GPS detection of total electron content variations following the 26 December 2004 earthquake

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The Sumatra-Andaman earthquake occurred at 00:58 UT on December 26, 2004. To investigate effects of the earthquake on the ionosphere, we have analyzed Global Positioning System (GPS) data obtained at Padang (0.9S,100.5E) and Medan (3.6N,98.7E), Indonesia. The dual frequency radio signals of the GPS allow measurements of the total number of electrons, called total electron content (TEC), along a ray path from GPS satellite to receiver. 14 min (16 min) after the earthquake occurred, TEC was enhanced by 4.0 TECU (7.0 TECU) at the sub-ionospheric point which is located about 300 km (600 km) north from the epicenter. This result indicates that the TEC enhancement propagated northward from the epicenter. At the south of the epicenter, TEC was slightly enhanced by 0.7 TECU, while TEC enhancement was not seen at the east of the epicenter. The observed time delay (14 and 16 min) from the earthquake occurrence to the TEC enhancement is consistent with an idea that acoustic waves generated by the earthquake propagated into the ionosphere at the sound speed. Due to the acoustic waves, the neutral particles oscillate in the direction parallel to the wave propagation direction. In the F region, the neutral particles move ions along the geomagnetic field lines through neutral-ion collisions. The ion motion across the magnetic field line is restricted because the ion gyro-frequency is much higher than ion-neutral collision frequency.This directivity of the ion mobility cause anisotropy in response of the electron density variations. Further, neutral particle motions across the magnetic field line experiences an anisotropic frictional ion drag force. These effects are expected to cause the observed

directivity of the TEC enhancement.