Earth's background free oscillation detected by GPS-TEC

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Total Electron Content (TEC) can be easily measured with Global Positioning System (GPS) receivers as the phase difference between the two carrier frequencies. Past studies with GPS-TEC technique include seismological studies of coseismic ionospheric disturbances (CID) (Heki & Ping, 2005; Astafyeva & Heki, 2009), study of source processes using CID of the 2004 Sumatra Earthquake (Heki et al., 2006), estimation of the explosion energy of the Asama volcano eruption in 2005 (Heki, 2006), sudden increase of TEC by solar flares (Heki, 2007), vanishing of ionosphere by exhaust gas of ascending rockets (Furuya & Heki, 2008).

Nawa et al. (1998) found the Earth's background free oscillations in spheroidal modes from superconducting gravimetry in Antarctica. The same phenomenon was observed by seismometer arrays (Suda et al., 1998). Nishida et al. (2000) found excessive amplitudes of the two particular modes with frequencies 3.7 and 4.4 mHz, and suggested that they correspond to the resonant frequencies between the solid Earth and the atmosphere. From the seasonal changes of the amplitudes of the oscillation in austral winter, Tanimoto and Um (1999) speculated that atmospheric turbulence in continental area in summer is exciting the oscillation. On the other hand, Rhie and Romanowicz (2004), by analyzing dense array of broadband seismometers, suggested that the excitement source is in winter oceans.

Excessive amplitudes of ${}_0S_{29}$ (3.7 mHz) and ${}_0S_{37}$ (4.4 mHz) have been found by ground-based seismometers (Nishida et al., 2000), but the same oscillation would propagate to the upper atmosphere and make undulations of electron density in the ionosphere. Heki and Kobayashi (2008) reported that 3.7 mHz oscillation continued for several hours shortly after a large earthquake. In the present study, we collect GPS data on days without earthquakes for a particular satellite from a particular station, and performed spectrum analyses for these data.

We could detect these frequency peaks almost every day. After stacking one month spectrograms, we found that 4.4 mHz peak was the largest. We also found an additional peak at 5-6 mHz, which might be a higher mode of atmospheric oscillation. We did not find significant difference between cases where the subionospheric points are in oceanic and continental areas. Difference between seasons was not clear, either. Next we will try to analyze GPS data taken middle in an ocean and in a continent and compare them to clarify seasonal and regional differences in such background atmospheric oscillation.

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