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Nonlinear Processes in the active geoecological monitoring

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The role of physical nonlinearity in the problem of active geoecological monitoring of the environment with infra low-frequency seismic and acoustic oscillations is analyzed. Such oscillations are generated in the Earth and atmosphere by low-frequency ground-based vibrators in a frequency range of 5-10 Hz. Sounding of the environment is accompanied by some nonlinear processes at the radiation and propagation stages of seismic and acoustic oscillations. Such processes enrich the seismic and acoustic wave fields with additional low- and high-frequency components. In this paper, results of numerical modeling of the processes at the both stages are presented. It is shown that allowance for the nonlinear processes increases the noise immunity of processing of both kinds of oscillations. This also increases the time resolution of main waves and makes it possible to measure their arrival times with higher accuracy.
It was proved that allowance for the amplitude ratios between second and base harmonics of seismic oscillations makes it possible to exclude the dependence of accurate results of monitoring on seasonal and instrumental variations of sounding seismic oscillations. At the same time, high sensitivity of numerical values to small stress variations in the Earth's crust is retained. The results are based on field experiments on Earth's crust sounding, which were carried out on a 355 km-long seismic profile during lunar-solar tides. The applicability of seismic nonlinearity to study of geodynamic processes in the Earth's crust is shown.