Day-to-day correlation of equatorial electrojet at two stations separated by 2000 km

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Abstract. Day-to-day fluctuations of the daily range of the geomagnetic field H at the equatorial electrojet stations Ancon (ANC, 77.0° W) and Sao Luis (SLZ, 44.2° W) are described for the period January–June 1993. The H field started increasing between midnight and sunrise, reaching a peak shortly before noon. The daily range of H was maximum during March and April and minimum during June. Regardless of the month, the range in H was significantly larger at ANC than at SLZ. The 27-day running mean of the range of H varied from 80 nT to 125 nT at SLZ and from 105 nT to 180 nT at ANC. The day-to-day values of the range of H showed very faithful variations at the two stations. The deviations of the daily range of H from its 27-day running mean values showed good correlation between the two stations. Some large storm-time effects were seen at both stations. The correlation was still significant, when data were corrected for \( D_s \) index values. It is suggested that the range in H at the two electrojet stations, separated by more than 2000 km, are affected by some common sources other than the ring current, which need to be identified. Spectral analysis of the range of H shows remarkable similarity at the two stations, with a dominant period of 15 days at both stations.

Keywords. Ionosphere (Electric fields and currents; Equatorial ionosphere; Ionosphere-atmosphere interactions)

1 Introduction

The daily variations of the Earth’s magnetic field at the ground stations were suggested by Stewart (1882) as due to the movement of the conducting upper atmosphere across the vertical component of the Earth’s magnetic field arising due to the solar heating of the atmosphere. Chapman (1919) suggested that the regular tidal movement of the atmosphere across the Earth’s magnetic field generates a regular pattern of electric field in the upper atmosphere, which causes currents that produce regular magnetic field variations at the ground. The discovery of the enhancement in the daily variation of the horizontal field, H, within a narrow belt of latitudes over the equator (Egedal, 1947), was explained by Chapman (1951) as due to an eastward current in the E-region of the ionosphere with a latitude belt of ±3° centered over the dip equator. This phenomenon, known as equatorial electrojet (EEJ), could not be explained by assuming an enhancement of either the electric field or the electron density over the dip equator. Thus, the same Sq electric field at low latitudes outside the electrojet belt can cause a larger current over the magnetic equator due to increased electric conductivity (Baker and Martyn, 1953).

The equatorial electrojet depends both on the maximum electron density of the E-region, \( N_m \), as well as the electric field E. Rastogi (1993) showed that the solar cycle variation of the daily range of H, \( R_H \) at Huancayo and Kodaikanal depend mostly on the corresponding variation of \( N_m \), with little effect from any variation of the electric field. The seasonal variation of \( R_H \) after correction due to the variation of \( N_m \) depends on the corresponding variations in the electric field. The daily variation of \( R_H \) depends on the product of \( N_m \) and E. The equatorial electrojet is affected by a temporary increase in the ionization during solar flares, increasing \( \Delta H \) during normal and decreasing it during counter-electrojet periods (Rastogi, 1999, and references therein). Slowly varying, as well as rapidly changing parameters of solar wind cause an imposition of the electric field on the equatorial ionosphere, thus triggering changes in the equatorial electrojet (Rastogi, 2006).