地上磁場観測に見られる津波起因電離層電流の効果：2011年東北地方太平洋沖地震の場合について

Tsunami-generated ionospheric currents inferred from geomagnetic observations at ground level: Case for the 2011 Tohoku Earthquake

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It is known that large earthquakes cause atmospheric gravity/acoustic waves reaching the ionosphere and drive ionospheric dynamo currents at the altitude (e.g. Iyemori et al. 2005). Related phenomena were detected by observations of total electron content (TEC) (e.g. Tsugawa et al. 2011) and reported by numerical simulations (e.g. Kherani et al. 2013). However, the form of electric currents due to the coseismic ionospheric dynamo has never been revealed from the perspective of geomagnetic observations at ground level.

We investigated 1-min sampling magnetic data at nineteen on-land stations on the Japan Arc and at one ocean-bottom magnetometer ~200 km off the Tohoku, to reveal the form of coseismic electric currents in the ionosphere during the 2011 Tohoku earthquake (Mw 9.0). First, we subtracted the effects of non-seismic components of ionospheric and magnetospheric origins from the geomagnetic data, using magnetic transfer functions between the stations of interest along the Japan Arc and a reference site in China, Changchun. Second, we subtracted the oceanic dynamo effects due to the tsunami by a time-domain finite element simulation in the same manner as Minami et al. (2017). By rotating the coordinate system at each station to that consisting of radial and transverse axes in terms of the tsunami centre, we recognized a clear concentric propagation of a trough in the radial magnetic component with a phase velocity of ~ 1 km/sec and a trough amplitude of ~ 7 nT. This propagation happens in all the directions and the propagation velocity is almost the same as that of the slow coseismic ionospheric disturbances (CID) observed by TEC observations (e.g. Kakinami et al., 2013). The radial propagation of a trough in the radial component indicates presence of anti-clockwise electric currents in the ionosphere.

In the presentation, we report our analysis of the geomagnetic data at ground level and the inferred characteristics of the coseismic electric currents in the ionosphere. We also plan to show some results of spectral analyses of the propagation features involved in the geomagnetic data.

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