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DETECTING SOLAR ENERGETIC PARTICLE EVENTS AND THEIR IMPACTS ON MARS WITH THE SWEET ALGORITHM

Abstract

The objective of this project is to detect space weather events around Mars using the Space Weather Event EDAC Tracker (SWEET) algorithm. Currently, the records of space weather events impacting Mars only go back to 2014, when Mars Atmosphere and Volatile Evolution (MAVEN) arrived. Besides, few spacecraft carry instruments dedicated to plasma and space weather purposes, and most space instruments are not operational at all times, which severely limits the amount of data we are able to collect about the planetary radiation environment.

The SWEET algorithm utilizes Error Detection And Correction (EDAC) data, which are cumulative counters, present on all spacecraft, that keep track of single event upsets in electronic components such as memory. EDAC software is often active even while other instruments are turned off, therefore long and continuous timeseries can be provided. From Mars Express we get 20 years of continuous coverage, almost equivalent to 2 full solar cycles, which is very useful for comparative solar transient event studies. Using the SWEET algorithm with EDAC counters from several Martian spacecraft, such as the ExoMars Trace Gas Orbiter (TGO), provides excellent coverage both in time and space. EDAC counters monitor a different energy range of primary radiation than instruments in orbit (MAVEN) and on the surface (Mars Science Laboratory (MSL)).

As humanity is aiming to further expand our presence on Mars, monitoring and understanding the radiation environment around the red planet is becoming more necessary than ever. Mars, unlike Earth, has a thin atmosphere and lacks a global magnetic field, although it has crustal magnetic fields. This leads to a harsh radiation environment on the surface - one of the main showstoppers for long-term human exploration. Increasing our knowledge of the impacts of solar transient events on Mars will aid in the planning of Mars missions.

In this study, solar transient events that have impacted Mars in the last 20 years are identified by the SWEET algorithm and collected into a database. The long-term radiation environment at Mars is studied, taking into account the long-term effect of solar cycle modulation of galactic cosmic rays and solar transient events. Data from other radiation monitors, both in orbit and on the surface of Mars, will be used to verify the output of SWEET.