Dependence of the electromagnetic energy input to the ionosphere on the ionospheric conductivity

Ryouichi Fujii[1], Masahiko Sugino[2], Satonori Nozawa[1]

[1] STEL, Nagoya Univ, [2] STEL

The magnetosphere and ionosphere strongly couple each other in terms of the exchange of energy and plasma. Recent observations have clearly shown that the ionosphere plays a more active role on the M-I coupling processes than we considered before. Indeed, observations with the FAST and Freja satellites have shown that ionospheric thermal electrons are sometimes greatly accelerated into field-aligned upward directions by downward-directed parallel electric fields, carrying downward field-aligned currents [e.g., Carlson et al., Geophys. Res. Lett., 25, 2017, 1998]. Such upward moving electrons were observed almost exclusively in a winter hemisphere, suggesting that the ionosphere should play an indispensable role in their formation. On the other hand, Newell et al. [Nature, 381, 766,1996] indicated that the ionosphere played an essential role on the occurrence/intensity of auroras, that is, energetic electron precipitation. One of the outstanding problems is then how the ionosphere regulates the electromagnetic energy input injected from the magnetosphere to the ionosphere. In this paper, based on an analysis of CP-1 data obtained between 1990 and 2000 from the EISCAT KST (Kiruna-Sodankylae-Tromsoe) tri-static radar, we will show quantitatively how the electromagnetic energy input to the ionosphere and the electric field are related to the Pedersen conductivities above the observation point and also at its conjugate point. EISCAT CP (Common Program)-1 data provide us with the ionospheric conductivity at every 3 km along the magnetic field line of Tromsoe and the perpendicular electric field. We have sorted out all the data with magnetic local time MLT (midnight, morning, daytime, afternoon), Kp and the solar-zenith angles at the local observation point and its conjugate point in the southern hemisphere. The analysis shows that the electromagnetic energy input and presumably the electric field also are regulated considerably by the ionospheric conductivity not only at the observation point but also at its conjugate point. The electromagnetic energy input is smallest when both local and conjugate regions are illuminated by the Sun.