



Leveraging the ESA's Swarm overfly conditions to step into an Equatorial Plasma Bubble

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The Swarm constellation by ESA adopted an "overfly" setup during September and October 2021, where the gap between the lower and upper satellites was the smallest since their launch. During nighttime tracks, the positioning favored to observe post-sunset equatorial plasma bubbles (EPBs). This study, recently published [1], focuses on the specific Swarm overfly from 00:41 UT to 00:59 UT on September 30, 2021, covering a highly instrumented area in South America for studying ionospheric irregularities within EPBs. Leveraging ground-based Global Navigation Satellite System (GNSS) receivers alongside Swarm plasma density measurements, we analyze the irregularities within the EPB formed around $\sim 60^\circ\text{W}$. The investigation delves into the various scales of these irregularities and the sequential processes along the magnetic flux tubes. We also emphasize the simultaneous occurrence of diffusion along magnetic field lines and plasma uplift, aiding in accurately interpreting the EPB's evolution and decay. The exceptional overfly conditions enable the introduction of ionosphere-related metrics, evaluated across satellite altitudes along the tracks, expanding the analysis beyond the available data along these paths. This opportunity opens avenues to estimate the impact of EPBs on GNSS signals using Low-Earth Orbit satellite data from future missions dedicated to studying the near-Earth environment and ionospheric phenomena. The overfly setup specifically allowed observations of an EPB at different altitudes, demonstrating the potential for quasi-tomographic reconstructions with larger constellations of LEO satellites orbiting at various heights. Within this context, we highlight potentially valuable metrics and their correlation with ionospheric data from ground-based GNSS measurements.

1. Spogli, L., Alfonsi, L., & Cesaroni, C. (2023). Stepping into an equatorial plasma bubble with a Swarm overfly. *Space Weather*, 21, e2022SW003331. <https://doi.org/10.1029/2022SW003331>