Geophysical Research Abstracts
Vol. 13, EGU2011-9672, 2011
EGU General Assembly 2011

Mars Express measurements of the ion escape rate for solar minimum

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The Mars' atmosphere escape due to the interaction with the solar wind is thought to be an important channel of the atmospheric gases loss. Particle escape is produced by several physical mechanisms of ion acceleration in the planet induced magnetosphere. The escaping ion distribution is controlled by the convective electric field and strongly variable and inhomogeneous in the time and space domains that makes calculations of the global escape rates ($particle/sec$) from the microscopic and instantaneous *in situ* measurements (time and space dependent differential flux) a very complex problem. To correctly calculate the rates we showed that the escape rates calculated in both the planet-related and electric-field-related frames are about the same, provided the orbital sampling is sufficiently dense and homogeneous in the electric-field related frame. We proved this criteria for a limited set of orbits where the electric-field-related frame can be reconstructed and used the whole data set to obtain the global escape rate. To properly take into account the limited instrument's filed of view we used the epoch superposition method. To correctly deal with the low energy part of the distribution function (1 - 10 eV) affected by unknown spacecraft potential we extrapolated the measurements from the range 10 eV - 30 eV down to the oxygen escape energy. We applied the developed method to two years of the Mars Express ion measurements over the period from May 20, 2007 to May 20, 2009 corresponding to the minimum solar activity. The paper provides the total escape rate of the heavy ions of planetary origin in the solar minimum and discuss the acceleration mechanisms.