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Near-field TEC response to the main shock of the 2008 Wenchuan earthquake

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For the first time we have registered near-field TEC response to the WENCHUAN earthquake (EQ) on 12 May 2008. The Wenchuan earthquake (magnitude 7.9) occurred at 06:28:01 UT as the result of motion on a northeast striking reverse fault (thrust fault) on the northwestern margin of the Sichuan Basin. The earthquake reflects tectonic stresses resulting from the convergence of crustal material slowly moving from the high Tibetan Plateau, to the west, against strong crust underlying the Sichuan Basin and southeastern China (http://earthquake.usgs.gov). Firstly we used the simple 3-GPS sites interferometric method D1 for determining the angular characteristics of the wave vector and phase velocity of N-shape shock-acoustic waves (SAW), generated during earthquakes. This method provided an estimation of SAW parameters without a priori information about the site and time of the EQ main shock. But using D1 method doesn't allow us to determine the form of phase front of SAW (plane or the spherical wave front). Therefore we used the quasi-optimum algorithm, QOA, developed by authors. This algorithm realized the coherent summation of the TEC series accounting for selected space-time parameters of disturbance. For each combination of the estimated parameters the normalized criterion function C for the coherent sum of all TEC series and the reference signal were calculated. The largest maximum value Cmax corresponds to the best-fit perturbation parameters. We found that an intensive N-shape SAW with a plane waveform and with half-period of about 200 sec propagated south-eastward with a velocity 600 m/s for distance about 1000 km from epicenter. The wave front of N-shape disturbance was parallel with the earthquake rupture direction (from NE to SW). The main directional lobe of shock-acoustic wave emitter is directed southeastward, i.e. transversely to the rupture. We suppose that the above properties of TEC response are determined by the geodynamics of the WENCHUAN earthquake. No noticeable TEC response on that earthquake was found in far-field regions in South Korea and Japan. Authors are grateful to members of the Crustal Movement Observation Network of China, the Japanese GPS network GEONET and the South Korean GPS array KGN for GPS data used in this paper. The work was supported by the SB RAS collaboration project N 3.24 and the RFBR-GFEN grant N 06-05-39026; by the Japanese Society for the Promotion of Science (JSPS); by the National Natural Science Foundation of China (grants 40774090 and 40636032) and the National Important basic Research Project (2006CB806306).