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Oral
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In the pursuit of understanding the underlying mechanisms driving geomagnetic storms induced by coronal mass ejections (CMEs) on a larger scale and enhancing the accuracy of space weather prediction, we have created the STORM Interaction (STORMI) module. This module utilizes 3D magnetohydrodynamics to simulate the intricate interactions between interplanetary CME (ICME) flux ropes and the Earth's magnetosphere. Through our simulations, we effectively capture the dynamic behaviors of the magnetosphere when influenced by ICMEs. This includes phenomena like the twisting of the magnetotail and the generation of induced currents, which in turn cause disturbances in the Earth's geomagnetic field. By combining data-driven simulations with fundamental physical principles, we have introduced a novel approach to estimating a geoeffectiveness proxy known as the Storm Intensity Index (STORMI). It demonstrates strong agreement with historical Dst/SYM-H values. Our method is notable for its simplicity and efficiency in terms of time. Most importantly, it holds the potential to significantly extend the timeframe within which we can make predictions, addressing a key challenge in forecasting the geospace environment. This potential assumes the availability of early predictions regarding the structures of near-Earth CME flux ropes derived from observations near the Sun. Additionally, we have carried out a series of interactions between interplanetary CMEs and the Earth's magnetosphere to investigate the impact of the twist present in the ICME's magnetic field and the alignment of the flux rope axis with respect to Earth. Our findings underscore the significance of these factors in augmenting geoeffectiveness and perturbing magnetospheric dynamics, including the twisting of the magnetotail. This study represents a significant advancement in our comprehension of space weather and offers insights into the determinants that influence geomagnetic storms.
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