Ion composition change in the magnetotail during a solar cycle

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The CAWSES (Climate and Weather of the Sun-Earth System) international program, which has been proposed by SCOSTEP, is going to start from 2004. The aims of the CAWSES project include analysis of the long-term relations among the valuables of the Sun and Earth systems. An outcome of such analysis can be applied to develop models that predict changes of space plasma environment. The present study focuses on ion composition changes in the magnetotail during one solar cycle (~11 years), being in line with the CAWSES project.

The Geotail spacecraft was launched in July 1992 and surveyed the mid- and deep-tail (X=-50 to -210 Re) for 2.5 years, then placed into the near-Earth (9x30 Re) orbit. It is still operational, accumulating data for nearly one solar cycle. Thus now is a good time to investigate the long-term variations of ion composition in the magnetotail by using the data of this unique spacecraft. We used ion flux data acquired by the energetic particle and ion composition (EPIC) instrument on board Geotail. The EPIC instrument provides suprathermal (9-210 keV/e) ion flux with charge and mass information. We examined the integral ion flux data for ion species such as H+, O+, He+, He++, N+, and O6+. Ion composition was surveyed in two regions: the near-Earth magnetotail (X=-8 to -20 Re) and the middle to distant magnetotail (X=-20 to -220 Re). From a viewpoint of the long-term variations, we found that flux ratios of the ionospheric origin ions to H+ (e.g., O+/H+) generally followed the sun spot number, while those of the solar wind origin ions to H+ (e.g., He++/H+) were rather constant throughout the solar cycle. It was also found that geomagnetic activities seemed to have short-lived effects on flux ratio changes.