



## Risk Indicators Web Site

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# Rationale

- To provide stakeholders and users with near real time risk indicators
  - For typical spacecraft orbits: GEO, Galileo, low inclination equatorial
  - For various spacecraft and component effects: ESD, surface charging, TID, solar cell displacement damage
  - Define 3 thresholds based on literature and stakeholder input
- Spacecraft trajectories
  - Actual trajectories generated using SPACE-TRACK TLEs: geographical and magnetic coordinates calculated at 1 minute intervals
  - GOES East and West, GioveA, 8,000km equatorial
- Environment specification
  - Use data when available (e.g. GOES proton and electron spectra)
  - Complement with model runs to
    - Extend energy ranges
    - Provide spectra where no real time data are available
- Use the real time environment to calculate effects quantities and apply thresholds to determine risk factors -> display on web page at hourly intervals

# Environment specification

- Near real time spacecraft data are downloaded continuously and stored in a database (developed during SPACECAST)
  - GOES proton and electron spectra from different instruments
  - GioveA/MERLIN/SURF plate charging currents
- Solar and geomagnetic indices are also continuously downloaded and stored
  - IMF components and solar wind parameters from DSCOVR
  - Kp, Dst, including 1 day Kp forecast produced by Met Office
- Spacecraft positions and indices are provided to BAS and FMI for model runs. Model output files are retrieved and used to complement measured spectra.
- GOES proton fluxes are attenuated by geomagnetic shielding for GioveA and 8,000 km equatorial orbits (using outputs from a tool developed for the ESA SEPTEM project).

# Calculation of effects quantities

- Internal charging
  - ESA DICTAT tool (web version)
  - Planar geometry behind 2 mm Al shielding
  - Risk quantity: charging current
- Surface charging
  - Risk quantity is the ambient 30-50 keV electron flux
  - Flux data are used for GOES, IMPTAM model runs for GioveA
- Total ionising dose
  - Dose in Si behind 2 mm spherical Al shielding
  - Calculated with SHIELDOSE-2
  - Risk quantity is the dose rate ( $\text{rad hr}^{-1}$ )
- Solar cell displacement damage
  - Risk quantity is damage equivalent electron flux ( $\text{cm}^{-2} \text{hr}^{-1}$ )
  - Calculated with EQFLUX for AZUR 3G28 multi-junction cell behind 500  $\mu\text{m}$  cover glass

Risk indicator web page: <http://risk.spacestorm.eu/>



## SPACESTORM Satellite Risk Indicators

This page provides a summary of the risk of damage to satellites due to space weather. It provides a risk indicator for each of the four main hazards and 4 representative orbits. The current hazard risk is indicated by a colour display and number 1–4 where 4 is the highest risk. Click in any effects box to view and download detailed plots and output files. Click on the effects header line columns to read more on the definition of the risk indicators.

The risk indicators have been calculated by combining satellite data with the BAS radiation belt model and radiation effects models developed under contract by the European Space Agency.

For science displays on the current radiation environment click [here](#).

### Risk Indicators

	Internal Charging	Surface Charging	Ionising Dose	Solar Cells
GOES East	1	1	1	1
GOES West	1	1	1	1
Giove-A	1	Not available	1	1
Slot Region 8,000 km	1	Not available	1	3

