

# Preceding CME effects on gradual SEP events: Modeling the 2013 March 15 event with EUHFORIA and PARADISE

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During solar maximum, the frequency of CMEs being expelled from the Sun is in the order of a few events per day. If an event is capable of driving a shock strong enough to accelerate particles, then we might be able to register a gradual SEP event at Earth's location. But what happens when we have a highly disturbed interplanetary medium at the time of the SEP event? How do preceding CMEs affect the profiles we register at Earth? And more importantly, are we capable of reproducing and forecasting these events before they arrive?

In this work, we model the gradual solar energetic particle (SEP) event that was observed by near-Earth spacecraft on March 15, 2013. This is done by using the model PARADISE (PArTicle Radiation Asset Directed at Interplanetary Space Exploration), which simulates the transport of SEPs through non-nominal solar wind configurations generated by the magnetohydrodynamic (MHD) model EUHFORIA (EUropean Heliospheric FOrecast Information Asset).

Several CMEs occurred in the days prior to the solar eruption of March 15. These preceding CMEs disturbed the solar wind, which may have affected the interplanetary transport of the SEPs, potentially explaining the delayed onset of the SEP event at Earth. To investigate this effect with the PARADISE model, also the preceding CMEs were included in the EUHFORIA simulation. Two different scenarios were explored, using different CME models to simulate the state of the heliosphere at the time of the SEP event. This work aims at showing how different solar wind configurations affect the SEP time-intensity profiles with in-depth analysis of the SEP event simulations.

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