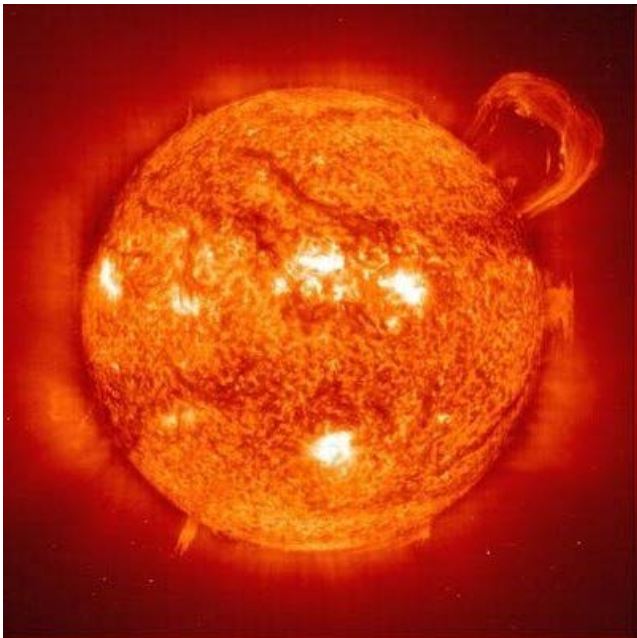


Impact of an Extreme Space Weather Event on European Space Assets



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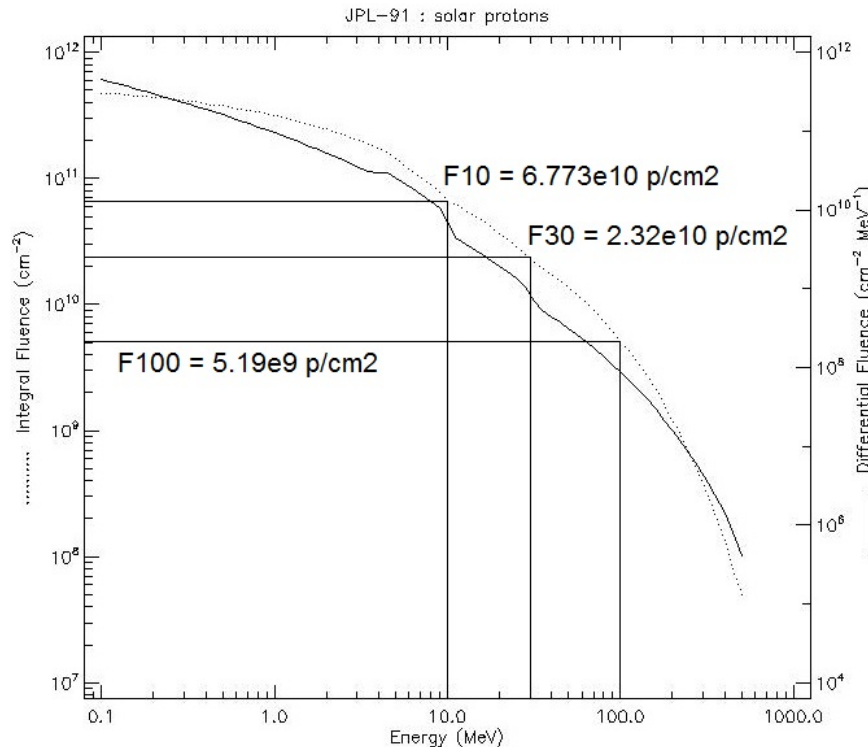
- What will be the impacts of an extreme solar storm on the **EGNOS and Galileo** satellites?
- Risk assessments usually consider events that happen **every 100 or 200 years.**

A three step process:

- Definition of an extreme event.
- Modelling of impacts: SPENVIS
- Study of previous events: Halloween, Bastille Day, etc...

- What will be the impacts of an extreme solar storm on the **EGNOS and Galileo** satellites?
- Risk assessments usually consider events that happen **every 100 or 200 years.**

JPL model for a once in 200 years radiation storm.



F30 -> 6 times stronger than Halloween.

Probability of exceeding = 0.64

Modelling of radiation sources:

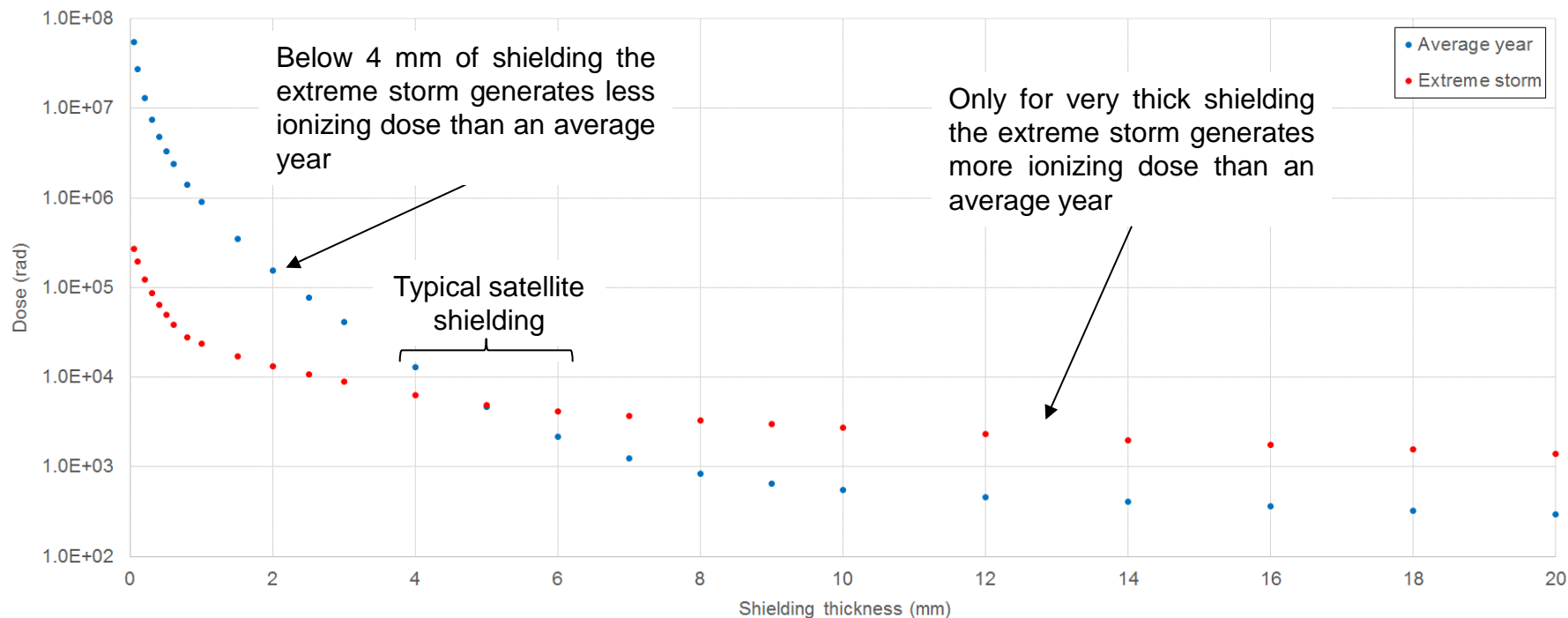
	Trapped Protons	Trapped Electrons	Solar protons
Solar min	AP8-MIN	AE8-MIN UPDATE	-----
Solar max	AP8-MAX	AE8-MAX	JPL 80.0%
Extreme Storm	-----	-----	JPL 99.2% Worst case electron fluence (internal charging)

Modelling of radiation effects:

Ionizing dose	Shieldose-2
Non-ionizing dose	NIEL
Damage to solar cells	EQFLUX
Single events effects	Long-term SEU rates
Internal charging	DICTAT

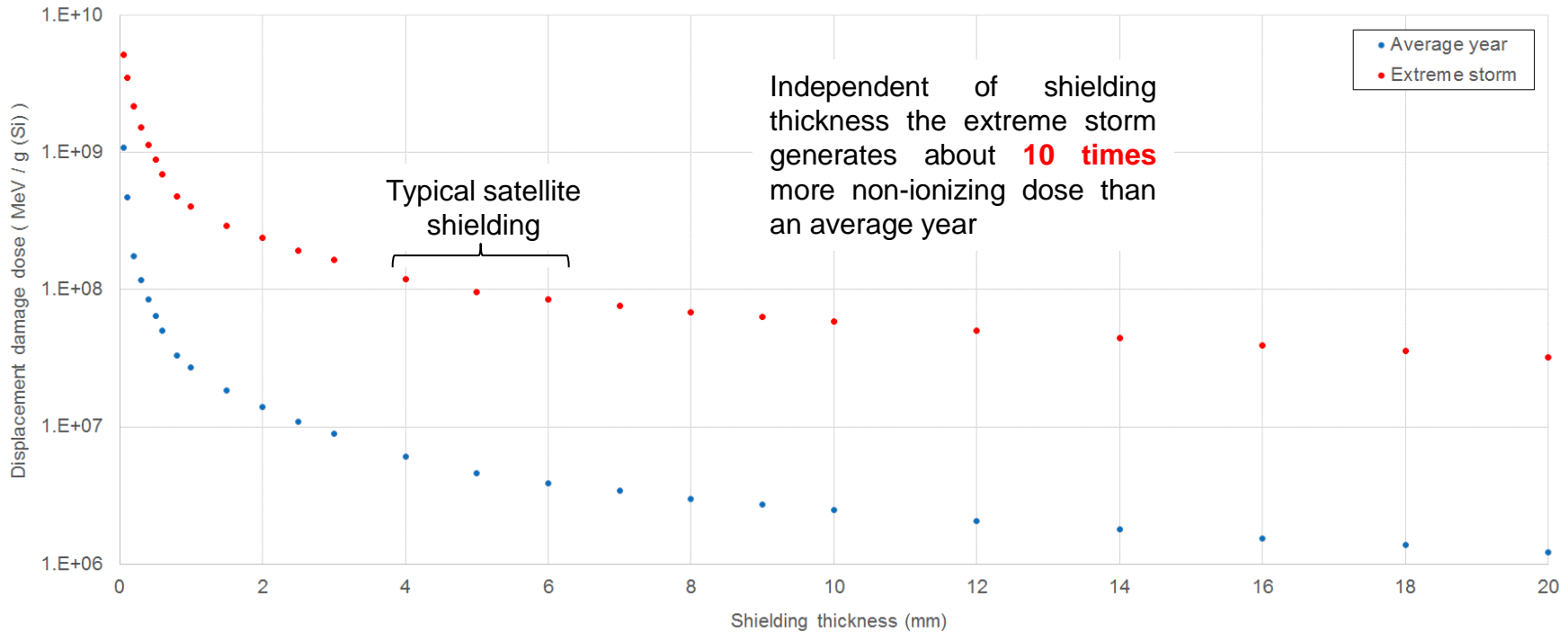
GEO and MEO orbits

Ionizing dose for an average year and the extreme storm at GEO

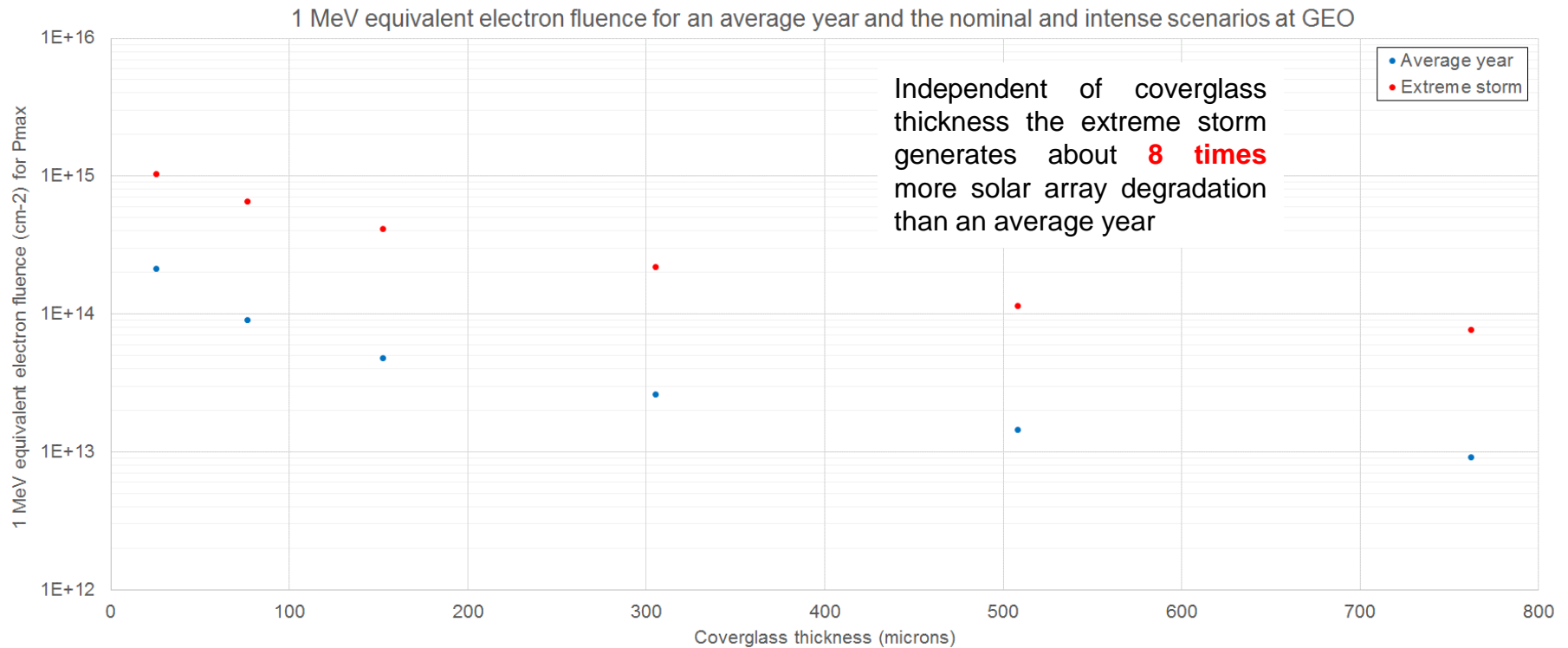


Ionizing dose risk level in GEO: **LOW**

Displacement damage dose for an average year and the extreme storm at GEO



Non-Ionizing dose risk level in GEO: HIGH



Solar array degradation risk level in GEO: HIGH

The **Halloween storm** is one of the most interesting solar storms to study because:

- It was perfectly characterized by in-orbit particle detectors.
- There were about **900 satellites** operating during those days.

The **telemetry** of those satellites contains precious information about the effects of a very intense solar storm on spacecraft hardware.

The collaboration with manufacturers, operators and other entities (ESA, EUMETSAT, NOAA, ...) will be crucial to access those data.



European
Commission

Thank you