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Cumulative exposure to ionizing radiation at aviation altitudes poses significant health risks for aircrews and, at higher altitudes, astronauts. Physics-based models are commonly used to estimate radiation levels during flight; however, they often do not fully capture the rapidly varying and complex nature of atmospheric radiation, limiting real-time prediction accuracy. To address this limitation, we explore machine learning (ML) approaches to improve the analysis and nowcasting of aviation radiation.

Using newly compiled, ML-ready aviation radiation datasets (publicly available at https://dmlab.cs.gsu.edu/rdp/), we train supervised ML models to identify nonlinear relationships between geospace environmental parameters and measured radiation dose rates. Our results show that a gradient boosting (XGBoost) model trained on the concurrent properties of the geospace environment improves radiation prediction accuracy by approximately 9% compared to the considered physics-based NAIRAS-v3 model. Feature importance analysis and Shapley Additive Explanations (SHAP) indicate key geospace parameters, including solar and polar field variations, that play a dominant role in controlling radiation variability at flight altitudes.

In a complementary observational study, we examine the role of secondary cosmic-ray muons in aviation radiation environments below 15 km altitude. Atmospheric muon flux measurements obtained from a CubeSat prototype developed by the Nuclear Physics Group at Georgia State University are analyzed alongside radiation doses modeled by NAIRAS-v3. Correlation studies reveal a strong positive linear relationship between muon counts per minute and modeled radiation dose rates (μSv/h), indicating a statistically significant association between these variables.
Poster session day
Tuesday, April 28, 2026
Poster location
8
Meeting homepage
[2026 Space Weather Workshop]
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