COSMIC observations of intra-seasonal variability in the low latitude ionosphere due to waves of lower atmospheric origin

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In the present study, COSMIC ionosphere observations are used to investigate temporal variability in the low latitude ionosphere that is driven by upward propagating waves of lower atmospheric origin. The particular focus is on sub-seasonal variability in the wavenumber-4 longitude structure of the low latitude ionosphere, which is known to be generated by the eastward propagating nonmigrating diurnal tide with zonal wavenumber-3 (DE3). Previous studies have identified a clear seasonal variability in the wavenumber-4 longitude structure in the ionosphere, and connected this variability to similar variability in the DE3 at E-region altitudes. Furthermore, first principles general circulation models have shown that tropospheric processes give rise to significant day-to-day, and sub-seasonal, variability in the DE3, and this is anticipated to introduce similar temporal variability in the wavenumber-4 longitude variability of the low latitude ionosphere. The COSMIC observations reveal that, superimposed on the background seasonal variability, there is significant sub-seasonal variability in the longitude structure of the low latitude ionosphere. The variability can be 50-100%, and is thus noteworthy, especially when interpreting short-term variability at a single ground-based observatory. Results based on the COSMIC observations are additionally connected to similar temporal variability in the mesosphere, confirming the connection between the observed ionosphere variability and upward propagating waves of lower atmospheric origin. The results of the present study demonstrate the role of the lower atmosphere on driving considerable short-term variability in the ionosphere during geomagnetic quiet time periods.