Geophysical Research Abstracts
Vol. 16, EGU2014-6676, 2014
EGU General Assembly 2014

Outflow of Low-Energy Ions and the Solar Cycle

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Non-thermal escape of ions from the upper Terrestrial atmosphere has been observed by spacecraft and radars for decades. Typical total upflow rates are 10^{25} to 10^{26} ions/s, mainly H^+ and O^+varying with solar and magnetospheric magnetic activity. Recent findings show that the escape, and the plasma in the magnetosphere, often is dominated by low-energy (below about 10 eV) ions. These ions often cannot be detected onboard sunlit spacecraft, which often become positively charged to tens of volts. We discuss how a supersonic flow of low-energy ions cause a wake behind a charged spacecraft and how this can be used to detect the ions.

We use the wake method and observations by two Cluster spacecraft, covering most of a solar cycle (2001 to 2010). We find that often (more than 50% of the time) low-energy ions dominate the magnetosphere. We also find a clear variation of the outflow of low-energy ions with the solar EUV flux.