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地上光学・電波機器とあらせ衛星・Van Allen Probes 衛星の同時観測に基づくサブオーロラ帯の３種類のオーロラの複数例解析

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Multi-event analysis of three-types of auroras at subauroral regions using ground instruments and magnetospheric satellites

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Strong Thermal Emission Velocity Enhancement (STEVE) is a latitudinally-narrow, purple band of emission seen at subauroral latitudes, which was discovered in 2016. Further, well-known Stable Auroral Red (SAR) arcs also occurs at subauroral latitude. Red and green arcs, which are similar in that they occur in the subauroral latitudes to SAR arcs with only red emission, have been reported. However, the characteristics of the magnetospheric plasma and electromagnetic field variations as a source of these three types of optical emissions have not fully been studied using conjugate observations between magnetospheric satellites and ground-based optical and radio instruments. In this study, we report the auroral morphology as seen in all-sky image data obtained at seven locations (Athabasca, Gakona, Husafell, Kapuskasing, Magadan, Nyrola and Tromso) during about four years from January 2017 to April 2021. By referring to the optical images as well as the ionospheric footprint of magnetospheric satellites (Arase and Van Allen Probes) calculated with the Tsyganenko magnetic field model (TS04), we have identified four cases of STEVE, four cases of SAR arc, three cases of green and red

arcs in which these satellites were located in the conjugate regions in the magnetosphere of the optical emissions. For all three types of optical emissions, satellite data showed that the plasmasphere and ring-current particles spatially overlapped in the conjugate regions of the magnetosphere. An increase in the low-energy (0.1 to a few keV) electron flux as also found for all types of arcs. No significant mHz to kHz electromagnetic waves, nor electrostatic waves from 0.01 Hz to 10 kHz, were observed for any of these 11 events. SuperDARN radar data showed a strong westward plasma flow in the ionosphere, especially during the STEVE events, while the plasma flows associated with SAR arcs and red and green arcs are relatively weak and variable. These analyses not only provide the first comparison of the magnetospheric particle and electromagnetic field characteristics of the three types of optical emissions in the subauroral latitudes, but also provide an important summary of the differences and similarities between these optical emissions.