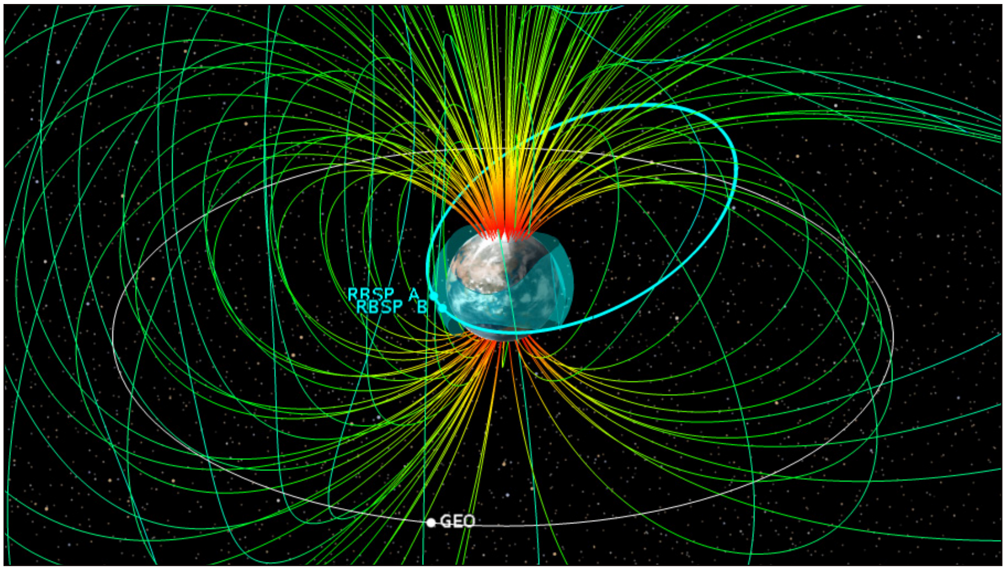
STK SEET

AGI

Space Environment and Effects Tool (SEET) evaluates the effects of the space environment on spacecraft.

Spacecraft designers, analysts, and operators rely on SEET to calculate spacecraft exposure to ionizing particles, thermal radiation, and space debris throughout the orbit, which is especially critically due to higher levels of man-made debris and increasingly energetic natural phenomena, such as the sun's solar flare activities.



Key components

SEET's functionality is provided by six key components consisting of scientific models of the space environment. These components are seamlessly integrated into the STK user interface.

- Trapped radiation environment
- South Atlantic Anomaly (SAA)
- Untrapped radiation environment
- Particle impacts
- Vehicle temperature
- Magnetic field

Trapped radiation environment

Information on vehicle dosing and incident energetic particle flux is important because devices on satellites degrade over time due to the total collected dose as well as the instantaneous dose rate.

- Computes expected dose rate and total dose due to energetic particle fluxes for a shielding thickness and materials.
- Computes the energetic proton and/or electron fluxes.
- Computes for a specified space vehicle as a function of time or for a specified set of spatial coordinates.
- Choose from AFRL CRRES or NASA standard models, or allow SEET to select the best model for the specific orbit.

South Atlantic Anomaly (SAA) component

SAA radiation can damage spacecraft electronics and cause Single Event Upsets (SEU), which can impair the functioning of electronic components.

- Computes entrance and exit times through SAA. SAA Transit component computes the energy flux and/or flux contour of SEU relative probability for altitudes between 400 and 1500 km.
- SAA model is based on data from the Compact Environment Anomaly Sensor (CEASE) detector.

Untrapped radiation environment component

Galactic Cosmic Ray (GCR). GCRs can lead to a variety of satellite anomalies, especially single event effects (SEE).

- Computes differential and integral fluxes and fluences.
- Provides three different options for GCR models: CREME86, ISO-15390, and Badhwar-O'Neill 2010.

Solar Energetic Particle (SEP). SEPs can cause problems similar to GCR, as well as other effects including increased ionizing dose. SEPs also cause other disruptions to technology, such as increased radiation dose to astronauts and airline crews and passengers, as well as degraded HF radio communications.

- Computes probabilistic fluences over mission lifetimes.
- Provides three different options for SEP models: JPL-91, Rosenqvist, and Emission of Solar Protons (ESP).

Particle impacts component

Define or select from lists of surface materials and properties that may be damaged by high-velocity impact with meteors and orbital debris.

- Computes the total mass distribution of meteor and orbital debris particles that impact a spacecraft along its orbit during a specified time period.
- Computes the mass distribution of these particles above a user-specified satellite surface damage threshold.
- The particle impacts algorithms are based on AF-GEOSpace meteor and debris models.

Vehicle temperature component

For vehicle sub-system design and operations, thermal environment energy combined with any internal heat dissipation requirements must be considered.

- Computes the mean temperature of a space vehicle, due to direct solar flux, reflected and infrared Earth radiation, and the dissipation of internally-generated heat energy using thermal balancing equations.

- Specify spherical objects or planar objects with particular orientation, and material emissivity and absorptivity.

Magnetic field component

SEET uses a highly customizable set of conditions to compute the local magnetic field at the current location. Information about the local magnetic field at the satellite is useful because these measurements can help give information about vehicle attitude.

- Computes total magnitude along the vehicle path or on a specified set of spatial coordinates using a chosen magnetic field model.
- Computes field-line tracing for display and magnetic conjugacy.
- Computes dipole L, McIlwain L, and B/Beq (ratio of magnetic field strength at the current location to that at the magnetic equator).
- Provides common magnetic field functionality with current AF-GEOSpace magnetic field models, including simply tilted dipole models based on time-interpolated moments of the full IGRF field representation, full time-interpolated IGRF, and full IGRF plus Olson-Pfitzer (1977) external field models.

Specialized report and graph options

Numerous customizable reports and graphs are available. Dynamic displays and strip charts containing SEET calculations can be displayed in real time as STK animates through a scenario.

SEET environment graphics

- SEET can display magnetic-field contour lines for a satellite, missile, or launch vehicle in both the 2D map and 3D globe.
- SEET can also display contours of the South Atlantic Anomaly (SAA) in 2D and 3D graphics windows.

SEET constraints

STK SEET constraints enable you to impose access constraints on a satellite, missile, or launch vehicle based on the effects of the space environment. You can also opt to exclude time intervals that satisfy a given constraint.