Implication of tidal forcing effects on the zonal variation of solstice equatorial plasma bubbles

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Abstract

Equatorial plasma bubbles (EPBs) are plasma depletions that can occur in the nighttime ionospheric F region, causing scintillation in satellite navigation and communications signals. Past research has shown that EPB occurrence rates are higher during the equinoxes in most longitude zones. An exception is over the central Pacific and African sectors, where EPB activity has been found to maximize during solstice. *Tsunoda* [2015] hypothesized that the solstice maxima in these two sectors could be driven by a zonal wavenumber 2 atmospheric tide in the lower thermosphere. In this study, we utilize satellite observations to examine evidence of such a wave-2 feature preconditioning the nighttime ionosphere to favor higher EPB growth rates over these two regions. We find the post-sunset total electron content (TEC) observed by FORMOSAT-3/COSMIC during boreal summer from 2007 - 2012 exhibits a wave-2 zonal distribution, consistent with elevated vertical plasma gradients favorable to EPB formation. Numerical experiments are also carried out to determine whether such an ionospheric wave-2 can be produced as a result of vertical coupling from atmospheric tides with zonal wavenumber 2 in the local time frame. We find that forcing from these tidal components produced wave-2 modulations on vertical ion drift, ion flux convergence, and therefore midnight TEC. The relation between the vertical ion drift and the midnight TEC enhancements are consistent with the aforementioned hypothesis, with vertical coupling effects from atmospheric tides preconditioning the nighttime ionosphere over the central Pacific and African sectors to favor higher EPB growth rates.