Space Weather Workshop, April 20-22, 2021, virtual meeting
https://cpaess.ucar.edu/space-weather-workshop-2021

Solar Radiation in the Earth Environment (SREE) Data Portal

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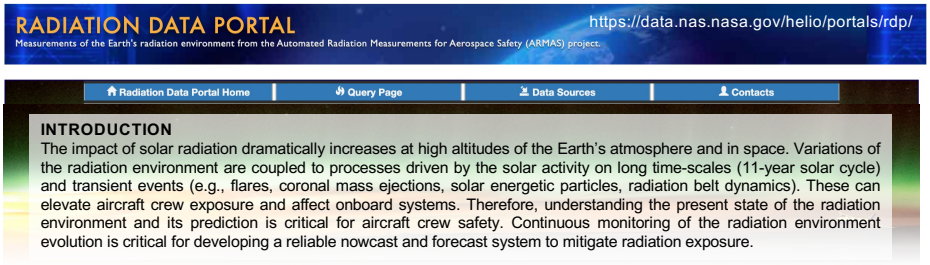
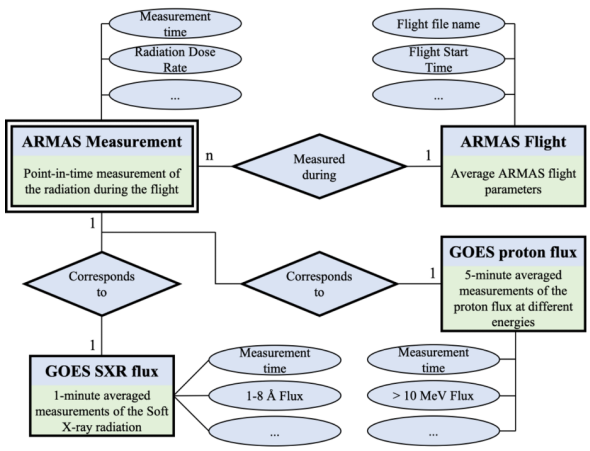
The impact of solar radiation dramatically increases at high altitudes in the Earth's atmosphere and in space. Therefore, continuous monitoring of the radiation environment and tracking of space-weather originated disturbances is critical for aircraft and spacecraft crew safety. The Solar Radiation in the Earth Environment (SREE) Data Portal is an interactive web-based application for convenient search and visualization of in-flight radiation measurements and exploration of various properties related to the radiation environment. The web application contains a comprehensive search form with built-in filters, allowing the user to customize flight selection and other search parameters and to access visualization tools. The search procedure is supported by dynamic histograms of flight parameters implemented with the Google Charts API. The database includes (1) data from the Automated Radiation Measurements for Aerospace Safety (ARMAS) experiment obtained during more than 780 airplane flights, which are accompanied by the Nowcast of Atmospheric Ionizing Radiation for Aviation Safety models (NAIRAS); (2) measurements of solar soft X-ray radiation in the 0.5-4 Å and 1-8 Å wavebands from the Geostationary Operational Environmental Satellite (GOES); and (3) measurements of solar proton fluxes in various energy channels from GOES. The Application Programming Interface (API) and related Python routines allow users to retrieve the database records directly and efficiently, without interaction with the web interface.



DATA SOURCES

- The Automated Radiation Measurements for Aerospace Safety (ARMAS), augmented with the integrated properties of the flight and environment. The ARMAS project utilizes a micro-dosimeter integrated into a data processing and communication electronics package to measure and report the absorbed dose rates with a one-minute cadence. The doses are converted to effective dose rates. The ARMAS data (e.g., Tobiska et al., 2018) are publicly available from Space Environment Technologies (SET) as individual files for each flight (https://sol.spacenvironment.net/ARMAS_Archive/)
- GOES Soft X-ray (SXR) radiation measurements in the 0.5 – 4 Å and 1 – 8 Å channels. The Data Portal currently utilizes calibrated 1-min averaged GOES fluxes available from the NOAA for Environmental Information archive (NCEI, https://satdat.ngdc.noaa.gov/). Each ARMAS measurement is linked to the nearest-time SXR measurement.
- Integrated GOES proton flux measurements: The Portal utilizes 5-min calibrated and integrated measurements of proton fluxes above the following thresholds: 1 Mev, 5 MeV, 10 MeV, 30 MeV, 50 MeV, 60 MeV, and 100 MeV.

The entity relationship diagram of the Radiation Data Portal



MySQL Database

The data sources are loaded to a MySQL relational database. The database structure represents an interaction between three entities:
1) integrated ARMAS flight properties,
2) measured time-series during a flight,
3) GOES measurements.
At the present time, the ARMAS flight measurements update is performed manually using the developed update scripts.

Application Programming Interface (API)

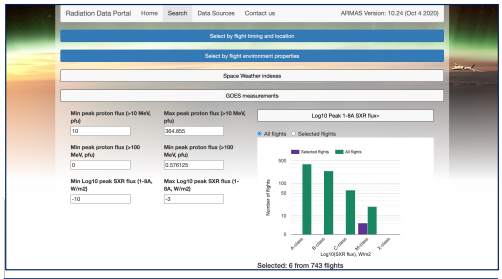
The API is developed to handle the requests to the database: 1) properties of ARMAS flights, and 2) measurements during a flight.
The requests are implemented as HTTP GET requests. The search results visualized in the form of dynamic histograms and quick-look of a flight route for the measurements are implemented using the Google Charts API. The documentation are available from the Radiation Data Portal web page and paper by Sadykov et al. (2021).

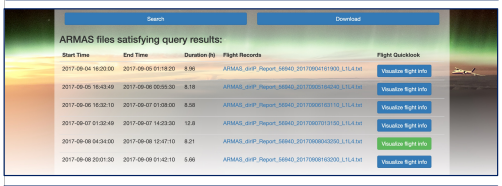
https://data.nas.nasa.gov/helio

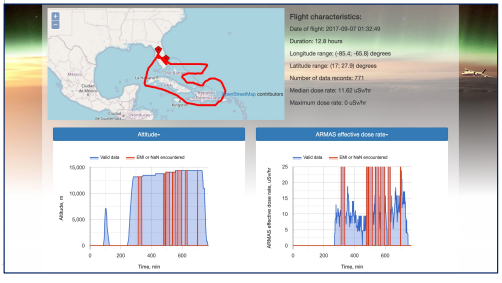
Radiation Data Portal Front-End

A comprehensive front-end web application is currently available at https://data.nas.nasa.gov/helio/portals/rdp/.
The search filters are organized into three categories:
1) Flight time and location properties: dates when flights were performed, flight duration, flight routes in ordinary and geomagnetic coordinates;
2) Environment characteristics: space weather and geomagnetic indexes (Kp, Ap, D, Dst, G-level), peak values of SXR, and proton fluxes during a flight;
3) Dosimetry measurements: total, averaged, and median dose measurements obtained during ARMAS flights and predicted by the NAIRAS v1 model, median geomagnetic cutoff rigidity and quality factor during the flight;
The search results are visualized in the form of dynamic histograms implemented using the Google Charts API. Each selected flight is supported by a quick-look visualization that includes the flight route on the map, summary of the key properties of the flight, and two dynamic charts presenting the flight parameters as functions of time.

Example of the Radiation Portal framework and quick-look visualization

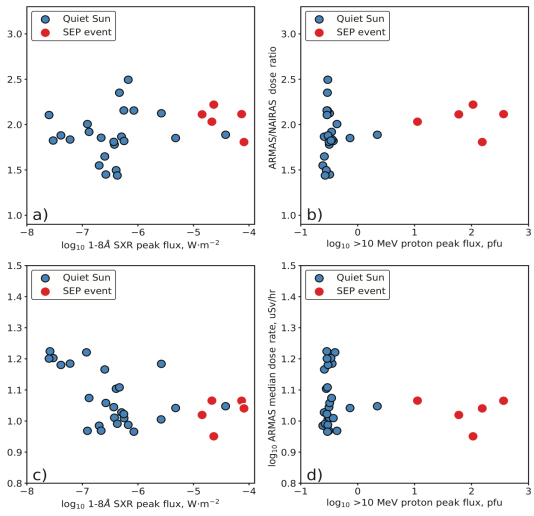






Case study: ARMAS measurements during solar proton events (SPEs)

Correlations between the total dose ratios of ARMAS to NAIRAS to X-ray flux (panel a) and proton flux above 10 MeV (b). Dependence of the ARMAS median effective dose rate from the X-ray flux (panel c), and proton flux above 10 MeV (d).



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