磁気圏圧縮に対する非圧縮性電離圏の応答－ HF Doppler 観測－

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Response of the incompressible ionosphere to the compression of the magnetosphere as observed with the HF Doppler sounder

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The ionospheric plasma in mid latitude is moved by the geomagnetic sudden commencement (SC), ULF pulsations, storm and substorms as observed with the HF Doppler sounders. The motion of the ionospheric plasma has often been considered to be caused by the fast mode or compressional magnetohydrodynamic (MHD) waves radiated by the solar wind magnetosphere interaction. Conversely, the ionosphere has been believed to be incompressible. In other words, the compressional MHD waves never cause the motion of the ionospheric plasma. This paper addresses the compressibility/incompressibility issue of the ionosphere by examining the motion of the ionospheric plasma observed with the HF Doppler sounder in mid latitude during the SC which is definitely caused by the compressional waves from the magnetosphere. We show that the daytime ionosphere moves upward toward the sun during the main impulse (MI) of SC, in opposite direction to the earthward motion of the magnetosphere. The ionospheric motion is well correlated with the enhancement in the equatorial electrojet, which implies that the electric field responsible for the ionospheric motion in mid latitude is a potential field associated with the ionospheric currents flowing from the high latitude to the equator. We note that the upward motion is preceded by the transient (<1 min) downward motion, but it is well correlated with the negative impulse in the equatorial electrojet. Therefore, even the transient electric field is a potential field associated with the ionospheric currents. We conclude that the ionosphere never responds to the compressional MHD waves but moves due to the potential electric field associated with the ionospheric currents transmitted from the high latitude. Since the electric field and currents are transmitted at the speed of light by the TM0 (TEM) mode waves in the Earth-ionosphere waveguide (transmission line), the ionospheric plasma moves simultaneously everywhere in the global ionosphere. The simultaneous motion is expressed as the incompressibility of the ionosphere.