



The influence of ionospheric plasma irregularities on the GNSS receiver onboard low Earth orbiting satellites

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The ionosphere is the ionized part of Earth's upper atmosphere, and is often characterized by irregularities and fluctuations in plasma density. The ionospheric irregularities can influence the propagation of trans-ionospheric radio waves and are thus of importance for any operations that rely on precise positioning with Global Navigation Satellite Systems (GNSS). Therefore, understanding the ionospheric plasma irregularities is of both scientific and practical interests. The influences of ionospheric irregularities on ground-based receivers have been widely reported. However, the situation for the receiver onboard Low Earth Orbiting (LEO) satellites under influences of irregularities is much worse. When a LEO satellite flies just inside an area of plasma irregularities, the GNSS signals from all directions are expected to be affected. In this report we present some Examples of signal outage from the Global Positioning System (GPS) onboard LEO satellites at different altitudes, e.g., Swarm, GRACE, CHAMP and GOCE missions. And the statistics show that when Swarm satellite encounters plasma irregularities with strong depletions, it experiences GPS signal outage as high as 95% for at least one channel, which indicates that the absolute depletion magnitude of plasma irregularities play a critical role in causing GPS outages for LEO satellites.