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Radio tomographic study of electromagnetic effects of earthquakes

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Electromagnetic effects of earthquakes can be caused by the seismotectonic phenomena in a solid Earth and also can appear in the near-Earth plasma after the impact of acoustic-gravity waves (AGW) propagating from the lithosphere to the atmosphere and ionosphere. In the paper AGW with typical frequencies of a few hertz - millihertz and their related electromagnetic effects are analyzed. AGW are often observed during strong earthquakes and some time (a few days to hours) before the earthquakes. Investigation of AGW as possible precursors of earthquakes is of great interest for quake prediction. In the atmosphere and ionosphere these phenomena appear as wavelike structures with alternating areas of enhanced and depleted density (in the atmosphere) or electron concentration (in the ionosphere). Numerical simulation of AGW generation by the oscillations of the Earth surface and related electromagnetic effects is carried out. Caused by small fluctuations of the Earth surface within a few hertz-millihertz frequency range, the AGW are built up at mid-atmospheric and ionospheric altitudes where they get their typical spatial scales of the order of a few hundred kilometers. Such structures can be successfully monitored by methods of satellite radio tomography (RT). For the purposes of RT diagnostics, 150/400 MHz transmissions from low-orbiting navigational satellites having polar orbits at about 1000 km altitudes are used as well as 1.2-1.5 GHz signals form high-orbiting (orbital altitudes about 20000 km) navigation systems like GPS/GLONASS. The main difficulty in studying the AGW as earthquake precursors is possible presence of atmospheric and ionospheric disturbances of other than seismic nature (for example, those caused by enhanced solar-geomagnetic activity). However, these effects can be separated by analyzing spatial two-dimensional and three-dimensional structures revealed by tomographic methods. In the paper examples are shown of AGW RT imaging based on the

real experimental satellite data for several strong earthquakes in the south-east Asia, California and Alaska. The results obtained proved the capability of RT methods to detect atmospheric-ionospheric precursors of earthquakes.