Title: - Characterization of the Rayleigh Surface Waves from Ionospheric Observations during the Mw 9.1 Tohoku-Oki Earthquake

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Abstract: - This study utilized the total electron content measured by nearly 1200 GEONET GPS receivers across Japan to examine ionospheric perturbations mainly generated by Rayleigh-induced acoustic waves (RAWs) during the Tohoku-Oki earthquake (2011). Earthquakes release a wide range of seismic energy, which propagates as seismic waves through the Earth's surface and interior. During these events, vertical surface movements caused by Rayleigh surface waves (RSWs) induce acoustic waves that travel into the atmosphere through dynamic coupling. When these waves reach the ionosphere, they alter the plasma density, resulting in co-seismic ionospheric perturbations. We analyzed data from various GPS satellites to estimate the propagation velocity and amplitudes of these perturbations. Subsequently, we examined seismic waveforms recorded by 64 seismic stations across Japan to determine the group velocities and amplitudes of RSWs. While correlating the ionospheric response with ground observations, we found that RSWs with periods of 10-50 s effectively manifested in the ionosphere, as their mean propagation velocity correlates with that of ionospheric perturbations, and their amplitudes correspond fairly well (Sunil et al., 2025). Furthermore, we extended this analysis to large earthquakes worldwide and confirmed that RSWs with periods of 10-50 s are most prominent at ionospheric heights.