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The north-south asymmetry of energetic oxygen and hydrogen ion distributions in the near-Earth magnetosphere: Cluster/RAPID observations

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Energetic ion distributions in the near-Earth plasma sheet can provide important information for understanding the entry of ions into the magnetosphere, and their transportation, acceleration, and losses in the near-Earth region. Studies have shown that there were remarkably different ion distributions in northern and southern hemispheres. However, the source for that asymmetry especially for the energetic ions is still an open question. In this study, 11 years of energetic proton and oxygen observations ($> \sim$100 keV) from Cluster/RAPID were used to statistically study the energetic ion distributions in northern and southern hemispheres in the near-Earth region. Results show that the strong north-south asymmetry regions of the energetic ion distributions are mainly located around the cusp in two hemispheres which indicates that the asymmetry is strongly related to the IMF directions. This is confirmed by examine the asymmetries under different IMF conditions. Results also show some important characteristics for different energetic ion species and thus help us understand the different ion acceleration processes for protons and oxygen ions.