First detection of giant plasma bubble by CSES-01 satellite

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Roma Tor Vergata

The August 25, 2018 geomagnetic storm



Plasma bubble detection by CSES-01 and Swarm A satellites



Calibration of CSES-01 electron density data

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$$N_{e,cal} = N_e \cdot 1,35 \cdot 1,5$$
 (1)

THEMIS-E observations ^{a)}

6

August 26, 2018 THEMIS-E Observations









Farris, M.H., Russell, C.T., 1994. Determining the standoff distance of the bow shock: Mach number dependence and use of models. J. Geophys. Res. 99, 17681. https://doi.org/10.1029/94JA01020.

Link between impulsive variation of the solar wind pressure and the observed plasma bubble generation

Delay time between CSES-01 and THEMIS-E observations

 $T_E = 21 \pm 1 \min$

Delay time between satellite observations in the interplanetary space and ground-based measurements

N_e (m⁻³)

Latitude

 $T_D = T_A + T_{B,M} + T_{Alf} + T_T + T_R + T_{Trans}$

 T_A Advection time of solar wind to travel from satellite to Earth's bow shock

 $T_{B,M}$ Propagation time from the bow shock to the magnetopause

 T_{Alf} Travel time along magnetic field lines from magnetopause to polar ionosphere

 T_T Time needed by interplanetary electric field to cross the magnetosphere

 T_R Reconfiguration time of the magnetosphere-ionosphere system

 T_{Trans} Propagation time from the high latitudes to the equatorial ionosphere

$T_D = 20, 2 \pm 2, 0 min$

6



Prompt Penetrating Electic Field causing ionospheric uplift



Remarks

Data from CSES-01, Swarm A and THEMIS-E satellites are analysed to investigate the possible origin of a significant post-midnight Equatorial Plasma Bubble (EPB) occurred on August 26, 2018 over western Africa, during the main phase of a geomagnetic storm.

- The proposed multi-instrumental approach allows supporting the hypothesis of a direct link between an impulsive variation of the solar wind dynamic pressure, observed by THEMIS-E, and the deep EPB observed by CSES-01 and Swarm A.
- The comparison between the time at which the EPB is recorded by CSES-01 and the time at which THEMIS-E detected the solar wind structure supports the idea that the impulsive variation of the solar wind pressure triggered an eastward Prompt Penetrating Electric Field, which, propagating from high to equatorial latitudes, caused the ionospheric plasma uplift.
- The comparison between Swarm A and CSES-01 observations suggest that the observed EPB was a real "fresh" bubble generated right in the post-midnight sector.
- Moreover, the comparison between Swarm A and CSES-01 observations highlights the higer capability of CSES-01 langmuir probe to record deep electron density depletions with respect to Swarm langmuir probe.