Perturbations in F-region vertical drift associated with cloud-to-ground lightning strokes detected in proximity to the southern mid-latitude station at Bundoora, Australia

Vickal V. Kumar[1], M. L. Parkinson[1], P. L. Dyson[1] and G. B Burns[2]

[1] Department of Physics, La Trobe University, Victoria 3086, Australia
[2]Australian Antarctic Division, Australian Government, Kingston, ACT, Australia
Correspondence to: Vickal V. Kumar (v.kumar@latrobe.edu.au)
Ph: 0400019618

Presenting author's name: **Vickal V Kumar**
Preferred mode of presentation: **Oral**

Abstract

An electrodynamic coupling between tropospheric thunderstorm generators and the ionosphere has been recognised for nearly a century but our understanding of the causal mechanism involved is still unclear. Recent optical observations of "sprites" initiated from the lower region of the ionosphere and the development of "blue jets" propagating upwards from the upper region of thunderstorms have completely transformed our perception of the region above thunderstorms. Most SuperDARN radars operate in high latitudes regions where thunderstorms and electrified clouds are rare. A modern digital ionosonde, the DPS-4, located at the southern mid-latitude station, Bundoora Melbourne (145.1°E, 37.7°S geographic; 49°S magnetic) has a Doppler drift mode which provides estimates of 3D drift vectors of the overhead ionosphere. Using mostly one specific mode of operation throughout a nearly 6-year interval (1999 Feb–Aug 2004), a unique database of drift measurements was complied. The drift velocity in the vertical direction is usually the most accurate component because the echoes tend to be concentrated toward zenith; hence the fit errors are larger for the horizontal components. The World Wide Lightning Location Network (WWLLN) estimates the location of cloud-to-ground (CG) lightning strokes by measuring the arrival time of VLF radio wave pulses ("sferics") at multiple receiver locations. This study makes use of superposed epoch analysis (SEA) to demonstrate the response of F-region vertical drift to CG lightning located within proximity to Melbourne. SEA is frequently employed to extract a relatively weak signal from other competing influences. The possible effects of thunderstorms may be disguised by the strong mid-latitude ionospheric processes, namely the E– and F–dynamos during quiet-times, and the penetration of aurorally enhanced winds and magnetospheric electric fields during disturbed times. The results of this study reveal clear, reproducible responses of the F-region ionosphere and may have implications for the new mid-latitude SuperDARN radars which should be able to detect gravity wave and direct electric field transients associated with electrified tropospheric clouds.