Field-aligned ion motions in the E and F regions

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The aim of this paper is to investigate, through an analysis using EISCAT CP 1 data, the characteristics of the field-aligned (FA) ion motions in the E and F regions and to understand the driving mechanisms of these FA ion motions, with taking account of the electromagnetic and particle energy inputs from the magnetosphere as well as the interaction with the vertical and horizontal neutral winds.

We find that 1) upward FA ion motions in the F region are a common characteristic in the westward electrojet current region; 2) there is no clear correlation between the upward FA ion velocity and other parameters and 3) but the ion direction is consistent to the plasma pressure gradient along the field line.

There have been a number of studies on the characteristics of the field-aligned (FA) ion motion as well as the vertical neutral motion based on satellite and ground-based observations, and simulations/modeling.

Below the F-region electron density peak, ions move predominantly perpendicular to the local magnetic field line, but sometimes show FA motions even in the F region particularly under relatively weak electric fields. The conventionally received interpretation is that these FA ion motions are driven by the neutral wind (friction/drag). It is usually believed to be the 'horizontal' neutral wind motion that drives the FA ions along the magnetic field line. It is, however, suggested recently that the 'vertical' neutral wind may sometimes play an important role as well.

The aim of this paper is to investigate, through an analysis using EISCAT CP 1 data, the characteristics of the field-aligned (FA) ion motions in the E and F regions and to understand the driving mechanisms of these FA ion motions, with taking account of the electromagnetic and particle energy inputs from the magnetosphere as well as the interaction with the vertical and horizontal neutral winds.

We find that 1) upward FA ion motions with occasionally more than 100m/s in the F region are a common characteristic in the westward electrojet current (southward electric field) region; 2) there is no clear correlation between the upward FA ion velocity and other parameters such as the electric field strength (equivalently the frictional heating), ion/electron temperatures and their time derivatives, and the electron density; and 3) but the ion direction is consistent to the plasma pressure gradient along the field line.

We will show more quantitative relationships between these parameters along with a simple simulation result.