

Statistical analysis of equatorward drift speed and intensity of SAR arcs detached from auroral oval based on all-sky imaging observations at Athabasca, Canada

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Stable Auroral Red (SAR) arcs observed at subauroral latitudes are the 630-nm optical emissions caused by low-energy electron precipitation into the ionospheric F layer from the interaction region between the ring current and the plasmasphere. In the recovery phase of geomagnetic storms, low-energy electrons in the plasmasphere are heated by high-energy plasma in the ring current, and precipitate into the F layer at subauroral latitudes where oxygen atoms are excited to emit 630-nm emissions at altitudes of ~400 km. Thus, SAR arcs are mainly observed at subauroral latitudes during geomagnetic storms. Recently, Shiokawa et al. (2009) reported an event of SAR arc detached from the main oval after substorms, based on observation at Athabasca, Canada (54.7N, 246.7E, magnetic latitude = 61.7N). However, statistical analysis of such SAR arcs detached from the main oval has not been done yet. In this study, we perform a statistical analysis of SAR arc detachment observed at Athabasca.

We analyzed 11 years of all-sky images at wavelengths of 630.0 nm obtained at Athabasca from 2006 to 2016. The SAR arcs move equatorward after the detachment from the oval. We estimate the equatorward velocity of the SAR arc motion. We also estimated the latitudinal distribution of the 630-nm intensity between SAR arcs and the main oval, which may correspond to the densities of high- and low-energy plasma in the interaction region between the plasmasphere and the ring current. We investigate dependences of these SAR arc velocities and intensities on AU/AL indices, SYM-H, solar wind pressure, IMF-Bz, and X component of magnetic field variation at Yellowknife (YKC), which is located in the north of Athabasca in the auroral zone. The 630-nm intensity between SAR arcs and the main oval is high in the dusk sector. The equatorward velocities of SAR arcs are higher in the dusk and dawn local times compared with those around midnight.

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