Observations of equatorial ionospheric scintillation using GPS

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A radio signal passing through small-scale irregularities in the ionospheric electron density fluctuates in amplitude and phase since the irregularities act as diffraction gratings. This phenomenon is called ionospheric scintillation. The ionospheric irregularities are associated with plasma bubbles, which are depletions in the equatorial F-region plasma. Bottomside F-region magnetic flux tubes with low-density plasma rise to higher altitudes to become plasma depleted flux tubes elongated along the geomagnetic fields.

Three single-frequency GPS receivers (1.575GHz), with a mutual distance of about 100m, have been operated at the Equatorial Atmosphere Rader site (0.20S, 100.32E; magnetic latitude 10.6S) in West Sumatra, Indonesia since January 2003. The GPS receivers sampled GPS signal intensity at 20 Hz to calculate scintillation index (S4) is every 60 seconds. In this study, we analyze S4 data (S4 is greater than 0.5) obtained from January to December, 2003.

We found that the scintillations frequently occurred at 20-01LT in March-April and September-October and that the occurrence rate was higher in March-April than September-October. The scintillations were not observed after 01LT. This is probably attributed to the decay of small-scale a few hundred meters irregularities causing scintillations. During March-April, there were two periods for which the scintillation occurred almost every day (March 8-16 and April 1-14). In the former period, scintillations started at 22LT, while they started at 20LT (just after sunset) in the latter period. This local time variations are probably explained as follows: During the former period, plasma bubbles were generated to the west of the observational site at the evening solar terminator and moved eastward through the observational site. On the other hand, during the latter period plasma bubbles were generated over the observational site. There is a possibility that these day-to-day variations of plasma bubble occurrences are controlled by gravity waves because gravity waves may seed plasma instability causing plasma bubbles. In this study, we compare the scintillation occurrence with cloud-top temperature observed with meteorological satellites to reveal a relationship between plasma bubbles and activity of convective clouds which may generate upward propagating gravity waves.