



Climatology of GPS signal loss observed by Swarm satellites

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By using three-year GPS measurements from December 2013 to November 2016 of Swarm satellites, we provide in this study a detailed survey on the climatology of the GPS signal loss for spaceborne receivers. Our results show that the GPS signal loss events prefer to occur at both low latitudes between $\pm 5^\circ$ - $\pm 20^\circ$ magnetic latitude (MLAT) and high latitudes above 60° MLAT in both hemispheres. These GPS signal loss events at all latitudes are observed mainly during equinoxes and December solstice months, while rarely observed during June solstice. The events at low latitudes are caused by the equatorial plasma irregularities shortly after post-sunset hours; the high-latitude events, more observed in the southern hemisphere, occurring mainly at cusp region and along nightside auroral latitudes, are also highly related to ionospheric irregularities associated with large density gradients. The signal loss happened mainly for those GPS rays with elevation angle less than 20° , and more commonly occurred when the line of sight between GPS and Swarm satellites is aligned with the shell structure of large density gradients. Our result also confirms that the capability of the Swarm receiver has been improved after the bandwidth of phase-locked loop widened, but it cannot radically avoid the interruption of tracking GPS satellite caused by the ionospheric plasma irregularities.