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Ionospheric Fluctuations Induced by Thunderstorms in the Central Region of Argentina

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Abstract

Global Navigation Satellite Systems (GNSS) measurements allow for the calculation of the Total Electron Content (TEC) present in the ionosphere. TEC is defined as the integrated electron density along the signal path from the satellite to the GNSS receiver (Lay et al. (2015)). It can be dynamically perturbed by both external and internal influences (Ogunsua et al. (2020)). In terms of internal influences, thunderstorms occurring in the troposphere can generate wave-like structures in the ionospheric plasma known as Atmospheric Gravity Waves (AGWs) (Lay et al. (2013); Lay et al. (2015)). These waves can be detected through GNSS measurements (Vadas and Liu (2013)). Therefore, the objective of this study is to investigate the ionospheric variations caused by thunderstorms that occurred during the night (00:00 UTC-08:00 UTC) of November 10, 2018, in the central region of Argentina. The data used were the TEC which was computed from GNSS measurements provided by Argentine Continuous Satellite Monitoring Network (RAMSAC by its Spanish acronym) stations and the atmospheric electrical activity data which were provided by the Earth Networks Total Lightning Network (ENTLN). As a result, oscillations in the ionosphere were observed at all RAMSAC stations, even at a distance of 1000 km. These perturbations had periods of up to 100 minutes and peak-to-peak amplitudes of up to 1.35 TECU (1 Total Electron Content Unit = $10^{16}\,\frac{electrons}{m^2}$). It was found that AGWs with the highest peak-to-peak amplitudes coincided with periods of intense Atmospheric Electrical Activity (AEA). Finally, it was observed that on stormy days, the peak-to-peak amplitudes of the waves were approximately 2.91 times larger than on non-stormy days.

Keywords: Ionosphere; Atmospheric Gravity Waves; Thunderstorm.

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