High ion temperature events at F region altitudes in the cusp: Spatial relations to the moving electron precipitation regions

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High ion temperatures at F region altitudes reflect how fast the ions convect through the slower moving neutral gas. Previous studies have shown that the high ion temperature regions exist in the vicinity of the mesoscale moving cusp aurora. For the large-scale motion of the electron precipitation region in the cusp, it is understood that fast ion flow often occurs nearly simultaneously with the intensification of the electron precipitation, but the detailed spatial relations between the fast ion flow and the large-scale motion of the electron precipitation region require clarification. In this study, we examined auroral image data obtained by an all-sky imager at Longyearbyen, Svalbard and data from field-aligned fixed EISCAT Svalbard Radar (ESR). From data obtained during six winter seasons (December 2012 to January 2018) we first identified approximately 84 hours as the period of the simultaneous observation in the daytime sector. Examination of the ESR ion temperature at F region altitudes during those periods of time has shown that the ion temperatures up to 2000 K are often observed, whereas the ion temperatures exceeding 2000 K are very limited. We present two cases from those high ion temperature events. Aurora image data show that one event is the repetitive poleward motions of the cusp auroras which were observed in the large-area of the imager's field-of-view, while another is the equatorward shift of the large-scale cusp aurora belt responding to the southward turning of the IMF. Although the maximum ion temperatures for both cases are similar, their rise and decay features during approximately 10 min are different. We show the detailed features of the ion temperature variations and their spatial relations to the motion of the electron precipitation regions, and discuss the ion-neutral interaction for the cases in which the large-scale electron precipitation regions move in the cusp.

Keywords: Plasma flow, cusp, ion temperature, electron precipitation, aurora

