REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

AD-A217 922 DTIC FILE COPY

1. AGENCY USE ONLY (Leave blank)	2. REPORT DATE	3. REPORT TYPE AND DATES COVERED
	1982	

4. TITLE AND SUBTITLE

A COMPARISON OF TWO NEUTRAL WIND MODELS AFFECTING IONOSPHERIC F2 REGION PEAK ELECTRON DENSITIES NEAR THE MAGNETIC EQUATOR

5. FUNDING NUMBERS

6. AUTHOR(S)

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7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)

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Boulder, CO

8. PERFORMING ORGANIZATION REPORT NUMBER

AFOSR-TR-83-0817

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)

AFOSR
BLDG 410
BAFB DC 20332-6448

10. SPONSORING/MONITORING AGENCY REPORT NUMBER

AFOSR-TR- 90-0097

11. SUPPLEMENTARY NOTES

12a. DISTRIBUTION/AVAILABILITY STATEMENT

unlimited

12b. DISTRIBUTION CODE

13. ABSTRACT (Maximum 200 words)

DTIC
ELECTE
FEB 07 1990
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14. SUBJECT TERMS

15. NUMBER OF PAGES

2

16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFICATION OF ABSTRACT	20. LIMITATION OF ABSTRACT
unclassified	unclassified		

NSN 7540-01-280-5500

Standard Form 298 (890104 Draft)
Prescribed by ANSI Std. 239-18
298-01

AFOSR Final Report
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A COMPARISON OF TWO NEUTRAL WIND MODELS AFFECTING IONOSPHERIC F2 REGION PEAK ELECTRON DENSITIES NEAR THE MAGNETIC EQUATOR

Previous use of models of dynamic processes in the ionospheric F2 region have not used thermospheric winds derived from data to match predictions of peak electron density in the F2 region with data from ionospheric stations. The model used in this study calculates low-latitude electron density distributions, theoretically, and includes ionization production by solar ultra-violet radiation ($\lambda < 911$ Å), loss through charge exchange with neutral molecules N_2 and O_2 and transport by diffusion, neutral winds and $\overline{E} \times \overline{B}$ drift (Anderson, 1973).

This study improves on the previous studies (Anderson and Matsushita, 1974; Anderson and Roble, 1981) by including an empircal model of vertical $\overline{E} \times \overline{B}$ drifts as observed by the Jicamarca incoherent scatter radar during equinox months of 1975 and 1976 (Fejer, 1981), and two thermospheric wind models. The purpose of the study is to compare calculated and observed foF2 values at low latitudes to determine which of the two wind models seems to be the most appropriate. The wind model by Mayr et al. (1979) relies on Atmospheric Explorer E (AE-E) measurements of temperature and solar radiation as input parameters while the wind model by Forbes (1982a, b) calculates thermospheric winds using Millstone Hill radar data as input. The MSIS model of the neutral atmosphere (Hedin, et al., 1977) and an electromagnetic vertical drift model derived from Jicamarca measurements to simulate the equatorial ionosphere during equinox. The conditions were an average of those observed during the equinox months of March, April, September and October of 1965 in the American sector and 1977 in the Indian sector. Both 1965 and 1977 were the years immediately following the minimum of the sunspot cycle. The Mayr meridional wind model was the most accurate in matching observations. It was most successful when combined with the observed Jicamarca drifts and MSIS model when applied to the Indian sector in 1977. The Forbes model was less accurate.

The Mayr and Forbes models differ in several respects. Mayr predicts an equatorward wind peak near 0200 LT at 10° geographic latitude and 2400 LT and 20° geog. lat. This wind peak coincides with a relative temperature maximum observed by AE-E at 0200 LT and used as an input to the Mayr model. Forbes uses data from Millstone Hill in his model and predicts smaller wind peaks two hours later. From 0800 to 1000 LT, Mayr's model has a small equatorward wind peak while Forbes' shows a poleward wind peak. This peak accounts for the Forbes model's better performance on the equator during the day, but off the equator, this poleward wind substantially reduces electron density values below the observed ones.

The Mayr model shows a pronounced poleward wind peak at 1900 LT that is present with a substantially smaller amplitude in the Forbes model. There is a strong terdiurnal (8-hour period) wind component due to the terdiurnal heating and wave models excited by the diurnal ion drag and semi-diurnal winds. The strong wind peak allows the Mayr model to reproduce the observed afternoon variations in the Indian sector for foF2. On the equator, the afternoon foF2 peak matches the observed peak in both magnitude and phase around 1630 LT; while off the equator, the peak near 1400 LT is matched very well.

The Mayr neutral meridional wind model used in conjunction with the MSIS neutral atmosphere and the electrodynamic drifts based on Jicamarca observation have yielded the best results in simulating foF2 in the equatorial ionosphere.

These results were obtained by Mr. Bruce Herniter and written up as a Masters' Thesis in the Astro Geophysics Dept., University of Colorado, Boulder, CO. The title of the thesis is "The Effects of Neutral Wind Advection on the F2 Region Peak Electron Densities Near the Magnetic Equator". This thesis is presently being written for publication as a refereed journal article.

REFERENCES

Anderson, D.N., A theoretical study of the ionospheric F region equatorial anomaly II. Results in the American and Asian Sectors, Planet. Space Sci, 21, 421, 1973.

Anderson, D.N. and S. Matsushita, Seasonal differences in the low-latitude F2-region ionization caused by $\overline{E} \times \overline{B}$ drifts and neutral wind, J. Atmos. Terrest. Phys., 36, 2001, 1974.

Anderson, D.N. and R.G. Roble, Neutral wind effects on the equatorial F-region ionosphere, J. Atmos. Terrest. Phys., 43, 835, 1981.

Fejer, B.G., The equatorial ionospheric electric fields. A Review, J. Atmos. Terrest. Phys., 43, 377, 1981.

Forbes, J.M., Atmospheric Tides, 1. Model description and results for the solar diurnal component, J. Geophys. Res., 87, 5222, 1982a.

Forbes, J.M., Atmospheric Tides, 2. The solar and lunar semidiurnal components, J. Geophys. Res., 87, 5241, 1982b.

Hedin, A.E., C.A. Reber, G.P. Newton, N.W. Spencer, H.C. Brinton, H.G. Mayr, and W.E. Potter, A global thermospheric model based upon spectrometer and incoherent scatter data MSIS 2 composition, J. Geophys. Res., 82, 2148, 1977.

Mayr, H.G., I. Harris, N.W. Spencer, A.E. Hedin, L.E. Wharter, H.S. Potter, J.C.G. Wakler, and H.C. Carlson, Jr., Tides and the midnight temperatures anomaly in the thermosphere, Geophys. Res. Letts., 6, 447, 1979.