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Day-to-Day Variability in Equatorial Plasma Bubbles due to Atmospheric Planetary Waves

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The mechanisms driving the day-to-day variability of equatorial plasma bubbles are not yet fully understood. Possible drivers of the variability in equatorial plasma bubbles include geomagnetic variability as well as sources from the lower atmosphere. The present study primarily addresses the role of lower atmospheric sources on driving the day-to-day variations in the occurrence and strength of equatorial plasma bubbles. Based on simulations in the Whole Atmosphere Community Climate Model with thermosphere-ionosphere eXtension (WACCM-X), it is shown that amplification of the quasi-six day planetary wave during January 2021 leads to a ~6-day oscillation in the simulated Rayleigh-Taylor (R-T) instability growth rates, which is considered to be a proxy for the occurrence of equatorial plasma bubbles. WACCM-X simulations considering only lower atmosphere and only solar/geomagnetic forcing, along with their combination, are used to elucidate the role of the lower atmosphere versus solar/geomagnetic forcing on the day-to-day variability of the R-T growth rate. The simulations demonstrate that the ~6-day periodic variation in the R-T growth rates is driven primarily by the lower atmosphere. In particular, the quasi-six day planetary wave modulates the migrating semidiurnal tide, which ultimately generates a ~6-day variation in the prereversal enhancement and R-T growth rates. The results demonstrate that atmospheric planetary waves can have a significant impact on the day-to-day occurrence of EPBs.