Ionospheric manifestations of wavelike disturbances in the atmosphere and ionosphere observed by radio tomography

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Wavelike disturbances are quite often observed in the atmosphere and ionosphere. These events can be caused by the influence from atmosphere and space, by oscillations of the Earth surface and other phenomena. In the atmosphere and ionosphere these wavelike phenomena appear as alternating areas of enhanced and depleted density (in the atmosphere) or electron concentration (in the ionosphere). In the paper, acoustic-gravity waves (AGW) with typical frequencies of a few hertz - millihertz are analyzed. AGW are often observed after atmospheric perturbations, during earthquakes and some time (a few days to hours) before the earthquakes. Numerical simulation of AGW generation by solar flares effects, particle precipitation, magnetosphere-ionosphere interactions, oscillations of the Earth surface, atmospheric perturbations, rocket launchings is carried out. Caused by weak oscillations 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. Results of experimental studies of wavelike disturbances generations by flares, particle precipitation and magnetosphere-ionosphere interactions are shown. Examples of ionospheric manifestations of atmospheric effects are given. Effects of AGW development after rocket launching are studied. One of possible applications of RT imaging of wavelike disturbances is the study of AGW as possible precursors of earthquakes. Main difficulty here is to distinguish the AGW from atmospheric and ionospheric disturbances of other than seismic nature (for example, those caused by enhanced solar-geomagnetic activity), which can be done by analyzing spatial two-dimensional and three-dimensional structures revealed by tomographic methods. Examples are shown of AGW RT imaging based on the real experimental satellite data measured in the Russia, south-east Asia, California and Alaska. The results obtained proved the capability of RT methods to detect wavelike disturbances in the ionosphere caused by the influence from atmosphere and space. The work was supported by RFBR grants No.

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