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Daily mid-latitude F2-region critical frequency foF2 variation with daily sunspot number R

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Abstract. Ionosonde data recorded at Kokubunji, Japan (Latitude 35.7 N; Longitude 139.5 E) during a year of low solar activity (1994) and high solar activity (1990) were used in our research work to study the correlation between daily sunspot numbers (R) and the daily mid-latitude F2-region critical frequency (foF2) for four seasons. There is a diurnal variation of (foF2) with (R). Trends found over the year of solar maximum (1990) are more positive in March and December, but negative in June and September. The year of solar minimum (1994) shows positive trends in June and September, but negative trends in March and December.

Keywords : Critical frequency – sunspot number – F2 layer

1. Introduction

The ionospheric F2-region depends very strongly on solar activity, so it suffers a large and persistent day-to-day (diurnal) and seasonal variations influenced by the variation of sunspot numbers represented by solar cycle (Kouris 1998 & 1994). Long-term variations (trends) of the ionosphere parameters are widely discussed in recent publications due to the problems of global climate changes (Yonezawa 1971; Su 1998; Jiuhou Lei 2005). Our study on the diurnal variation of the daily F2-region critical frequency (foF2) with daily sunspot numbers (R) is investigated and discussed for mid-latitude region which differs from other studies by taking this relation for each hour from the day alone.

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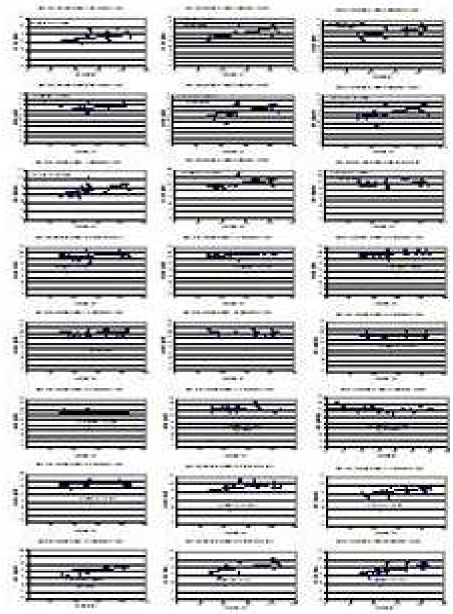

Figure 1. foF2 with sunspot R (3/1990).

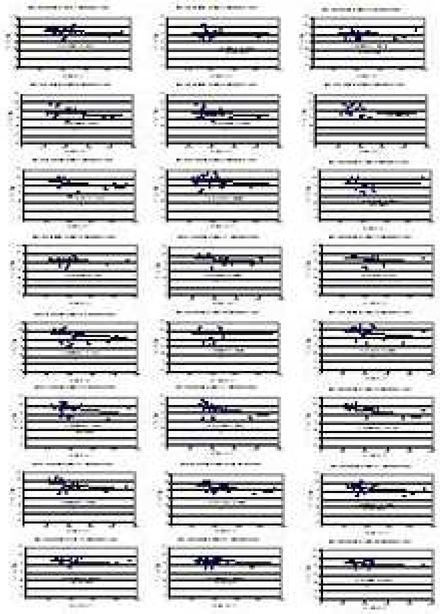

Figure 2. foF2 with sunspot R (6/1990).

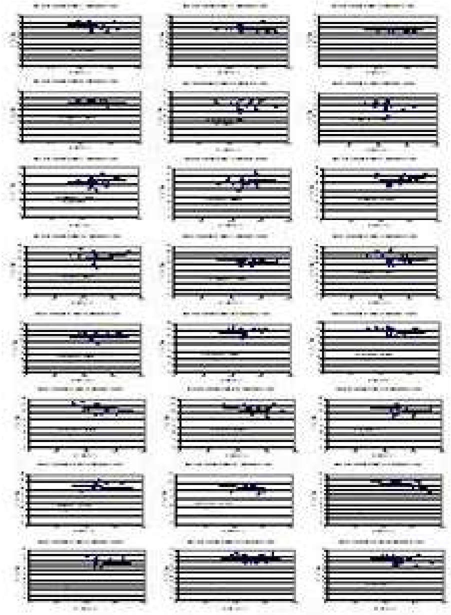

Figure 3. foF2 with sunspot R (9/1990).

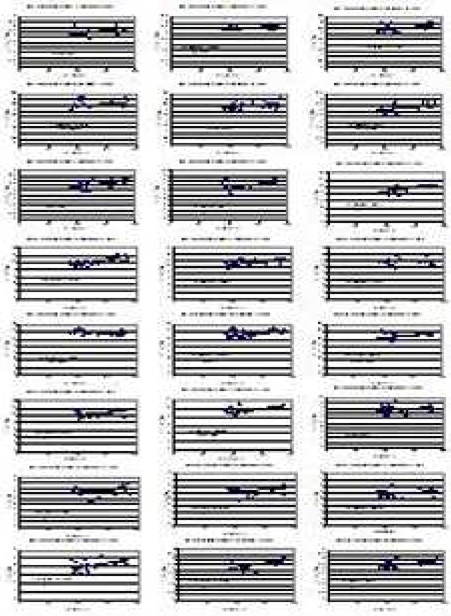

Figure 4. foF2 with sunspot R (12/1990).

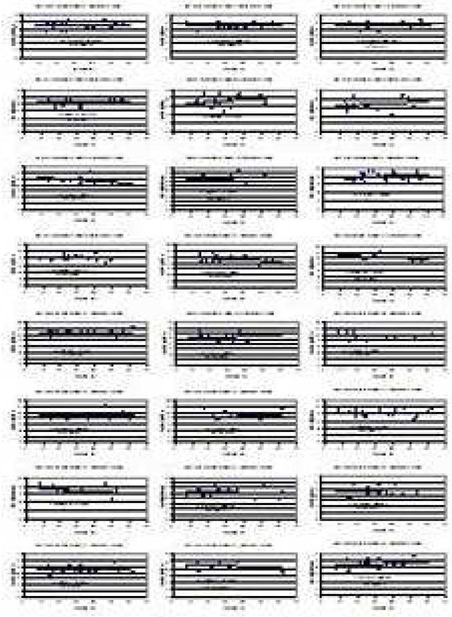

Figure 5. foF2 with sunspot R (3/1994).

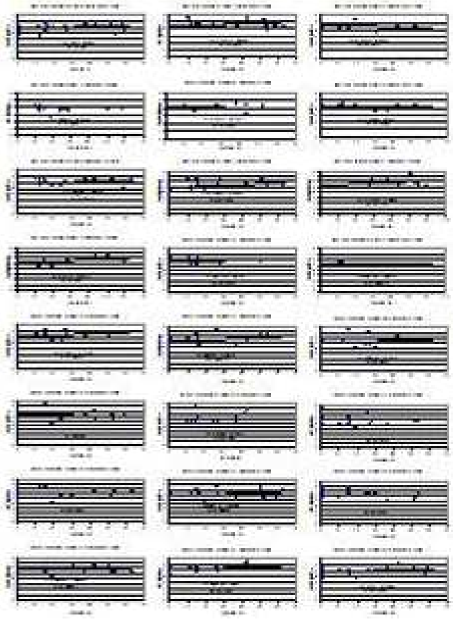

Figure 6. foF2 with sunspot R (6/1994).

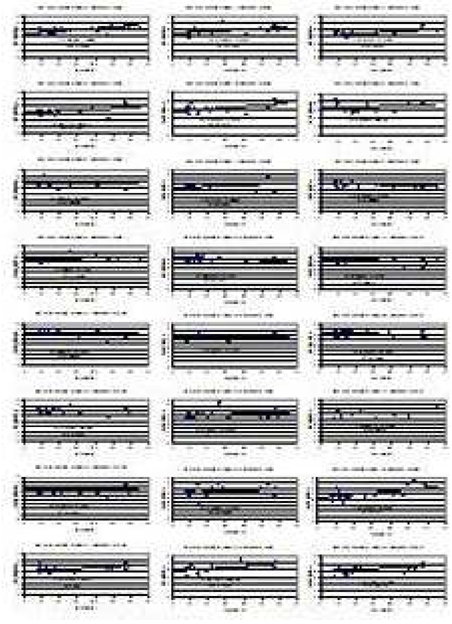

Figure 7. foF2 with sunspot R (9/1994).

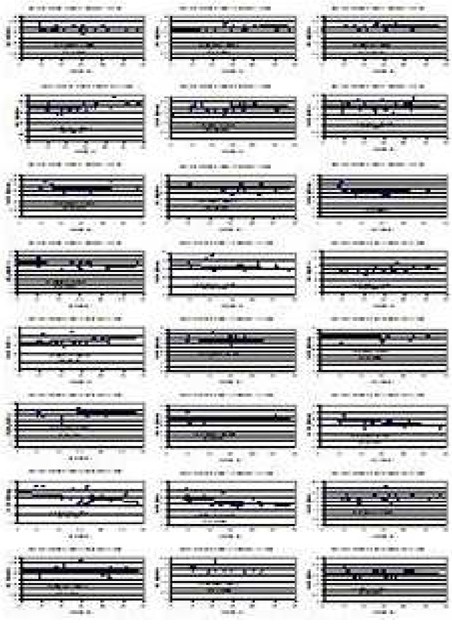

Figure 8. foF2 with sunspot R (12/1994).

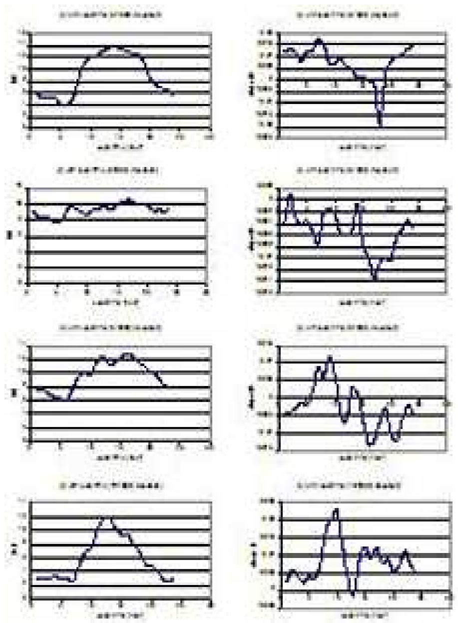

Figure 9. Trends with local time (1990) for four seasons.

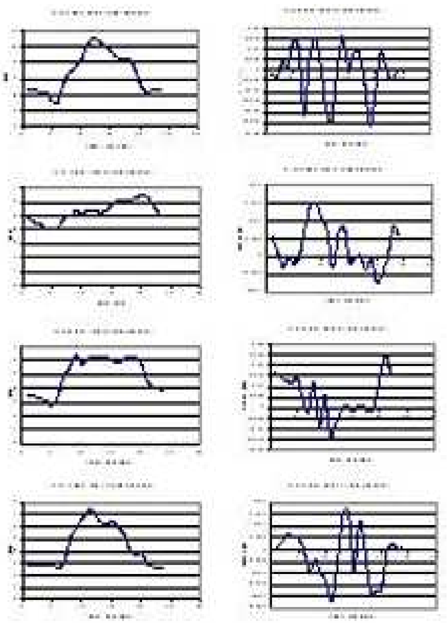

Figure 10. Trends with local time (1994) for four seasons.

2. Data selection

Ionosonde data recorded at Kokubunji, a Japanese station located at mid-latitude region (Latitude 35.7 N; Longitude 139.5 E) during a year of low solar activity (1994, R_{12}=29.9), where R_{12} is 12-months running mean sunspot number, and high solar activity (1990, R_{12}=142.6) were used in our research to study the correlation between daily sunspot numbers (R) and the daily mid-latitude F2-region critical frequency (foF2) for four seasons (Spring, March; Summer, June; Autumn, September; Winter, December). Daily sunspot data used in this research work is taken from sunspot center[1] (SIDC, 2006) for the same years and months chosen.

3. Data analysis

We investigate the response of the sunspots number on the foF2. From the data analyzed as shown in Figs 1– 4 the daily F2-region critical frequency (foF2) with daily sunspot numbers (R) for four seasons, respectively during a year of high solar activity (1990),

[1]Sunspot Index Data Center (SIDC), Sunspot Bulletin (Brussels), Data Analysis Service Supported by the FAGS, (1940-2006)

which reveal that trends found over year of solar maximum (1990) are more positive in March and December but negative in June and September as shown in Fig. 9. Figs 5–8 represent the daily F2-region critical frequency (foF2) with daily sunspot number (R) for four seasons, respectively during a year of low solar activity (1994). For the year of solar minimum (1994) there are positive trends in June and September, but negative trends in March and December as shown in Fig. 10.

4. Conclusion

There is a diurnal variation of (foF2) with (R). Trends found over year of solar maximum (1990) are more positive in March and December but negative in June and September. For the year of solar minimum (1994) there are positive trends in June and September, but negative trends in March and December. The opposite trend between 1990 and 1994 in the above correlation needs to be investigated in detail.

Acknowledgments

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