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Oxygen ion outflow observed at high altitude

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The results of a statistical study of oxygen ion outflow using Cluster data obtained at high altitude above the polar cap is reported. The questions we want to answer are: To what extent do significant oxygen energization occur at high altitude, what are the physical mechanisms for such energization and finally are there other non-adiabatic processes affecting the distribution of the oxygen plasma? The latter is important both for the net outflow and for the interpretation of observed parallel to perpendicular temperature rations in terms of long adiabatic transport from a relatively low altitude source vs. local or distributed high-altitude energization. Some of the major features of the statistical data set are: The oxygen temperature ratios are mainly isotropic, inconsistent with a long adiabatic transport from a heating region well below the spacecraft, at least in the absence of significant pitch-angle scattering. However, when the temperature is anisotropic the ratio parallel to perpendicular temperature is well above 1, and this is observed for relatively high energy ions, which is in principle in agreement with adiabatic transport from a relatively distant source.. The highest energy oxygen ions are only observed at the highest altitudes whereas the latitude distribution is such that such ions should be observed also at lower altitudes if they attained the high energy well below the spacecraft. An attempt has also been initiated to compare oxygen ion and proton fluxes observed simultaneously. At least at times the oxygen and proton parallel velocities are the same, and we will report whether this is also seen in the statistical data set. Whether such energization to the same velocity for both ion species is common is an important issue to understand oxygen ion dynamics.