



The response of the Martian ionosphere to short and long term solar energetic particles, a scientific goal of the ESA M7 candidate M-MATISSE

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The response of the Martian environment to Space Weather activity is not yet very well characterised as many factors from both the planet and from outside play large roles in the observed dynamics, particularly in the ionosphere. One of the most intense factor is when showers of Solar Energetic Particles (SEP) hit the planet as they are able to penetrate down to the surface and produce significant levels of aurora emissions. Moreover, both SEP protons and electrons are able to create ionospheric layers in the mesosphere, which in turn produce significant radio attenuation. In this study, we analyse data from all the active missions at Mars covering the track of the SEP particles up to the surface in order to provide the most complete characterization of the response of the Martian plasma system to Space Weather with respect to the solar cycle. We also evaluate short term responses, such as during the February 2022 and May 2024 events, when despite very large SEPs hitting Mars, the ionosphere did not absorb as many particles as it was expected. The main objective of this work is to provide the best possible characterisation of the Martian radiation environment in order to support to support the ESA M7 Mars, Magnetosphere, ATmosphere, Ionosphere, Space Weather Science (M-MATISSE) candidate.