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Rapid detection observation and simulation of co-seismic ionospheric disturbances

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Co-seismic Ionospheric disturbances (CID, or "ionoquakes") are disturbances in the electron density or total electron content (TEC) of the ionosphere, produced by the ground motion due to earthquakes. Usually, ionoquakes are detected in the near-epicentral region within 8-10 minutes after an earthquake onset time. In this work, we present a new methodology that allows to estimate the ionoquakes arrival time based on determining the ionoquakes peak time in TEC measurements with respect to the peak time of seismic waves registered by the nearest seismic station. Our methodology also allows to understand the altitude of GNSS detection that otherwise remains ambiguous. We apply the newly developed techniques to detect ionoquakes signatures associated with large earthquakes. We show that for the analyzed earthquakes, the ionoquakes arrive 250-430 seconds after the time of the seismic wave peak, or 350-700 s after the earthquake onset time. Our analysis shows that the first ionoquakes are detected at the altitudes of 150-300 km.