The Lunar Wake as cause of the Allais Effect

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Recently I have found a very strong correlation between unsolicited motions of a special torsion balance and instabilities of the geomagnetic field. I argue that these geomagnetic variations, if steep enough, might induce eddy currents into the metallic mass of the balance. Such currents would in turn generate magnetic fields which could urge the balance to rotate. Geomagnetic instabilities arise when the solar wind is unstable as an effect of solar activity. I have noticed that such instabilities occur, for an observer at Earth, even when the sun is calm and the solar wind is stable, but the observing point is swept by the effects of the "lunar wake", i.e. the vacuum of solar wind which extends from the moon in the anti-sunward direction. This happens around solar eclipses. I think that the lunar wake could be accounted for the so called "Allais Effect" (abnormal behavior of Foucault pendulums and other devices around solar eclipses) by the above mentioned mechanism. Actually I have found the magnetic signature of the lunar wake in geosynchronous satellite data around the occurrence of solar eclipses during which it was claimed a detection of the Allais Effect. In this article I present both satellite and test devices data for some eclipses. I think that the elusive and somewhat mysterious Allais effect falls into the realm of commonly accepted physics. The geomagnetic activity depends on the interaction of the solar wind with the magnetosphere. The effects of the lunar wake in the near-Earth environment has not been well studied yet, and I suggest that the “all American” August 2017 solar eclipse would be a good opportunity for further investigation.

1- Introduction

By “Allais Effect” it is meant an abnormal precession of the swinging plane of a Foucault-style pendulum. It was first observed by the French Nobel laureate (in economics) Maurice Allais during the solar eclipse of June 30th 1954 [1].
Later, some abnormal behavior was noticed by other workers on other instruments such as, just to mention, gravimeter by Wang et al. [2], torsion pendulum by Saxl & Allen [3], stationary pendulums by Iovane [4], and more swinging pendulums [5][6].
The unexplained effect captured the interest of NASA, which in 1999 promoted a worldwide eclipse experiment [7] whose results have never been published.
I had been participating in that experiment getting a positive result [4], and since then I have spent several thousand hours making equipment and experiments.
The mysterious effect was initially supposed to be of gravitational nature.
Among other workers, very interesting results were achieved by Prof. Alexander Pugach of the National Academy of Sciences of Ukraine, with the use of a special torsion balance of his own design. This very delicate and sensitive balance is described in [8][16] and some results have been published in [9][10]. In short, the balance consisted of a thin aluminum disc of about 12 cm in diameter, weight 0.1g, suspended in the center by a single filament

of natural silk, closed in a sealed container but not empty of air, electrostatically but not magnetically shielded, with an automatic monitoring system of the azimuth of a reference on the disc. The system was in an isolated environment, away from people and electrical noise in an closed unattended ambient, etc ... Pugach called this special balance “torsind”.
A great merit of Pugach is to have made measurements over a long period of time, covering different phases of the current solar cycle from minima to maxima. I am in contact with Pugach since several years, and had the opportunity to look at his data. We also had a personal meeting.
Pugach has published several articles in which he claims to have observed anomalous behavior of his instrument in conjunction with solar eclipses (such as [9][10]). His articles are credible, as around solar eclipses actually a strange behavior is observed in a family of devices that have the common feature of having a freedom of movement around a pivot point (pendulums, spring-mass gravimeters, torsion balances) as above mentioned.
Anyway there was a main issue with all of the above mentioned “positive” results: most of the times the observed anomalies were shifted in time relative to the optical eclipse, sometimes by hours such as in [11].
No solid explanation of all of the above mentioned phenomena was available as of late 2013.
It is ending 2013 that I had the idea that the vacuum of solar wind which occurs on the anti-sunward side of the moon, i.e. the well known lunar wake, could be responsible for the observed effects, causing the induction of eddy currents into the test device at Earth by the below explained mechanism.

2- The Torsind reaction

Around eclipses of the sun, the Pugach’s disc rotated some little. This during periods of calm sun in late last decade. With the passage of time (which "a posteriori" means practically with the approach of maxima in this solar cycle) the disc rotated sometimes in the absence of eclipses. The more time passed, the more this happened . From Pugach's data and official sunspot number data, I saw that there was a gross correlation over the long period between the two things. But in the short term there was no correlation. Pugach reported this[16]. Nothing clear at that time, only a rough correlation and no idea of the mechanism.
At one point I had the intuition that, as an effect of fast variable geomagnetic field, some eddy currents could arise in the disk, with associated magnetic fields and associated effects (such as the disk of old style watt-hour power meters). Hence I begun to study the correlation between solar wind and magnetosphere.

3- The Mechanism

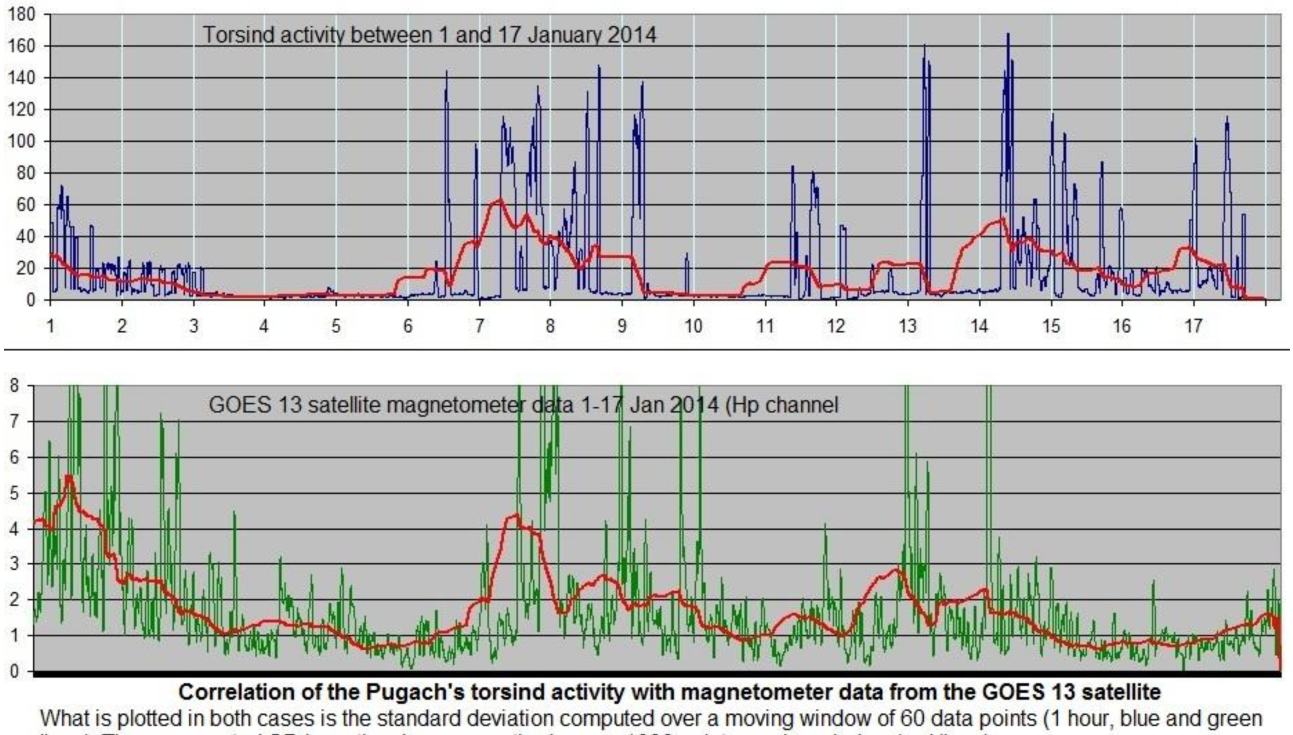
It is common knowledge that the solar wind is always present, and is responsible for the shape of the magnetosphere . Under conditions of quiet sun the solar wind is uniform and the magnetosphere is quiet, without disruption of the equilibrium of electrical currents and of lines of force of the Earth's magnetic field which pervades it. When there is solar activity, the solar wind can be disturbed, with accelerated and diverted gusts and more. This occurs in coarse correlation with the sunspot number, but not always the solar wind disturbances do hit the Earth. The sun emits the wind all around, and only if a disturbance is emitted in a favorable direction it would reach Earth. The solar wind is blocked by the magnetosphere, as it is well known, and a non-uniform wind is likely to cause geomagnetic storms and other minor geomagnetic disturbances. A non-uniform solar wind disturbs the tranquility of the magnetosphere. An unsettled geomagnetic field has easily measurable

effects on Earth-based and satellite-based magnetometers. Geomagnetic storms are capable of producing effects from delicate (aurorae boreales, deviation of compass needles) to dramatic (such as the Carrington event [12]). They induce currents into the ground, into pipelines and power lines, and most likely into the masses used for Allais Effect tests.
As I have found magnetic signatures of the lunar wake in satellite data around the occurrence of solar eclipses, I suggest that the lunar wake is responsible for geomagnetic effects similar to those caused by geomagnetic storms, even if to a lower and somewhat local extent.

4- The correlation

I needed to find data on geomagnetic activity to be correlated to the Pugach's data, and I found them in NOAA archives with respect to geostationary satellites carrying magnetometers on board.
The correlation was striking. In January 2014, the rotations of the disk due to geomagnetic activity were orders of magnitude greater than the rotations observed during solar eclipses in periods of calm sun. In such conditions as in January a solar eclipse would not be "seen" by a torsind, being much under, say, the noise level.

In January 2014, a non-eclipse epoch, the situation was as in Fig. 1. By torsind activity we mean rotations of the torsind about its vertical axis. Note that the observing point (Kiev) and the GOES13 satellite are at different longitudes. It is worth mentioning that with calm sun, and no eclipse, both curves are flat or near flat.



Correlation of the Pugach's torsind activity with magnetometer data from the GOES 13 satellite
What is plotted in both cases is the standard deviation computed over a moving window of 60 data points (1 hour, blue and green lines). These computed SD have then been smoothed over a 1000 points moving window (red lines).

Fig. 1 – Torsind data credit Pugach, satellite data credit NOAA

5- Eclipse data

What is likely to happen around solar eclipses? After having seen what happens to a torsind when the sun is active, let’s consider the condition of calm sun and uniform solar

wind. The lunar wake, i.e. the “eclipsed” solar wind, causes a localized imbalance in the magnetosphere and hence a local geomagnetic instability, inducing currents into conductive materials such as genuine geomagnetic storms do.
It is worth mentioning that most of the times the lunar wake is not coaxial with the optical shadow of the moon, for at least these reasons: a) the solar wind comes angled to Earth, as it follows the “Parker spiral” [14]; b) the wake is turbulent as it is gradually refilled by surrounding particles of the solar wind (this is common knowledge). In my view some experimental results seem to suggest that the lunar wake might exhibit a Kelvin-Helmholtz instability [15] causing periodicities in the observed anomalies [4]. That said, the apparent direction of origin of the lunar wake is not easily predictable, and it could reach the magnetosphere above an observing point before, during or after an optical shadow. This is what most of the experimental results do show. Looking at the presented data, please consider that the satellites are at longitude W75 and W135, while the observing sites at Earth are at different longitudes. As an example Kiev is at E30. This means that a given disturbance might be detected at different times from different instruments, but also that some instruments could not detect it at all, depending on where they are located relative to the lunar wake trace at Earth. It is worth recalling that the shape of the lunar wake might be not well defined and is turbulent. Further, generic geomagnetic disturbances are known to have possible reverberations and persistence, and this could also be the case of lunar wake induced disturbances.
I would emphasize that I found traces of the lunar wake in satellite data in correspondence of eclipses in periods of calm sun in which Pugach and others had detected rotations of the torsind or abnormal behavior of pendulums, and in correspondence of anomalies that I had detected with a stationary pendulum during an eclipse. Let’s examine some cases.
(Note that a calm magnetometer trace aboard a geosynchronous satellite is a clean slowly-varying quasi-sinusoidal curve with a diurnal periodicity, such as in the first days of Fig. 2).

1) Solar eclipse in Shanghai on July 22 2009. Li, Olenici et al. had observed abnormal behavior of a ball-born swinging pendulum [5]. The GOES11 and GOES12 satellite magnetometers say that the geomagnetic field was disturbed in the morning of July 22, see Fig. 2. Note some persisting noise in the days after.

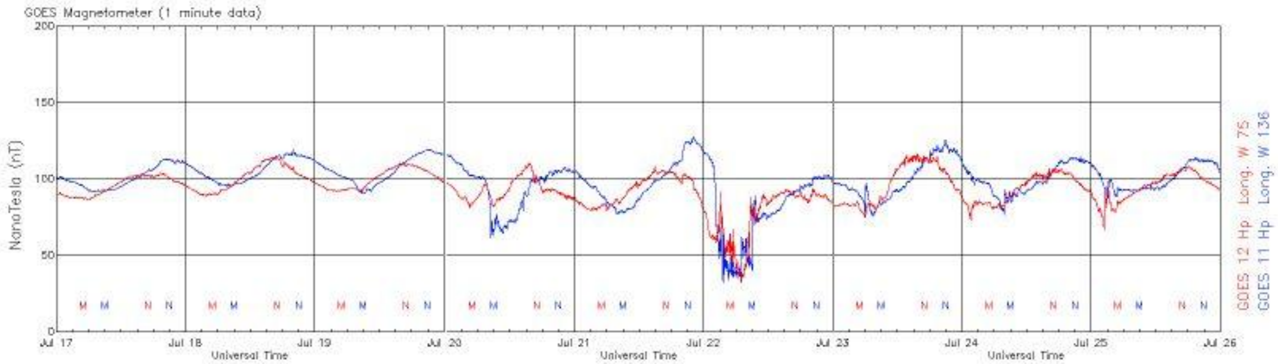


Fig.2 – Magnetometer data from NOAA satellites showing geomagnetic unrest in the morning of July 22 2009, the day of a solar eclipse.

On July-August 2009 the sun was spotless (sunspot number = 0) since July 12 and up to August 30. The July 22 solar eclipse occurred in a period of very quiet sun. Nevertheless the satellite magnetometer data for the period 17-25 July say that in the morning of July 22, the solar eclipse day, there was a remarkable magnetic disturbance. I interpret this disturbance as an effect of the lunar wake on the magnetosphere.

2) Solar eclipse over Australia and Pacific Ocean in the night (UT) of November 13-14 2012. Olenici et al. observed anomalies both with torsinds and pendulums [13]. The satellite graph of Fig. 3 (credit NOAA), shows that the geomagnetic field was disturbed in that night and early morning.

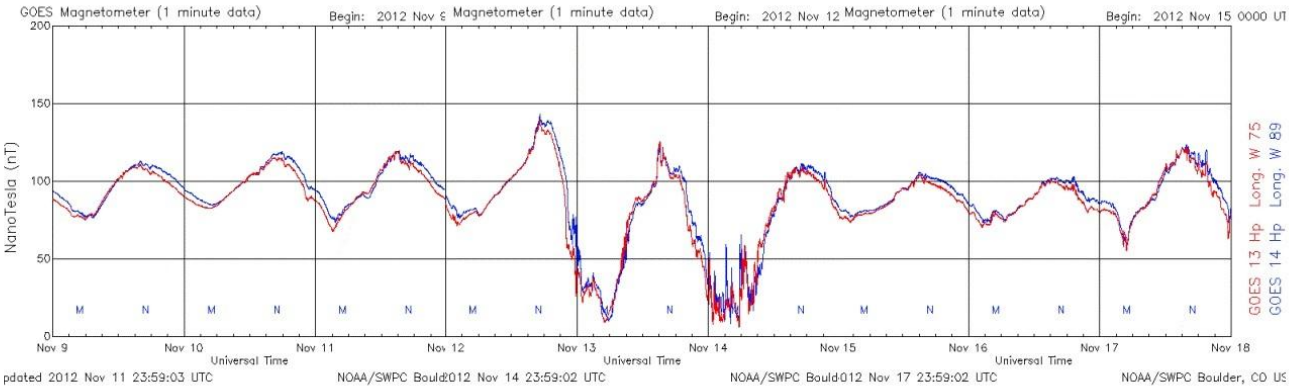


Fig. 3 – Geomagnetic disturbances in the night between November 13 and 14 2012.

3) Solar eclipse of November 3 2013 over Atlantic Ocean and Africa. Pugach detected abnormal behavior of three torsinds. The satellite data show a disturbed geomagnetic field in the morning of November 3, see Fig. 4.

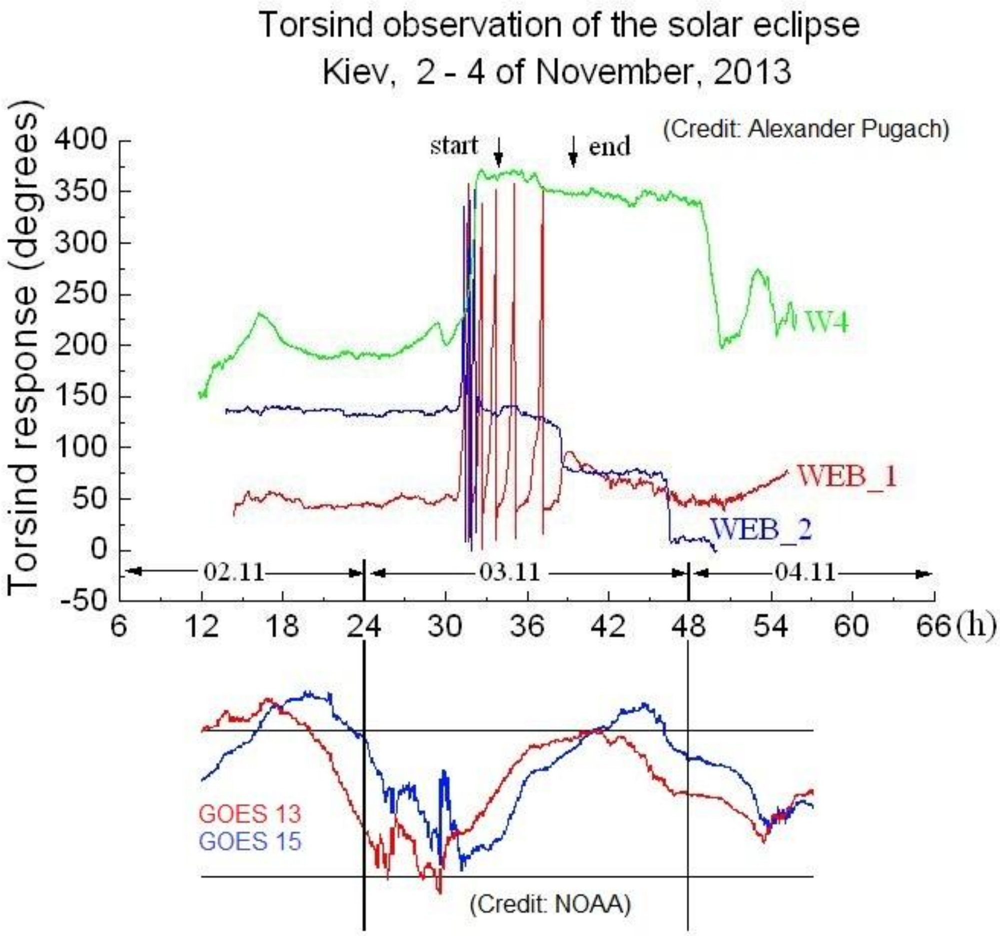


Fig.4 – Pugach's torsind activity and satellite data of November 3 2013. I interpret the geomagnetic disturbance as a trace of the lunar wake.

4) Solar eclipse of January 26 2009. Pugach and Olenici observed correlated abnormal behavior of torsind and paraconical pendulum. Fig. 5 is the satellite magnetometric trace showing steep variations in the morning of January 26. I interpret them as being caused by the lunar wake.

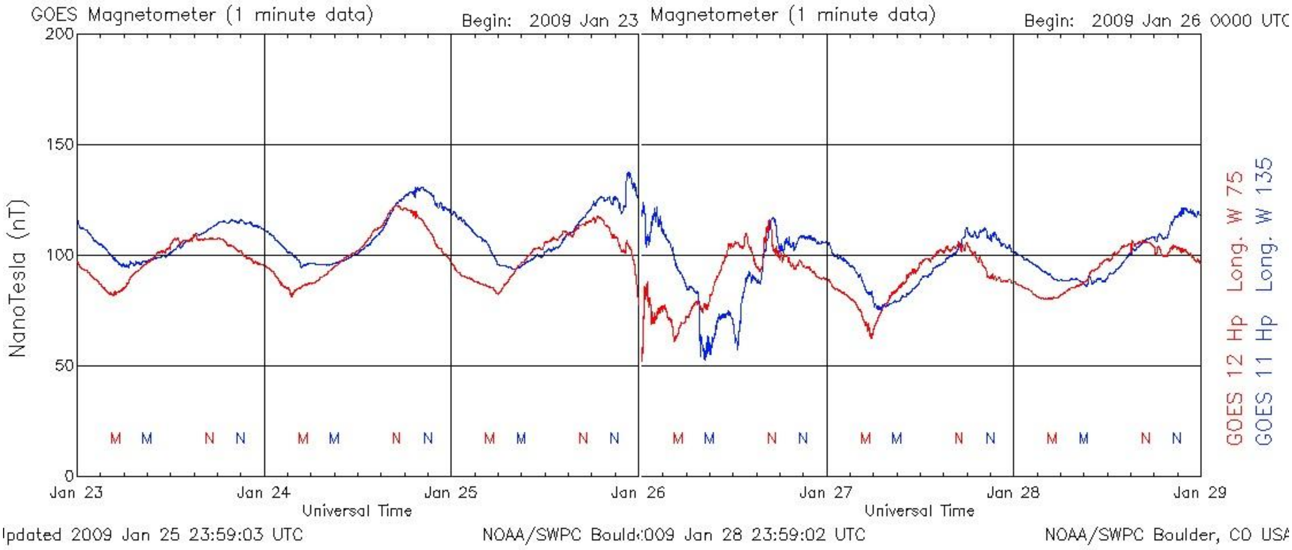


Fig.5 – Geomagnetic disturbances of January 26 2009. No doubt that the abnormal behavior of the instruments was correlated to these disturbances.

5) LUNAR eclipse of October 8 2014 (moon at opposition). Recently Pugach installed a new torsind at a different location. He recorder the trace of Fig. 6 which shows torsind activity in the mornings of October 7, 8 and 9 2014. This interesting new test, made at a new location with a new device, confirms that the torsind responds to instability of the geomagnetic field. The bottom of Fig. 6 shows the satellite data for the same period. In this case the torsind detected ordinary geomagnetic disturbances, stronger in a non-eclipse day, and not the lunar wake which was on the other side. The eclipse was a coincidence.

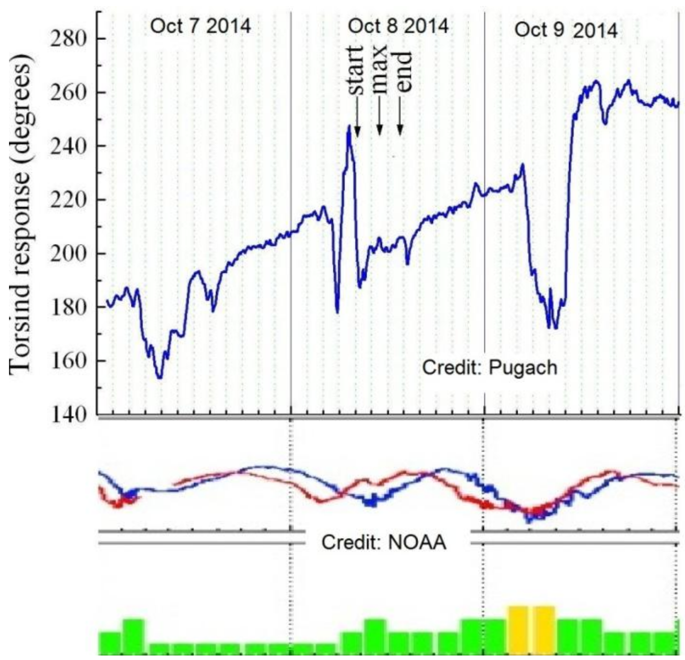


Fig. 6 – Top: Torsind data for October 7-8-9 2014. Bottom: Satellite magnetometer data and averaged estimate of the planetary magnetic Kp index. On October 8 there was a lunar eclipse, marked in the figure by start-max-end.

6) Solar eclipse of May 31 2003 early morning. Iovane [4] recorded abnormal tilts of a stationary pendulum. Unluckily he recorded only 8 hours centered on the eclipse, while the geomagnetic field was strongly disturbed since a couple of days, and the effect of the lunar wake is not clearly visible due to the general geomagnetic conditions.

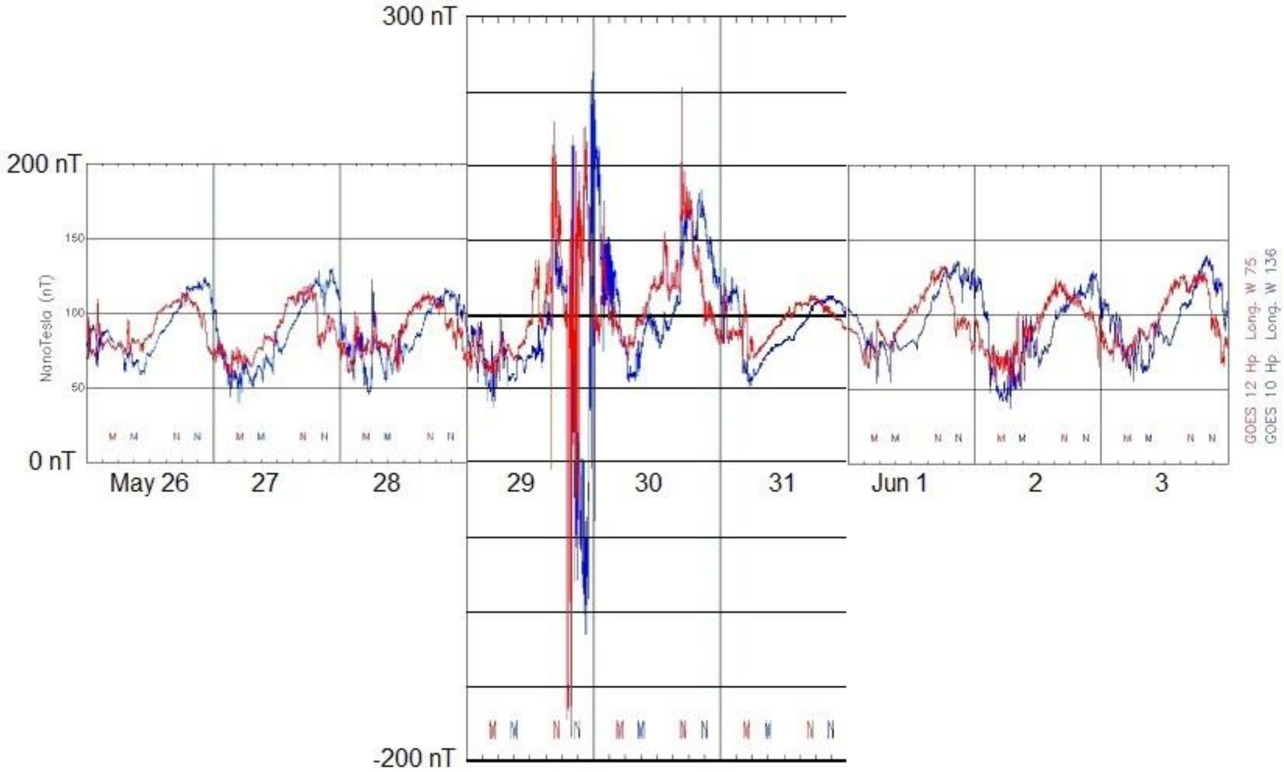


Fig. 7 – Heavily disturbed geomagnetic field in the days around the 31 May 2003 solar eclipse makes the lunar wake not distinguishable.

7) It is interesting to have a look at the solar eclipse of August 1 2008. Goodey et al. claimed to have observed correlated anomalies on their instruments [6], but there is no strong evidence of the lunar wake in satellite data, see Fig. 8. In this case the satellites I'm using as a reference might have not seen all the effects of the lunar wake, because their longitudes were too far from the longitudes of the eclipse path. Anyway the August 1 curve is not completely free of disturbances, and as an example the blue curve, instead of being quasi-sinusoidal, shows a "V" shaped dip.

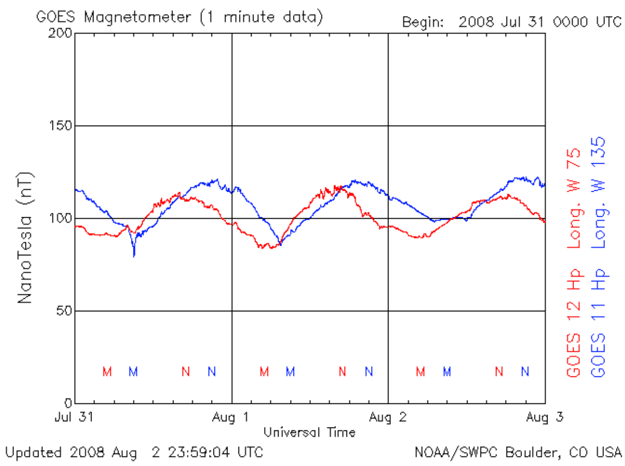


Fig. 8 – Rather calm geomagnetic conditions as seen by satellites away from the eclipse path.

6- Conclusion

The lunar wake as a cause of disturbances at the magnetosphere level left its signature in magnetometer data around the occurrence of solar eclipses, which is a circumstance in which such a wake is Earth-directed. It appears that the lunar wake is the cause of something like geomagnetic storms, even if with limited amplitude and extension. Such lunar-wake-induced “storms” might have effects similar to known effects of genuine geomagnetic storms, such as the induction of eddy currents into conductive masses. These currents would in turn generate magnetic fields which, interacting with the Earth’s magnetic field, might cause these masses to move, typically to rotate if pivotally mounted, provided that such masses have sufficiently low or virtually null friction.
The Allais Effect has been elusive since its discovery. Sometimes it was detected, sometimes it was not. Its correlation with the optical solar eclipse has been loose most of the times, and no predictions on its detection have ever been successful based on the optical eclipse geometry. I suggest that the abnormal behavior of the Allais Effect test devices is due to eddy currents induced into the test masses by the geomagnetic disturbances caused by the lunar wake hitting the magnetosphere. The effects might be cumulative on swinging pendulums, causing abnormal precession of the swinging plane of Foucault-style pendulums. On pendulums of which the period is monitored, such as torsion pendulums or even ordinary pendulums, the period might vary following a variation of the magnetic braking effect of the local magnetic field. Spring-mass gravimeters with a feedback circuit, such as the often used LaCoste Romberg model D, might have currents induced somewhere into the circuit, falsifying the feedback signal. The fact that these gravimeters have a negligible susceptibility to static magnetic fields doesn’t mean that they would not be adversely affected by quickly varying magnetic fields.

7- Acknowledgements

I wish to thank Prof. Alexander Pugach for his permission on using his data and for all the cooperative work.

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