Imprint of equatorial electrodynamical processes in the OI 630.0 nm dayglow

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Received 25 March 1999; received in revised form 2 August 1999; accepted 13 August 1999

Abstract

Results from coordinated measurements of OI 630.0 nm dayglow intensities (centered on ~220 km altitude), along with VHF (50 MHz) coherent backscatter returns from Thiruvananthapuram, a dip equatorial station in India, revealed that the temporal variability at short periods (< 4 h) of the Doppler frequency of the coherently backscattered 50 MHz radar signal in the electrojet region (~101 km altitude) preceded the dayglow variations. The time delay was found to be inversely related to the electric field magnitude inferred from the Doppler frequency and also with the independently estimated electrojet strength inferred from the ground magnetic data. These results are presented as direct evidence for the prevailing electrodynamical coupling between the E- and F-region of the ionosphere over the dip equator. © 1999 Elsevier Science Ltd. All rights reserved.

1. Introduction

The E- and F-regions of the equatorial ionosphere are known to be controlled by electrodynamical forcings which are responsible for the generation of a variety of processes like the Equatorial Electrojet (EEJ) and also one of its manifestations, namely the Counter Electrojet (CEJ), the Equatorial Ionization Anomaly (EIA), and the nighttime phenomenon of Equatorial Spread-F (ESF) (Forbes, 1981; Raghavarao et al., 1988b; Fejer and Kelley, 1980, and the references cited therein). The strength of the EEJ is usually inferred from the differences between the average nighttime value and the instantaneous daytime value of the horizontal component of the geomagnetic field (ΔH) from two stations, one over the dip equator and another well away from the EEJ belt. For the Indian zone, Thiruvananthapuram (0.3°N dip latitude) and Alibag (13.2°N dip latitude) are usually considered, and ΔHTRD−ΔHABG is taken to be a measure of the intensity of the EEJ at any instant (Rastogi and Patil, 1986). On certain occasions the (ΔHTRD−ΔHABG) values go below the average nighttime values and this is referred to as the CEJ when the primary electrojet current is believed to change its direction from eastward to westward (Rastogi, 1973) or as a partial CEJ when the electrojet intensity decreases for some time before reverting back, not necessarily crossing below the nighttime values. During such CEJ events, the associated electrodynamical effects are severely affected.

The zonal electric field is treated to be nearly altitude independent though the irrotational nature of the E-field requires a small altitude variation (Murphy and