Title and Research Team

Title: Prediction of solar energetic particle radiation timing and dosage using physics-guided machine learning algorithms with remote observations of the solar photosphere, corona and interplanetary medium

Research Team:
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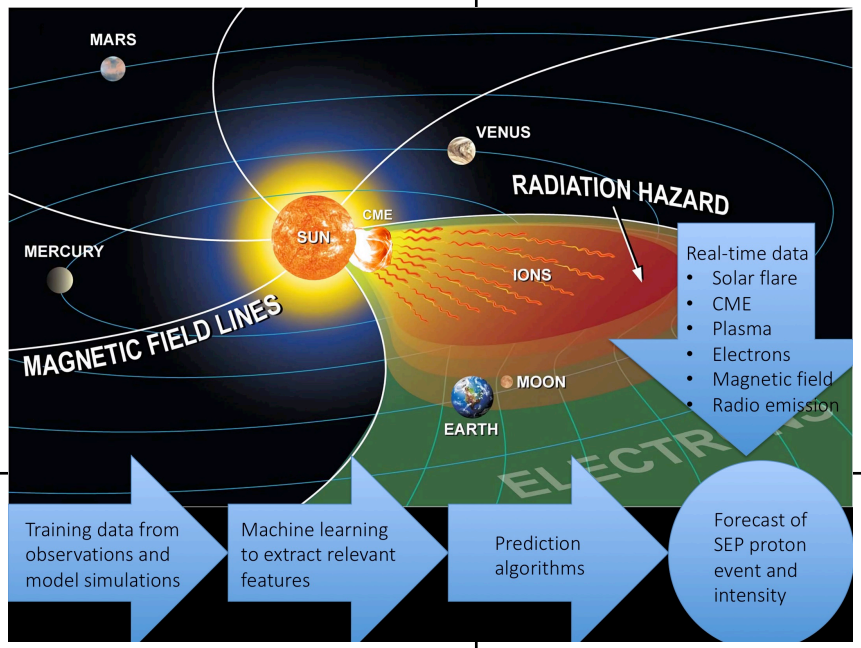
Research Objectives

- Use machine learning techniques to build models that can continuously predict SEP events and radiation dose in several future time windows based on up-to-date extensive observational and theoretical modeling results.
  - Incorporate a wide array of remote sensing and in-situ measurements.
  - Understand the physical relationships between the characteristics of SEP events and feature variables.
  - Target TRL4 and get ready for field test.



Approach

Apply machine learning techniques (random forest, LightGBM, neural network, and etc.) using three different types of features:

1. direct observations including both remote-sensing and in-situ measurement and features derived from them;
2. features that are calculated based on hand-crafted physics-based models and computer simulation results;
3. features that do not currently have hand-crafted physics-based models and are ML-based models trained from observations.

Potential Impact

- Our proposed model will forecast the occurrence and flux of >10 MeV particles (S1-S5 event on the NOAA space weather prediction center solar radiation scale).

A successful forecast will help protect the health of astronauts during a lunar mission and valuable instruments on spacecraft.

- The generated/engineered new and unanticipated patterns/features that we extract from the machine learning procedure will further help us understand the properties of SEPs and their underlying physical processes.