VOLATILE LOSS FROM MARS DRIVEN BY THE SOLAR WIND: FORMATION OF HEAVY ION PLUME FROM THE IONOSPHERE

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Mars is the second smallest body in the solar system with a significant atmosphere. Enriched D/H isotope ratio compared to Earth hints that Mars has lost major amount of water during the evolution of the solar system. But, it is poorly constrained what proportion of initial water (and other volatiles) on Mars has photodissociated and escaped to space through the atmosphere, and what proportion is retained in the soil as different compounds. This work studies how escaping oxygen ions in the Mars ionosphere and exosphere gain energy from the solar wind. A recently developed highly parallelized simulation model for the Mars-solar wind interaction and volatile erosion is used to analyze multi-spacecraft observations on European Space Agency's Mars Express (MEX) and NASA's Mars Atmosphere and Volatile EvolutioN (MAVEN) missions. Escaping planetary ions are measured by the Analyzer of Space Plasma and Energetic Atoms (ASPERA-3) instrument on MEX mission and by several instruments on MAVEN. In the observations and the model a prominent escape channel of heavy ions like oxygen is the heavy ion plume. The plume forms when planetary ions mostly from the ionosphere are accelerated directly by the large-scale solar wind convection electric field and finite Larmor radius effect strongly affects the dynamics of these heavy ions. Life times and flight distances of the plume ions along MEX and MAVEN orbits are estimated based on the model. This allows quantifying the efficiency of the solar wind driven acceleration of oxygen ions in the heavy ion plume.