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Hindcasting, nowcasting and forecasting with the Dynamic Radiation Environment Assimilation Model (DREAM)

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The penetrating radiation environment in Earth's Van Allen radiation belts is highly dynamic and highly orbit-dependent. Los Alamos National Laboratory has developed the Dynamic Radiation Environment Assimilation Model (DREAM) to study this environment and a varsion has been developed for real-time space weather applications. Real-time applications impose some constraints on DREAM but the assimilation of data in physics-based models produces information that has significantly more spatial coverage, accuracy, and utility than either the data or model alone. The minimum data input for DREAM is real-time electron fluxes from a single satellite but data from multiple satellites can improve the model accuracy – particularly when different orbits are included. Data from different sources and different data latencies can also be assimilated asynchronously. Even data that is several days old can affect the real-time assimilated state so, when new data become available, DREAM reprocesses the intervening time period, updating both past and current forecasts. Unlike simple time series of particle fluxes or geomagnetic indices, assimilative models like DREAM produce multi-dimensional data products that require innovations in user interfaces. One example is output that specifies the space environment along a user-selected orbit and time interval. More sophisticated applications can determinethe relationship of the current environment to known statistics and extremes in order to quickly flag environments that have known (or suspected) correlations with anomalies. We will discuss the underlying framework of DREAM, the user interface that we have developed and its use for both hindcasting and nowcasting. We will also discuss future development plans for DREAM and how the same paradigm can be applied to integrating other space environment information into operational systems.

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