56th IAA SYMPOSIUM ON SAFETY, QUALITY AND KNOWLEDGE MANAGEMENT IN SPACE ACTIVITIES (D5)
Predicting, testing, and measuring the effects of the space environment on space missions (3)

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PROBABILISTIC FORECAST OF SOLAR ENERGETIC PARTICLE (SEP) EVENTS

Abstract

Solar flares, Coronal Mass Ejections (CMEs), and Solar Energetic Particles (SEPs) are among the key drivers of space weather. While some CMEs and flares are associated with intense SEPs, some show no or little SEP association in the near-Earth environment. The latter is due to the complexities that dominate SEP origin, acceleration, and transport. To date, robust long-term (hours to days) forecasting of SEPs does not effectively exist.

We present an ensemble of neural networks that uses a comprehensive dataset from multiple sources to predict the true probability of SEP occurrence and its properties (e.g., peak intensity, onset time, and duration). We show that incorporating the SEP occurrence probability as a weighting factor into the regression can tighten the prediction of event properties on the test set. We also show how the uncertainty estimated through the ensemble of models enables robust forecasting decisions for unseen data.