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大地震によって励起される大気変動および電離層変動のモデリング
Modeling of Atmospheric and Ionospheric Perturbations Excited by Large Earthquakes

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Evidence of the 2008 Iwate-Miyagi Nairiku Earthquake, of which moment magnitude is 6.9 and focal depth is only 6km or less, was recorded in non-seismic observations such as atmospheric and electromagnetic observations. A CTBT infrasound monitoring station at Isumi, Japan at an epicentral distance of 417km recorded air pressure variations excited by this earthquake. Clear two large wave packets having amplitudes of several pascals appeared in 1 minute and 20 minutes after the origin time. The earlier arriving packet was the Rayleigh wave coming together with the ground motion whereas the later one was the acoustic waves that had propagated in the atmosphere directly from the rupture zone.

A normal mode summation technique synthesizes this observational evidence based on a given realistic source mechanism in a one-dimensional joint model that consists of the solid Earth and the atmosphere extending from the center of the Earth to the altitude of 1000 km. The simulation model parameters, e.g., the rupture velocity and the moment magnitude of each subevent hypothetically placed along the fault, are determined through the framework of data assimilation, which is capable to provide not only an optimum value but also a probability distribution function for each model parameter. The obtained synthetic waveforms successfully account for the observed ones in the period range $>$30 seconds assuming a focal depth of 3-4km, which is shallower than in the previously proposed models. Since the amplitude of such seismoacoustic wave is more sensitive to the focal depth than seismic wave, a joint analysis with seismograms could give strong constraints on seismic mechanisms especially in the cases of shallow earthquakes.

On the other hand, an electromagnetic observation using the HF-Doppler radar, which monitors ionospheric activities at the same epicentral distance with the Isumi observatory, recorded the Rayleigh wave traveling in the ionosphere at an altitude of 250km. Our procedure also successfully reproduces this waveform with the optimum model parameters determined by the inversion of the infrasound phenomenon mentioned above, although the assumed reflecting altitude is slightly lower than the observation.

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