iJRASET
International Journal For Research in
Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 8 **Issue:** V **Month of publication:** May 2020

DOI: http://doi.org/10.22214/ijraset.2020.5376

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.429
Volume 8 Issue V May 2020- Available at www.ijraset.com

Study of Day to Day Variation of M(3000)F2 at Low Latitude Station

Bhanupriya[1], Kalpana Maski[2], S K Vijay[3]
[1]Research Scholar Barkatullah University Bhopal
[2]Regional Institute of Education, NCERT Bhopal
[3]Govt. Maharani Laxmi Bai Girls P.G. College, Bhopal

Abstract: The day to day variability for M(3000)F2 parameter of F-region for a low latitude station Darwin(12.47°S,130.85°E) for the year 2014 considered in the present work. The diurnal, seasonal and monthly variation of M(3000)F2 parameter has been studied. The standard deviation method is used to analyze the variation of M(3000)F2 parameter. The seasonal variation is divided into three seasons- winter months, equinoctial months and summer months. In the study it has been found that, the diurnal percentage deviation of M(3000)F2 is higher during nighttime than day time. For seasonal variation, the variation of percentage deviation of M(3000)F2 for the nighttime is higher in summer months as compared to winter and equinoctial months. The percentage deviation of M(3000)F2, for monthly variation is high in November and low in March and September.
Keywords: Ionosphere, Variability, F-region, Low latitude, M (3000)F2.

I. INTRODUCTION

The ionospheric F2-layer has been studied for a long time and is primarily responsible for the reflection of radio waves in high frequency communication and broadcasting. The M(3000)F2 parameter shows great significance in the investigation of the F2-layer. It is defined as

$$M(3000)F2 = MUF(3000)/foF2$$

where foF2 is the F2 layer critical frequency and MUF(3000) is the maximum usable frequency at which a radio wave can be reflected and received at a horizontal distance of 3000 km [1]. M(3000)F2 is important in practical applications such as frequency planning for radio-communication as well as in ionospheric modeling. Ezquer[2]. et al, studied the diurnal, seasonal and latitudinal behavior of the variability of ionosphere parameters (foF2 and M(3000)F2) and observed low variability for propagation factor M(3000)F2. The prediction of M(3000)F2 is important in ionospheric modeling [3].

Hoque and Jakowski [4], used a large database of propagation parameter M(3000)F2 and hmF2 which were collected through a worldwide network of 69 ionosondes and derived an empirical hmF2 model. Bilitza [5] et al, observed seasonal differences in variability and suggested that seasonal effects seen are more likely a result of seasonal changes in the build-up of the equatorial anomaly crest. Oyekola [6], studied the variations of M(3000)F2 local time seasonal and solar cycle and compared the results with the International Reference Ionosphere 2007 model.

Anju Nagar [7] et al, observed F-region variability of the ionospheric parameter (foF2 and M(3000)F2) at low latitude stations during low solar activity periods and found the magnitude of the variability of M(3000)F2 are smoother and smaller than in that case of foF2 and for both parameters, there are no remarkable changes in day to day variability with geomagnetic activity during low solar activity period.

In this paper, we studied the day to day variation of propagation factor M(3000)F2 for a low latitude station for the year 2014. The diurnal, seasonal and monthly variation of M(3000)F2 has been studied for a low latitude station. The standard deviation method is used for the study of variation in propagation factor M(3000)F2.

II. DATA AND METHOD OF ANALYSIS

Our analysis is based on hourly daily values of the propagation parameter M(3000)F2 of a low latitude station Darwin (12.47°S,130.85°E) obtained through the UK Solar System Data Centre (UKSSD) website(https://www.ukssdc.) for the year 2014. To represent the variability the standard deviation σ of hourly M(3000)F2 values from the monthly median value (X) is determined, from which the ratio of (σ/X) in percentage is derived for each hour of each month of observation. The variability parameter (σ/X) is calculated for each month and seasons of the year. To understand the seasonal variation of M(3000)F2 we will divide the year into three seasons: winter (January, February, November, December), equinox (March, April, September, October) and summer (May, June, July, August).

ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.429
Volume 8 Issue V May 2020- Available at www.ijraset.com

III.RESULTS

A. Diurnal Variation of M(3000)F2

The diurnal variation in the percentage of the standard deviation of M(3000)F2 for Darwin for the year 2014 is shown in figure-1. The variation in the percentage of the standard deviation of M(3000)F2 is high(6.51)at 2.00 LT in the night and at the time of sunrise(6.78)at 5.00 LT and then it decreases but from 8.00 LT it starts to increase(3.79) again and after 11.00 LT the percentage of the standard deviation of M(3000)F2 get slightly down and get low(3.73) at 20.00 LT and after that it starts to increase again.

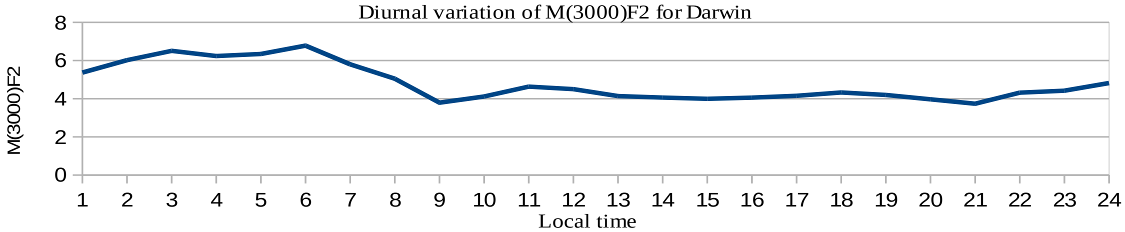


Fig.-1-The diurnal variation in the percentage of the standard deviation of M(3000)F2 for darwin for the year 2014.

B. Seasonal Variation of M(3000)F2

The seasonal variation in the percentage of the standard deviation of M(3000)F2 for Darwin for the year 2014 is shown in figure-2. The variation in the percentage of the standard deviation of M(3000)F2 is higher in summer months as compared to winter and equinoctial months, but the frequency of variation is more in winter as compared to summer and equinox. In summer months the variation in the percentage of the standard deviation of M(3000)F2 is maximum at 4.00 LT(8.53) and 5.00 LT(8.27) and minimum at 8.00(3.55), 9.00(3.88) and 12 LT(3.97), for winter it is high at 5.00 LT(6.26) and 6.00 LT(6.27) and low at 21.00 LT(3.14) and for equinox it is high at 1.00LT(6.25), 2.00LT(6.47)and 3.00 LT(6.27) and low at 16.00LT(2.83), 17.00LT(2.97), 19.00LT(2.98).

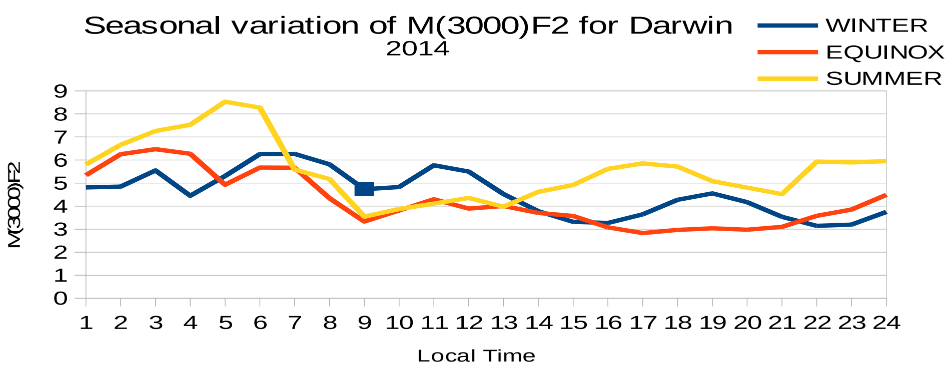


Fig.-1-The seasonal variation in the percentage of the standard deviation of M(3000)F2 for darwin for the year 2014.

C. Monthly Variation of M(3000)F2

The monthly variation in the percentage of the standard deviation of M(3000)F2 for Darwin for the year 2014 is shown in figure- 3. The variation in the percentage of the standard deviation of M(3000)F2 is maximum in November(6.69) and minimum in March(3.67). After March it increases to July and than decreases to September and than again increases to November.

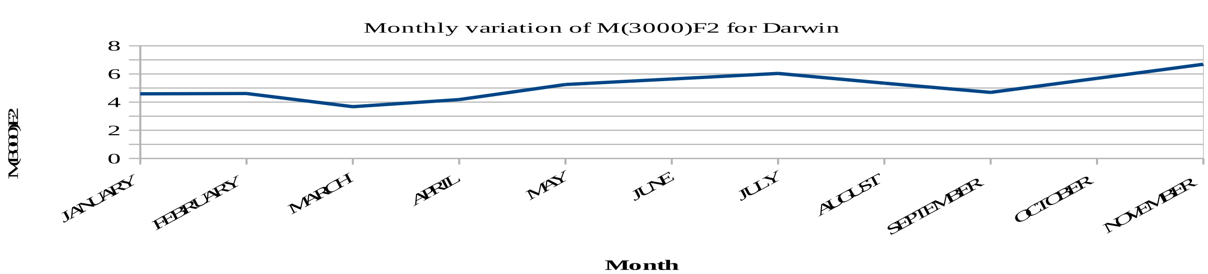


Fig.-3- The monthly variation in the percentage of the standard deviation of M(3000)F2 for Darwin for the year 2014.

IV. DISCUSSION

Ionospheric day-to-day variability is controlled by many factors, such as solar radiation, geomagnetic activity, even seismic activity (H.Risbeth and M.Mendillo, [8]) (S.A.Pulinets, and J.Y. Liu,[9]). For the diurnal and local time variations, the neutral air winds and EXB drift (VZ) play important roles. Forbes et al. [10] studied that for both low and high frequency ranges and alllatitudes, the ionospheric variability increases with magnetic activity. T Shimazaki [11] found a strong anti-correlation between F2-layer peak height (hmF2) and the propagation factor (M(3000)F2).

Araujo-Pradere et al. [12] and Risbeth and Mendillo [8], analyze global ionosondes observations and studied the local time and seasonal variations in the ionospheric F layer variabilities. Risbeth and Mendillo [8] suggested that the variabilities are greater at night, especially in winter, it is partly due to the lower electron density and partly due to the lack of the strong photochemical control that exists in the daytime F2-layer, but occurs largely because the auroral sources of magnetic activity become stronger and move to lower latitudes at night. This effect is enhanced in the winter when nights are long.

Lee and Reinisch (13) concluded that daytime hmF2 has a positive correlation with solar activity in the equinoctial and summer months. The authors also remarked that at Jicamarca, the higher hmF2 values during the daytime are related to the upward vertical EXB velocity; while the lower hmF2 during nighttime is associated with the downward velocity. M(3000)F2 is also anti- correlated with F2-layer critical frequency (foF2) (or F2-layer peak electron density, NmF2). Risbeth and Mendillo [8], investigated that there are greater variabilities in the night, especially in winter. This is due to the lower electron density and the lack of strong photochemical control that exists in the daytime F2-layer.

O.S. Oyekola [6] found that the values of M(3000)F2 should be higher during low solar activity than that of high solar activity. Nighttime values of the propagation factor are expected to vary much higher than the daytime values and also found that seasonal effects are mainly likely due to the highly variable equatorial anomaly crests. Oyekola [6] also found that the disparity is higher in December months, moderate in June months and lowest in equinox. Anju Nagar [7], observed that daytime variability is maximum in summer and minimum in equinox while during night-time variability maximum in summer and minimum in winter.

Based on the above evidences we concluded that, for diurnal variation, the percentage of the standard deviation of M(3000)F2 is high in the nighttime than day time. For monthly variation, the percentage of the standard deviation of M(3000)F2 is maximum in November and minimum in March and September and moderate in May, June, July, August. For seasonal variation, the percentage of the standard deviation of M(3000)F2 for day time is maximum in summer and minimum in equinox while for nighttime variability maximum in summer and minimum in winter.

V. CONCLUSIONS

A. *We Conclude That*

1) For diurnal variation, the percentage of the standard deviation of M(3000)F2 is high in the nighttime than day time.
2) For monthly variation, the percentage of the standard deviation of M(3000)F2 is maximum in November and minimum in March and September and moderate in May, June, July, August.
3) For seasonal variation, the percentage of the standard deviation of M(3000)F2 for day time is maximum in summer and minimum in equinox while for nighttime variability maximum in summer and minimum in winter.

VI. ACKNOWLEDGMENT

We are thankful to the World the UK Solar System Data Centre (UKKSD) website (https://www.ukssdc)for providing the data of ionospheric parameters and M(3000)F2 values for the duration under consideration of the present study. We also thank referees for their valuable suggestions for improving the presentation of the work.

REFERENCES

[1] P.A.Bradley , J.R.Dudney , A simple model of the vertical distribution of electron concentration in the ionosphere, J. Atmos. Terr phys. 35,2131-2146, 1973.

[2] R.G.Ezquer, M.Mosert, R.Corbella, M.Erazu, S.M.Radicella, M. Cabrera and L. de la Zorda, "Day to day variability of ionospheric characteristics in the American Sector", Adv. Space Res. Vol. 34, no. 9, 2004, pp. 1887- 1893.doi: 10.1016/j.asr.2004.03.016, 2004.

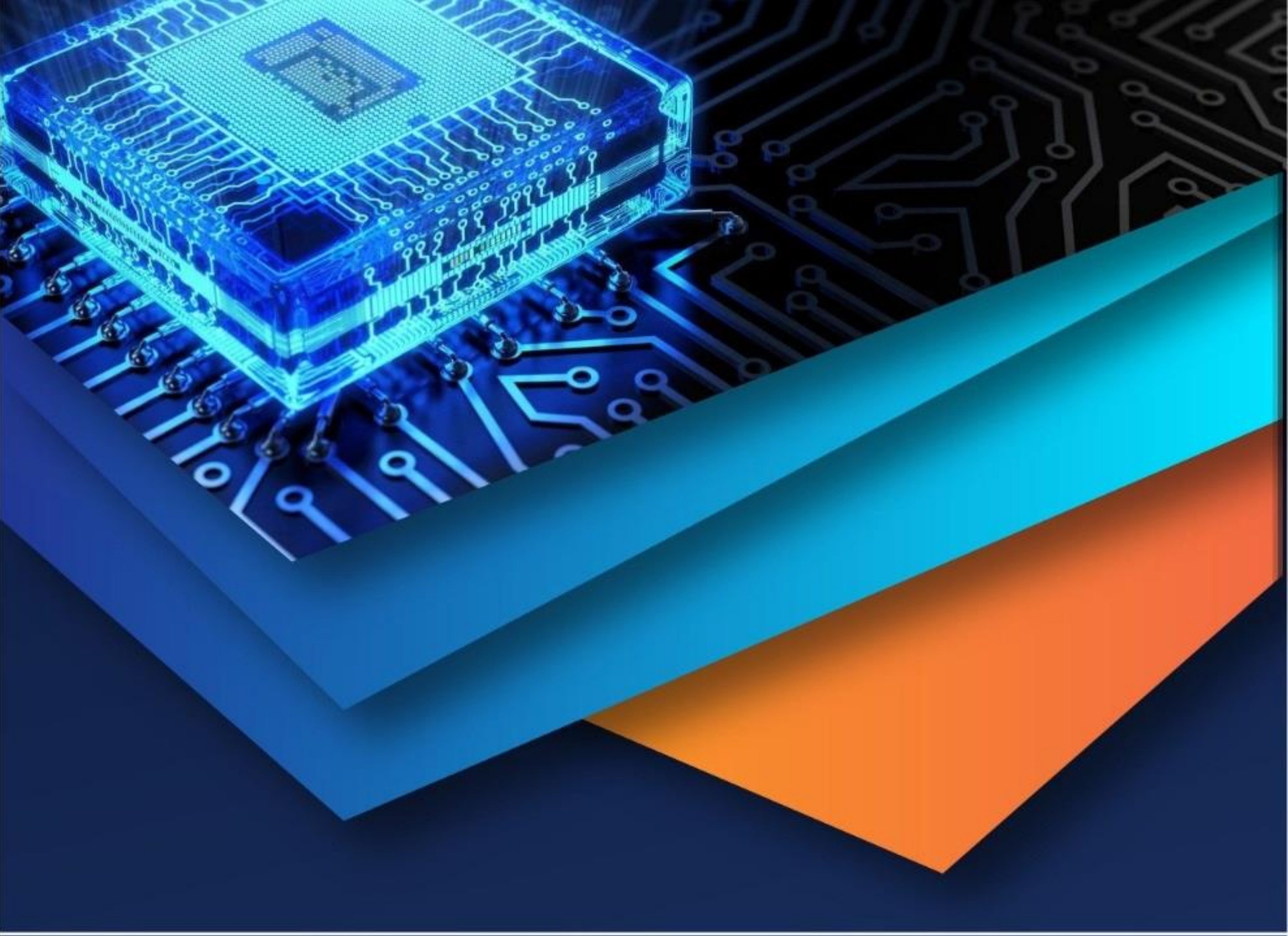
[3] C.M.Rush, D.N.Anderson, An ionospheric observation Network for use in short-term propagation Predictions.Telecommun. J.43, 544-549,1975.

[4] M.M. Hoque and A. Jakoswki,"A new global model for the ionospheric F2 peak height for radio wave propagation", Ann. Geophys., vol. 30, 2012, pp. 797-809.doi:10.5194/angeo-30- 797-2012, 2012.

[5] O.Bilitza, O.K.Obrou, J.O.Adeniyi and O.Oladipo, "Variability of FoF2 in the equatorial ionosphere", Adv. Space Res., vol. 34, no. 9, 2004, pp. 1901-1906.doi: 10.1016/j.asr.2004.08.004, 2004.

[6] O.S.Oyekola, "Variation in the ionospheric propagating factor M(3000) F2 at Ouagadougou, Burkina Faso", Adv. Space Res.,vol. 46,no. 1, 2010,pp. 74-80.doi: 10.1016/j.asr.2010.02.017, 2010.

[7] A Nagar, S.D. Mishra, S.K. Vijay,“Day-to-Day Variability of Low Latitude F-Region Ionosphere During Low Solar Activity”,International Journal of Astrophysics and Space Science2015; 3(3): 30-4. doi: 10.11648/j.ijass.20150303.12, 2015.
[8] H.Risbeth and M.Mendillo, “Patterns of ionospheric variability”. J. Atmos. Terr. Phys., vol. 63, no. 15, 2001, pp. 1661-1680.doi: 10.1016/s1364-68266(01)00036-0, 2001.
[9] S.A.Pulinets, and J.Y. Liu,“lonospheric variability unrelated to solar and geomagnetic activity”, Adv. Space Res., vol. 34, no. 9, 2004, pp. 1926-1933.doi:b10.1016/j.asr.2004.06.014, 2004.
[10] M.J. Forbes., E.S.Paol and X. Zhang, “Variability of the ionosphere, J. Atmos. Terr. Phys., vol. 62, no. 8, 2000, pp. 685-693.doi: 10.1016/S1364-6826(00)00029-8, 2000.
[11] T. Shimazaki, “Wolrd-wide daily variations in the height of the maximum electron density of the ionospheric F2-layer”, J. Radio Res. Labs., vol. 2, no. 7, 1955,pp. 85-97, 1955.
[12] E.A. Araujo-Pradere, T.J. Fuller Rowell, M.V. Codrescu, and D.Bilitza, “Characteristics of the ionospheric variability as a function of season, latitude, local time, and geomagnetic activity”, Radio Sci., vol.40, no. 5, 2005,pp. RS5009.doi:10.1029/2004RS003179, 2005.
[13] C.C.Lee, B.W.Reinisch, “Quiet-condition hmF2, NmF2, and Bo variations at Jicamarca and comparison with IRI-2001 during solar maximum.” J. Atmos. Solar- Terr. Phys. 68, 2138–2146, 2006.



10.22214/IJRASET

INDEX COPERNICUS 45.98

IMPACT FACTOR: 7.129

IMPACT FACTOR: 7.429

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY