SEASONAL EFFECT OF NOON BITE-OUT OVER A SOLAR CYCLE

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ABSTRACT

The seasonal effect of noon bite – out over a solar cycle using the foF2 data of Ouagadougou (13°N, 5°W, dip 7.6) for the years between 1972 – 1983 (with the exception of 1977 where there were no data) is investigated. The difference between the higher peak and the depression in diurnal variation of foF2 which is used to represent noon bite – out in the study is plotted against the months of the years. A comparison of the noon bite – out of Ouagadougou and Ibadan was also carried out during 1973. It is observed that the noon bite – out for 1972 shows a semi – annual variation and annual variation for 1973 – 1983. The semi – annual variation of the noon bite – out of foF2 ionization during 1972 is curious and may have to be investigated further.

KEYWORDS: Ionosphere, noon bite – out, seasons and solar cycle.

INTRODUCTION

Rishbeth and Garriott (1969) defined the ionosphere as the part of the earth's upper atmosphere where ions and electrons are present in sufficient quantity to affect the propagation of radio waves. It is the ionized region of the atmosphere.

The ionosphere is divided into regions within which there can exist distributions called layers (Ratcliffe and Weekes,1960).The part of the ionosphere below 90km is called the D-region, between 90km and 160km the E region and that above 160km the F-region (Somoye,1984). These limits are rather conventional boundaries for it has been observed, for example,that the ionization of the F-region extends below 140km under certain circumstances (Kouris, 1998).The actual number of layers, their height and the intensity of ionization all vary from hour to hour, day to day, month to month, season to season and year to year. The amount of ionization in the ionosphere varies greatly with the amount of radiation received from the sun. Thus, there is a diurnal (time of day) effect and a seasonal effect. For this study these variations are considered: diurnal, seasonal, solar cycle of Noon-bite out.

Husan et al(2005) described the depreciation or decrease in frequency equal to or more than 0.5MHz observed in the diurnal variation of foF2 (ordinary wave critical frequency of F2-layer) at or around noon as the Bite out phenomenon. If the maximum depression occurs in the fore-noon period it is called the fore-noon bite out and if after noon period, post-noon bite out. He also reported that the cause of noon bite out was the ExB drift where E is the electric field of electrojet and B is the geomagnetic field .The bite out according to him shows a marked dependence on longitude , solar cycle epoch, magnetic disturbance and latitude.

Adeniyi (1989) referred to the trough that occurs at the peak of low solar activity as noon bite out.

Rajaram and Rastogi (1977) opined that the noon bite out feature is most pronounced in the equinox months irrespective of solar cycle epoch.

DATA AND METHOD OF ANALYSIS

The data for this study were obtained at an ionosonde station in Ouagadougou(geographic latitude 13N, longitude 50W) in West Africa, but down loaded from the archive of NASA's Space Physics Interactive Data Resource (SPIDR) website (http://spidr .ngdc.noaa.gov/).

(Ouagadougou is chosen for this study because it is one of the few of ionosonde stations in West Africa where recent ionospheric data are available).

The raw data were averaged into 30-day of the month by 24-hour of a day. Seasonal variations were investigated by plotting the mean values of fof2 against months of the year. Solar cycle variation was verified by plotting the value of the difference between the higher peak and depression of fof2 against the months of the year for 11 years (1972-1983) excluding 1977 for which no data were found).See Figures 1 and 2.

The data which are hourly values of foF2 readings were plotted with the hours of the day. The difference in the values of the pre-noon or post noon peak (depending on which is greater) and that of the minimum value (which usually occur at about noon) between the two peaks and known as noon-bite-out (following the example of Husan et al., (2005)) is recorded. Seasonal variations and solar cycle variations are then determined (Figures 1 and 2).

Mean values of foF2 obtained at Ibadan and Ouagadougou during 1973 are correlated in order to determine the similarity or otherwise of both set of data (foF2 data at Ibadan were only available for 1973). Lasisi (2009) defined correlation as the relationship between two or more paired variables.

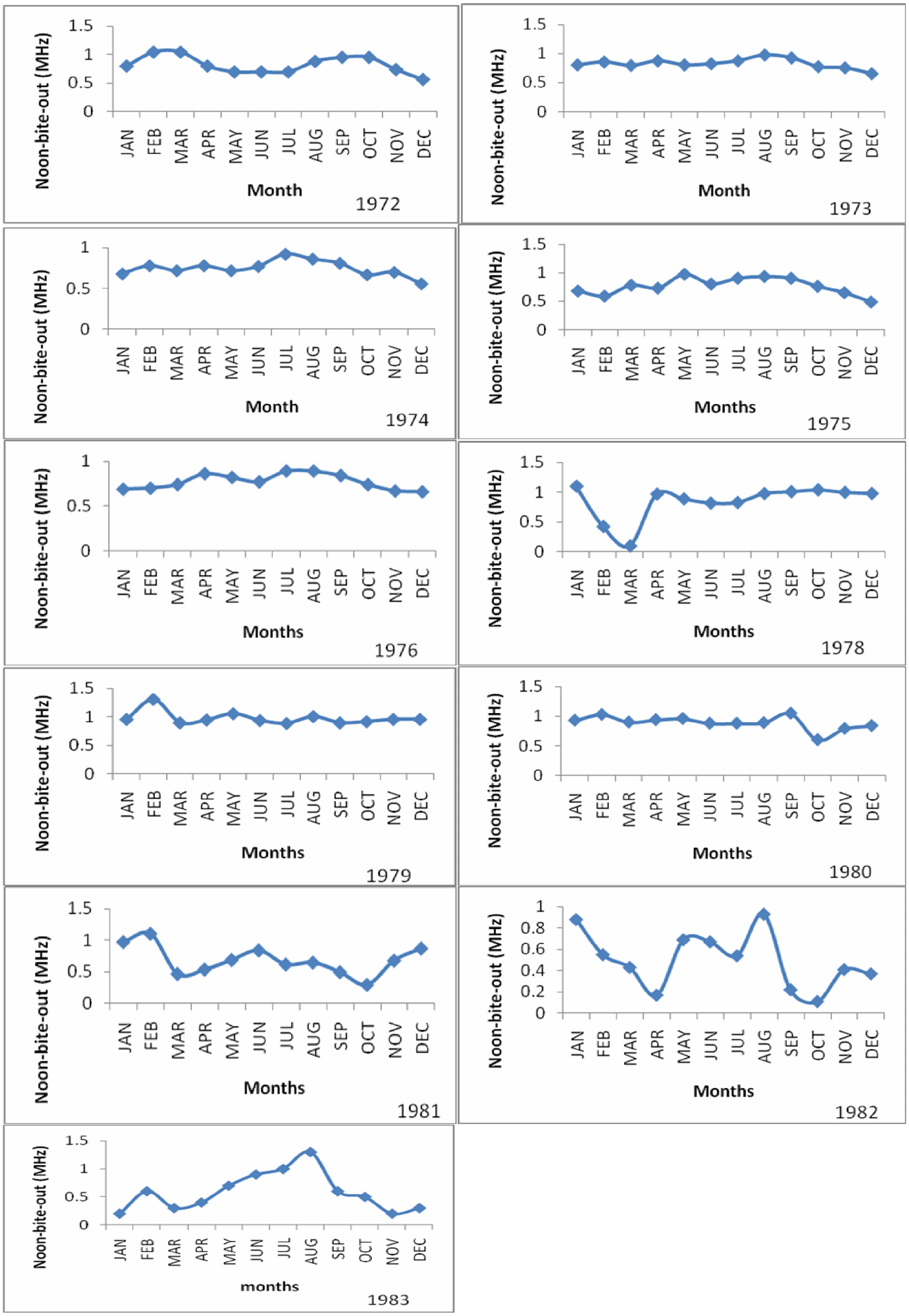

Figure 1: Illustrating solar cycle variation of Noon-bite-out for different epochs of solar cycle.

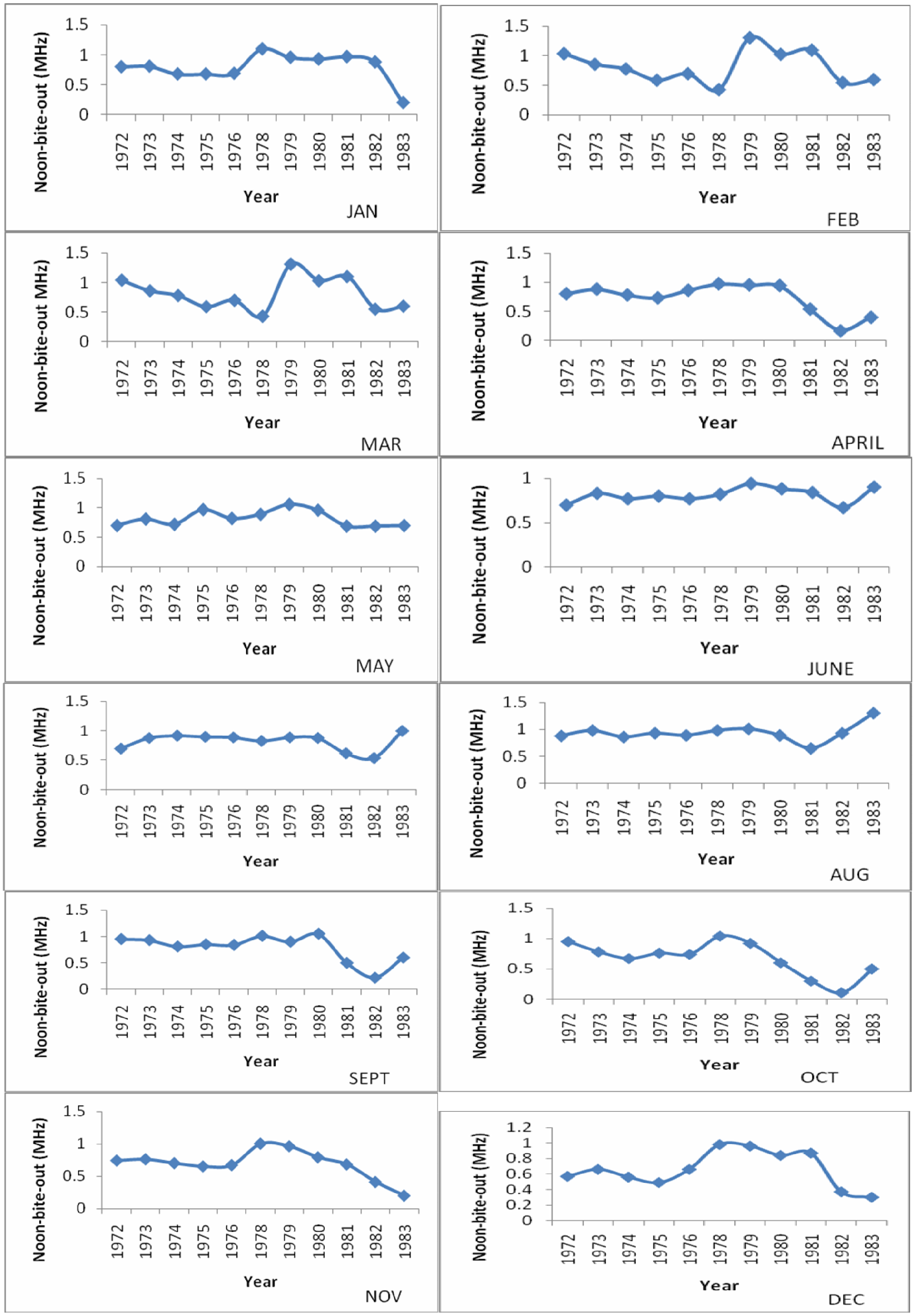

Figure.2: Illustrating solar cycle variation of Noon-bite-out for different months.

DISCUSSION

Generally, Noon- bite-out is more prominent during the Equinoctial months at all the epochs of the solar cycle (see Figure 1). This result agrees with that of Rajaram and Rastogi (1977). In the present result, noon-bite-out is also found prominent on a few occasions during the solstices. This difference may be due to the fact that Ouagadogou is on the flank of the dip equator (dip 15.9^0) while the station of Koidakanal (dip 3.5^0) considered by Rajaram and Rastogi (1977) is within the dip equator.

In order to find the solar cycle trend not masked by seasonal variation,the noon-bite-out is plotted with the epochs of solar cycle during each month as illustrated in figure 2. In general, noon-bite-out is higher during high solar cycle than during low solar cycle. This is possible due to a higher E x B force associated with the large range of geomagnetic horizontal component responsible for the noon bite out during higher solar cycle than low solar cycle.

CONCLUSION

The observation of the noon bite out for 1972, reveals a semi-annual variation while those of 1973, 1974,1975,1976,1978,1979,1980,1981,1982 and 1983 reveals annual variation .

The correlation computed for Ouagadougou and Ibadan gives a positive correlation (0.365679) which is rather weak to establish any relationship between the noon-bite-out of both stations.

REFERENCES

1. **Adeniyi, J.O. (1979).** A study of some features of the Equatorial Ionosphere on magnetically quiet and disturbed days. Ph D Thesis, University of Ibadan, Nigeria.
2. **Husan A., Shahrukh Z., Jamali A. (2005).** Bite-out in F2 layer at Karachi during solar maximum year (1999- 2000)and its effects on HF- Radio Communication in "Physisc in our lives". pp 201-207.
3. **Kouris, S.S (1998):** The dependence of ionospheric characteristics on the state of the solar cycle, Annali di Geofisica, Vol.41, N.5-6, Nov-Dec.
4. **Rajaram G. and Rastogi, R.G. (1977).** Equatorial electron densities-seasonal and solar cycles, J. Atmos. Terr. Physics, Vol 39, pp 1175-1182.
5. **Ratcliffe and Weekes, (1960).** Physics of the Upper Atmosphere, Academic Press , New York.
6. **Rishbeth and Garriott (1969).** Introduction to lonospheric Physics, Academic Press, New York .
7. **Somoye E.O. (1984).** A statistical study of the critical frequency of the lonospheric F region, M. Sc. Thesis, University of Ibadan, Nigeria.
8. **Lasisi A (2009).** "Research methods in Education: The fundamentals" Stirling Horden publishers (Nig.) Ltd. S Pp 51-53