An analysis of the daily variability in the TIEGCM-derived Rayleigh-Taylor growth rate

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The daily variability in the occurrence of post-sunset Equatorial Plasma Bubbles (EPBs) continues to be an active research topic in ionospheric physics. Collectively, many long-term datasets have revealed a repeatable occurrence pattern (or climatology) that is dependent on season and longitude. For example, EPBs are common across all longitudes during the equinox months and are rarely observed during the June solstice in the Southeast Asian and South American sectors. During the December solstice, EPBs are common in the South American and African sectors, but are rare in the Pacific sector. This climatology has been shown to be largely controlled by the strength of the pre-reversal enhancement in the upward plasma drift, which depends on the angle between the local magnetic field and the solar terminator. Gaining a clear understanding of the daily variability in the EPB occurrence has been a more challenging task, because it is superposed on top of the background climatology. One approach is to classify the daily EPB variability based on the corresponding background climatology. For example, one could state that the daily EPB occurrence variability during peak EPB season is not controlled by days of EPB growth, but rather it is controlled by days of suppression, and vice versa for the off-peak season. This approach can simplify the analysis of which physical processes are responsible for day-to-day variability in EPB growth, which could be very helpful for EPB prediction.

In recent years, outputs from the TIEGCM have been used to reveal some daily variability in the Rayleigh-Taylor instability growth rate. It was shown in those works that this variability resembled the occurrence of EPBs at various locations during peak EPB seasons under “quiet” geomagnetic conditions, and was ultimately caused by the model’s parameterisation of the Kp index. In this contribution, this research is continued using extended GPS and VHF scintillation datasets from different longitude sectors and the most recent version of the TIEGCM. The thresholds used to classify EPB-days and non-EPB days that are applied to the GPS scintillation observations and the modelled R-T growth rates are further scrutinised. The results will be discussed in terms of the development of a global EPB prediction capability.

Keywords: Equatorial Plasma Bubbles, GPS Scinitillation, Coupled thermosphere-ionosphere modeling