The Interaction of Solar Eruptions and Large-Scale Coronal Structures Revealed Through Modeling and Observational Analysis

Evans, Rebekah (1), Rebekah.e.frolov@nasa.gov; A. Savcheva (1); K. A. Kozarev (1), J. L. Zink (1); K. Muglach (1); M. Opher (3); and B. van der Holst (4).
(1) NASNASA Goddard Space Flight Center, Greenbelt, MD, USA
(2) Harvard-Smithsonian Center for Astrophysics, Cambridge, MA, USA
(3) George Mason University, Fairfax, VA, USA
(4) University of Michigan, Ann Arbor, MI, USA

We use numerical and observational approaches to explore how the interaction of a coronal mass ejection (CME) with preexisting structures in the solar atmosphere influences its evolution and space weather effects. We study two aspects of CME evolution: deflection of the CME's propagation direction, and expansion. First, we perform a statistical study of the influence of coronal holes on CME trajectories for more than 50 events during years 2010-2014. Second, we use a global solar wind model within the Space Weather Modeling Framework (SWMF) to study a CME's expansion. The interaction of the modeled CME with a nearby streamer results in non-uniform expansion. We calculate the pile-up of material along the front and sides of a CME due to the non-uniform expansion, and constrain the properties of the pile-up under a range of conditions. These plasma density structures prove to be important for space weather: using the global MHD simulation data as input to a proton acceleration and transport model (EPREM), we demonstrate that the compression regions efficiently accelerate protons to high energies, whereas other locations along the CME produce little proton acceleration. Looking toward the future, we show data-constrained simulations of CME initiation in the Alfven Wave Solar Model (AWSoM) within the SWMF, which employs a sophisticated treatment of the physics of coronal heating and solar wind acceleration. We discuss how this approach will improve our understanding of CMEs.

R. M. E. is supported through an appointment to the NASA Postdoctoral Program at GSFC, administered by Oak Ridge Associated Universities through a contract with NASA.