Statistical analysis for trunk structure of ring current ions using Arase ion observations

Ryosuke Fujii[1]; Yoshizumi Miyoshi[2]; Masafumi Shoji[2]; Kazushi Asamura[3]; Lynn M. Kistler[4]; Vania Jordanova[5]; Tomoaki Hori[2]; Shoichiro Yokota[6]; Satoshi Kasahara[7]; Kunihiro Keika[8]; Ayako Matsuoka[9]; Iku Shinohara[10]
[1] ISEE, Nagoya Univ.; [2] ISEE, Nagoya Univ.; [3] ISAS/JAXA; [4] ISEOS, University of New Hampshire; [5] LANL; [6] Osaka Univ.; [7] The University of Tokyo; [8] University of Tokyo; [9] ISAS/JAXA; [10] ISAS/JAXA

The distribution of ring current ions is determined due to transportation, acceleration and loss process in the magnetosphere. Various structures on energy spectrum are seen along the satellite orbit. Besides well-known structures such as ’nose’ or ’wedge’ structures, ’trunk’ structures are newly found by Van Allen Probes. The structure looks like elephant trunk and the energy of peak flux decreases toward the Earth. A case study by Van Allen Probes showed that ’trunk’ structures are seen in energy spectrums of helium and oxygen. However, detail characteristics of ’trunk’ have not been well understood, and statistical survey using the long-term observation data is necessary. In this study, we investigate characteristics of ’trunk’ using Low-energy particle experiments-ion mass analyzer (LEPi) / Medium-energy particle experiments-ion mass analyzer (MEP-i) onboard the Arase satellite from April 2017 to March 2019. A number of trunk structures in helium and oxygen ions as well as protons are identified. We analyze the geomagnetic activity, local time, latitude and L-value dependences of the trunk. The minimum L-shell of trunk is distributed mostly around L = 2.0 - 2.5 and off-equator, extending from dusk region to pre-midnight region. The average of the minimum Al index and maximum Kp index during 1 day before observations of helium trunk structure are ˜-400 nT and 2+ respectively. Previous studies suggested that impulsive enhanced electric field or a temporal gap of injection from the tail region combined with charge exchange causes formation of the ’trunk’. Beside ’trunk’ structures, more typical ’nose’ events and ’inverse trunk’ in which the typical energy gets increase in the lower L-shell are also found from the Arase observations. We show statistical characteristics of ’trunk’ and ’inverse trunk’ from the Arase observations. Moreover, we discuss how charge exchange affects the formation of the ’trunk’ by comparing with RAM-SCB simulations.