



The IRI's B parameters measured by the MU radar

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ABSTRACT

The IS measurements of power profile by the MU radar at Shigaraki (34.9°N, 136.1°E) are analyzed to give IRI's B-parameters, B_0 , B_1 for 1986-1991. Empirical formulas are obtained to represent their variations as functions of local time and season at high solar activity. They are compared also with ionosonde ones for Wuchang (30.5°N, 114.4°E). ©1999 COSPAR. Published by Elsevier Science Ltd.

INTRODUCTION

The IRI bottomside N_e profile is defined as $N(h)/NmF2 = \exp(-\chi^{B_1})/\cosh(\chi)$ with $\chi = (hmF2 - h)/B_0$ (Bilitza, 1990). B_1 is set equal to 3 usually, while the thickness parameter B_0 is provided by the tabular values which have been deduced from ionosonde observations at few locations. Recommendations have been made recently to establish global plots and include new values in IRI of the B-parameters [Reinish and Huang, 1997; Zhang and Huang, 1998]. The present paper will show results from the MU radar IS measurements of the power profile for 1986-1992 at Shigaraki (34.85°N, 136.10°E). They are also compared with ionosonde results at Wuchang (30.5°N, 114.4°E).

DATA

The MU radar IS measurements of power profile operate normally with 4.8 km height resolution and 1 hour time resolution. We have not corrected the plasma temperature effects in deriving N_e profile from the power profile, which may cause an error less than 15 km. The data are grouped according to season and solar activity, i.e., 1986-1987 for low solar activity (LSA), 1989-1991 for high solar activity (HSA); November-February for winter, May-August for summer and others for equinox. The hourly data number is larger usually in HSA.

The "best" B_0 and B_1 are obtained by fitting the IRI profile to the measured power profile from the F_2 -peak to $h_{0.24}$ if no F_1 -layer exists or to the F_1 peak if F_1 -layer occurs. In general, these fits of the profiles are found to be fairly good.

THE IRI B-PARAMTERS

As shown in Figures 1-2, B_1 averages are found to be between 2-3, smaller by day and for LSA, and changing little with season. B_0 is between 70-120 km varying with season and solar activity. At HSA, it is larger for summer season than for winter, especially for daytime. It increases with solar activity.

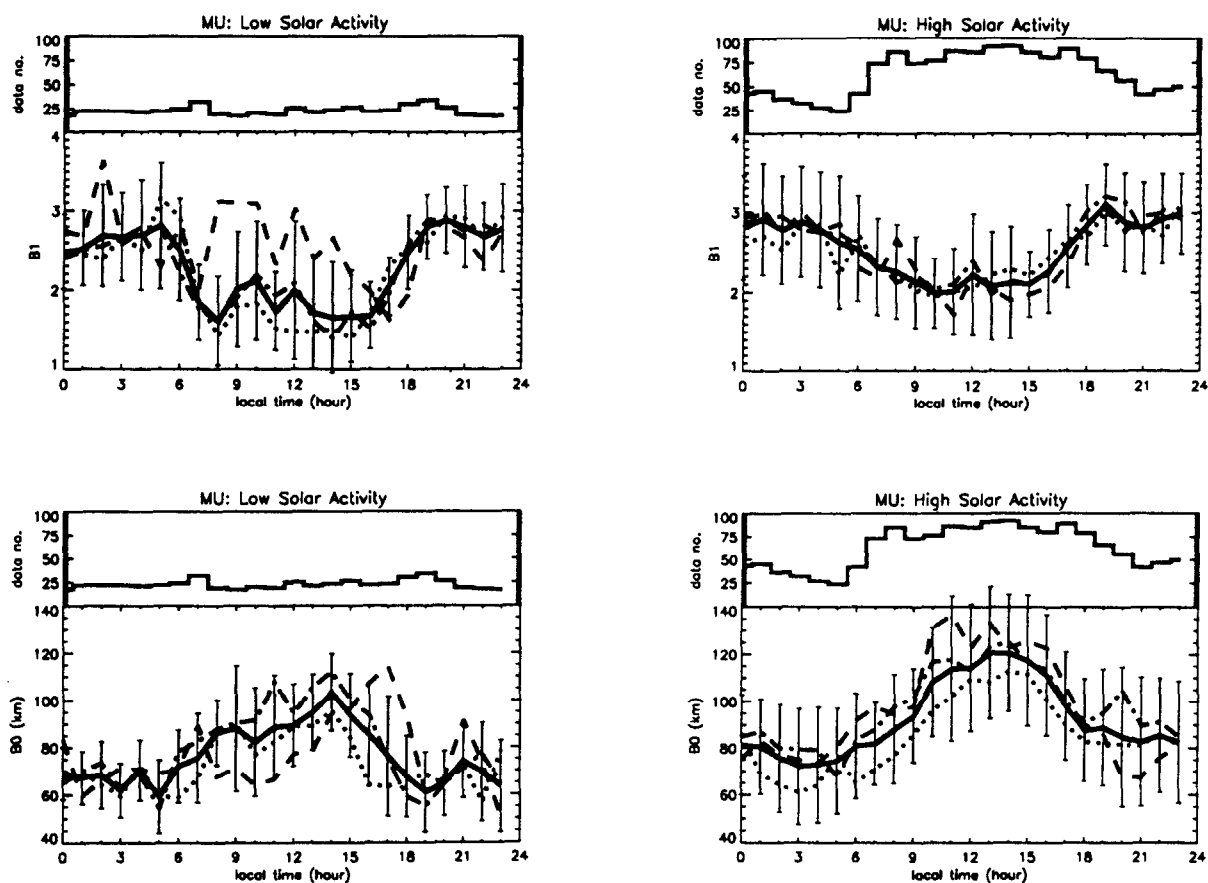


Fig. 1. Diurnal variations of B_1 and B_0 at low solar activity and high solar activity for summer (dashed), winter (dotted), equinox (chain). Given also are the yearly average (solid), its standard deviations and data numbers.

Empirical formulas are constructed to represent the HSA B_0 and B_1 as a function of local time, season:

$$B_0 / km = (5.25s + 12.08) \cos[1.32 \times 2\pi(t + 0.46s + 4.44) / 24] + 0.52t + 6.92s + 77.44$$

$$B_1 = 0.47 \cos[1.22 \times 2\pi(t - 1.65) / 24] + 0.01t + 2.41$$

(t , local time, hour; $s = 1, 2, 3$ for winter, equinox and summer)

The original data by day can be reasonably reproduced by the above model (Figure 2).

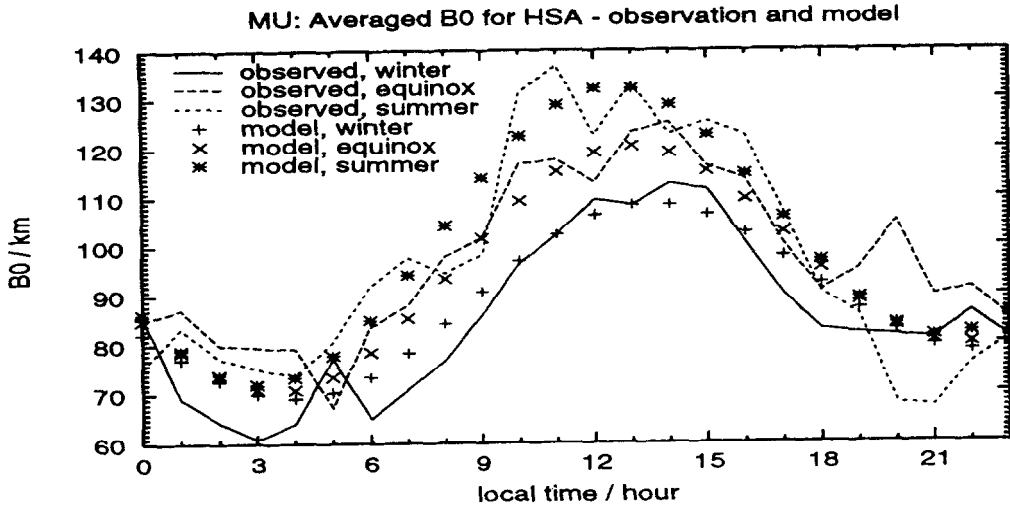


Fig. 2. A comparison of B_0 at high solar activity obtained with measurements and with the model.

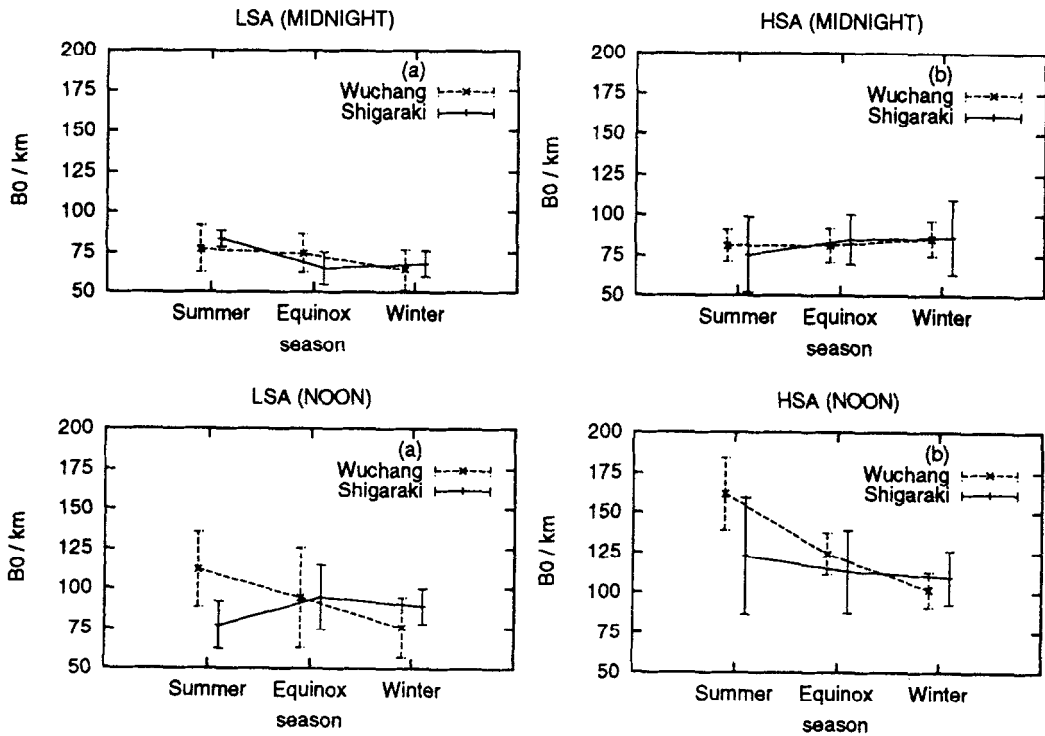


Fig. 3. A comparison of B_0 measured from Shigaraki and Wuchang at midday and midnight.

Compared with the ionosonde one for Wuchang, MU radar B_0 for Shigaraki at noon is smaller in summer but greater in winter; at midnight they are more or less close to each other (see Figure 3). For B_1 values, best agreements are found at midnight for LSA, at HSA, however, Shigaraki B_1 is near to 3 but Wuchang B_1 to 2 --- such a large difference could possibly be in part due to the lack of plasma temperature correction for the MU radar power profile data; at noon, the former is larger than the later, especially in summer and equinox (see Figure 4).

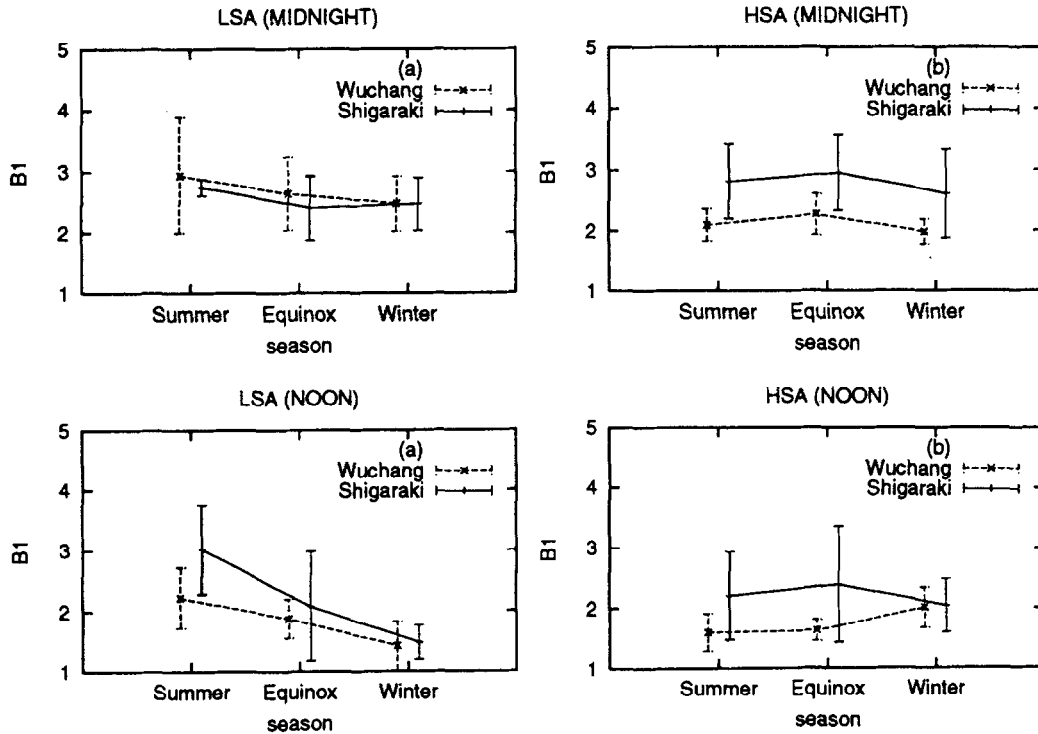


Fig. 4. A comparison of B_1 measured from Shigaraki and Wuchang at midday and midnight.

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REFERENCE

- Bilitza, D., International Reference Ionosphere 1990, National Space Science Data Center / World Data Center A for Rockets and Satellites, NSSDC/WDC-A for Rockets and Satellites, Greenbelt, Md., U.S.A., 90-22 (Nov. 1990).
- Zhang S.-R. and X.-Y. Huang, Variations of bottomside electron density profile parameters obtained from observations at Wuchang, China, *Adv. Space Res.*, 22, (6)749-(6)752 (1998).
- Reinisch B. W., and X. Huang Fitting the IRI F2-profiles to measured profiles, in Proceedings of the IRI Task Force Activity 1996, edited by S. M. Radicella, ICTP, Trieste, Italy (May 1997).