

# Ionospheric Scintillation and its effect on GPS tracking performance in China Low Latitude

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## Abstract

Based on the observations of GNSS scintillation monitor at Shenzhen (22.59°N, 113.97°E) and GNSS receiver at Hongkong (22.37°N, 113.93°E) in China low latitude from 2011 to 2016, the correlation between the occurrence of Loss of lock and strength of ionospheric scintillation that is expressed with amplitude scintillation index (S4), phase scintillation index ( $\sigma\phi$ ) and rate of TEC index (ROTI) are studied. Results show that the ionospheric scintillation mainly occur after sunset until midnight (19:00–02:00 LT), and the scintillation occurrence for different strength exhibit a little difference. The peak time of weak scintillation occurrence is about 21-22:00LT and moderate and strong scintillation occurrence is around 20-21:00LT. In addition, the loss of lock of GPS L1 and L2 signals derived from GPS observation observed at HKSL GPS station that is near Shenzhen are also used to compare with the ionospheric amplitude scintillation, it is found that the local time variation of the loss of lock is very similar to the strong ionospheric scintillation occurrence. The stronger the intensity of amplitude scintillation is, the better the correlation between amplitude scintillation and loss of lock is. The seasonal variation of ionospheric scintillation is similar to that of previous studies in this area, that is, the scintillation mainly occurs in the equinox months and rarely occurs in winter and summer months that coincides with the seasonal distribution characteristics in Asia-Pacific sector. In solar cycle variation, the ionospheric scintillation is dependent on solar activity. From 2011, the scintillation occurrence increases gradually and, reaches peak in spring 2014, then drops quickly until to 2016, the scintillation rarely occurs. This variation shows a good positive correlation with sunspot number, considering the scintillation data only in equinox months, the correlation coefficient between the scintillation occurrence and the sunspot number can reach to more than 0.6. In addition, considering scintillation occurrence in different S4 intervals, except 2014, occurrence

satisfies weak > moderate > strong, but in 2014, strong scintillation occurrence is obviously larger than that of weak scintillation. For the spatial distribution of scintillation, the scintillation occurs more frequently in the southern part of Shenzhen. With the increase of scintillation intensity, the azimuthal distribution of scintillation become narrow, the weak scintillation mainly occur between the azimuth angles of 100-250° while the strong scintillation mainly occur between the azimuth angles of 180-200°. Finally, by analyzing the rate of cooccurrence of scintillation and GPS loss of lock, the probabilities of Loss of Lock under different scintillation strength levels are given.