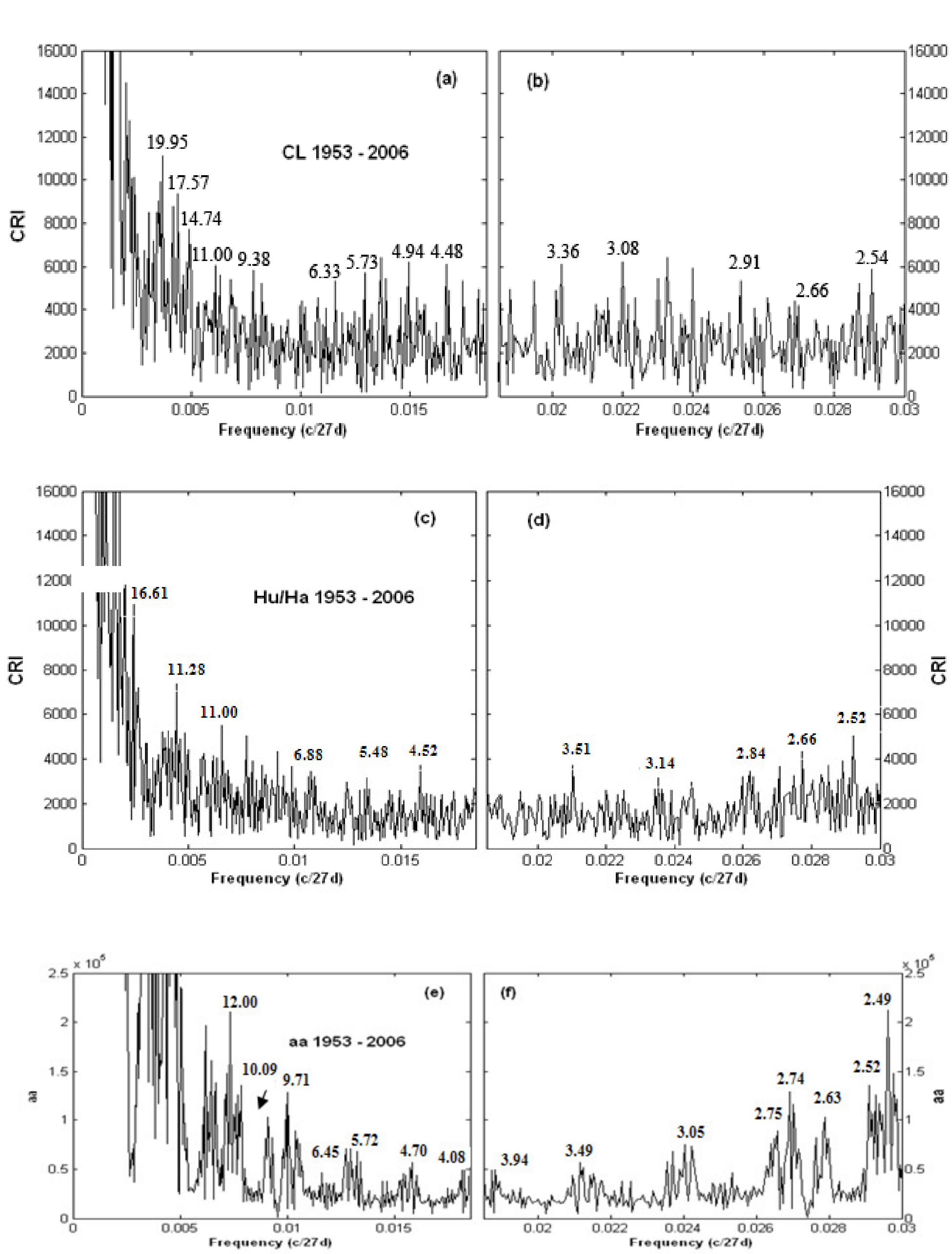

Fig 2. *PSD every 27 days GCR intensity at: (a & b) Cl, (c & d) Hu/Ha and (e & f) aa index during (1953–2006).* Periodicities are shown in years.

Table 1. List of Periodicities in Years for Sunspot Number, aa Geomagnetic Activity Index, GCR (Hu/Ha and Climax) 1953-2006.

SN	Aa	HU/Ha	CL	Terrestrial Responses
21.6				20.99 is the strongest in Equatorial Nile 622-1420 AD
			19.95	
			17.57	
16.2		**16.61**		
			14.74	
13.6				13.9 yr Algerian Earthquakes
13.24				
	12.00			
		11.28		11.0 yr is the 2nd strongest in Equatorial water 650-886 AD
11.01	11.0	11.0	11.0	11.1 in earthquakes
10.43	**10.09**			10.09 yr is the strongest in Nile flood 650-886 AD
9.98	9.71			
			9.38	
8.12				
7.18	7.37			
		6.88		
6.15	6.45		6.33	
6.00				
	5.72		5.73	
		5.48		5.5 surface waves (earthquakes(
4.83			4.94	
4.62	4.70	4.64		4.6 yr appears in earthquake, body waves
			4.48	
4.06	4.08			
3.94	3.94		3.78	3.8yr appears in earthquakes, 3.97 in earthquakes
3.52		3.51		
3.37				
3.31				3.31 and 3.13 are the strongest in Ethiopian Nile 879-1128 AD
3.1			3.36	3.05 in equatorial water 622-1420 AD
2.96				2.91yr is the strongest in Ethiopian water 650-878 AD
2.91				2.7yr is the strongest in Nile flood 1870-1945
2.74	2.74			
2.67	2.63	2.66	2.66	2.6 yr appears in earthquakes
2.54	2.52	2.52	2.54	2.5 in earthquakes and 2.56 in Ethiopian water.
2.48	2.49			2.48 yr is both a solar and maximum Nile flood 1749-1800.

References for terrestrial responses:

1- For the Nile; Yousef and El Raey (1995).

2- For earthquakes Shaltout et al. (1999), strong periodicities are bold

Terrestrial Responses

1-The Equatorial and Ethiopian Sources of Nile Floods

The river Nile brings water and fertility to Egypt. It has two sources; The Equatorial Plateau source that includes the Equatorial Plateau Lakes like L. Victoria and L. Albert and brings water to the Nile all the Year round. The other source is the Ethiopian source and have several tributaries like Subat and Atbara but its main river is the Blue Nile that starts from L. Tana and brings the summer flood to the main Nile stream. Our knowledge on Nile discharge goes back to 9000 BC based on Geological records (e.g Yousef 1999 and references therein). It is from those records that it was recognized that the start of the seven years of high Nile floods at the time of the prophet Yusuf (Joseph) peace be upon him was 2200 BC (Yousef 2006). The Karnak Nilometer was used in Ancient Egypt (Yousef 2010). However the best of all is the prolonged Nile flood records (622-1467 AD). Several papers have studied this Arab Epoch Nile records e.g. Yousef and El Raei (1995), De Putter et al. (1998), Kondrashov et al. (2005). Since extensive list of Nile periodicities are given in the first reference for the three Nile cycles that were found and since the periodicities in this reference are segregated into those attributed to Equatorial, Ethiopian and total Nile water, we have thus listed the strong Nile periodicities given by this reference and relate them to the solar periodicities computed in the present paper and given in Table 1.

Yousef and El Rae (1995) found the following periodicities in Nile water; about 266 yr, 133 yr, 80 yr, 52.8 yr, 22yr and 11yr. plus a several other shorter periods. De Putter et al. (1998) found the following periodicities in minimum Nile levels; 256, 75.9, 52.6, 38, 28.9, 20.9, 18.5 and 13.4 yrs. In the case of flood level, they found the following periodicities (75.9, 33.6, 21.4, 14.7, 13.7, 9.7, and 8.1 yr.

Table 1 gives the stronger short period periodicities between about 22-2.5 yr.

2-Sun- Earthquakes Periodicidities

Shatout et al. (1998) found periodicities for the worldwide earthquakes of M≥5 for the period 1903-1985. The data source is the National Oceanic and Atmospheric Administration NOAA\ Boulder\ Colorado. The earthquake periodicities are listed in Table 1 for comparison with sunspot number and aa periodicities. The following periodicities were found for earthquakes, sun and aa index 4.6, 3.8 and 2.6 years. The 11 yr solar periodicity is found in Earth geomagnetic records (Foullon 1998).

Elias and Silbergleit (2008) discussed the influence of strong geomagnetic disturbances and induced currents on earth surface. In fact, geomagnetic disturbances generate electric fields that drive currents in the Earth which may have significant effects on electrical systems and pipelines.

Conclusions

Of particular interest is the effect on precipitation on Nile sources. Table 1 lists the periodicities that influence Nile water. On one hand, the 11 year cycle and 21 yr (22) cycle affected the White Nile originating from the Equatorial plateau. On the other hand the Blue Nile arising mainly from Lake Tana in Ethiopia was affected mostly by the 3.3 yr, 2.9 yr, 2.7 yr, and the 2.52 yr periodicities. Such short periodicities are also present in cosmic rays.

This indicates that different sources of the same river are affected by different solar or solar induced periodicities. The strengths of such periodicities are solar cycle dependant.

The Equatorial Lake Plateau regime is controlled fully by solar cycles. This statement is very true particularly at the time of weak solar cycles where the second and the following weak cycles of the series force the lakes level to rise and fall in sympathy (Yousef 2006b). This happened earlier with cycles 13, 14 and 15(1890-1923). Consequently this is going to happen with cycles 24, 25 and may be 26. The first weak cycle of the series induce abrupt rise in Equatorial lakes level followed by a decline to drought condition at the end of the 12 yr duration of the cycle. This happened for cycles 12 and 23 as was predicted by Yousef and Amer (2000 and 2003). The coherence between weak solar cycles and lakes levels are shown in Fig 3. The correlation coefficents between sun and L.Victoria, Kyoga andAlbert are 0.86, 0.90 and 0.87 respectively.

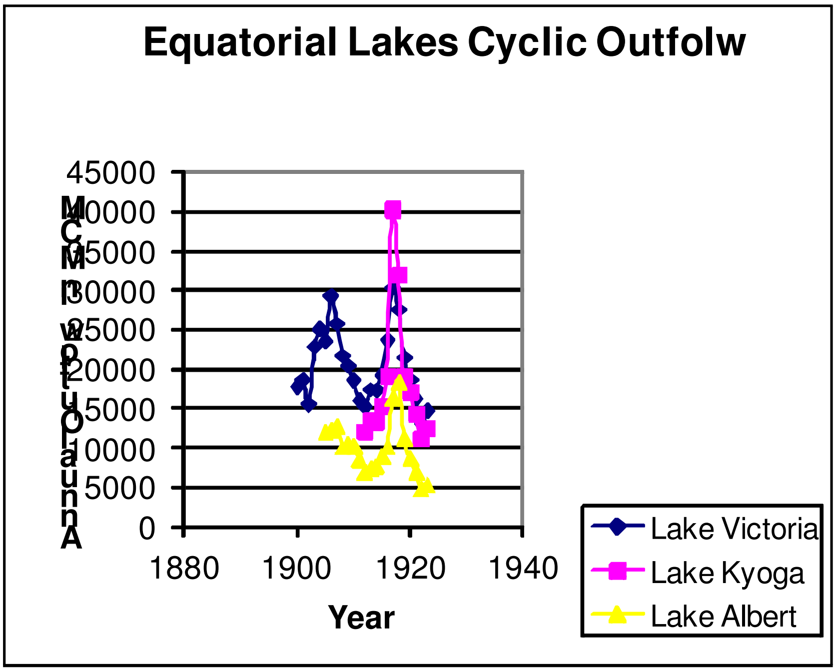

Fig 3. Variation of Equatorial Lakes level in response to positive solar forcingduring the period 1890-1922. The relation failed afterwards.

There is something amazing here perhaps it can be solved by introducing the equatorial ring current 11 yr periodicity or the invasion of cosmic rays to the earth at the time of weak cycles. However it is something to do with Equatorial precipitation and this point has to be tackled.

As for the effect of the 2.48 yr periodicity which is evident in Ethiopian water contribution to the Nile, we can explain it in the following manner: There exist a solar and geomagnetic effect on the Quasi Biennial Oscillations of the equatorial zonal wind between the easterlies and westerlies in the tropical stratosphere with a mean period 28-29 months (2.42 yr). QBO affect the ozone as well as the monsoon precipitation inducing Nile floods over Ethiopia.

Of particular interest also are the 4.6, 3.8 and 2.54 yr periodicities which are found in earthquakes periodicities (Shaltout et al 1999). The 4.6 yr periodicity was strong during cycle 20 while the 2.52 yr periodicity was strong during cycles 20, 21 in both the sun, aa and GCR. It was not strong in GCR during cycles 22 and 23 in spite of its high strength in the solar periodicities of cycle 23 (Al-Shehri 2011). One can postulate that such periodicities increase electricity in the ring current at the equator as well as electric currents in the auroral ionosphere (Lang 2001) or perhaps generally in the ionosphere. Induced electric currents in the mantle affects plate tectonics and thus initiate earthquakes and perhaps volcanoes. Detailed test of such hypothesis needs verifications on long time spans.

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