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Unexpected Field-Aligned Structure in Equatorial Plasma Bubbles

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Equatorial plasma bubbles (EPBs) are ionospheric irregularities which tend to be aligned parallel to the Earth's magnetic field. They are initated in the bottomside
of the F-region of the equatorial ionosphere by an instability
known as the Rayleigh-Taylor instability. EPBs impose effects on radio signals
and cause errors in Global Navigation Satellite Systems (GNSS) because
they alter the amplitude and phase of satellite signals. In this study, we
utilized 2 Hz plasma density
measurements from the Swarm satellite mission, which were collected in 2014, to study the characteristics of equatorial plasma bubbles, such as their size and occurrence frequency.
We used a smoothing filter to remove background levels and calculated the relative
plasma density to identify the boundaries of the bubbles based on a specified threshold.
We compared our results from the Communication/Navigation Outage Forecasting System (C/NOFs) satellite, which orbits in an easterly direction, whereas Swarm is in a polar orbit. Our results
show that plasma bubbles occur after sunset and before sunrise, as per previous research and theory. Although it is generally taken for granted that EPBs are relatively smooth along the geomagnetic field line, our study shows that bubble scale sizes are the same in both the Swarm and C/NOFs observations, despite the fact that Swarm flies predominantly along the magnetic field lines (B), while C/NOFs fly transverse
to them. This indicates that the bubble structure along the field lines is more significant than previously thought, which in turn suggests an unidentified source of plasma density structuring parallel to B.

Keyword-1

Equatorial Plasma Bubbles

Keyword-2

Swarm Satellite

Keyword-3

Rayleigh-Taylor Instability

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