



Cluster CIS observations of polar cap O⁺ outflow; A relation to pc1 waves?

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We put observations of high altitude outflow and energization of oxygen ions into the context of pc1 waves. The ions were observed poleward of the cusp over the polar cap, i.e. in the mantle. This region has been suggested as a source of pc1-2 waves. Such low frequency waves could be effective in preferentially heating the heavier oxygen ions, in particular for the low magnetospheric magnetic field values at high altitude (well above 5 Earth radii). Previous studies has established that the oxygen ions have typically close to the same parallel bulk velocity as simultaneously observed outflowing (reflected) protons of magnetosheath origin, whereas the thermal velocity is typically well below that of the protons. Therefore parallel acceleration for example through the centrifugal force mechanism or a two-stream interaction seems to be important. Still the perpendicular temperature of the heavier ions is increasing with altitude (decreasing magnetic field) despite the effect of the mirror force and exceeds that of protons at high altitudes (typically above 8 Earth radii). Therefore effective perpendicular heating takes place at high altitude where the magnetic field is relatively weak and the gyro period of the oxygen ions large, of the order of pc1 waves. Therefore the source of pc1-2 waves reported in the plasma mantle could be related to the high altitude outflowing oxygen population and possibly involved in the perpendicular heating of it.