The generation of pressure pulses of short-range gravity waves within the auroral ionosphere due to Joule- and Lorentz heating

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Abstract

Auroral electric field is a probable source of Atmospheric Gravity Waves (AGW) in the thermospheric region of the auroral zone of the ionosphere and associated Travelling Ionospheric Disturbances (TID). Large variations in the nature of TIDs are generated by various processes from auroral sources. Different investigations are made to explore the variability of observed gravity waves and its relationship with the TIDs, so that the upward energy flow from troposphere to mesosphere via stratosphere can be understood. This way of energy coupling from lower to upper atmosphere along with the resulting ionospheric effects gives the overall upper atmospheric energy balance.

Auroral region of the ionosphere may be characterized by different non-linear processes due to variations of the velocity distribution of the thermospheric constituents, medium temperature, ionizing frequency, effective collision frequency and recombination coefficient of electron and ions.

Perturbations in temperature and wind in the auroral region of the upper atmosphere indicate the presence of high latitude heat sources. The presence of fluctuating electric field initiates Joule heating along with viscous heating. Magnetosphere-Ionosphere coupling mechanism also provides informations about Joule heating rate along with various other electrodynamic parameters.

Using magnetohydrodynamic formalism, the expressions of Joule heating and viscous heating have been derived. A model calculation is performed through which the magnitude and the form of the anticipated atmospheric wave-train is obtained. An expression of electric field under the stated circumstances is derived, which is considered to be active through Lorentz force and Joule dissipation that influence the neutral gas of the medium through collision. The process introduces the short-range gravity waves. The expressions for the low-frequency part of the fractional pressure variations have been derived which are applied at the auroral region of the ionosphere. The results of numerical analyses are presented graphically.