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► **To cite this version:**

N. Romanelli, Gina Dibraccio, Ronan Modolo, François Leblanc, Jared R. Espley, et al.. Recovery Timescales of the Dayside Martian Magnetosphere to Interplanetary Magnetic Field Variability. EPSC-DPS Joint Meeting 2019, Sep 2019, Geneva, Switzerland. pp.EPSC-DPS2019-281. insu-04449758

HAL Id: insu-04449758

<https://insu.hal.science/insu-04449758v1>

Submitted on 9 Feb 2024

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Recovery Timescales of the Dayside Martian Magnetosphere to Interplanetary Magnetic Field Variability

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Abstract

In this work we revisit an event observed by Mars Atmosphere and Volatile Evolution Mission (MAVEN) [1] in the solar wind (SW) on 23 December 2014 where the IMF rotates around the Mars-Sun axis during 6 minutes. Based on a time-dependent LATMOS Hybrid Simulation (LatHyS) [2, 3, 4] run taking into account MAVEN observations [5, 6, 7], we have determined ratios between the angular velocity associated with the recovery of the dayside magnetic field morphology in the magnetosheath and magnetic pile-up region and the associated IMF rotation observed by MAVEN upstream from the Martian bow shock. Such ratios provide recovery timescales of the dayside Martian magnetosphere normalized by the IMF variability timescale. In particular, we find that the recovery timescales of the Martian magnetosphere (up to the $X_{MSO} = -1 R_M$ plane) range between 5 s and 8 min for an IMF rotation that lasts 50 s, depending on the considered region. We also find that recovery timescales of the O^+ plume to the IMF rotation varies between 40 s and 120 s, and take greater values for further downstream distances. Such temporal range is on the order of the local O^+ gyrofrequency in the Martian magnetosheath, showing the kinetic nature of the O^+ plume recovery process.

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