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Comparison of The Very Low Frequency Signal Amplitude in The ISIO and The French Station for The Same Solar Events

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Abstract:

There are heterogeneity and increase in the percentage of ionization with solar explosions, where the so-called sudden ion disturbance (SID), Which can be measured by the so-called very low frequencies (VLF), where used in this study to calculate the extent change of the signals amplitude between the receiver built in our station (ISIO) and the transmitters from different regions of the world comparing that with another receiver 4000 kilometers north, when location at southern France (A11٣), which receives the signals from the same transmitters, which we received the same signals and the timing of each solar event. Five events received by our station from the period (2017-6-3) to the period (2017-9-10).

These events are compared with a set of events that recorded at different periods .The results showed that the signals amplitude in all events is much higher than the signal amplitude received from the French station. This variation in amplitude is due to the heterogeneity of the receiving location at our station, which also means that the ionosphere at the top of this region, which is considered to be part of the subtropical regions, is different from those near the polar gap.

Keywords: Ionosphere, Very low frequency,X-RAY,GOES satellite, Solar flares.

1.Introduction:

Many studies have been monitored the ionosphere disturbances in different parts of the world [1]. Measured near-track measurements near Cambridge (UK) on a 18.3 KHz signal from the French transmitter while the long-distance measurements took place near Dunedin, New Zealand, on the NLK signal in Seattle, VLF is increased in amplitude to about 8 dB . Dr. Grover and others in 2005 [2]. Synchronous analysis of X-ray radiation from solar flares and the amplitude of VLF signals, and was performed on GQD / 22.1 kHz waves. They found that the occurrence of solar flares from class C to class X affected the VLF amplitude in different ways and could be classified according to the type of effect produced by the wave-ionosphere on the propagation of VLF waves. And for S. T. Moore and others 2010 [3]. The ionosphere in general is not calm, but is always fickle. The quite sun and cosmic rays are the normal sources of ionization. Ionization in the ionosphere is dominated by the sun during the day and cosmic rays during the night. As a result, there is a day and night variation in ionization. Day-time fluctuations activity on the sun or other cosmic sources can cause sudden changes in the ionosphere. Like energy from solar eclipses or other disturbances (such as Gama rays) when you reach the Earth's upper atmosphere, ionization in the ionosphere increases suddenly increase ion density and the location of electron layers change [4]. Very low frequency refers to the class of radio waves ranging from 3KHZ to 30 KHZ in frequency with wavelengths ranging from 10 to 100 km. Very low frequency (VLF) applications include underwater communications, radio navigation services, and secure military communications. In these frequency ranges, radio waves can radio waves can propagate within the Earth-wave-ionosphere guide (EIWG) and performs 40 meters in saline water.

The significance of the large wavelength propagates over large distances. Radio waves can be used as a sensor for disturbance in the lower ionosphere, region D. In about 60 km VLF radio waves are reflected by the earth and the ionosphere, allowing it to travel around the world like waves in the waveguide of a parallel plate. Very low frequency radio waves are called the EIWG, which is defined It is an area extending from the Earth's surface to the top of the E and D in the ionosphere [5]. One of the scientific motivations that prompted us to carry out this study is the heterogeneity of the ionosphere according to the Solar activity, altitude and the geographic latitude on the Earth’s surface [6]. The thickness of the ionosphere is reduced as we approach the North and South Poles, while from measurements made for many years that the atmosphere generally be thicker at the equator. This means that external influences, such as solar X-rays, may be influenced by location [7].

Figure 1. VLF transmitters site(red dots) for ISIO station in Iraq(Green dot).

2.Data Analysis

A. The event (1) observed at ISIO station, which was the magnitude of the VLF amplitude change by 2.3 dB according to the signal sent by the DHO station, which resulted from solar flares in the active area 2661 and X-RAY by C2.1, (GOES) and here it was noted that this signal was received by the French station (3dB) as shown in Table (1) and Fig. (1)

B. The event (2) observed at our ISIO station, which was the magnitude of the change in VLF signal amplitude by 2 dB according to the signal sent by station DHO, which resulted from solar flares in the active area 2671 and by X-RAY by $C_{2.9}$ by satellite data GOES Here, it was noted for the same event and the same source that the signal received by the DHO transmitter was received by the French station, which was the amount of the change in the received signal (0.1dB) as shown in Fig. (2) and table (1) .
C. Event (3) observed at our ISIO station, which was the magnitude of the change in VLF signal amplitude by (6dB) according to the signal transmitted by the TBB station, which resulted from the solar flares in the active area 2673 and with an X-RAY power of $M_{2.4}$ according to GOES satellite data It was noted that this signal was received by the French station in VLF signal amplitude by (1.7dB), while we noted for the same event and the same source that the signal received by the sender TBB was received by the French station, which was the amount of change in the signal received in our station (0.1dB) and in ISIO station (3dB) As shown in Fig. (3) and Table(1) .

D. The event (5) observed at our ISIO station, which was the magnitude of the VLF amplitude change by (2.8dB) according to the signal sent by the TBB station, which resulted from solar flares in the active area 2673 and by X-RAY by $X_{1.3}$ by satellite data GOES and here it was noted that this signal was received at the French station (1.4dB) As shown in Fig.(4) and Table (1).
This clarification applies to the rest of the sporadic events

3.Results

Table 1. represents the solar events obtained with details.

Event number	Date of Event	Active area	X-ray class	Send a signal station VLF	ISIO station	Amplitude change in ISIO station	French station	Amplitude change in French .	The difference
1	3/6/2017	2661	C2.1	DHO38	YES	2.3 dB	YES	dB٣	.7 dB٠
2	20/8/2017	2671	C2.9	DHO	YES	2 dB	YES	0.1dB	1.9dB
3	7/9/2017	2673	M2.4	TBB	YES	6dB	YES	1.7dB	4.3dB
4	7/9/2017	2673	C8.2	TBB	YES	3dB	YES	0.1dB	2.9dB
5	7/9/2017	2673	X1.3	TBB	YES	2.8dB	YES	1.4dB	1.4dB
6	8/9/2017	2673	M8.1	DHO	YES	9dB	YES	2dB	7dB
7	8/9/2017	2673	C1.3	DHO	YES	4dB	YES	0.1dB	3.9dB
8	8/9/2017	2673	C8.3	GQD	YES	3dB	YES	0.2dB	2.8dB
9	9/9/2017	2673	M1.1	TBB	YES	8dB	YES	3dB	5dB
10	10/9/2017	2673	C2.9	DHO	YES	7dB	YES	2.6dB	4.4dB

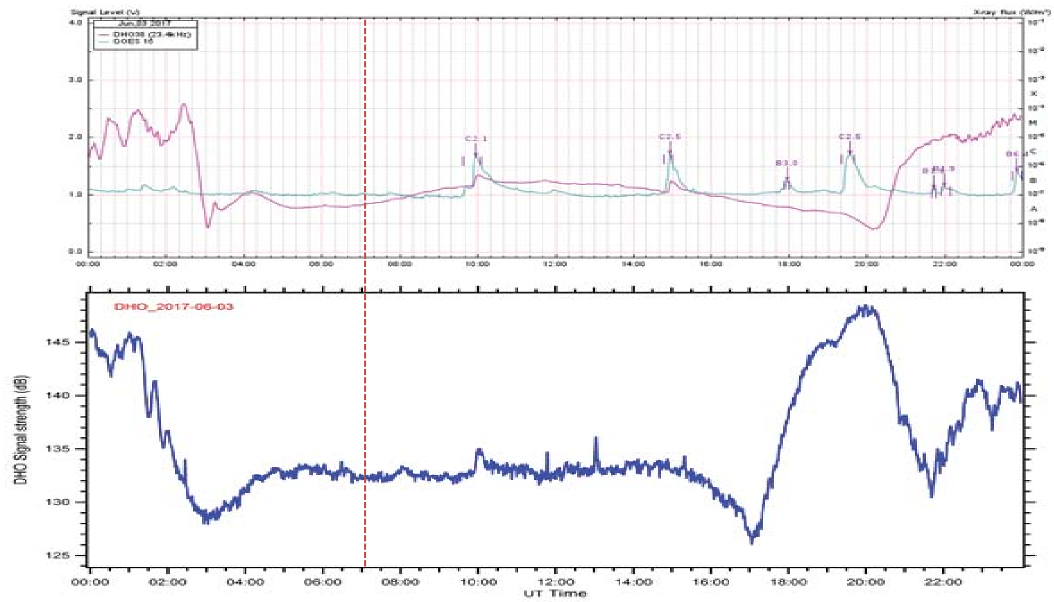

Figure 2. Solar events on 3/6/2017, where the top (green line) represents the X-ray amplitude of the satellite GOES and the (pink line) represents the change of signal amplitude received at the A113 station DHO and the bottom part (blow line) represents a change The amplitude of the signal received at our station from the DHO transmitter.

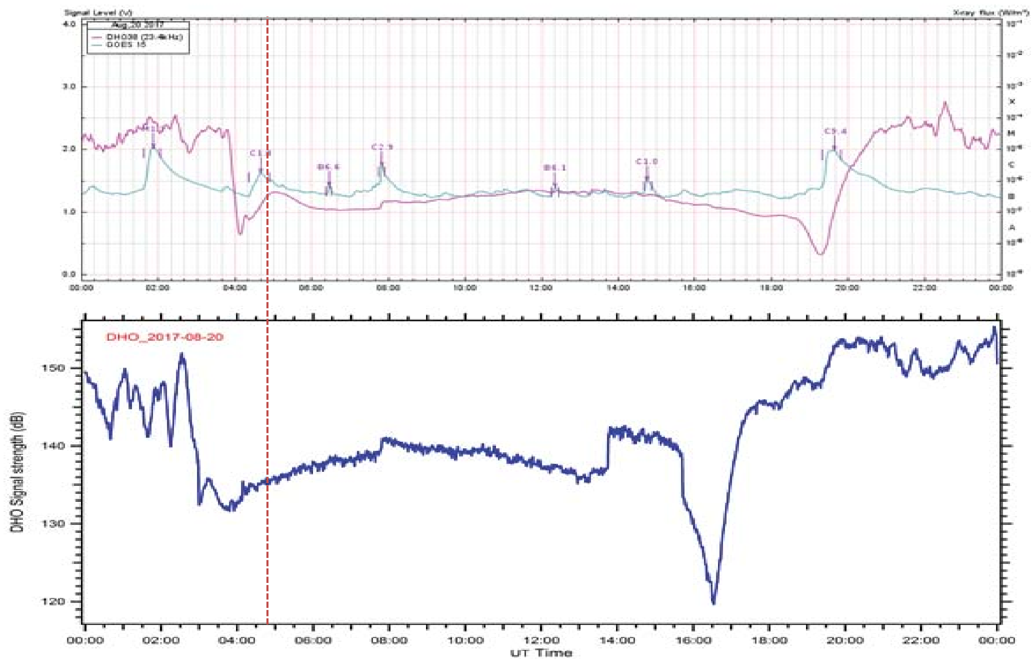

Figure 3. Solar events on 20/8/2017, where the top (blue line) represents the X-ray amplitude of the satellite GOES and the pink line represents the change of signal amplitude received at the French station DHO and the bottom part (blue line) represents a change The amplitude of the signal received at our station from the DHO sent.

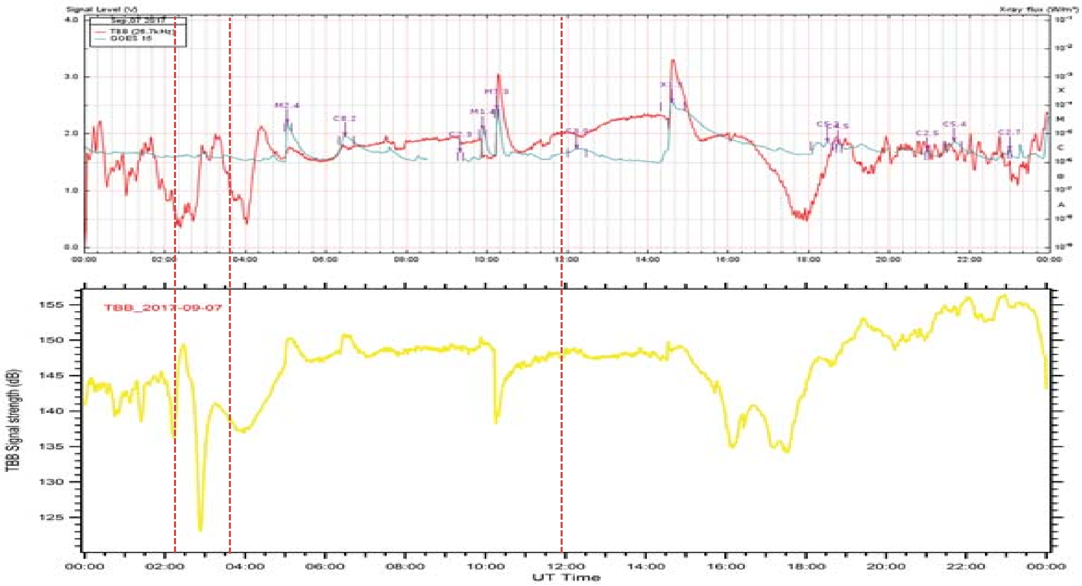

Figure 4. Solar events on 7/9/2017, where the top (blue line) represents the X-ray amplitude of the satellite GOES and the red line represents the change of signal amplitude received at the French station TBB and the bottom part (yellow line) represents a change The amplitude of the signal received at our station from the TBB sent.

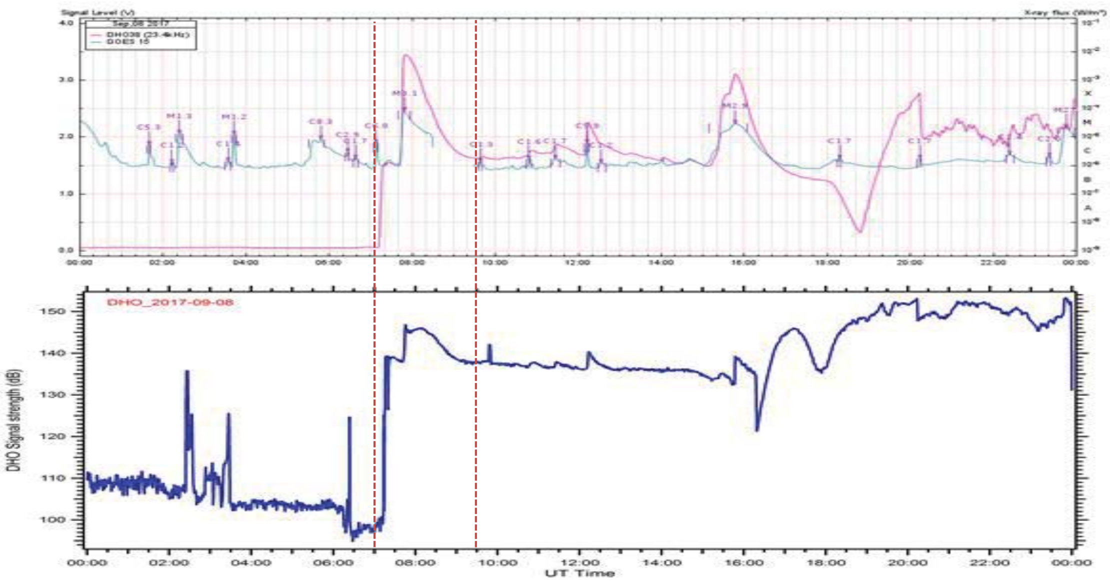

Figure 5. Solar events on 8/9/2017, where the top (blue line) represents the X-ray amplitude of the satellite GOES and the pink line represents the change of signal amplitude received at the French station DHO and the bottom part (blue line) represents a change The amplitude of the signal received at our station from the DHO sent.

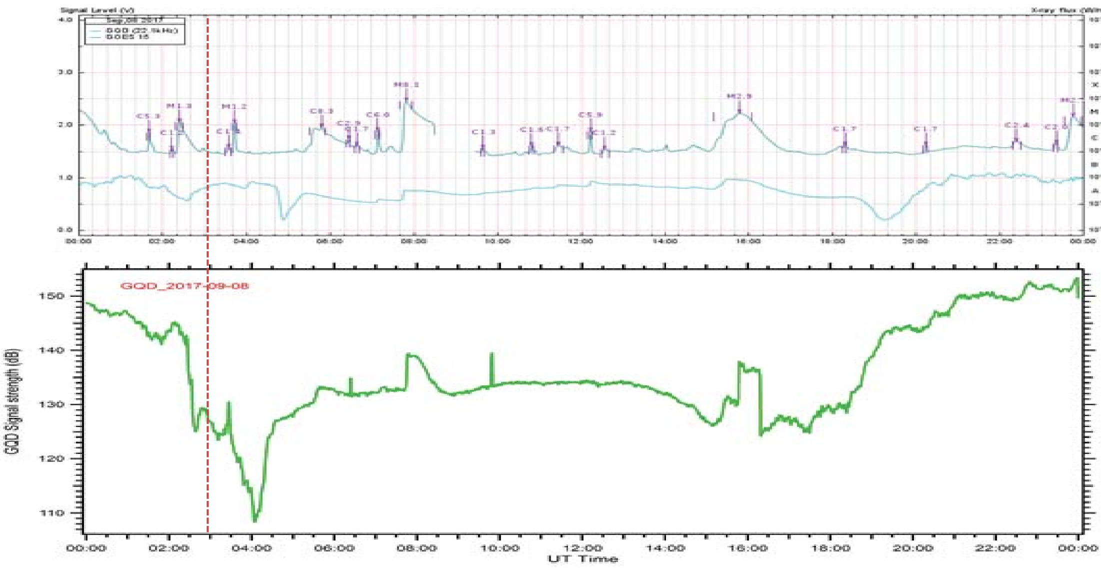

Figure 6. Solar events on 8/9/2017, where the top (blue line) represents the X-ray amplitude of the satellite GOES and the pink line represents the change of signal amplitude received at the French station DHO and the bottom part (blue line) represents a change The amplitude of the signal received at our station from the DHO sent.

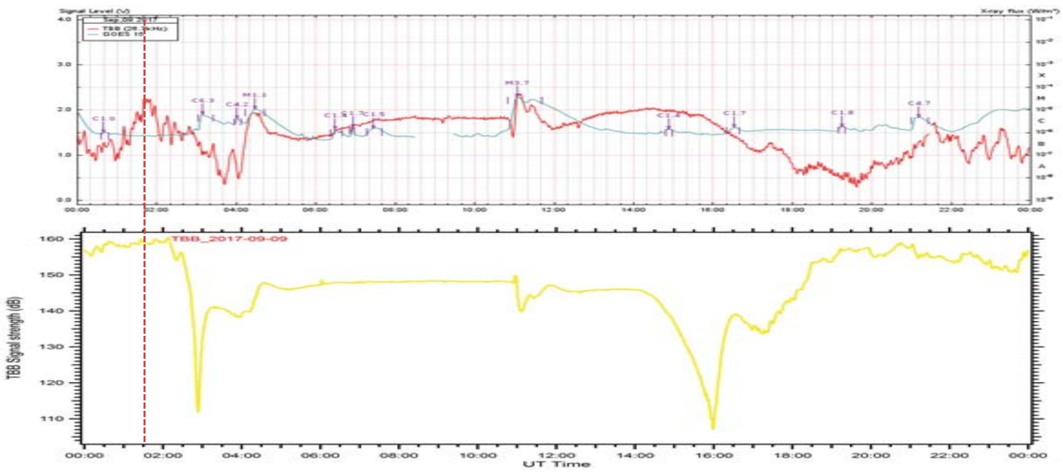

Figure 7. Solar events on 9/9/2017, where the top (blue line) represents the X-ray amplitude of the satellite GOES and the pink line represents the change of signal amplitude received at the French station DHO and the bottom part (blue line) represents a change The amplitude of the signal received at our station from the DHO sent.

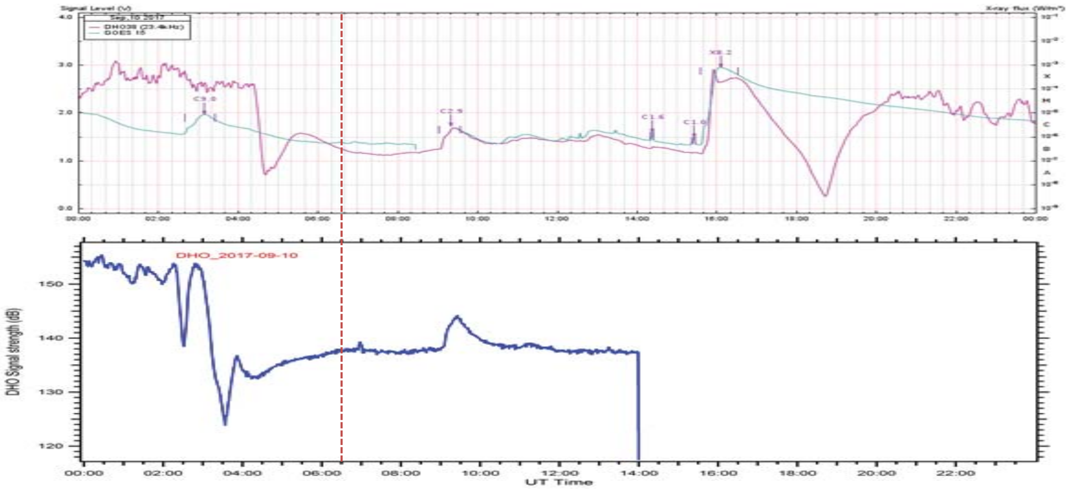

Figure 8. Solar events on 10/9/2017, where the top (blue line) represents the X-ray amplitude of the satellite GOES and the pink line represents the change of signal amplitude received at the French station DHO and the bottom part (blue line) represents a change The amplitude of the signal received at our station from the DHO sent.

4.Discussion

All the studied here occurred when the signal was received in the daytime. The best curve of the amplitude disorder is fully compatible with the flame amplitude similar to the shape previously obtained by Macry [9].

Where noticed that the effect of X-ray intensity does not effect on the amplitude of signals received except in some isolated events. This means that the amplitude of the signal depends on the distance from the transmitter as well as the reflective ionosphere of the signal [7].

In this study, we present and analyze the results obtained work and monitoring of our station (ISIO) and for a period of five months starting from May and ending in mid-September 2017, which was approved in the last years of the solar cycle (24) Here the sun is idle or inefficient always at the end of its solar cycle, which is usually 11 years for each full cycle [8].

However, data points are lower than those reported by these researchers .the increase in the amplitude of the VLF signals with increased solar flare intensity can be qualitatively explained as: With the increase of the flame flux, two phenomena may occur. The first is the increase in the electron density of layer D and the other is the electron density distribution with elevation [11].

5. Conclusion

The results showed that there are a difference in the type of signals monitored from their receivers located at north of our station faraway about 4000 km. This indicates that the ionosphere may have different effects on the signal by geographical location.

The ionosphere varies daily, seasonally and annually according to the solar cycle. It is also spatially heterogeneous. The length of the path of receiving signal radiation depends on the waveguide. This guide depends mainly on the surface of the earth from the bottom and on the ionosphere. It is effect on the amplitude and development of the signal received.

Our results show clearly that the amplitude of the signals which received at our station is much higher than in the station south of France, where the signal amplitude is less than the same solar effect of X-Ray and at the same time.

This idle period of solar explosions was very typical of our work. Our timing of the study was very good because we expected that a few isolated events would be observed and this is what has already happened. This has also been reflected in the accuracy of our readings and the absence of any interference or effects between them. Consecutive events at short periods.

Our selection of the summer season for the monitoring process also gave us a positive boost to the length of the daytime monitoring period, as is known in Iraq. In this ideal environment for monitoring, we found that the capacitance is relatively variable with the logarithm of the falling x-ray. Where the capacitance can be useful and convenient to extrapolate x-ray emission when the GOES detectors are saturated during a very powerful solar flare to determine the actual flux densities associated with strong solar flares. The EIWG limit may become more severe and low, and as a result, VLF signals are reflected at sharp limits with relatively lower penetration in layer D and therefore less attenuated / under-absorbed than under normal propagation conditions.

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