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Ion outflow above polar cap arcs and solar illumination.

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We investigate the solar illumination dependence of the flux and composition of ion beams, often observed by Cluster during periods of prolonged northward interplanetary magnetic field, escaping from the polar ionosphere. They have been energized by the electric fields parallel to the magnetic field, that are also responsible for accelerating electrons downwards, which then create polar cap arcs when colliding in the polar ionosphere. To do this, we use Cluster CIS data to measure the density, composition and energy of the outflowing ions, and trace the spacecraft position back to the footpoint of the magnetic field line in the ionosphere. When characterizing the data in terms of the solar zenith angle (SZA) of this footpoint, we find a clear transition in the O^+ flux densities from lower SZA (<94°) to higher SZA (>107°). So a difference is found between the outflow above a sunlit polar cap and above a dark polar cap. The same is found for the H^+ ions, but to a lesser extent. The data shows evidence for the fact that the ions originate in the local ionosphere at the footpoint. Therefore we also explore what these results might mean for outflow from the whole polar cap, i.e. polar wind.

Also the energy is analyzed in this way, and again different regimes are found above a sunlit ionosphere and a dark ionosphere. This energy corresponds to the field-aligned potential drop, and therefore this dependence is evidence for an ionosphere-magnetosphere coupling, likely through the change in ionospheric conductivity.