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Modeling of electromagnetic E-layer waves before earthquakes

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A dielectric model for electromagnetic (EM) waves in the Earth's E-layer is developed. It is assumed that these waves are driven by acoustic-type waves, which are caused by earthquake precursors.

The dynamics of the plasma system and the EM waves is described using the multi-component magnetohydrodynamic (MHD) theory. The acoustic waves are introduced as neutral gas wind. The momentum transfer between the charged particles in the MHD system is mainly caused via the collisions with the neutral gas. From the MHD system, relations for the velocity fluctuations of the particles are found, which consist of products of the electric field fluctuations times coefficients α which only depend on the plasma background parameters. A quick FORTRAN program is developed, to calculate these coefficients (solution of 9x9-matrix equations).

Models of the altitudinal scales of the background plasma parameters and the fluctuations of the plasma parameters and the EM field are introduced. Besides, in case of the electric wave field, a method is obtained to calculate the altitudinal scale κ of the amplitude (based on the Poisson equation and knowing the coefficients α).

Finally, a general dispersion relation is found, where α, κ and the altitudinal profile of κ appear as parameters (which were found in the numerical model before). Thus, the dispersion relations of EM waves caused by acoustic-type ones during times of seismic activity may be studied numerically. Besides, an expression for the related temperature fluctuations is derived, which depends on the dispersion of the excited EM waves, α, κ and the background plasma parameters. So, heating processes in the atmosphere may be investigated.