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Vertical total electron content and geomagnetic variations during X-class solar flares in 2022

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We analyzed the ionospheric and geomagnetic response to the most intense X-class solar flares recorded in 2022 during quiet geomagnetic conditions. We studied the influence of each solar flare using measurements from the Global Navigation Satellite System (GNSS) and geomagnetic observatories located at mid- and sub-auroral latitudes. Geomagnetic field variations, dB, and vertical total electron content variation, Δ VTEC, were obtained at different solar zenith angles. We used X-ray measurements from the Geostationary Operational Environmental Satellite (GOES) program, to evaluate the delay between maximum X-ray flux and VTEC and dB maximum values.

This work presents a study of the ionospheric and geomagnetic response to three X-class solar flares with different morphologies.

We have found that the maximum VTEC and dB are one to two minutes later than the maximum X-ray flux.

Δ VTEC variation depends on the flare position on the solar disc and the geographic location of the GNSS station.

On the other hand, dB depends on the time and position of ionospheric currents and the influence of the equatorial electrojet in the observatories.

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