On the relationship between auroral absorption, electrojet currents and plasma convection

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In this study, the relationship between auroral absorption, electrojet currents, and ionospheric plasma convection velocity is investigated. We employ cosmic noise absorption (CNA) observations obtained by the Imaging Riometer for Ionospheric Studies (IRIS) system in Kilpisjärvi, Finland, plasma convection measurements by the European Incoherent Scatter (EISCAT) radar, and estimates of the electrojet currents derived from Tromsö magnetometer data. In this experimental configuration, the IRIS and EISCAT measurements are representative of the particle component of Hall conductance and the ionospheric electric field, respectively. It is shown that the electrojet currents are controlled by both enhanced conductance and electric field but with the relative importance of these two factors varying with magnetic local time (MLT). The correlation between the current and electric field (absorption) is the highest near magnetic noon 12-15 MLT (midnight 00-03 MLT) as expected. It is demonstrated that the conductance-dominated region is wider than previously thought extending from 21 to 09 MLT, whereas the electric-field-dominated region is asymmetric with respect to magnetic-noon-midnight meridian extending from 09 to 21 MLT. The extension of the conductance-dominated region to the morning sector is interpreted as being due to high-energy electron clouds drifting from the midnight sector eastward around the Earth, towards the morning sector where they eventually precipitate. It is also shown that during periods of high current-electric-field correlation, the electric field and absorption exhibit an approximately inverse proportionality relationship, which can be explained by limitation of the electrojet current by the magnetospheric voltage generator. We also compare the EISCAT ion drifts with the simultaneous and coincident CUTLASS Finland velocities and show that the correlation and linear slope are maximised at the CUTLASS range gate 17 (range of 945 km) reaching values of 0.75 and 0.84, respectively. This possibly implies a considerable ambiguity between the detected radiowave propagation distance and the straight-line-distance to the EISCAT scattering volume.