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Automatic detection and dynamics of Martian plasma boundaries from Mars Express and MAVEN missions

Philippe Garnier (1), Thibault Noël (1), Vincent Génot (1), Christian Jacquey (1), David Ecoffet (1), Nicolas Aunai (2), Gautier Nguyen (2), Christian Mazelle (1), Xiaohua Fang (3), Benjamin Hall (4), and Kei Masunaga (5)

(1) IRAP, Universite Toulouse 3, IRAP, Toulouse, France (philippe.garnier@irap.omp.eu), (2) Laboratoire de Physique des Plasmas Ecole Polytechnique, Palaiseau, France , (3) Laboratory for Atmospheric and Space Physics University of Colorado, Boulder, US, (4) Space & Planetary Physics Group, Department of Physics, Lancaster University, Lancaster, UK , (5) Swedish Institute of Space Physics, Kiruna, Sweden

Many spacecraft have probed planetary environments to understand their dynamics and evolution. The datasets returned from instruments on these spacecraft have been used by researchers to classify “events” and “boundaries” within the planetary environments. This has typically been a time-consuming task, leading in particular to empirical models that however often do not reflect the large dynamics observed. Moreover, eye-based detections may display strong and unexplained biases from a scientist to another.
In this paper we report results from the use of machine learning techniques (in particular neural networks) to automatically detect plasma regions or boundaries at Mars (e.g. the solar wind, bow shock and close environment). We also investigate the variability in the Martian bow shock position with different drivers, in particular regarding the influence of the Martian crustal magnetic fields, solar wind parameters and extreme ultraviolet fluxes. We use for these two studies large datasets from both the Mars Express and MAVEN missions.