極域電離圏の電子エネルギー収支と電離圏状態の関係

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Relationship between the electron energy budget and the ionospheric conditions in the polar ionosphere

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The electron fluxes precipitating at the top of the high latitude ionosphere contribute to the production of ionization, to the excitation of atmospheric constituents, and to the heating of the ambient electrons directly or by the secondary electrons. The precipitated electrons lose their energy by ionization creating the secondary electrons, by heating of the ambient electrons and neutrals until they are assimilated into the ambient electrons. The heated ambient electrons transport this energy to the neutral gas and ambient ions. As a result, the temperature gradient produced in the ionospheric plasma induces a heat flux. For stationary conditions, the budget equation determines the balance between the heating rate, the cooling rate, and the heat conduction. The electron energy budget in the ionosphere is important for the interaction between ionized and neutral atmosphere and have been studied theoretically, but there is almost no studies based on long, continuous observations.

We estimated the intensity of the cooling rate and the heat conduction quantitatively as a function of altitude in the ionosphere using the European incoherent scatter (EISCAT) radar data and NRLMSIS-2000 model. From the results of the analysis for the disturbed conditions, the region where the heating rate is negative exists because the cooling rate is small compared to the heat conduction. This is caused by neglecting the terms including field-aligned current, such as adiabatic expansion, heat advection and divergence of the electron heat flow. We evaluate these terms quantitatively assuming the field-aligned current in this region, and the result indicates that the downward current is required to achieve a quasi-steady state. In this presentation, we discuss the effects of the field-aligned current on the electron energy budget and the relationship between the electron energy budget and the ionospheric conditions.