Ionospheric response to two intense geomagnetic storms over South American using GPS measurements

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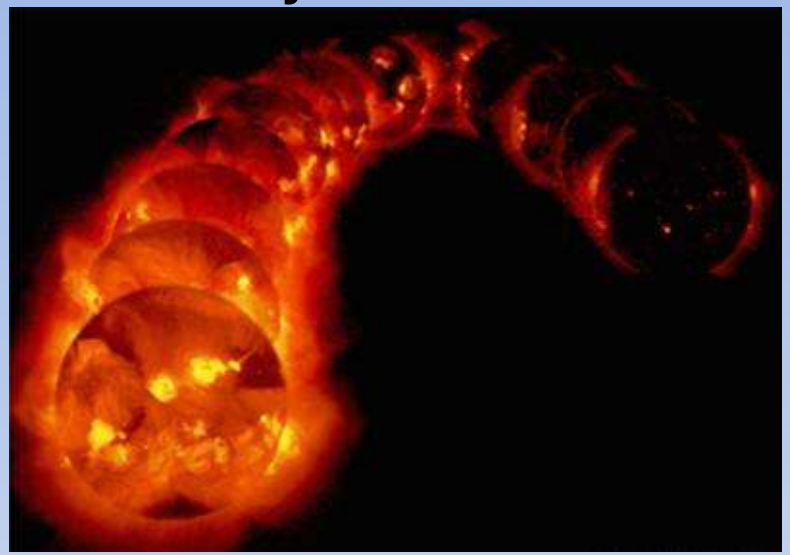
Objective

To study the behavior of the ionospheric F layer in equatorial and low latitude regions during occurrences of:

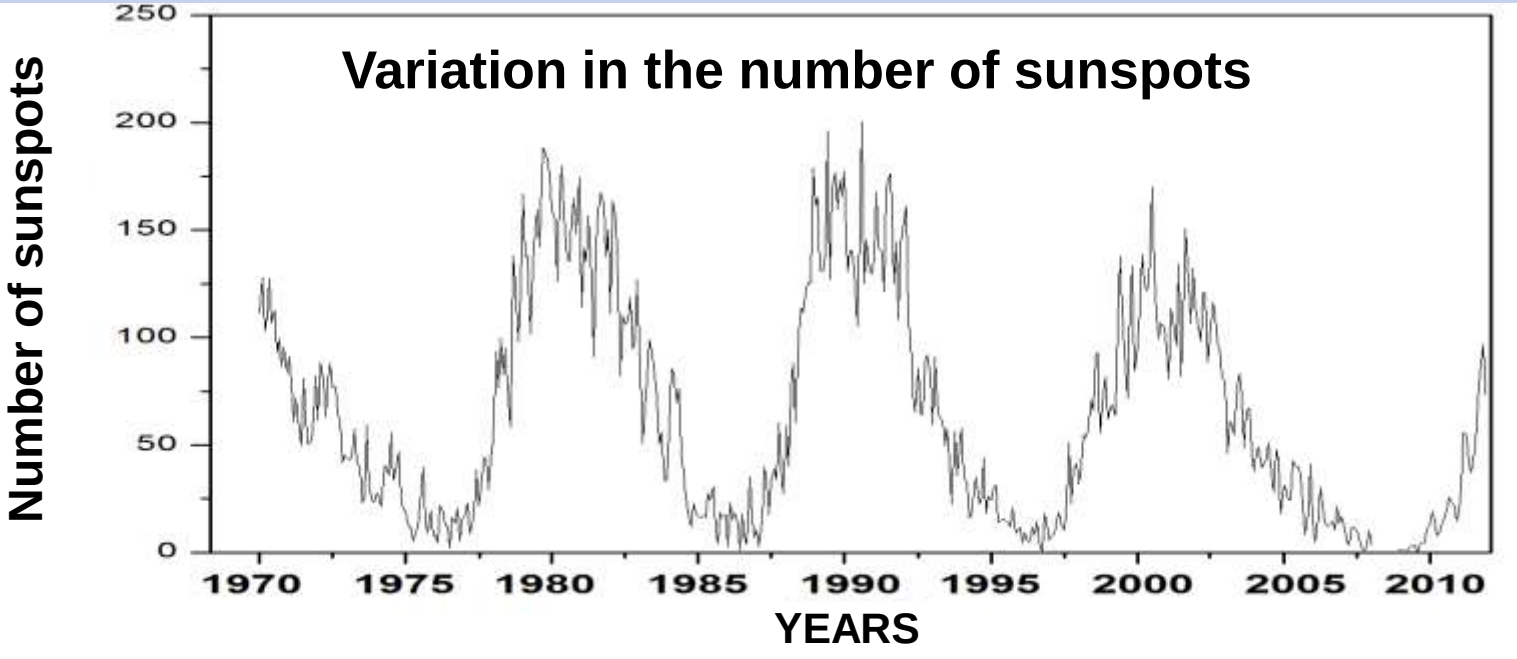
- Geomagnetic Storms

INTRODUCTION

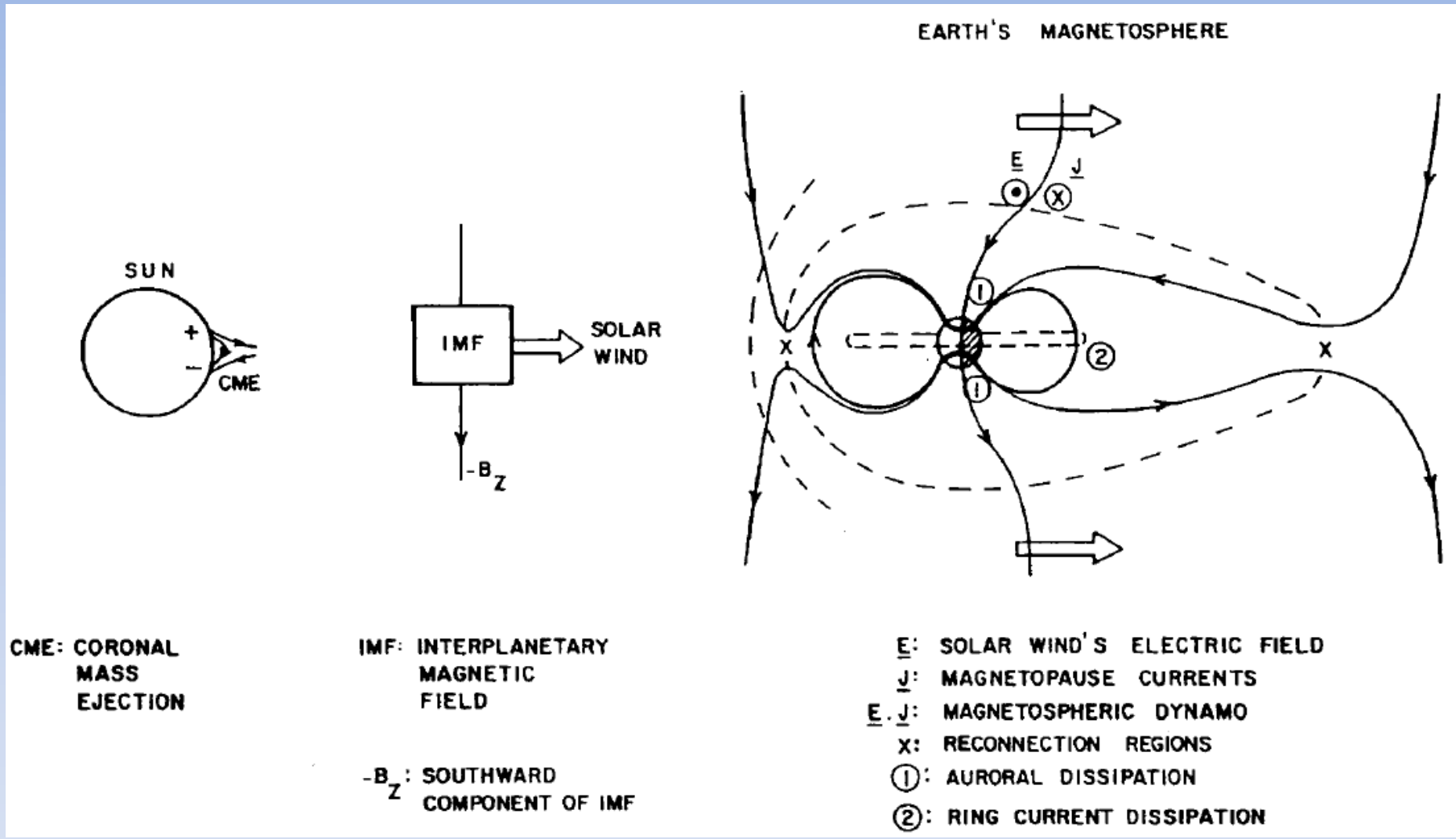
Solar cycle variation



Reference: NASA

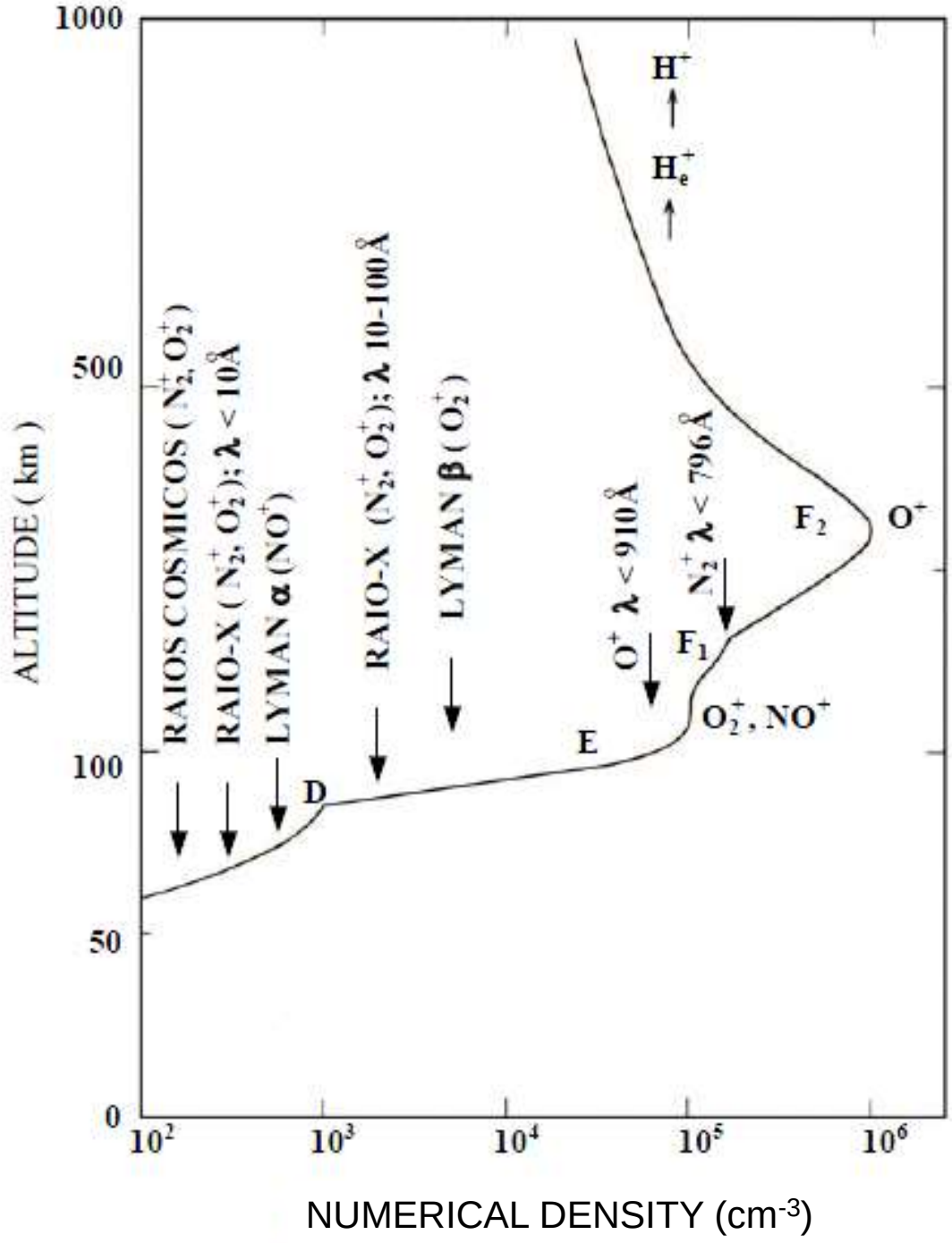


Geomagnetic Storm



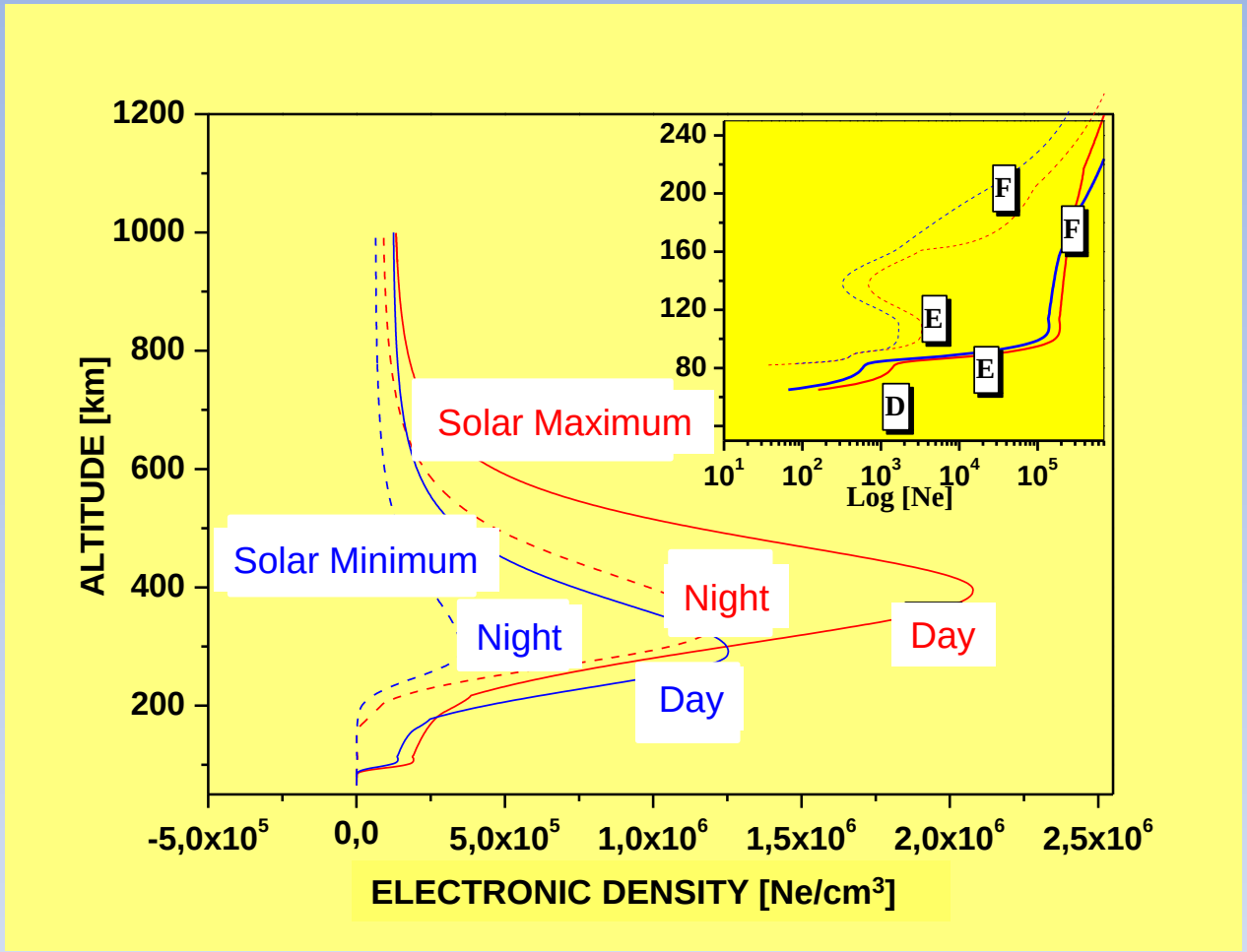
Reference: Tsurutani e Gonzalez (1997)

Earth Ionosphere



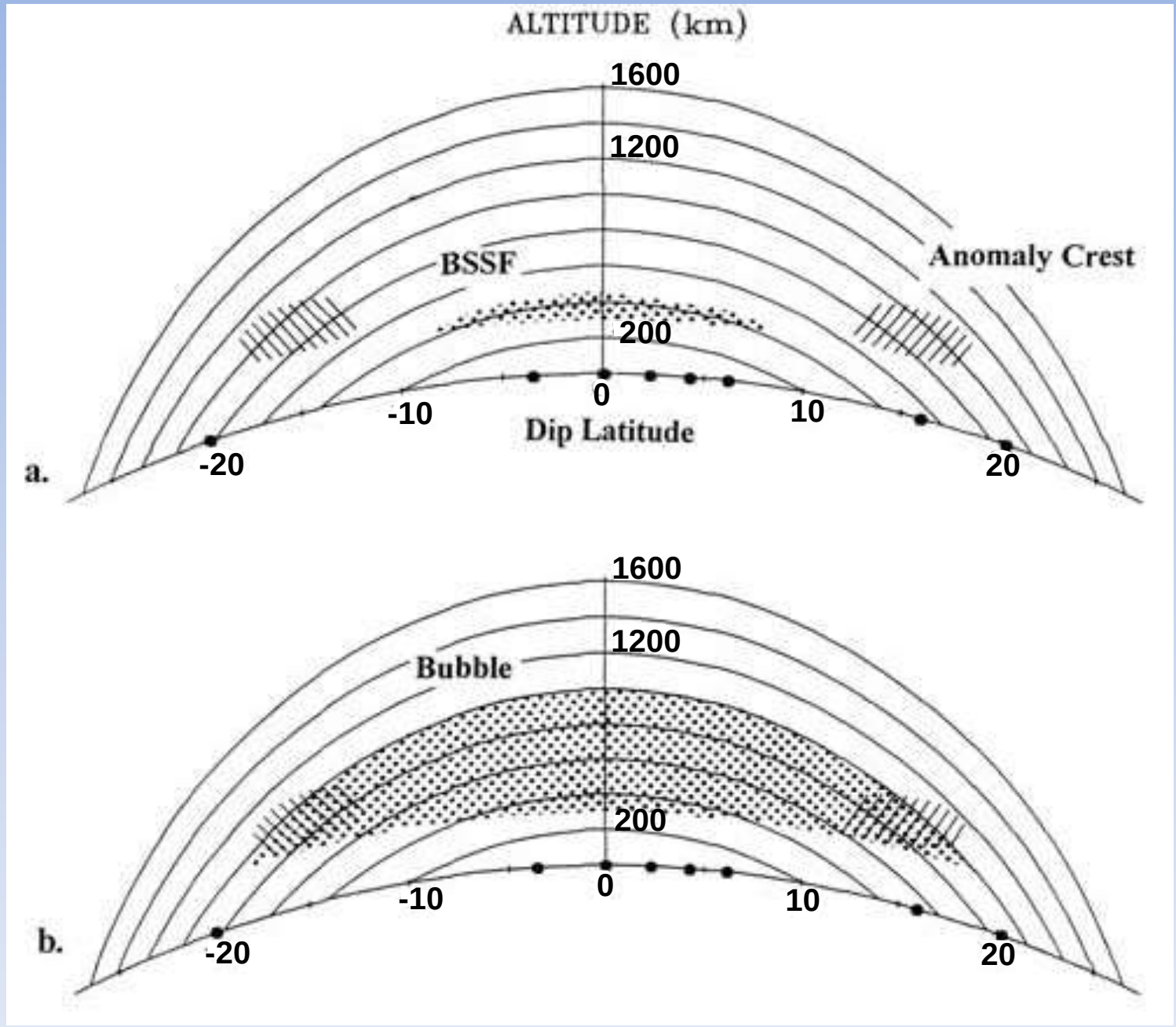
Region F is ionized by EUV radiation (26-34 nm) (KANE, 2006).

Reference: Banks (1973, p. 13) apud Pimenta 2002.



The vertical profile of the ionospheric layers D, E and F on conditions of maximum (day and night) and minimum (day and night) solar activity (results obtained with the International Reference Ionosphere model, IRI-2001).

EQUATORIAL IONOSPHERIC IRREGULARITIES



Reference: Whalen (2002)

INSTRUMENTATION

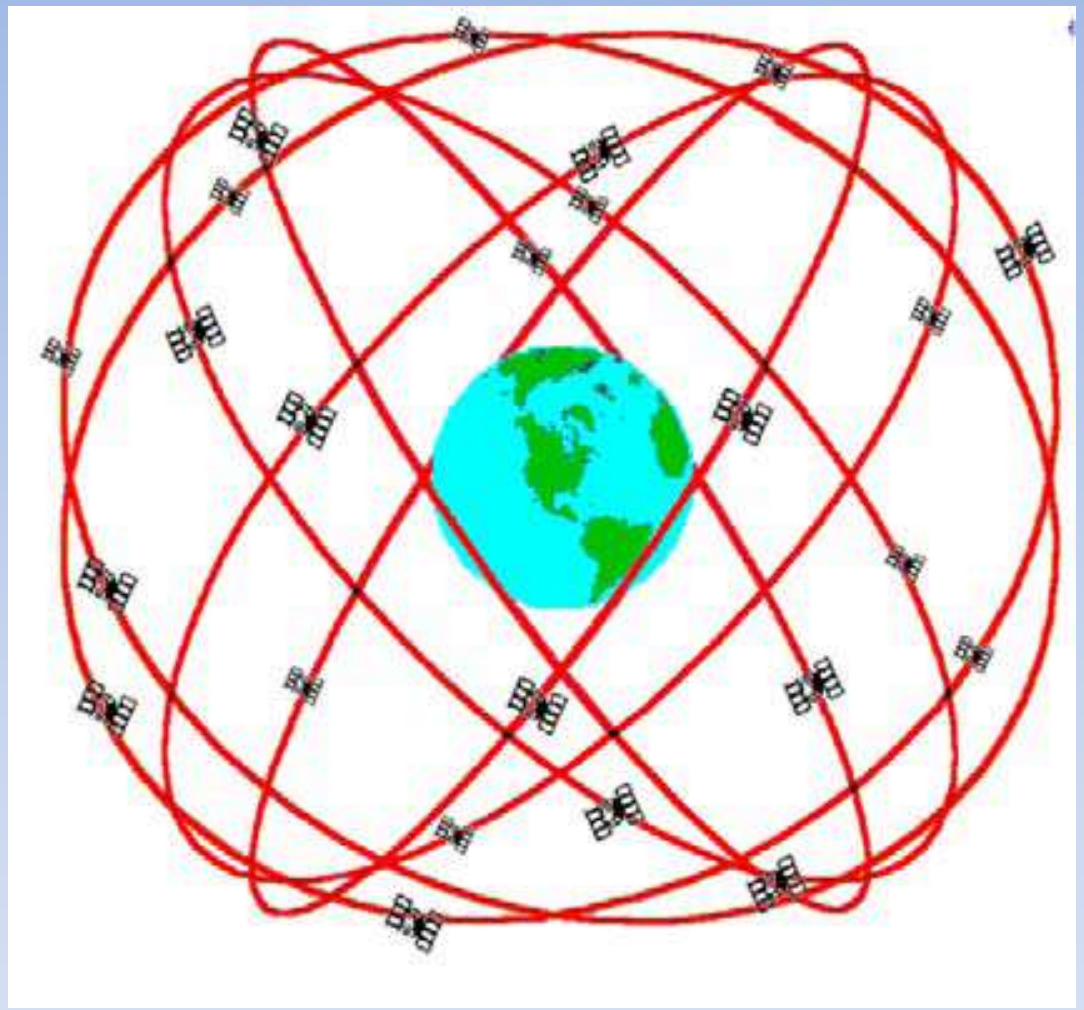


Illustration of the constellation of 24 satellites of the GPS system

Reference: Dana (2000) apud de Abreu (2007).

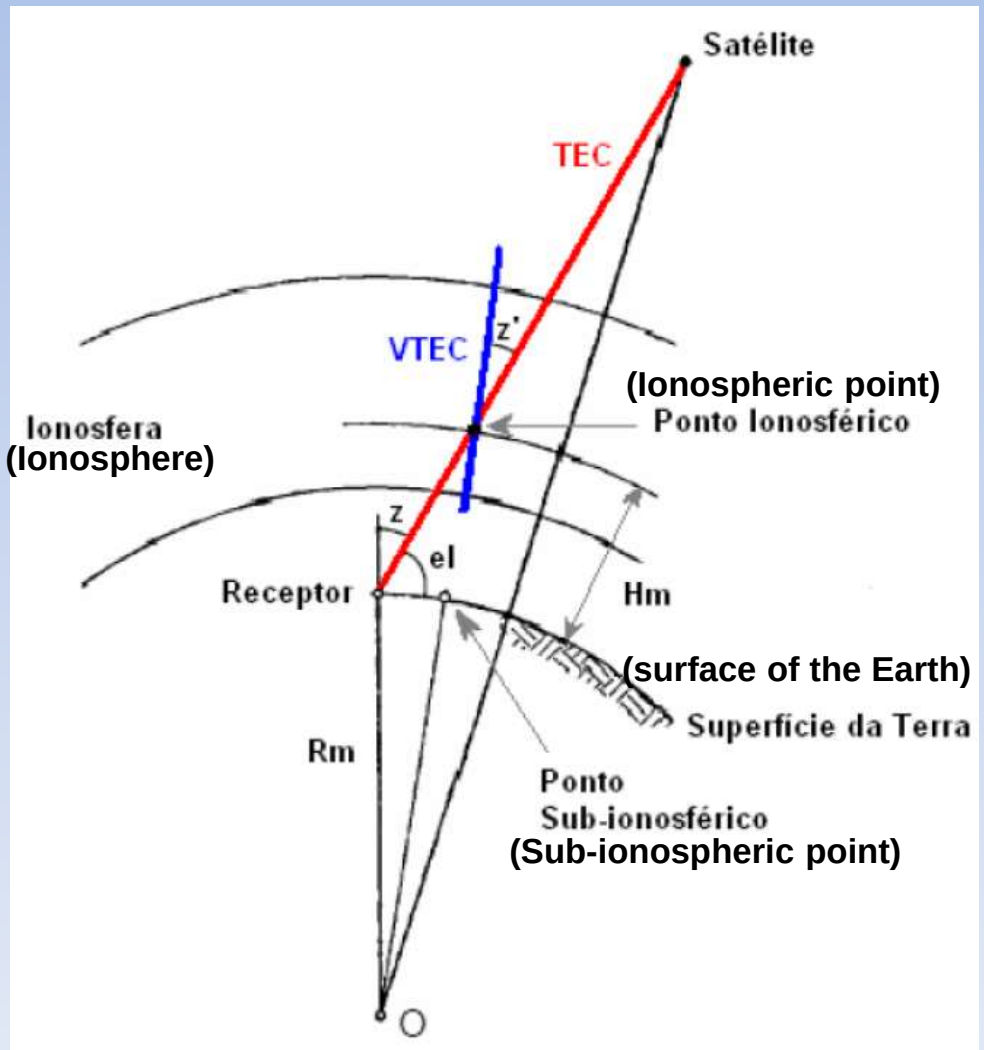
Total Electron Content (TEC) – Conteúdo Total de Elétrons

The TEC is related to the electron density contained in a cylindrical column that extends from the receiving antenna (R) to the satellite (S), where the base area is unitary. The TEC can be given by (KLOBUCHAR, 1991):

$$TEC = \int_{R}^{S} n_e ds$$

$$VTEC = \cos(z')TEC$$

$$sen\ z' = \frac{Rm}{Rm+Hm} sen\ z$$



Rate of TEC (ROT) or phase fluctuations

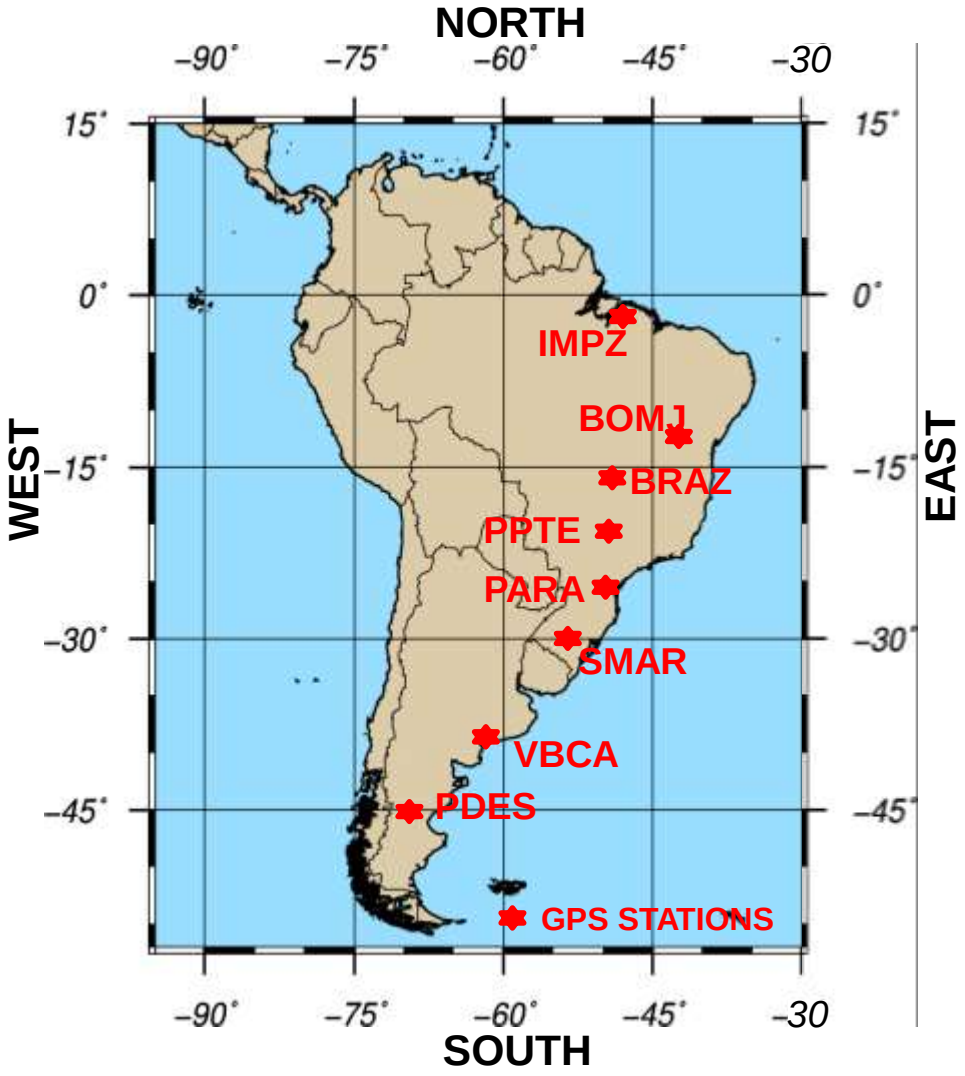
The rate of change of TEC (ROT) is useful for tracing the presence of the ionospheric irregularities of the order of kilometers (Aarons et al., 1996). The ROT is defined as:

$$ROT = \frac{\Delta TEC}{\Delta t}$$

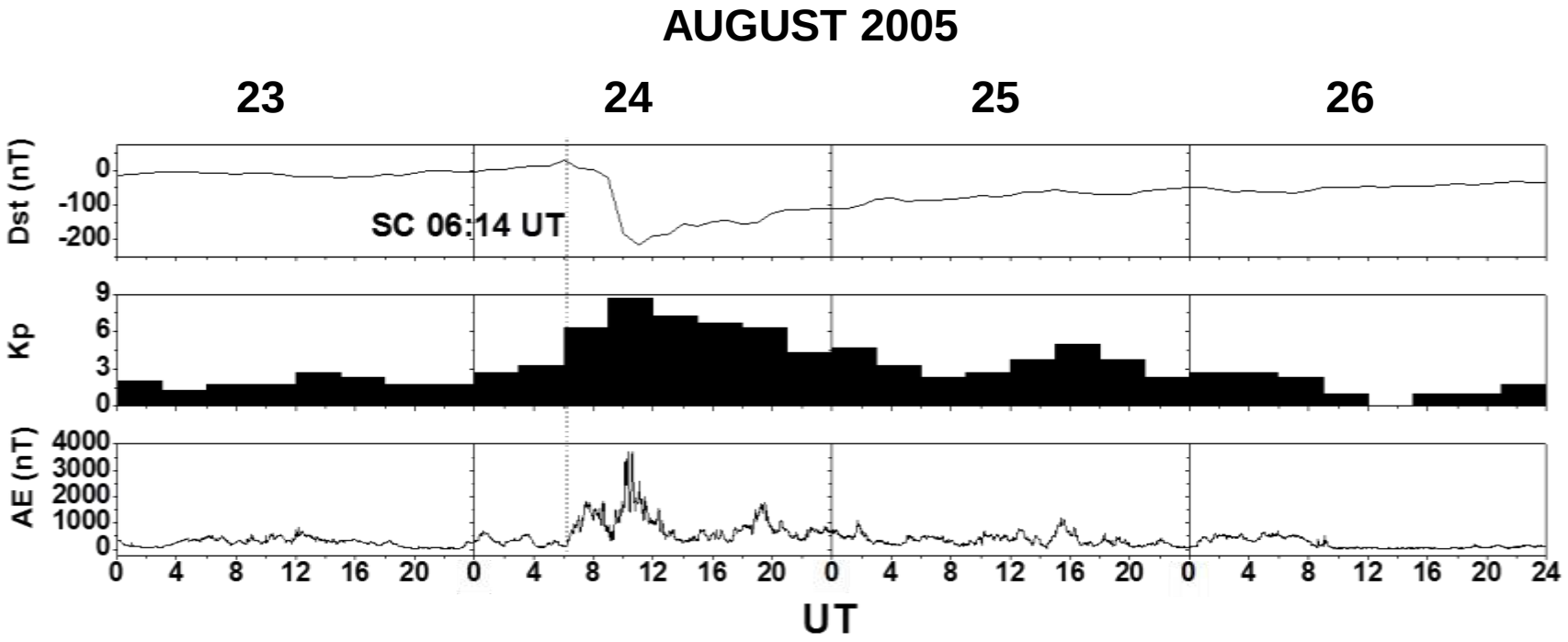
RESULTS

In this work the ionosphere response was investigated during:

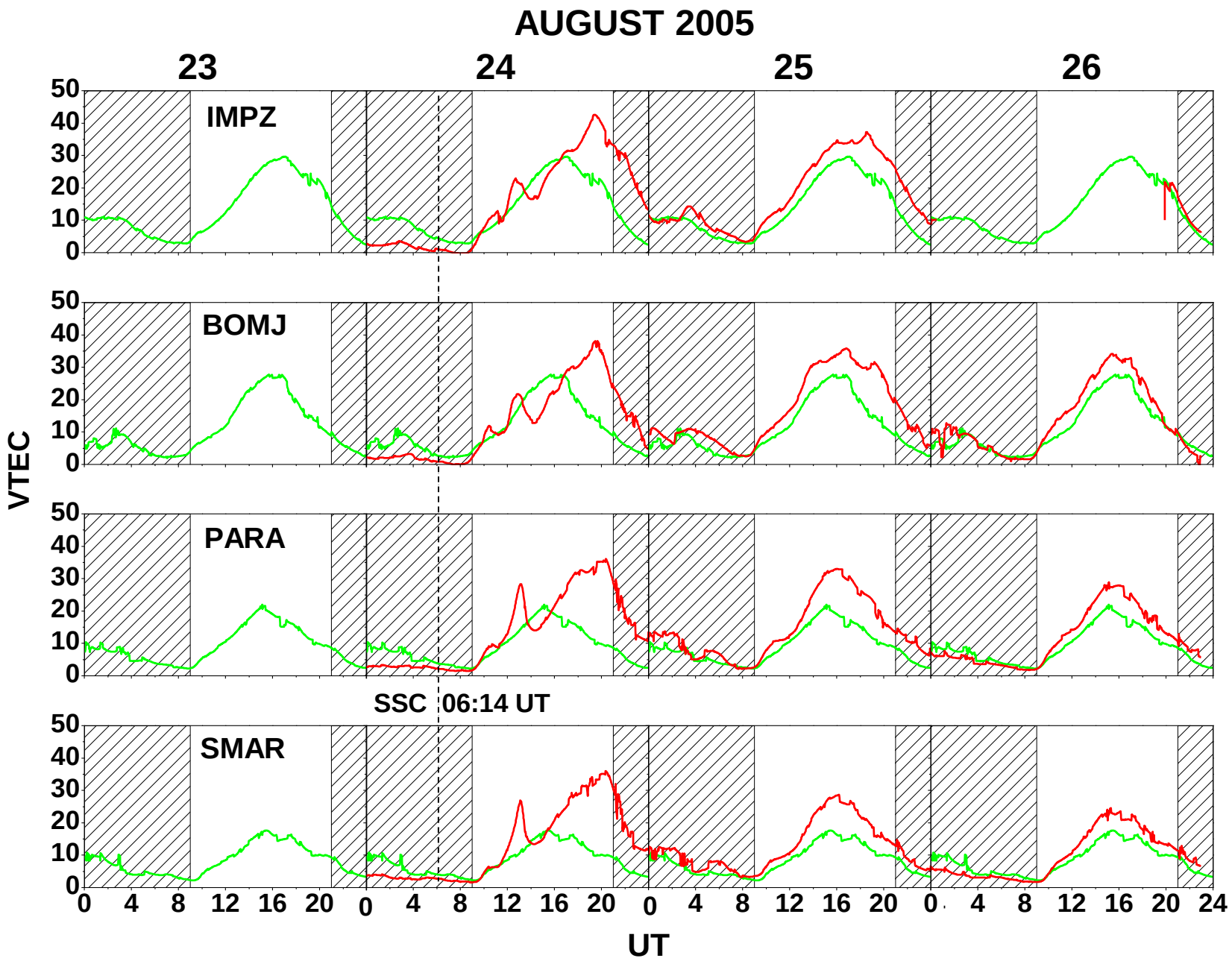
1) Two geomagnetic storms that occurred on 24/08/2005 and 14/12/2006



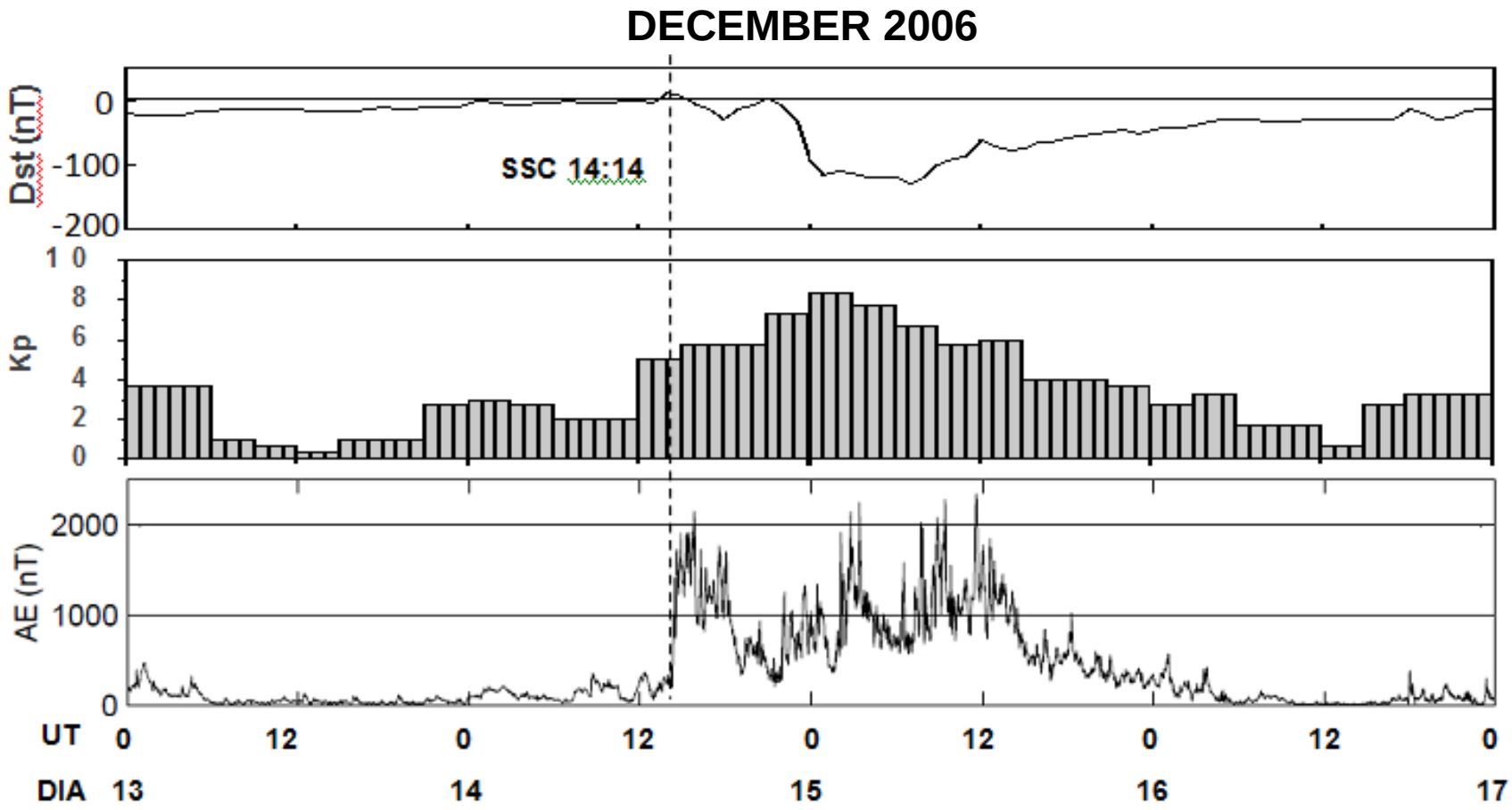
Location	Station code	Dip. Lat.
Imperatriz, Brasil	IMPZ	02,4ºS
Bom Jesus da Lapa, Brasil	BOMJ	11ºS
Brasília, Brasil	BRAS	11,3ºS
Presidente Prudente,Brasil	PPTE	14,6ºS
Curitiba, Brasil	PARA	18,2ºS
Santa Maria, Brasil	SMAR	19,6ºS
Bahia Blanca, Argentina	VBCA	23,1ºS
Puerto Deseado, Argentina	PDES	28,2ºS



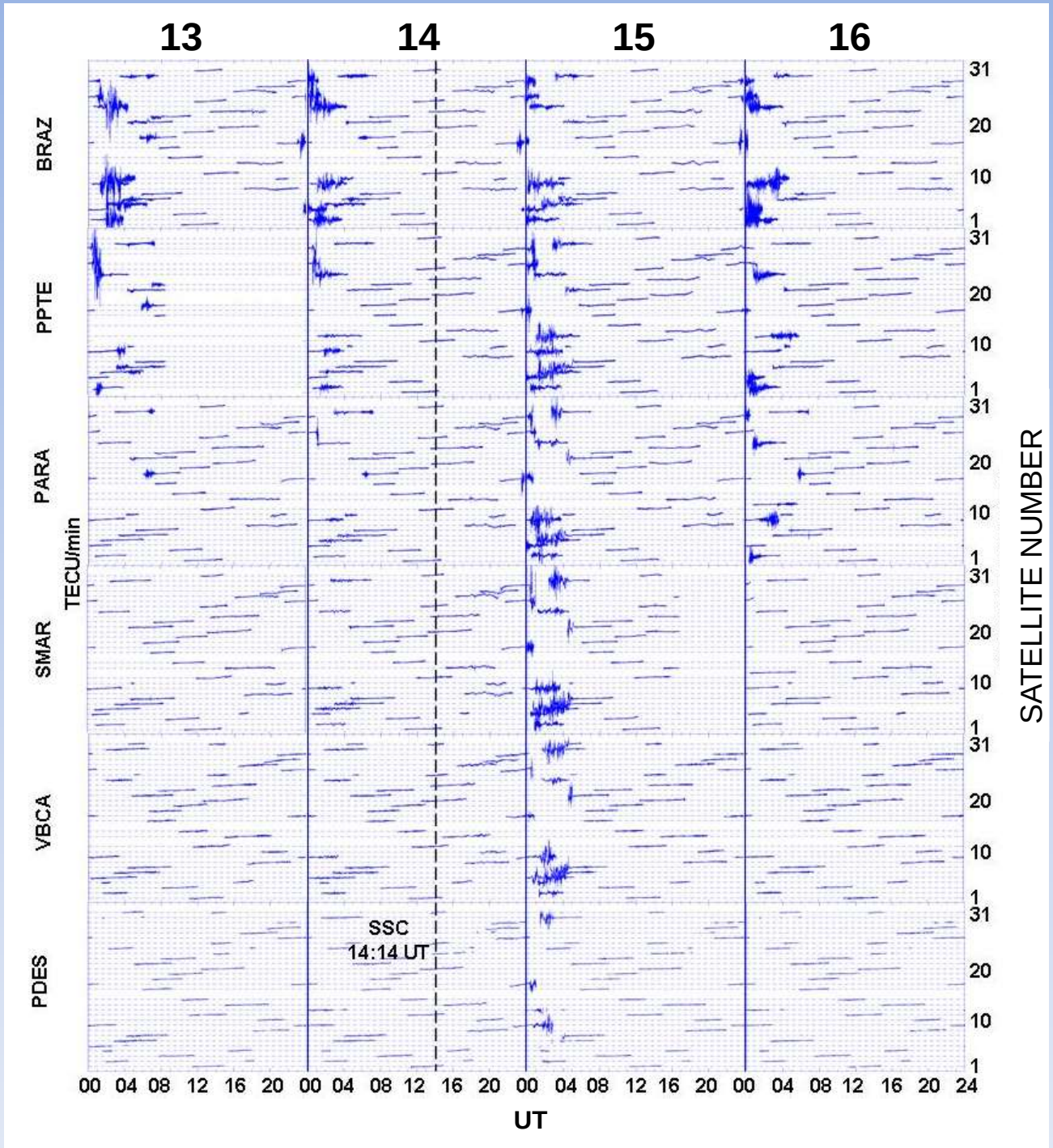
Reference: de Jesus et al. (2012)



Reference: de Jesus et al. (2012)

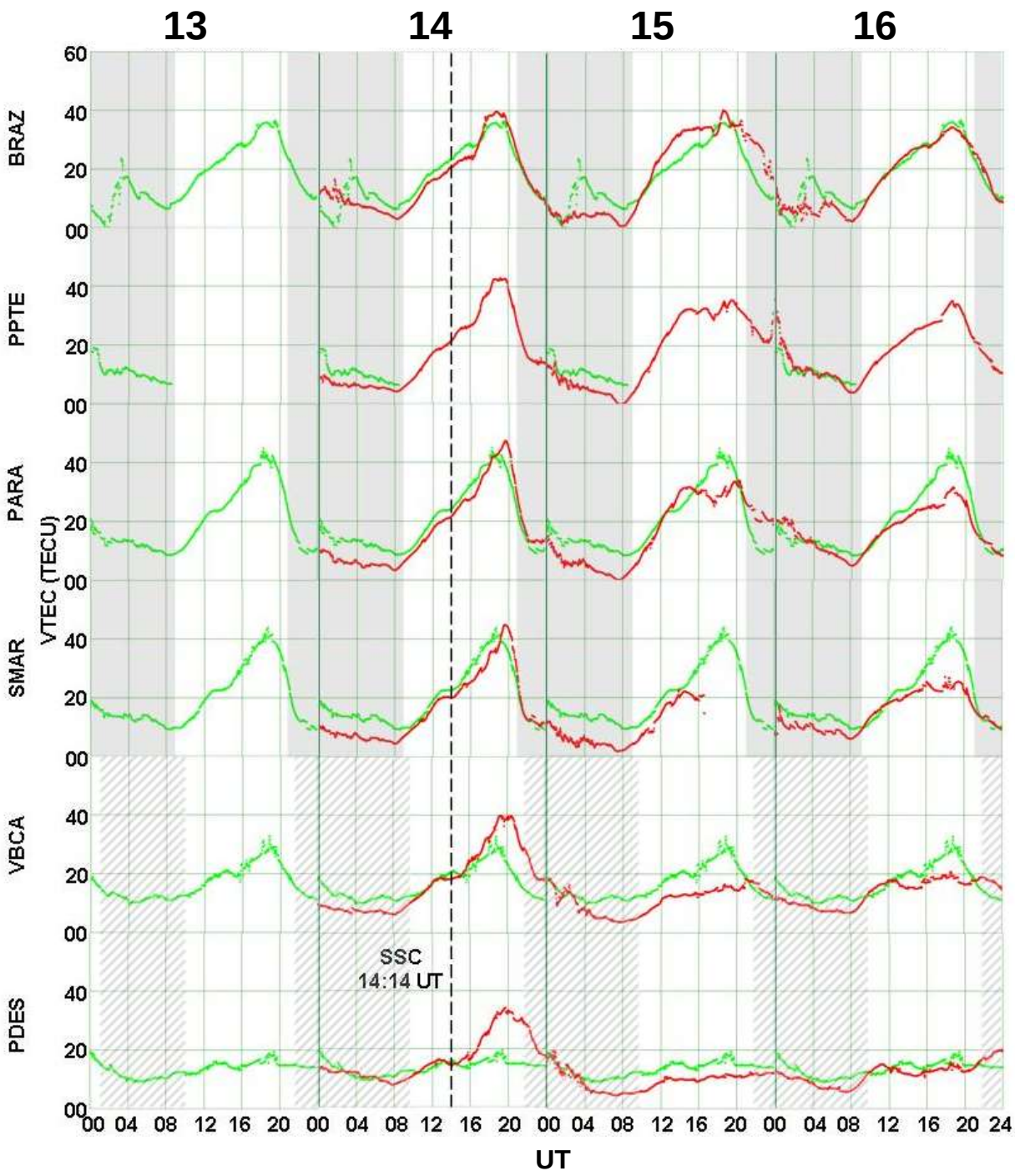


Reference: de Jesus et al. (2010)



DECEMBER 2006

Reference:
de Jesus et al. (2010)



DECEMBER 2006

Reference:
de Jesus et al. (2010)

CONCLUSIONS

The effects observed during the geomagnetic storms were varied in the ionosphere. The observed effects include:

- Positive ionospheric storm (VTEC) in GPS stations associated with major changes in the circulation of winds.

- Negative ionospheric storm in the South American sector, probably due to changes in the O / N2 rate in this sector.

- Generation of equatorial ionospheric irregularities in the F region.

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THANK YOU !