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Numerical investigation of solar energetic particle transport between the Sun, Earth, and Mars.

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Solar energetic particles (SEPs), are particles (mostly electrons, protons and alpha particles) that are generated in a solar flare or at a shock driven by a coronal mass ejection (CME), resulting in super-thermal particles with energies from a few keV up to several GeVs. These high energy particle increases pose a danger to astronauts in space, can lead to the degradation of precious satellites and other Earth infrastructure, and even closer to home, they can result in a radiation hazard for airline passengers. With computer advancements, numerical methods such as finite-difference (FD) method have become invaluable tools in approximating various properties of SEPs, primarily focusing at Earth position, noting the accuracy to spacecraft observations. We shall seek to give a brief introduction to FD methods, and their implementation into the development of a Python model that simulates SEP transport. Given the current NASA and SpaceX aspirations of a Mars research base, and eventual colony, we shall provide initial model results at Mars, and perform a comparative study of the initial model solutions to spacecraft observations near both Earth and Mars, noting the limited observational spacecraft data from the MAVEN mission at Mars.

keyword(s): Solar energetic particles, Finite-difference methods, Earth, Mars.

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