

Coseismic crustal deformations and associated nocturnal ionospheric perturbations during 13 November 2016 Mw 7.8 Kaikoura New Zealand earthquake

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In general, the Earth crust uplift during any earthquake produces compressional waves in the overlying atmosphere. These waves propagate upward in the region of exponentially decreasing atmospheric neutral density, and thus, its amplitudes increase with atmospheric altitudes. On arrival at ionospheric altitudes, the waves redistribute the ionospheric electron density and produce coseismic ionospheric perturbations. The thrust earthquakes induce significant crustal uplift, while the strike-slip event mostly deforms the crust horizontally. The massive Mw 7.8 Kaikoura earthquake occurred in the complex multisegmented fault system between the Australia-Pacific plate boundary with a combination of vertical and differently oriented horizontal crust movements. This oblique-thrust earthquake which struck New Zealand on 13 November 2016 at 11:02:56 UTC (local time at 00:02:56 a.m. on 14 November 2016) was one of the most geometrically and tectonically complex earthquakes recorded onshore in modern seismology. As mentioned, the event ruptured in the region of multisegmented faults and propagated unilaterally northeastward for more than 170 km from the epicenter. The Global Positioning System (GPS) derived coseismic surface displacements reveal a larger widespread horizontal and vertical coseismic surface offsets of ~6 m and ~2 m, respectively, with two distinct tectonic thrust zones. The study of coseismic ionospheric response to this event, using GPS measured total electron content (TEC), revealed peculiar ionospheric manifestations following the contortion. The characteristics of the ionospheric perturbations, derived based on tectonic and nontectonic forcing mechanisms (i.e. geomagnetic field-acoustic wave coupling, satellite geometry and ambient electron density), demonstrated that these perturbations are linked to two distinct surface thrust zones with rotating horizontal reinforcement trending the rupture, rather than merely to the displacements oriented along the rupture propagation direction (Bagiya et al., 2018).

References:

Bagiya, M. S., Sunil, P. S., Sunil, A. S., & Ramesh, D. S. (2018). Coseismic contortion and coupled nocturnal ionospheric perturbations during 2016 Kaikoura, Mw 7.8 New Zealand earthquake. *Journal of Geophysical Research: Space Physics*, 123. <https://doi.org/10.1002/2017JA024584>