R005-31
B 会場 ：9/25　PM1 （13:45-15:30）
15:00〜15:15

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Strong ionospheric irregularities in sunlit conditions and its impact on GNSS-based navigation systems

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Ionospheric delay which is proportional to the ionospheric total electron content (TEC) and scintillation caused by small-scale irregularities are main error sources in GNSS. While ionospheric delays with large spatial scales can be corrected well by the differential correction technique, it is difficult to correct when the ionospheric delay significantly changes in space. The plasma bubble is the primary cause of such small-scale but large amplitude variation in the low magnetic latitude region.

Since the plasma bubble is know to occur in the night, most often from sunset to midnight, and rarely occur in the sunlit condition, some GNSS-based air navigation systems are operated from sunrise to sunset to avoid the impacts by the plasma bubble. While a few reports of plasma bubble occurrences around sunrise have been reported, their impacts on GNSS-based air navigation systems have not been well studied.

From 20:00 to 22:30 UTC on 27 February 2023 (from 04:15 to 06:45 LT), strong ionospheric irregularities were observed in Ishigaki (24.4N, 123.3N, 19.6 Mag.Lat). The irregularities were observed even after the local sunrise for more than 30 minutes. The event was characterized by irregular variation of the ionospheric delay (TEC) with occasional depletion of it and strong scintillation, which are the characteristics of the plasma bubble. At the same time, the background ionospheric delay (TEC) was enhanced in the western side of Japan. It was in the recovery phase of a magnetic storm commenced on 26 February 2023. These observational results indicate that the ionospheric delay (TEC) depletions with irregularities were embedded in the TEC enhancement that looked similar to the event known as the storm induced plasma stream (Maruyama et al., 2013).

By using closely separated GNSS receivers at Ishigaki Airport, the characteristics of the spatial variation of the ionospheric delay (TEC) are estimated, and their impact on GNSS-based air navigation systems are evaluated.