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THE SHARP RISE OF LAKE VICTORIA, A POSITIVE INDICATOR TO SOLAR WOLF-GLEISSBERG CYCLES TURNING POINTS

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ABSTRACT

The Sun experiences long range cycles of the order (80-120) years known as the Wolf – Gleissberg cycles. 1877-1878 marks the end of one of those cycles and the beginning of a series of three low activity 12 years solar cycles. 1878 was also characterized by a sharp rise in Lake Victoria level followed by continuous drop till 1890. Later on, the lake level rose and fall in sympathy with solar cycles till the end of the low activity period around 1922 when such correlation ceased to exist.
The maximum of the following Wolf – Gleissberg cycle occurred around 1958, followed by another ~ 2.5 meters sharp rise in lake Victoria level in the early sixties.
Again 1997 marked the end of the past Wolf–Gleissberg cycle and the beginning of a new era of lower activity solar cycles. As a consequence, the level of Lake Victoria rose sharply by 1.6 meters and at present dropping down is in progress. Such drop is expected to last up till the end of the present 12 year solar cycle in the same fashion as in the 1887 case, leading to drought conditions around 2009±2-3 years. This condition is expected to be followed by a cyclic rise and fall of the Equatorial lakes level in response to solar cycle forcing, perhaps for two or three solar cycles leading to alternate floods and droughts.
Attention is made to Nile Basin countries in the Equatorial Lake plateau to take care of such rise which has already been followed by a drop.
Several years of drought conditions similar to those that happened around 1900 (When swum south of the Sobat connection to the Nile were dried, similar dryness were also observed in Bahr - El-Zaraf) are expected to prevail over Uganda and other Equatorial Lake countries at 2009±2-3 years, 2021± 2-3 and perhaps 2033± 2-3 years.
Since several African and the American Great Lakes showed contemporary level rise in the sixties with lake Victoria, alert is extended to governments around Lake Tanganyika, Lake Malawi, Lake Rudolf and other lakes which showed the 1960s rise, to expect droughts in the years mentioned above. Paper II will be devoted to study other lakes on global basis.
Similar Lake Victoria rise in the sixties is to be expected at the maximum of the following Wolf-Gleissberg cycle.
Similar lake Victoria and other Equatorial lakes rise must have happened at earlier Wolf-Gleissberg turning points, some of them were at 1779(max turning point, 1797(min) and 1838-1840(max)).
The abrupt rise of Lake Victoria level is a positive indicator to the Wolf- Gleissberg cycles turning points and can be taken as an indicator to their confirmation.
A search for the solar stimuli which lead to such turning points and to the solar terrestrial responses which lead to climate change as manifested by both the rise of the Equatorial Lake levels and the turning points in precipitation cycles worldwide is currently in progress.
It is advisable to be ready as soon as possible with the Jungli canal in order to benefit from the rise in Equatorial water particularly at the time of the expected drought in Ethiopia.
It is also urgent to benefit from the present excessive rain to increase food production and store it for the time of need.
The problem of electricity production at drought conditions perhaps can be solved by an engineering technique that can use something like varying water level in two basins as in the Panama canal.

1-INTRODUCTION

Lakes can be treated as large rain gauges and their levels can be used to monitor rainfall. One classic example in sun/climate relationships concerns Lake Victoria. Hoyt and Schatten (1997) and references therein, reported that as early as 1901, E.G. Ravenstein pointed out that the level of lake Nyanza in Africa parallels the level of solar activity. In 1923 Brooks made a classic study of Lake Victoria and Lake Albert. Brook's study showed very strong correlations between the levels of these two lakes and solar activity from 1896 through 1922. This 0.87 correlation implies that as much as 75% of the year to year variations is solar induced.

Eddy updated the Lake Victoria level till 1972. Vincent et al (1979) found that correlation then was insignificant and that a nearby Lake Naviasha has a weak but significant correlation of –0.32 with the Wolf sunspot Number (Hoyt and Schatten (1997) and references therein). The level of Lake Mitchigan rose and fell with solar activity for three cycles between 1901-1933, i.e. the lakes sympathy with solar activity extended one more solar cycle for lake Mitchigan (American great Lakes) than for Equatorial African Lakes.

The water level of lake Victoria as an indicator of tropical rain, was positively correlated with the 11-yr. sunspot cycle from 1880 to 1930, became uncorrelated until 1950 and then showed a negative correlation (Herman and Goldberg 1978).

2-THE WOLF-GLEISSBERG CYCLES

A long variation of roughly 80 yr., referred to as the Wolf-Gleissberg cycle is seen in sunspot cycle amplitudes, as measured by the annual mean sunspot number, (Gleissberg 1971, Siscoe 1978). Fig 1 illustrates such cycles and includes two projections into the future; either a coming drop of weak 12 years cycles or an inactivity period, the Yusof minimum which is similar to the Maunder minimum that prevailed in 1645-1715 AD (Yousef 1998).

Table I reproduced from Yousef (1995a) shows the characteristics of the last three Wolf-Glelssberg cycles as well as the coming one. It indicates that the maxima of the previous two cycles are double humped. The interval between the start of the minimum duration of the cycles 2 and 3 is 80 years. The duration between the start of minima of cycles 3 and 4 is 120 yr. and the interval between the two maxima of cycles 2 and 3 is 119 years, while the duration between the secondary maxima of cycles 2 and 3 is 121 years. This explains the 121 year periodicity found in Equatorial Nile water for the period (1129-1351 AD). The 80 year periodicity is also found in Nile water (Yousef &El Rae 1995). It is also important to note that the interval between the maximum of cycle 1 and cycle 2 is 59 yr.. The duration of the Wolf-Gleissburg cycles oscillates between 60 and 120 years. The 60 years is the second harmonic of the 120 years.

TABLE 1

CHARESTERISTICS OF SOME RECENT SOLAR-WOLF-GLEISSBERG CYCLES

CYCLE	1	2	3	4
DURATION OF MIN		1797-1823	1877-1913	1997-2032
SMOOTHED MIN		1810-1811	1901	2009
SMOOTHED MAX	1779-1780	1838-1840	1957-1958	
SECONDARY MAX		1860	1981	

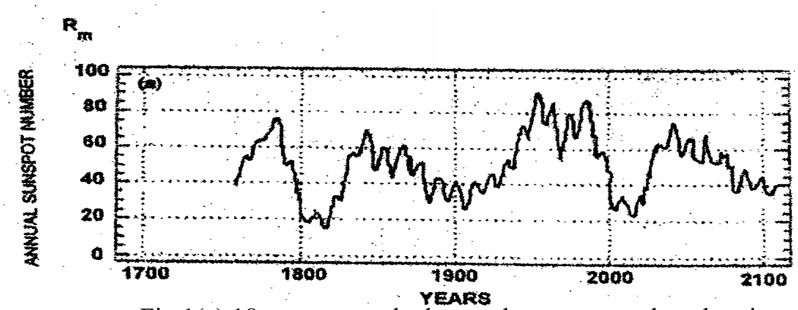


Fig 1(a) 18 years smoothed annual sunspot number showing observed and predicted Wolf-Gleissberg cycles.

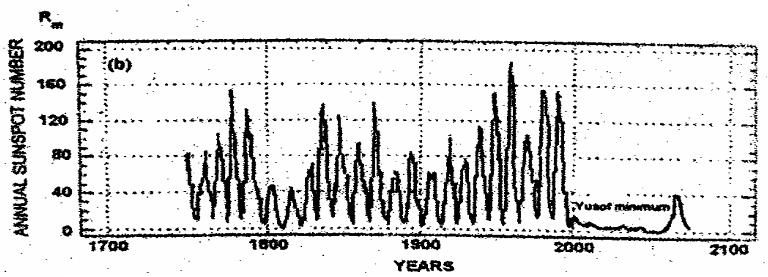


Fig 1(b): Observed and predicted annual sunspot number (1749-2080) showing the Yusof minimum.

3-The 1878 RISE OF LAKE VICTORIA

The variation of the level of Lake Victoria can be summarized in the following fashion.

1- Rise in 1878 followed by continuos drop from 1880 to 1890, Garston (1903).
2- Continuos rise from 1892 to 1895 followed by continuos drop from 1896 to 1902, Garston (1903).
3- From 1902 to 1922 rise and fall of Lake Victoria level in close correlation to sunspot number for two solar cycles as shown in fig 2 (see also Shaw's 1933 digram reproduced in Burroughs (1994).
4- Cut off of the relation between solar cycles and Equatorial lakes level afterwards.

The first rise was at a turning point in Wolf-Gleissberg cycle marking the end of active cycles and the beginning of a series of weak solar cycles of 12 years duration. 1877 was a Nino year that caused a low Nile flood, followed by 1978 la Nina which caused destructive Nile flood as well as other floods elsewhere which are teleconnected (Yousef 1995b,1996). This rise must have been sharp perhaps of the order of 2-2.5 m coincident with the start of the first weak 12 year solar cycle. The lake level did not rise in coherence with solar cycle, but rather a sharp rise occurred followed by a continuos decay. But this rise was an indication of abrupt climate change to an era of low solar cycles manifested by flood-drought hazards world wide. Several strong El Nino and La Nina events where in progress during that time.

Following this cycle, the Equatorial Lakes levels rose and dropped in sympathy with the following three solar cycles till 1922.

The following 10 year solar cycle was the first one of a series of a new Wolf-Gleissberg cycle characterized by high solar activity and this was the end of four weak solar cycles control of Equatorial Lake levels.

Table II
Cross Correlation Between Sunspot Number and Equatorial Lakes Outflow

	L. Victoria(1900-22)	L. Albert(1905-22)	L. Kyoga(1912-22)
Sunspot Number	0.85538	0.86888	0.90892
L. Victoria		0.90995	0.94764
L. Albert			0.93163

Table II shows very good cross correlation between sunspot number and the Equatorial lakes outflow ranging from 0.86 for Lake Victoria and 0.91 for Lake Kyoga. Such strong correlation indicates solar control of the Equatorial lake levels for the period under consideration.

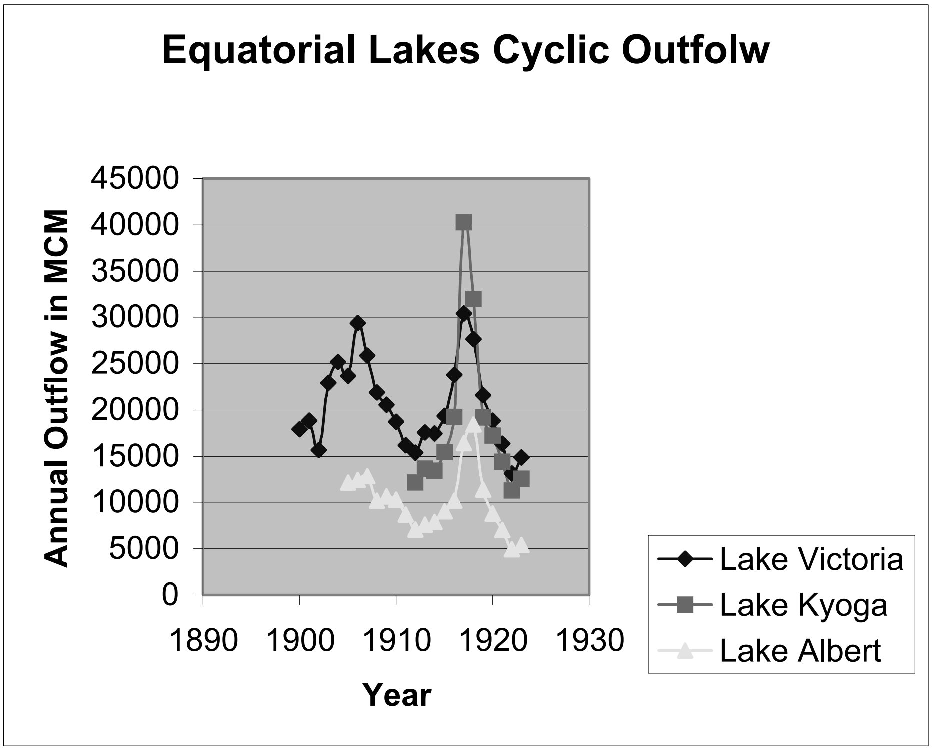
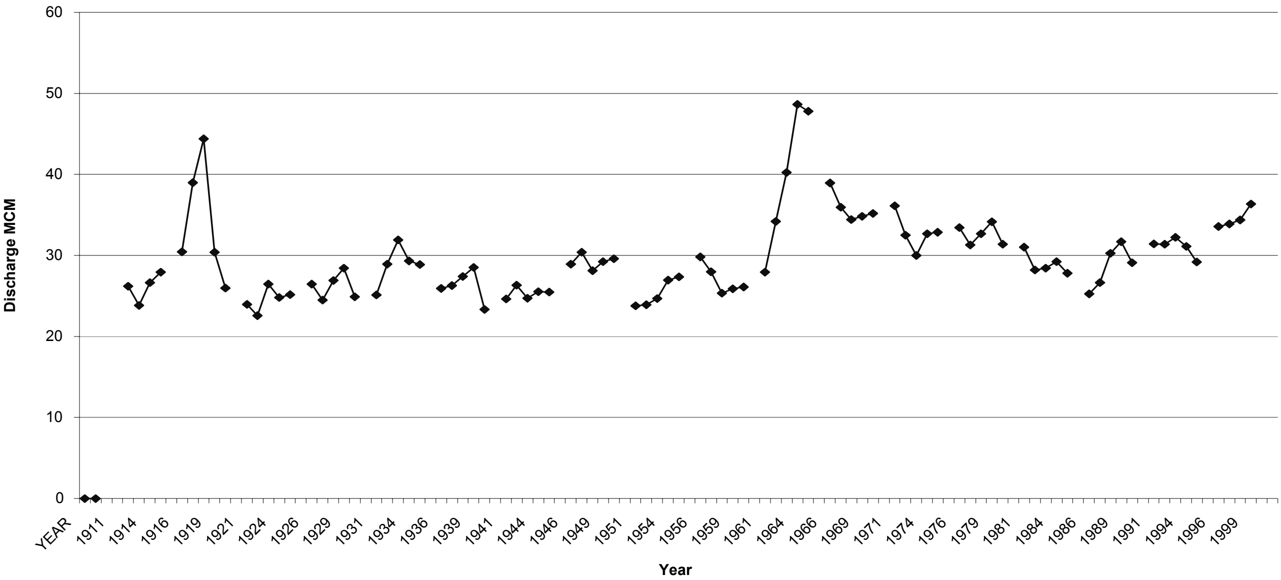


Fig 2: Variation of Equatorial Lakes level in response to positive solar forcing
During the period 1890-1922. The relation failed afterwards.

4-The 1961 Rise of Lake Victoria

Following the maximum of Wolf-Gleissberg cycle, another sharp rise of lake Victoria occurred. Lake Albert also showed such distinguished up rise. This again was an indication of a turning point in Wolf-Gleissberg cycle. This is also reflected at Malakal as seen in Fig 3**.** At the extreme left of the diagram, cyclic variation of discharge in response to the last solar cycle of the drop in between Solar-Wolf Gleissberg cycles. According to Eddies diagram for correlation between Lake Victoria's level (reproduced in Hoyt and Schatten 1997) became negatively correlated around 1950 with the sunspot cycle which is the maximum of the Wolf-Gleissberg cycle.

Fig .3. TOTAL Annual DISCHARGE FOR MALAKAL IN MILLIARDS CUBIC METERS



5-The 1997 Sharp Rise of Lake Victoria

Figure 4 below shows the daily level of Lake Victoria at Jinja for the years 1997-2000 compared to the 1982-1999 average. 1997 was a unique year as the lake level dropped steadily from June to October to 11.32 m then rose abruptly up to 12.87 m in May 1998. Around this time was the end of of the previous solar cycle and the beginning of a new one. 1997-1988 was also a strong El Nino year.

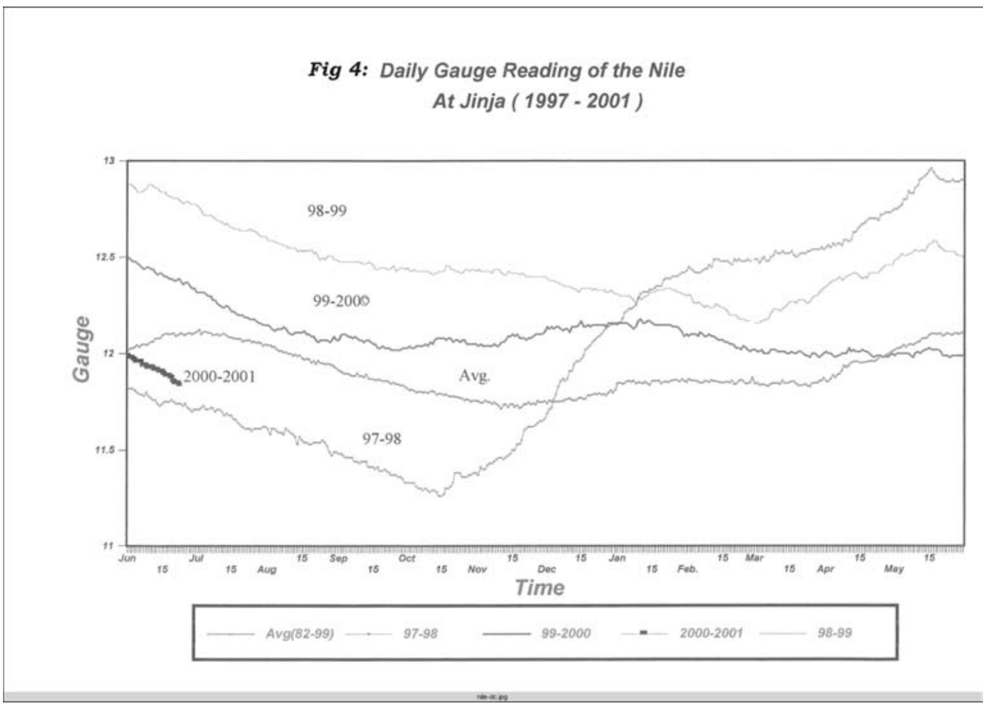
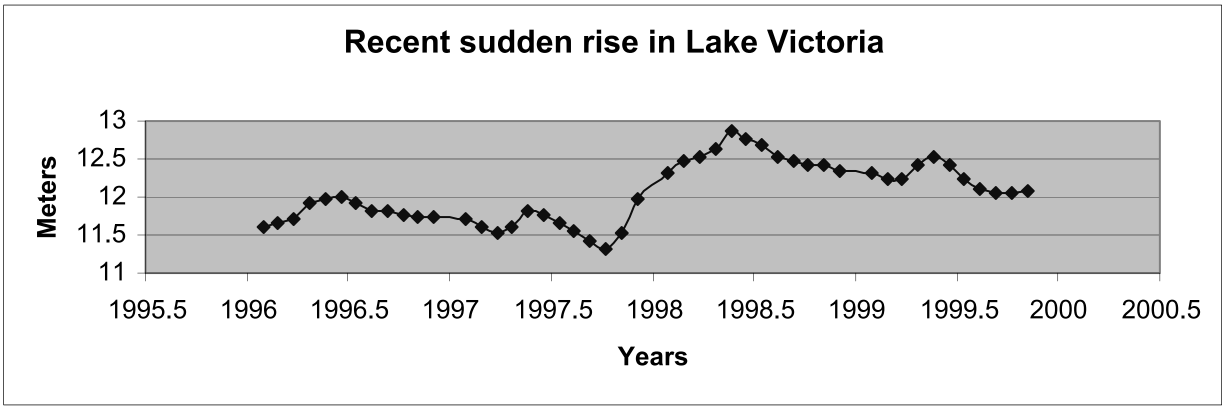
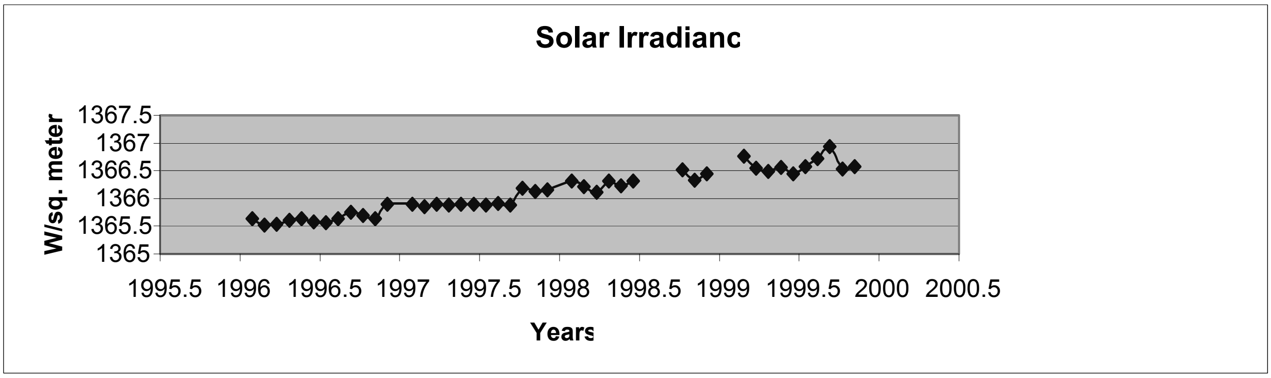
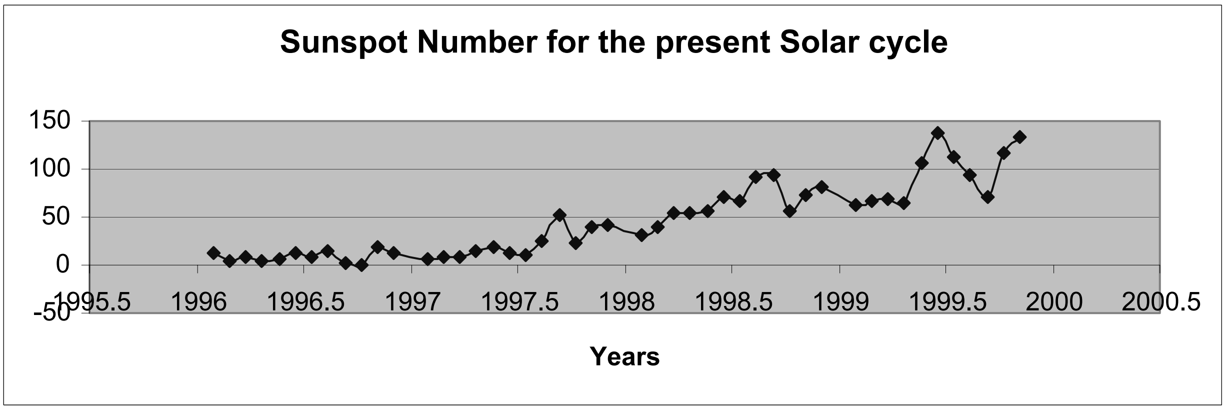


Fig 5: The 1997-98 sharp rise in Lake Victoria level an indication to the end of previous Wolf-Gleisberg cycle and start of a weak 12 years solar cycle.







Comparison of the 1997-98 sharp rise with sunspot number for the present solar cycle and solar irradiance is shown in Fig 5. It is obvious that the sharp rise was coincident with the start of new weak sunspot cycle with some delay. Solar irradiance increase of about 0.11% in the above period is well associated with an increase of about 1.6 meters in Lake level . The mechanism of this relationship is not currently well defined

This sudden rise must have been similar to the rise which was reported earlier at 1877-87 at the end of a Wolf-Gleissberg cycle. 1997-98 marked the end of the last Wolf-Gleissberg cycle which started in 1913.

TABLE 2
Variation of Lake Levels In Response To Solar Forcing Arising From Wolf-Gleissberg Cycles

	Lake Victoria	Lake .Nyasaland	American Lakes	Lake George
Cycle 2 Duration of Min 1797-1823			Follow Sunspot cycles closely. Lake of the Woods very low in 1823	Chief max 1823
Smoothed Max 1838-1840		1830 very low	Great Lakes: High water mark in 1838 Lake of the Woods: well marked high water in 1838	Dry 1848
Secondary Maximum 1860		1857 –63 very high	high level in 1859 Lake of the Woods 3 feet rise in 1859	
Cycle 3 Duration of Min 1877-1913	Sharp rise 1878 Drought 1902 Follow sunspot cycles closely 1902-1921	1873high, 75-8 falling annual variation about 3 feet, then follow sunspot cycles	1901-1933 Lake Michigan showed sympathy with solar cycles	Chief max 1875 dry 1902 filing in 1919
Max a 1958	Sharp rise 1961		Rise start 1964	
Max b 1980	rise ~1980			
Cycle 4 Duration of Min 1997-2032	Drop in level followed by Sharp rise in 1997-98 expected drought 2009±2-3 yr. Should follow sunspot cycles drought 2021±2-3 & 2033 ±2-3 yr. ?		Drop in Lakes level in 1997-1998	`

6-COMPARATIVE STUDY OF LAKES LEVELS IN RESPONSE TO SOLAR WOLF-GLEISSBERG CYCLES

Dawson (1874) studied the fluctuations of the American lakes and the development of sunspots. and sunspot areas. We note the very important remarks given by Dawson:

1) The first four maxima of sunspot being separated by long intervals of years with few spots, and not being very intense, would appear to have been closely followed by L. Erie. In other words, lake Erie level follow the weak solar cycles in between Wolf Gleissberg cycles around 1800.
2) More specially 1837, the year of greatest known intensity according to both the spot curve (333 new groups of spots according to Schwabe), was marked in its effects on the lake, giving rise in 1838 to the highest recorded level of the waters in Erie and Ontario, and probably also in Superior, though the data are not so certain. The high mark of 1838 has since been employed as the datum to which all the measurements of the Lake survey are reduced.
3) The last periods of maxima of sunspots are extreme, and the lakes seem to have been unable to follow them as before however there is a general high level for the last thirty years, which may be connected with the Wolfian cycle of 56 years in the development of sunspots.

4) The important sunspot maximum of 1859-1860 was evident in its effect on the lakes even at their present high level. With regard to the Lake of the Woods, it was very low in 1823, and in 1859 to have attained a point which it has never touched since, and which is about 3 feet higher than the present level. This lake derives its water from the western slope of the same Laurentian range which feeds Lake Superior.

Table II summarizes the response of several lakes to Wolf-Gleissberg solar cycles. Lake Nyasaland, the third largest lake in Africa, also showed solar cycles sympathy in between Wolf-Gleissberg cycles (Dixey 1924).

The variations in the level of Lake George in Australia are also summarized in Table II (Hoyt and Schatten 1997after Brooks 1923). It is also reported that Lake Zurich,, Lake Hamun-Sumpf in Persia and the Great Salt Lake have major maxima and minima concurrently with Lake George (cited in Hoyt and Schatten 1997 and references therein).

The general remarks that can be deduced from Table II are as follows:

I) A major rise in Lakes level occur at the maximum of the Wolf-Gleissberg cycle indicating climate change. In the case of a secondary maximum of those cycles the lakes level re-rise as in the 1980 case.

II) Another rise in Lakes level (lower than the maximum one) marks the end of the Wolf-Gleissberg cycle and the beginning of 12 year weak solar cycles. This will be followed by a decay in Lakes level and end with a drought period around the minimum of sunspot cycle.

III) The lakes level will then follow the weak 12-yr. sunspot cycles during the drop in between Wolf-Gleissberg .

IV) Such sympathy of lakes level to sunspot cycles disappears by the end of the weak 12-yr. cycle and the beginning of a new Wolf-Gleissberg with 11-yr. sunspot cycles. However at some locations, this sympathy might continue for one more sunspot cycle. Climate change will occur at the border of the new Wolf-Gleissberg affecting various aspects of meteorological parameters worldwide.

Since the sharp rise in Lake Victoria level already happened in 1997-98, as mentioned in item II, then this is a confirmation of the end of the previous Wolf-Gleissberg and the beginning of a period of weak 12 years sunspot cycles with the following expectations of lakes level:

i) The present drop in Equatorial lakes will continue up till the end of the present sunspot cycle (2009) causing several years of severe drought conditions in those areas.

ii) A re-rise in the lakes level will follow afterwards with maximum prosperity conditions perhaps after 4 years from minimum and will remain there for some years.

iii) Another drop in Lakes level will follow causing a second period of droughts about 2021± 2-3 years.

iv) One to three cyclic variations of lakes level will follow causing high outflow and ending by droughts conditions. The expected drought years are 2033± 2-3, 2044 or 45± 2-3.

v) Climate change will occur by the end of weak solar cycles period.

In the case of Lake George in Australia, perhaps the sudden rise in Lake's level marks the end of weak 12-yr solar cycles and the beginning of a new Wolf-Gleissberg cycle (opposite to other lakes) as the chief maximum of the lake was reported at the end of low activity period (1821). Also it was reported that rainfall at Adelaide, Australia had a negative correlation with the 22-yr. cycle up to about 1922 and no apparent relationship afterward, which also points to a period of change in 1920s. . However confirmation will be done once the real data of Lake George are available. Note that Lake Victoria had positive solar correlation over the same period.

7-SUN WEATHER RELATIONS

There are numerous relationships that are found in the field of solar-terrestrial relationships. Currie 1979(cited in Hoyt and Schatten 1997) examined the U.S temperature records in 1,197 locations and found cyclic variations in temperature at nearly every location. . One major finding is that east of the rocky mountains, these cyclic variations are in phase with the solar irradiance, while west of the rockey mountains they are 180º out of phase. Currie argued that large atmospheric standing waves keep some regions in phase and some 180º out of phase with solar variations for many decades. Power spectra showed peaks at 10.4 and 18.8 yr. The first peak arose from solar-irradiance variations and the second possibly arose from lunar tidal effects.

In 1976 Roberts reported the work of Mustel that following large geomagnetic storms by 2-4 days, the surface barometric pressures exhibited an average increase at some large area, while at adjacent locations the pressure drops from 1 to 5 days after geomagnetic disturbance.

7.1Cyclones and Solar Activity

The number of Indian Ocean cyclones shows positive correlation with group sunspot number from 1840. By 1910 the positive correlation with solar activity has become negative (cited in Hoyt and Schatten 1997).

In Addition, the priodicities in Atlantic Ocean tropical cyclones, the length of the season of the tropical cyclones show prominent peaks at 11.3 and 51.3 years matching solar periodicities at 11 and 52.7 years.

Hoyt and Schatten (1997) and references therein in the number of Atlantic tropical cyclones report a 133-yr. peak. A 137-138 yr. periodicity is detected in ocean sediments (Burroughs 1994 and references therein). The strongest periodicity in historical Nile water (622-1467AD) in Ethiopian and Equatorial water is 266 yr. Its harmonics are 133,88.7 and 66.5 yr. On considering the cross-correlation between the Equatorial and Ethiopian water for historical Nile water with a lag of 300 years, a very clear cycle is distinguished with the following remarks (Yousef and El Rae 1995).

a) The two variables are negatively correlated, at zero lag the correlation coefficient is –0.8.

b) It changes from negative to positive correlation gradually over a cycle of 133 years, reaching zero lag at about 80 years delay

c) A fundamental cycle of (266±1) year exists between two successive maxima.

7.2Energetic solar particles and the Weather

It is well established that the density and temperature of the atmosphere above 100 km vary markedly with solar activity during the 27- day solar rotation and eleven year solar cycles (king 1973 and references therein). Solar wind particles entering the atmosphere at invariant latitudes between 75 and 79 may be associated with meteorological pressure changes. In connection to the maximum of Wolf Gleissberg cycle at 1959, Bradely 1973(cited in King 1973) has observed that the pressures over the Canadian Arctic were very different in 1955-63 from those in 1964-72.

7.3Galactic Cosmic rays

Variation of the average ground-level cosmic ray intensity with the 11-yr. sunspot cycle are well documented and show clear inverse correlation. The ionization rate due to cosmic ray energy exhibits an 11 year cycle dependence which is more pronounced at high altitudes than near the surface. At Thule, for example the ratio of ionization rate between 1958(maximum of Wolf- Gleissberg cycle) and 1954(solar cycle minimum) at an atmospheric depth of 200 g/ cm^2 (approximately 12 km altitude) is about 1.4, but at 20 g/ cm^2 (26 km) is about 2.2 (after Herman and Goldberg 1978 and references therein). Galactic cosmic rays invades the Earth during the weak solar cycles in between Wolf-Gleissberg cycles , while solar cosmic rays invades the Earth at its maximum.

8-SOME UBNORMAL PHENOMEA AT THE TURINIG POINTS OF WOLF-GLEISSBERG

The years or periods of reversals and breakdowns in statistical correlation between sunspot number and meteorological or climatological parameters are summarized after Herman and Goldberg 1978).

8.1 Near maximum Of Wolf-Gleissberg Cycles

1: For global surface temperature, the correlation with the 11-yr. sunspot cycle went from negative to positive in the period 1958-1963, and 1974-1975 data indicate that it may have subsequently returned to negative.

2-The altitude of the 500-mbar surface for the period 1951-64 was highly correlated with solar activity while the rainfall at Beirut was highly negatively correlated with solar activity. The rainfall was low during a period of several years centered approximately a year after sunspot maximum. It must be conceded that the data reported by Winstanley , for the period after 1964 do not fit into the solar cycle pattern evident for the period 1951-64(cited in King 1973.) As a matter of fact this particular solar cycle is the maximum of the Wolf- Gleissberg cycle. The rise of Lake Victoria level could be due to a negative correlation of 500mb in the southern hemisphere with the maximum of solar Wolf-Gleissberg cycle and a positive correlation of this cycle with rainfall over Lake Plateau. Further work has to be done in order to check this suggestion.

8.2 In Between Two Wolf-Gleissberg Cycles

1- In central England in July, the surface temperature was in phase with the 22-yr. solar cycle from 1750 to 1830 and 1860 to 1880, and in phase with the 11-yr. solar cycle after 1880.The crucial periods for this parameter are accordingly 1830-1860(maximum of Wolf Gleissberg cycle 2 in Table 1) and the years after 1880 (minimum in between Wolf- Gleissberg cycle 3). Also the air-surface temperature from Edinburgh, Wakefield and Greenwich in Great Britain appears to be out of phase with solar activity from 1880 to1930 but in phase from 1840-1880 and 1830 –1960 (Hoyt an Schatten 1997 and references therein)

2- Tropical temperatures were negatively correlated with the 11-yr. cycle prior to 1920s and then positively correlated to at least 1950. The crucial period is approximately 1920-1925.

3-studies of the winter temperature record for Marengo, Illinois between 1860-1900 show that between 1873 and 1886 there was marked biennial oscillations, but outside this period there was no such regular oscillations.

3- Rainfall at Forrtaleza Brazil, being positively correlated with the 22-yr. cycle from 1865 to 1925 and negative afterward indicates a crucial period in the 1920s decade.

4- Rainfall at Adelaide, Australia had a negative correlation with the 22-yr. cycle up to about 1922 and no apparent relationship afterward, which also points to a period of change in 1920s.

5- Rainfall in the latitudinal band 50º-60° N reversed its correlation with the 11-yr. cycle from strongly negative prior 1913 to strongly positive after that year.

6- In the 40-50N band, there was a period of no apparent correlation between rainfall and the 11-yr. cycle from 1905 to 1918 and then a series of reversals spanning the period 1928-1935.

7- A strong positive correlation between Etesian wind occurrence in Greece and the 11 -yr. cycle has been in evidence for the span 1893-1961, except for a brief failure near the sunspot minimum near 1922.

Nearly every meteorological variable either changed its correlation sign or ceased to exist during the period 1910 to 1930(Hoyt and Schatten(1997).

9- Recommendations For Equatorial Lake countries and Sudan.

It is advisable to make the best of the present rainy years and to save food for the coming prolonged drought years. The problem of electricity has to be solved during drought.

It is advisable to finish the Jungli canal immediately while the equatorial Lake levels are high. All obstacles have to be overcomed soon. This is urgent for Sudan and Egypt to increase the discharge of the White Nile as drought conditions are expected in the near future in Ethiopia. It is anticipated that an increase of 4.7 billion cubic meters of water will come from the Equatorial plateau. A 19% loss in water due to evaporation and other factors will make the discharge gain due to Jungli canal about 3.8 Milliard cubic meters to be divided equally between Sudan and Egypt (Said 1993). In fact this figure is highly underestimated because of the present high level of the Equatorial lakes which are in its maximum. However successive cut down in rain over the plateau over a period of about seven years will gradually bring the estimated figure down considerably during the expected Equatorial drought and perhaps make the canal then useless. However another expected period of Lake plateau re-rise will again increase its water budget In the case of Sudan, It is recommended that Sudan should exploit the expected the Nile flood 2000 and make use of both the Waters of Blue and white Nile this year. Increased cultivation on the banks of the White Nile during drought periods of the Blue Nile should save Sudan from famine.

The Sahelian Sudan may also expect dry years in few years. Food for sheep can be cultivated on the White Nile water.

The vision for Nile Basin countries should be peaceful as great efforts and thought has to be given to solve economic crises. Particular efforts has to be done in the southern parts of Sudan for great efforts has to be carried out in this region to save Sudan from food crisis at the time of low Blue Nile. On the other hand, the southern part of Sudan needs help from the north around 2008-9 drought.

358, Cairo January 5-10 1996.

CONCLUSIONS

Summary of 87 years of the variations of the Lake Victoria level in the prospective of solar activity can be deduced from fig 6. Note the general low lake level prior 1961 which was an upward jump in lake's level followed by slow general decay till end of 1997. In addition note: the cyclic behavior of the lake's level in response to a weak solar cycle at the beginning of the records, the failure of response of lake level to sunspot cycles after 1922 (i.e. climate change at 1922),the sharp rise of Lake's level in the early sixties in response to the decay(i.e. negative response) of the strongest sunspot cycle marking the maximum of the Wolf- Gleissberg cycle, the rise in the eighties in response to the second maximum of the Wolf Gleissberg Cycle, the following rises and falls of lake's level in response to positive solar forcing for two more sunspot cycles, negative response of the lake's level at the end of each of the solar cycles since 1961 particularly as a precursor (about 0.5 meter variation) few years before the 1997–1998 sudden rise in Lake level marking the end of the last Wolf-Gleissberg cycle and the beginning of a weak solar activity period of cycles of 12 years duration.

The coming period is expected to resemble the variation of Lake level around 1800. However it may be that the next solar cycle will raise the level of lake Victoria to about 12 meters and the annual outflow to about 30000 MCM (milliard cubic meters). The annual outflow of Lake Kyoga is expected to be around 40000 MCM and that of Lake Albert around 19000 MCM.

The sudden rise and fall of the Equatorial lakes indicates turning points in Wolf- Gleissberg solar cycles. If the rise occurs at the tail of those cycles, then it will be followed by a gradual drop of lakes level ending by a drought period. Re-rise and drop of cyclic nature will follow in sympathy of sunspot weak solar cycles. This allows long range forecast of excessive rain and drought periods in Equatorial Lakes region.

The sharp rise of about 1.6 m in Lake Victoria level in 1997- 1998 is a confirmation of the end of previous Wolf –Gleissberg in 1997 and the sun entering a weak mode of activity of solar cycles of 12 years duration which may last between 3-4 solar cycles.

Terrestrial responses of such period is and will be manifested as a hazard period of Hurricanes, droughts, floods and strong El Ninos and La Ninas years with the existence of Pacific decadal oscillations.

Equatorial droughts are forecasted for the years 2009±2-3 years, 2021±2-3, 2033±2-3 and perhaps 2044±2-3. The drop of Lake Victoria is expected to reach about 10.3 meters and the Lake’s outflow 14000 MCM , and that of Albert and Kyoga around 5000-7000 MCM and 13000 MCM respectively. The discharge at Malakal at the time of the drought is expected to be around 22 milliard cubic meters.

The sharp rise in the level of Lake Victoria in the early sixties was coincident with the decay of the strongest solar cycle of all sunspot cycles since the start of observations (i.e. with the descending from the maximum of the Wolf- Gleissberg cycle). This sharp rise was contemporary with similar rises in several African lakes. Lake Tanganyika level rose by 4 meters in 1964 over its level in 1960. Lake Rudolf level rose by 4 m. Lake Malawi’ s level was six-m higher in 1963 over its 1915 level. On the other hand, the Dead sea level dropped by few meters from 1957-63 (Mosa and references therein 1996). Countries concerned around those lakes are also warned of similar drought periods as those expected for lake Victoria.

In other words, the 1960s sudden variation of lakes levels either positive or negative indicated climate change due to solar forcing.

It should also be noted that 1877-78 was a year of climate change since reports of sharp rise of Lake Victoria level is available. This rise was a response to the end of a Wolf-Gleissberg cycle and is similar to the 1997-98 sharp rise in lake Victoria level. It was an indication of entering a period of solar forcing on Lake Victoria level up till 1922, a period of severe natural hazards every where.

The coming period will be similar to the 1877-1922 . Natural hazard alert is made to all governments.

Finally, we support the recent efforts of studying the sensitivity of the climate to variation of the solar output from the viewpoint of the radiative transfer and its parameterization in the general circulation pattern.

In a following paper, God’s permit, studies of the world lakes will be considered collectively.

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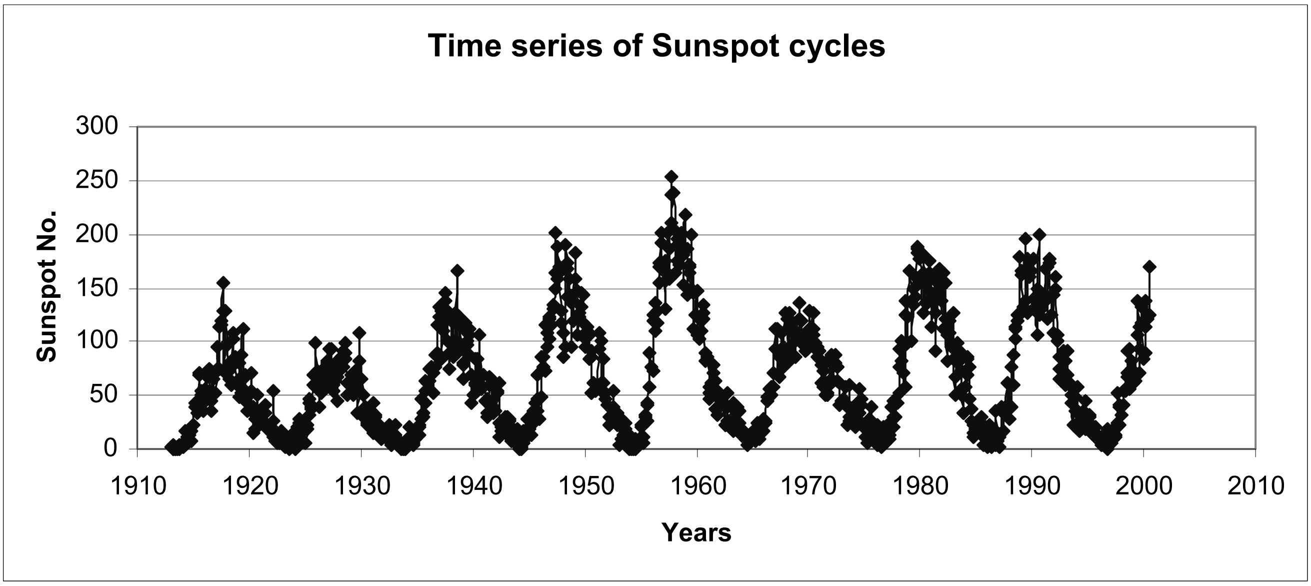
I am also indebted for Engineer Ahmed Fahmy and computer staff at Ministry of Irrigation and Water Resources for providing the data used in this research. May also this work be of benefit to my beloved country Egypt and other Nile Basin countries.

I am also calling upon the Ethiopian authorities to provide me with Lake Tana’s levels since the start of records, this will allow me, the first author, to make long range forecast for the lake’s level and Blue Nile discharge. The return will be for the benefit of Ethiopia , Sudan and Egypt.



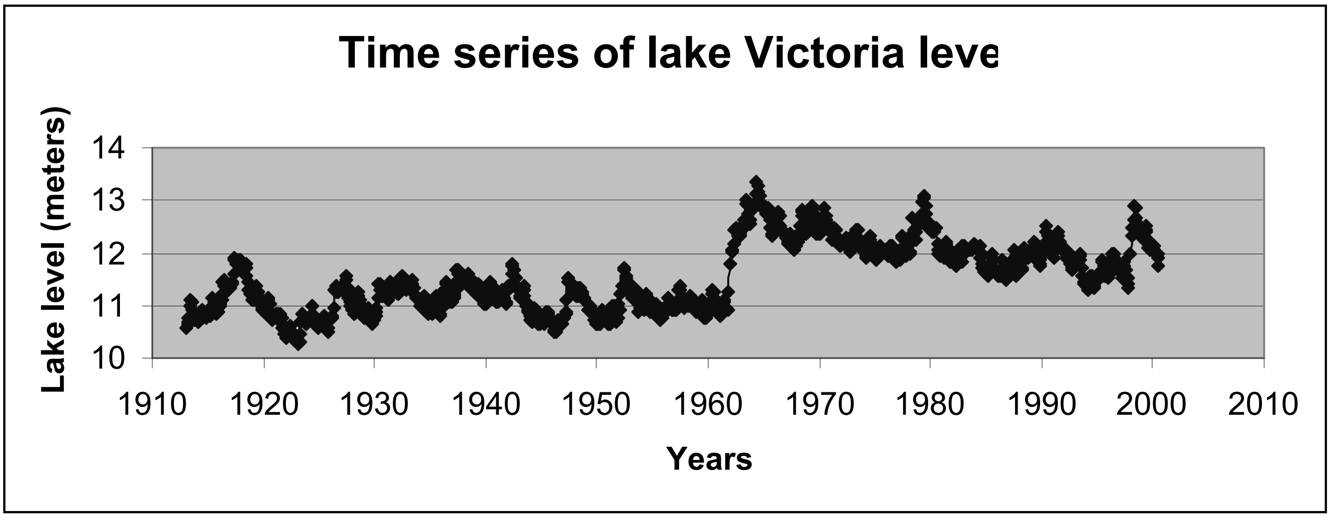


Fig 6: Investigation of the variation of Lakes Victoria level (lower diagram) in the light of solar activity (upper diagram).

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