Toward the establishment of scientific principle of M-I-T coupling: Alfven wave interaction with the weakly ionized ionosphere

Akimasa Yoshikawa[1]; Teiji Uozumi[2]; Aoi Nakamizo[3]; Shinichi Ohtani[4]; Ryoichi Fujii[5]
[1] ICSWSE/Kyushu-u; [2] ICSWSE, Kyushu Univ.; [3] Strategic Planning Department, NICT; [4] JHU/APL; [5] STEL, Nagoya Univ.

Interaction between the shear Alfven wave and weakly ionized ionosphere is discussed in the context of inductive Magnetosphere-Ionosphere-Thermosphere coupling.

The conventional equations of ionospheric electrodynamics, highly successful in modeling observed phenomena on sufficiently long time scales, can be derived rigorously from the complete plasma and Maxwell's equations, provided that appropriate limits and approximations are assumed. For example, an interaction between shear Alfven wave and ionospheric current system has been successfully described in terms of the reflection and mode conversion process at the

electrostatic Ohmic current layer, in which Hall and Pedersen conductivities are derived under stress balance equilibrium between Ampere force and frictional force by plasma-neutral collisions.

However this approach cannot describe dynamic developments inside the ionosphere or provide information about causal relations of MIT coupled variables. The verbal descriptions are intended to provide an intuitive understanding of results from calculations, but sometimes they go beyond their nominal purpose and are expanded into qualitative discussions of causal sequences and sometimes even of temporal developments, even though these are not really described by the conventional equations.

To correctly describe the inductive and dynamic process of MIT coupled system or perform verbal description of MIT responses, we need to explicate the generalized Ohm's law for determination of electric field, plasma motion of equation for evolution of plasma velocities, Faraday's induction law for evolution of magnetic field, and Ampere's law for distribution of current density.

In this study on the basis of causal sequence of the aforementioned inductive MIT coupling process, we try to understand the interaction process between shear Alfven wave and weakly ionized ionosphere, how Alfven waves propagate inside the ionosphere, how they attenuate by interaction to the neutral particles, how the field aligned current of wave modes bifurcate into the conducting current, and how the reflection process can be described by the causal relations inside the ionospheric E-region.