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On the estimation of heating effects in the atmosphere because of seismic activities

Claudia-Veronika Meister and Dieter H.H. Hoffmann
Technische Universität Darmstadt, Institut für Kenphysik, Darmstadt, Germany
(c.v.meister@skmail.ikp.physik.tu-darmstadt.de)

The dielectric model for waves in the Earth's ionosphere is further developed and applied to possible electromagnetic phenomena in seismic regions. In doing so, in comparison to the well-known dielectric wave model by R.O. Dendy [Plasma dynamics, Oxford University Press, 1990] for homogeneous systems, the stratification of the atmosphere is taken into account. Moreover, within the frame of many-fluid magnetohydrodynamics also the momentum transfer between the charged and neutral particles is considered. Discussed are the excitation of Alfvén and magnetoacoustic waves, but also their variations by the neutral gas winds. Further, also other current driven waves like Farley-Buneman ones are studied.

In the work, models of the altitudinal scales of the plasma parameters and the electromagnetic wave field are derived. In case of the electric wave field, a method is given to calculate the altitudinal scale based on the Poisson equation for the electric field and the magnetohydrodynamic description of the particles. Further, expressions are derived to estimate density, pressure, and temperatur changes in the E-layer because of the generation of the electromagnetic waves. Last not least, formulas are obtained to determine the dispersion and polarisation of the excited electromagnetic waves. These are applied to find quantitative results for the turbulent heating of the ionospheric E-layer.

Concerning the calculation of the dispersion relation, in comparison to a former work by Meister et al. [Contr. Plasma Phys. 53 (4-5), 406-413, 2013], where a numerical double-iteration method was suggested to obtain results for the wave dispersion relations, now further analytical calculations are performed. In doing so, different polynomial dependencies of the wave frequencies from the wave vectors are treated. This helped to restrict the numerical calculations to only one iteration process.