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The influence of viscosity and stratification of the atmosphere on the propagation of periodic and pulsed acoustic signals related to seismic processes in the Earth's crust

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Seismic activity usually precedes a major earthquake over a large area near the future epicenter. This activity of the earth's surface can be considered as the emission into the atmosphere of low-frequency acoustic waves by a piston radiator. Although the initial amplitude of these waves is small, they have a major influence on the upper atmosphere and lead to the generation of electromagnetic waves, because with the proliferation in a stratified medium, their amplitude in the linear approximation increases exponentially. Therefore, for proper investigation of the acoustic field in the upper atmosphere is necessary to take into account nonlinear effects, as well as viscosity, which determines the structure of the shock front. The studying the propagation of acoustic waves in the atmosphere is very important, since it is closely related to the monitoring of seismic activity.

In this paper, the nonlinear wave equations for three-dimensional and one-dimensional cases, describing the propagation of acoustic waves in a viscous stratified atmosphere, were obtained. Also we derived a generalized Burgers equation with variable effective viscosity. We built exact self-similar solution of this equation describing the finite width jump, as well as the asymptotic solutions for the initial periodic and pulsed signal on the stage of development of shock fronts. The improvements of standard procedure joining asymptotic expansions based on accurate self-similar solution were suggested.