

RECENT RESEARCH ACTIVITIES

Equatorial Plasma Bubble (EPB) to atmosphere relationship found from day-to-day variation of GPS scintillation and GAIA assimilation data

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Equatorial plasma bubble (EPB) is one of intense ionospheric phenomena that occur in the low-latitude and equatorial ionosphere. EPB is the phenomenon in which depletion of ionospheric plasma at the bottom side F-region becomes unstable, and rapidly grows and upwells to an altitude of up to 1000 km. The growth mechanism of EPBs is understood via the Rayleigh-Taylor instability. However, studies of day-to-day variability in EPB activity are few.

We tried to elucidate the relationship between EPBs and the behavior of the lower atmosphere by a combination of observations and simulations. This study is based on the previous study in which the GPS scintillation index and the tropospheric cloud-top temperature are used as proxies for EPB-activity and atmospheric perturbations, respectively, and a correlation was found between their day-to-day variations [Ogawa et al. 2009]. In this paper we maintained the same GPS scintillation data but substituted the atmospheric data via an assimilation run of the Ground-to-topside model of Atmosphere and Ionosphere for Aeronomy (GAIA). Cross-correlation between the EPB activity and the atmospheric temperature is similar to the results in the previous study (Figure 1). The new findings from our study include 1) an enhanced correlation between the EPB activity and the neutral atmosphere is found in horizontally and vertically large areas, 2) the longitudinal disturbance of atmospheric temperature and wind velocity during the EPB-active days is enhanced, and 3) the enhancement of atmospheric disturbance during the EPB-active days shows a similarity to the characteristics of large-scale wave structures in the ionosphere (Figure 2). These results more clearly support couplings between EPBs and the neutral atmosphere [Yamamoto et al. 2018].

References

- [1] Ogawa T, Miyoshi Y, Otsuka Y, Nakamura T, Shiokawa K (2009) Equatorial GPS ionospheric scintillations over Kototabang, Indonesia and their relation to atmospheric waves from below. *Earth, Planets and Space*, 61:397-410.
- [2] Yamamoto, M., Y. Otsuka, H. Jin, Y. Miyoshi (2018) Relationship between day-to-day variability of equatorial plasma bubble activity from GPS scintillation and atmospheric properties from GAIA assimilation, *Progress in Earth and Planetary Science*, 5:26, doi: 10.1186/s40645-018-0184-7.

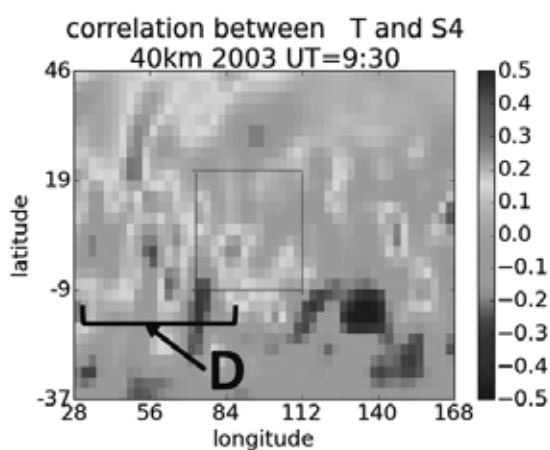


Figure 1. Correlation between day-to-day variation of GPS S4 index and GAIA temperature at 2hPa (~40 km in altitude) show high-correlation region (marked by "D") in the low-latitude region with North-South elongated structures.

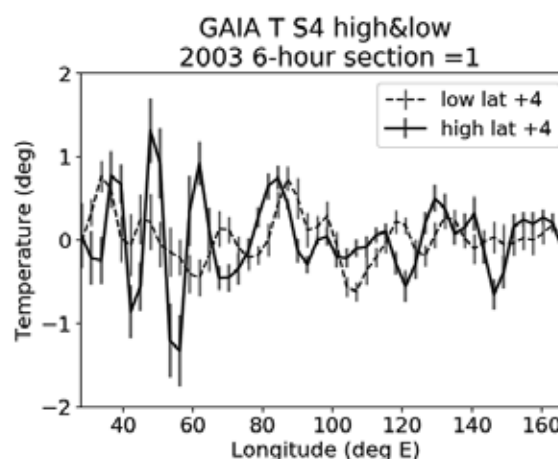


Figure 2. GAIA temperature on EPB-active days (solid) show enhanced longitudinal variation compared to the data on EPB-inactive days.