Conjugate Point Equatorial Ionospheric Responses under Quiet and Disturbed Conditions from the COPEX Observational Campaign in Brazil

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Abstract:
A conjugate point equatorial observational campaign (COPEX) involving digisondes and different complementary instruments was conducted in the western longitude sector of Brazil during October to December 2002. The campaign objective was to investigate the conditions of equatorial spread F/plasma bubble irregularity (ESF) generation conditions in terms of the ambient ionospheric properties along the magnetic flux tubes in which they occur.

Introduction

The ambient conditions that control the equatorial plasma bubble developments are determined by a variety of processes and related phenomenology of the equatorial ionosphere-thermosphere system. The most important of them are: (a)-the ionospheric dynamo electric fields and the associated plasma fountain and the equatorial ionization anomaly; (b)- the zonal, meridional and vertical components of the thermospheric neutral wind; (c)- the ionospheric conductivity spatial distribution, especially, the longitudinal gradient that occur across the sunset terminator, that determine, through interaction with the thermospheric zonal wind, the post sunset zonal electric field enhancement; (d)- disturbance electric fields, arising from the solar wind-magnetosphere shock events and high latitude processes, that penetrate to equatorial latitude, and that arising from the disturbance dynamo effects; and (e)- atmospheric gravity waves propagating up from their possible sources in tropospheric disturbances. The precise identification of the specific roles of all these factors in a given plasma bubble event is a difficult task because of the difficulty to acquire simultaneous and adequate data sets representing these diverse parameters. The items (a), (b), and (c) constitute the most investigated and therefore identified possible immediate causes of the quiet time plasma bubble development and its day to day variability. They operate under conditions of the strong electrical and electrodynamical coupling that characterize the equatorial F region and its conjugate (low latitude) E layers, connected by the highly conducting magnetic field lines. Thus, the field line integrated parameters determine the growth rate of the generalized Rayliegh-Taylor instability process believed to be responsible for the plasma bubble irregularities development. These processes are in turn controlled by the symmetry-asymmetry conditions of the equatorial ionization anomaly and the conductivity distributions at the conjugate lower ionospheric regions.

Results

The COPEX digisonde observations permitted field line mapping of the conjugate E layers to dip equatorial F layer peak/bottomside. Extensive ionospheric measurements were carried out at the two conjugate stations and over the dip equator with the objective to investigate the possible causes of the day-to-day variability in spread F/plasma bubble development. The analysis of the data set should help identify for a given ESF event the possible roles of the different factors that could contribute to its development as mentioned above. In this paper we present some preliminary results of analysis of a part of the data collected during the COPEX campaign.

The daytime and post sunset equatorial anomaly developments in terms of the conjugate point symmetry/ asymmetry conditions would appear to control (based on the presently believed mechanism for instability growth) a post sunset ESF development. Therefore a better understanding of the equatorial ionization anomaly development and related ionosphere-thermosphere dynamics under quiet conditions is an important requirement towards our stated objective of ESF investigation. In Figure 1 we present the critical parameters of the F layer, that is, foF2 and hmF2, over Boa Vista and Campo Grande, the two conjugate stations, and over Cachimbo, the dip equatorial stations. These results correspond to the four quietest days of the COPEX campaign. The quiet-time characteristics of the EIA development can be understood from this figure. These results will be compared with similar results under magnetically disturbed conditions. Other relevant features as well as the related conjugate F layer dynamics will be presented and discussed in this paper.

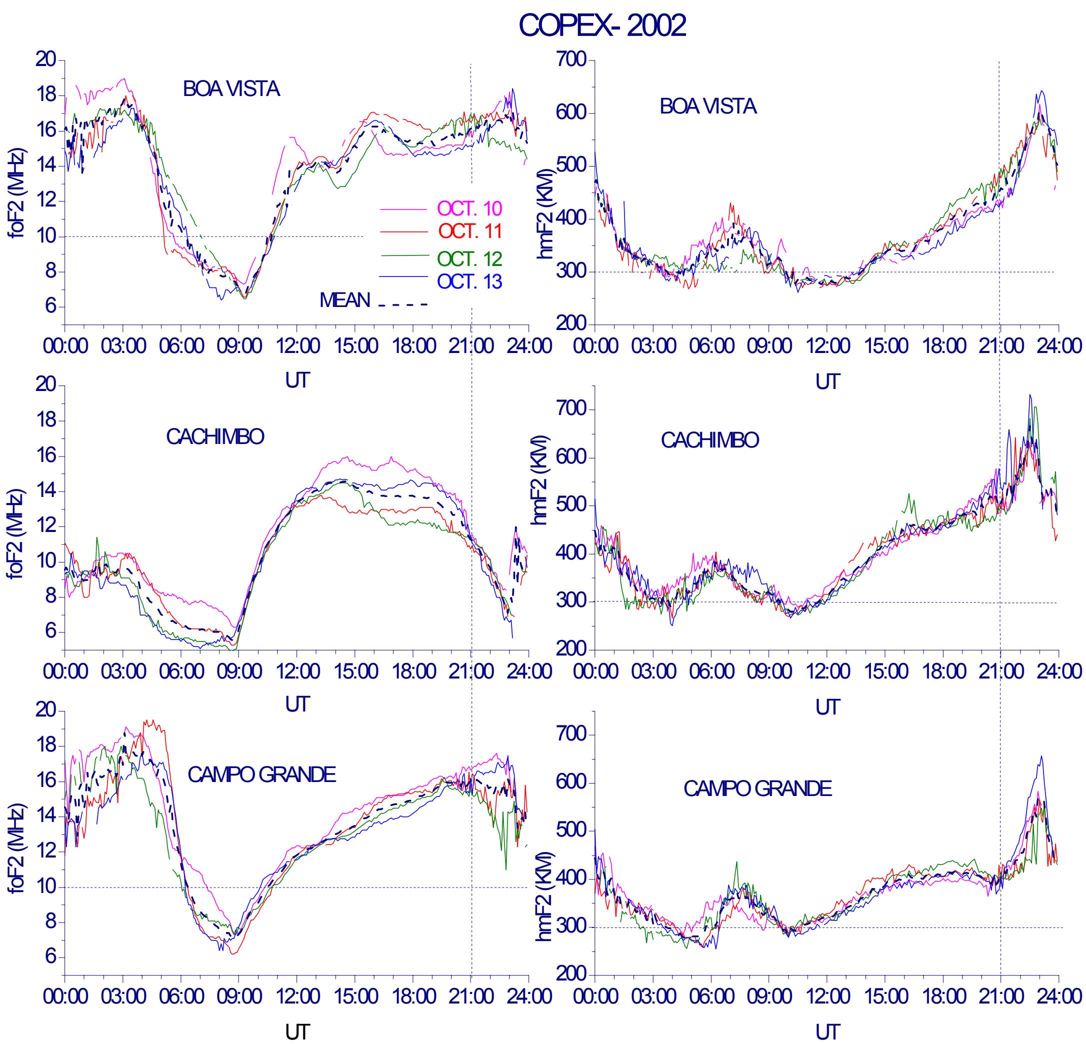

Figure 1- Local time variation (plotted in UT) of the F-layer critical frequency (foF2) and the peak height (hmF2) over the three stations (Boa Vista, RR, Cachimbo, Pa and Campo Grande, MG) during the 4 quietest days of the COPEX campaign. The evening (after 21 UT) hmF increase associated with the prereversal zonal electric field enhancement and the associated EIA development (in foF2), as precursors to ESF development (not shown here) can be noted.

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Conclusions

The concusions will be presented after completing further analysis of the data.

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References