

# A LOCAL TIME VARIATION OF OCCURRENCE OF EQUATORIAL PLASMA BUBBLE DURING THE GEOMAGNETIC STORM FOR THE PERIOD OF EIGHT YEARS FROM 2015 TO 2022

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## ABSTRACT

This study investigates the local time variation of equatorial plasma bubble (EPB) occurrence during geomagnetic storms over an eight-year period, spanning from 2015 to 2022. Using data from SWARM, this research analyzes the temporal distribution of EPBs at the equatorial region and their correlation with geomagnetic storm activity. The study reveals distinct patterns in the occurrence of EPBs during different phases of geomagnetic storms, including the storm's initiation, main phase, and recovery period.

## INTRODUCTION

An equatorial plasma bubble is a phenomenon that occurs in the lower latitude of the Ionosphere which depletes the plasma density.

- Rayleigh-Taylor instability
- PPEF and DDEF
- Effects the satellite based communication and space based navigation systems such as GNSS (Global Navigation Satellite Systems).

## OBJECTIVES

### GEOMAGNETIC STORM AND DST INDEX

Geomagnetic storm are the temporal disruptions in Earth's magnetosphere, caused by solar winds, CME etc. Geomagnetic storms enhances the ionospheric disturbances, resulting in formation of EPBs.

### SWARM

Swarm mission, provided by European Space Agency (ESA). The mission consists of 3 satellites: *Swarm Alpha (A)*, *Swarm Bravo (B)*, and *Swarm Charlie (C)*.

### Swarm L2-IBI product

### IBI CRITERION

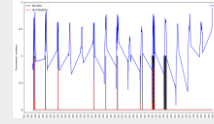
Bubble Index	Description
0	Quiet
1	Bubble
-1	Unanalysable

1. Bubble Index = 1
2. Bubble Probability  $\geq 0.5$
3. Bubble flag = 1, Hence IBI event is observed.

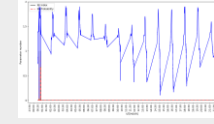
## RESULT AND DISCUSSION

### Observations of IBI events in Universal Time (UTC)

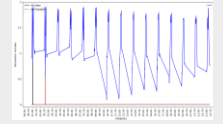
Super Storm-March 17 2015



Intense Storm-August 28 2015

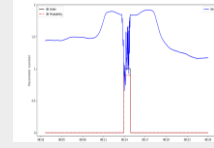


Moderate Storm- April 11 2015

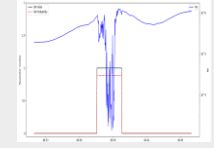


### Observations of a single IBI event

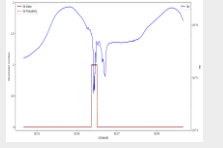
Super Storm-March 17 2015



Intense Storm-August 28 2015

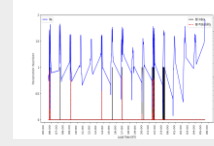


Moderate Storm- April 11 2015

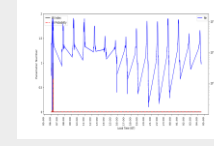


### Observations of IBI events in Local Time (IST)

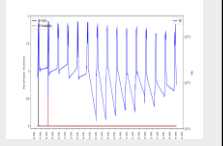
Super Storm-March 17 2015



Intense Storm- August 28 2015



Moderate Storm-April 11 2015



After the analysis of LT variation, we divide time into four equal segments, namely (00:00-06:00), (06:00-12:00), (12:00-18:00) and (18:00-24:00). Probability of occurrence of IBI events are as follows: (00:00-06:00), (06:00-12:00), (12:00-18:00) and (18:00-24:00) are 37.66%, 50.21%, 2.51% and 9.62% respectively.

## CONCLUSION

Utilizing Swarm L2-IBI product to collect information on IBIs for about 8 years from 2015-2022, we did an investigation to study the EPB incidents. Initially, we plotted the number of IBIs with local time variation and then divided time into 4 equal parts, also calculated the total number of IBIs for each time interval. Thus it is inferred that the period between 6 am and 12 pm in LT is the time when the majority of EPBs produced reporting 50.21% during daytime.

**ACKNOWLEDGEMENT:** We would like to express our sincere gratitude to the European Space Agency for generously providing us with the data recorded by the Swarm constellation mission. We express our gratitude to the creators of the VirEs swarm for providing us with an invaluable resource for exploring the world of bubble events.