Ion motion owing to Joule heating and particle precipitation

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The ionospheric ions are controlled not only by electromagnetic forces but also by non-electromagnetic forces such as friction and pressure gradients through an interaction with the neutrals. This ion-neutral interaction leads to rather complicated motions for the ionospheric plasmas (ions + neutrals).

One of the physical processes related to driving the plasmas is Joule/frictional heating, which is produced by friction owing to the difference of velocity between the ions and neutrals. The release of this energy, expressed as JE' (E'=E+UxB) which is a function of the Pedersen conductivity and the electric field strength, becomes more remarkable when a strong electric field is provided from the magnetosphere. This process provides the plasmas with the thermal energy, thereby changes their pressure distributions that may consequently have the plasmas move accordingly. The ions tend to be dragged by the neutrals due to the dominance of the neutrals in terms of the number density. If the Joule heating brings about vertical motions (upwelling/downwelling) of the neutrals, then the ions are expected to show corresponding motions, in particular, along the magnetic field line, along which the ions can move more freely. The present study aims at determining quantitatively the response of the ions in the E and F regions to the energy inputs from the magnetosphere, such as Joule heating and particle precipitation. We will show a statistical study on the relationships between the ion motions and Joule heating/particle precipitation based on EISCAT CP-1 data.

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