

Qualifying Exam
Kimberly Moreland

Date: Monday, September 19, 2022

Time: 2:00pm/CT

Advisor: Dr. Maher Dayeh

Abstract

Investigating the Physical Relationships among the Elements of Space Weather Events and their Importance in Forecasting

Solar Flares (SFs) and Interplanetary Coronal Mass Ejections (ICMEs) are two main phenomena that drive Space Weather (SWx) in the near Earth environment. Both phenomena are associated with solar energetic particles (SEPs) in which electrons and ions (e.g., protons) are accelerated to very high energies (tens of MeV/nucleon) and can bring sudden and significant increases to the near-Earth particulate radiation. These radiation enhancements pose serious hazards to astronauts and assets in space. Astronauts can suffer acute and long-term illnesses, such as increased cancer risks. High energy particles can disrupt spacecraft electronic operations by causing degradation or permanent damage to instrument components. Understanding solar activity and the links between the physical drivers and their associated particle enhancements is thus crucial to advance the capabilities of space weather modeling. This work is two-fold: it encompasses understanding the physical properties and processes in interplanetary shocks and associated energetic storm particles (ESPs), and builds upon a comprehensive dataset to examine and quantify the effects of different inputs on predictive models outcome. Three focused studies will be performed: (1) Examining the effects of time window selection on shocks and ESP parameters, and characterizing the relations between shocks and ESPs. (2) Determining the hierarchical importance of SFs and associated properties in determining ESPs at 1 au using a newly-assembled comprehensive multivariate solar dataset. (3) Exploiting the parameter space of this dataset using an ensemble model by individually varying the inputs and examining the predictive out-puts, enabling the identification of the main variables driving the prediction of SEP occurrence and properties.