

Inter-annual variability in the longitudinal structure of the low-latitude ionosphere due to the El Niño–Southern Oscillation

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Ground-based measurements are used to investigate inter-annual variability of the wave-4 longitudinal structure of the low-latitude ionosphere between 1960 and 1993. The basic ionospheric parameter used is foF2, the critical radio penetration frequency of the ionosphere and a measure of the electron density. The variability is thought to be due, in part, to changes in atmospheric and oceanic circulations arising from the El Niño–Southern Oscillation (ENSO). Wavelet analysis reveals that similar periodicities and occurrence times exist between ionospheric monthly and sea surface temperature anomalies, represented by the Oceanic Niño Index (ONI). Furthermore, the yearly ONI extreme value is well correlated with the extreme value of the foF2 ratio monthly anomalies in the subsequent 5 months. This surprising connection is attributed to changes in tropospheric convection, and hence latent heating, associated with changing sea surface temperatures due to the ENSO. Changing distributions of latent heat tidal forcing are thought to induce changes in the strength of the upward and eastward propagating diurnal tide with zonal wave number $s = 3$ (DE3) which subsequently produces the observed changes in the amplitude of the wave-4 longitudinal structure through modulation of the electric fields generated by the dynamo mechanism in the ionospheric E region. Our results demonstrate that there is significant inter-annual variability in the ionospheric wave-4 longitudinal structure and further indicate that the ENSO phenomenon represents a source of ionospheric variability that has previously not heretofore been considered.