The Polar Wind Modulated by the Spatial Inhomogeneity of the Strength of the Earth's Magnetic Field

Kun Li1, Matthias Förster2,3, Zhaojin Rong4,5, Stein Haaland2,6, Elena Kronberg2,7, Jun Cui1,8, Lihui Chai4,5, and Yong Wei4,5

1School of Atmospheric Sciences, Sun Yat-sen University, Zhuhai, China (likun37@mail.sysu.edu.cn)
2Max Planck Institute for Solar System Research, Göttingen, Germany
3German Research Centre for Geosciences, Helmholtz Centre Potsdam, Potsdam, Germany
4Institute of Geology and Geophysics, Chinese Academy of Sciences, Beijing, China
5College of Earth and Planetary Sciences, University of Chinese Academy of Sciences, Beijing, China.
6Birkeland Centre for Space Science, University of Bergen, Bergen, Norway
7Ludwig Maximilian University of Munich, Munich, Germany
8Chinese Academy of Sciences Key Laboratory of Lunar and Deep Space Exploration, National Astronomical Observatories, Beijing, China

When the geomagnetic field is weak, the small mirror force allows precipitating charged particles to deposit energy in the ionosphere. This leads to an increase in ionospheric outflow from the Earth’s polar cap region, but such an effect has not been previously observed because the energies of the ions of the polar ionospheric outflow are too low, making it difficult to detect the low-energy ions with a positively charged spacecraft. In this study, we found anti-correlation between ionospheric outflow and the strength of the Earth’s magnetic field. Our results suggest that the electron precipitation through the polar rain can be a main energy source of the polar wind during periods of high levels of solar activity. The decreased magnetic field due to spatial inhomogeneity of the Earth's magnetic field and its effect on outflow can be used to study the outflow in history when the magnetic field was at similar levels.