On the Ionospheric Effect of Ground Motions

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A relatively large body of literature deals with the observation of the earthquake effect on upper atmosphere including ionospheric heights with the use of ground radars and GPS, and some numerical models has been developed to describe this phenomenon as a result of infrasound propagation. Similar effect of tsunamis was also considered. However, in a majority of these works (unlike in the works concerned with Sun atmosphere), no magnetic field effect is taken into account. This presentation is aimed at demonstration of the role of magnetic field on the linear and nonlinear propagation of infrasound from ground motions up to the ionospheric layers. We consider a simple, one-dimensional model of vertical propagation of a plane acoustic wave in an exponential atmosphere in the presence of a homogeneous, obliquely directed magnetic field of the Earth (such a model is not as far from reality as it may seem, because only the rays relatively close to vertical direction reach the ionosphere). The main role seems to be played by the fast magnetic infrasound which in the lower, dense layer behaves as a non-magnetic infrasound. The displacement amplitude of such wave increases with height but the magnetic field slows the growth down. Nonlinear effects that are expressed mostly in upper layers where density is small, lead to the formation of shocks and the corresponding nonlinear attenuation of the wave. Again, this attenuation is slowed down by magnetic effects, and for sufficiently long or weak waves, the shock formation can even be completely suppressed. Quantitative estimations show the importance of magnetic effects starting from the heights of order 150 km. Some published experimental data can be considered as those confirming the above results.