

Causality for formation of electromagnetic channel from Polar to Equatorial Ionosphere

*Akimasa Yoshikawa¹, Aoi Nakamizo², Shinichi Ohtani³

1. Department of Earth and Planetary Sciences, Kyushu University, 2. National Institute of Information and Communications Technology, 3. APL/JHU

Formation of global ionospheric current system and its associated plasma dynamics are frequently discussed under the electrostatic approximation of plasma electrodynamics. Since the Poynting flux never crosses the equipotential line, it is impossible to provide electromagnetic energy from source region to loading region across the magnetic field line. And hence, to discuss causality for evolution of ionospheric current system, we need to take into account an electromagnetic process of coupled system. To resolve this problem, we propose electromagnetic coupling model from polar to equatorial ionosphere. In this model, ionospheric current produces Ampere force and generates motion of plasma. The motion of plasma and associated mechanical process excite electromotive force and resultant electric field. Curl of electric field causes magnetic field disturbances and evolution of ionospheric current. Therefore, causality for evolution of electromagnetic energy and plasma acceleration for expanding of ionospheric current system has occurred at the wave front region and/or conductivity gradient region. In this talk, we will discuss about what type of plasma motion induces electric field in the ionosphere, and how and where they produce magnetic field disturbances (hence the Ampere force) for acceleration of plasma as wave propagation process. Furthermore, we also discuss what kind of mechanical and electromagnetic process have occurred at the conductivity gradient region, which become very important for establishment of geometrical structure of ionospheric current system.

Keywords: Magnetosphere-ionosphere Coupling, electromagnetic coupling, plasma dynamics, Polar-Equator coupling