Commercial Applications of Space Weather Data

Agenda

1. European Space Agency (ESA)
2. ESA Business Applications Space Solutions (BASS)
3. ESA Space Safety Programme (S2P)
4. Commercial Applications of Space Weather Data
5. Guest Speaker
    1. Bob Arritt, Electric Power Research Institute
6. How to Apply
7. Q&A

Speakers

Christopher Frost-Tesfaye

Space Applications

European Space Agency

Alexi Glover

Space Weather Service Coordinator

European Space Agency

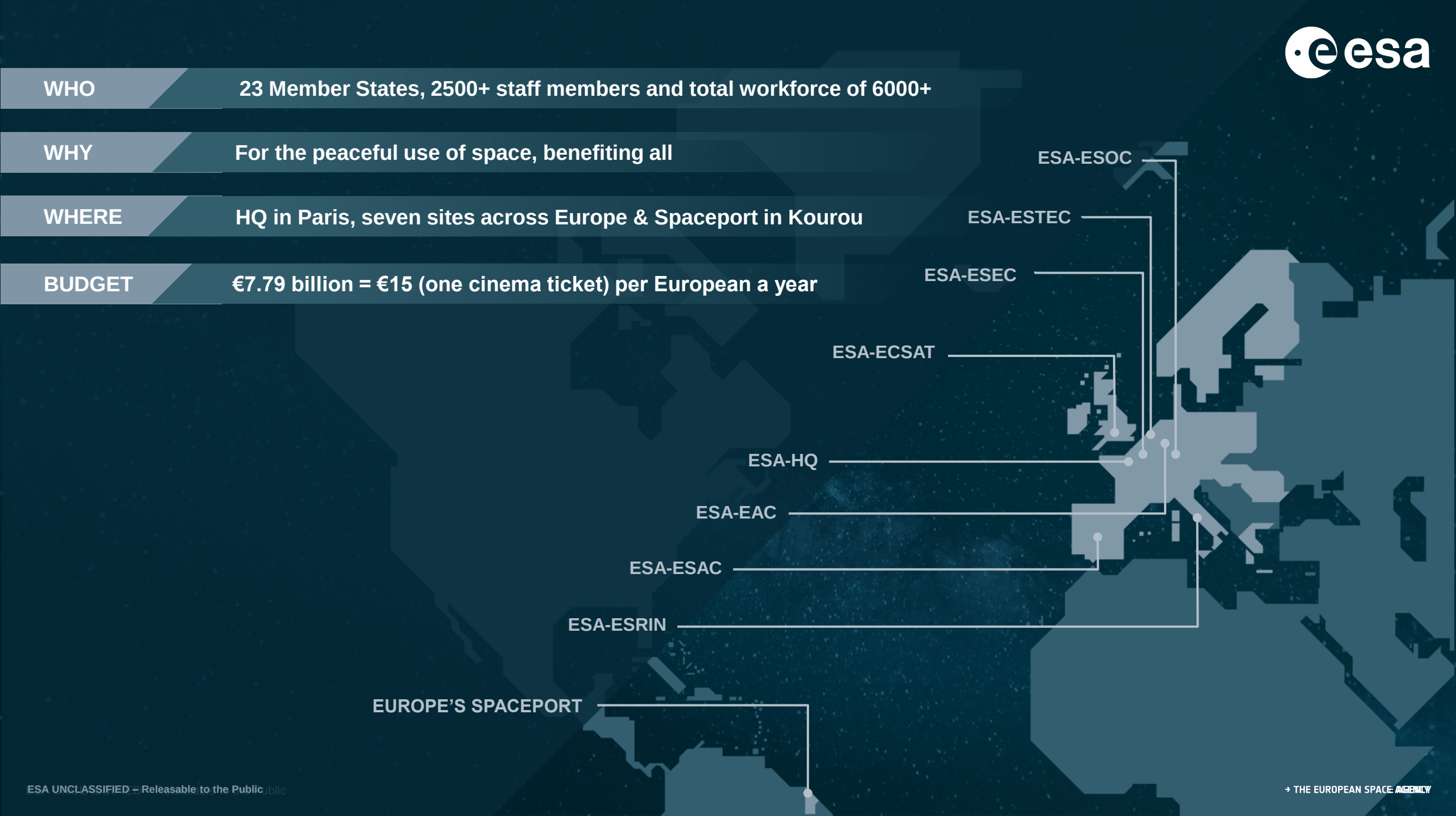
Bob Arritt

Technical Executive

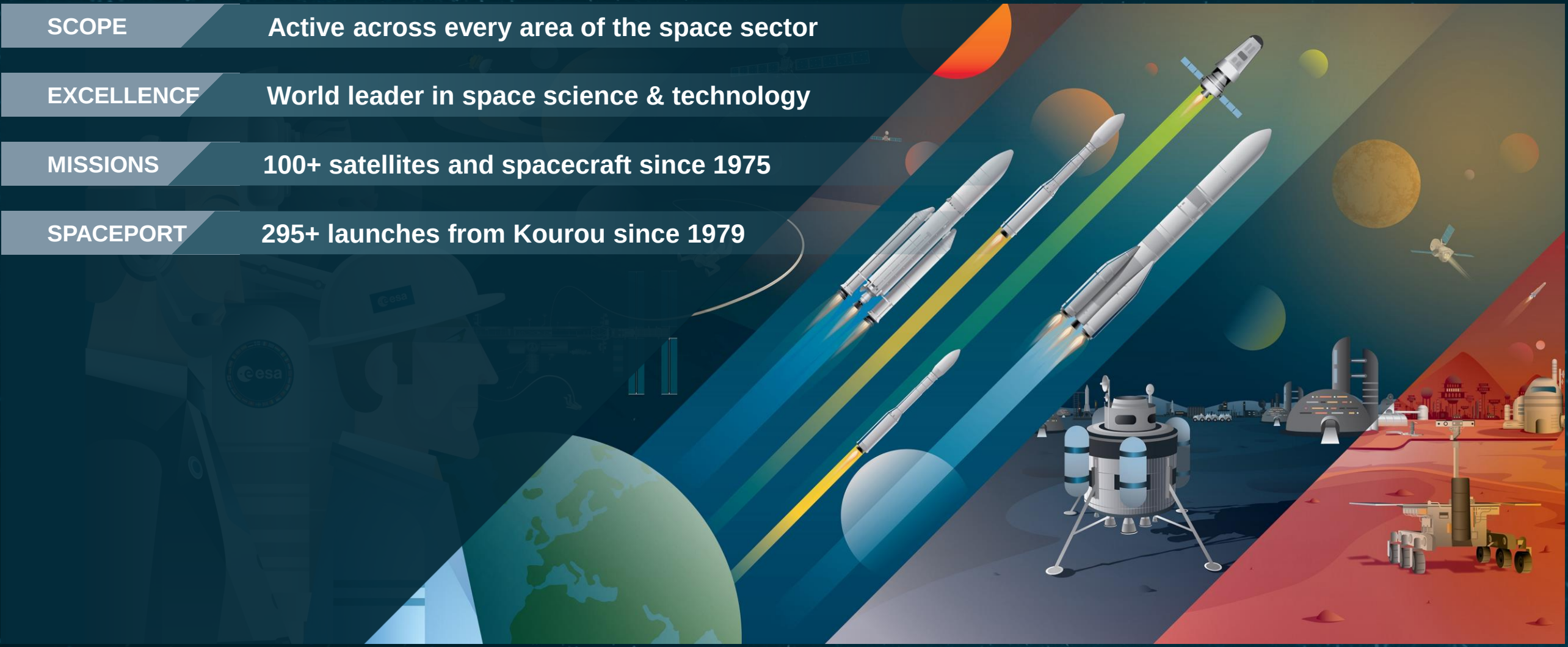
Electric Power Research Institute

We are committed to the peaceful exploration and use of space for the benefit of people, society and our planet

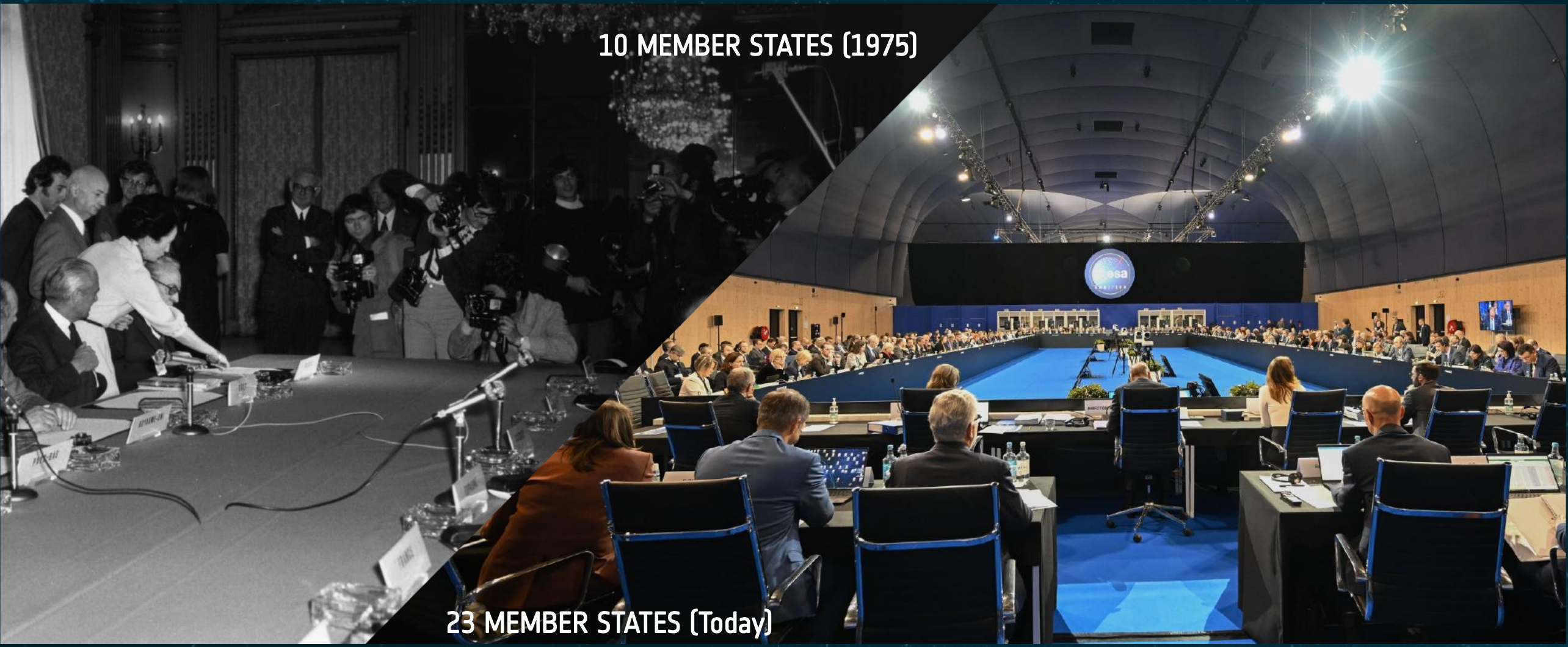
WHO	**23 Member States, 2500+ staff members and total workforce of 6000+**
WHY	**For the peaceful use of space, benefiting all**
WHERE	**HQ in Paris, seven sites across Europe & Spaceport in Kourou**
BUDGET	**€7.79 billion = €15 (one cinema ticket) per European a year**



SCOPE	**Active across every area of the space sector**
EXCELLENCE	**World leader in space science & technology**
MISSIONS	**100+ satellites and spacecraft since 1975**
SPACEPORT	**295+ launches from Kourou since 1979**

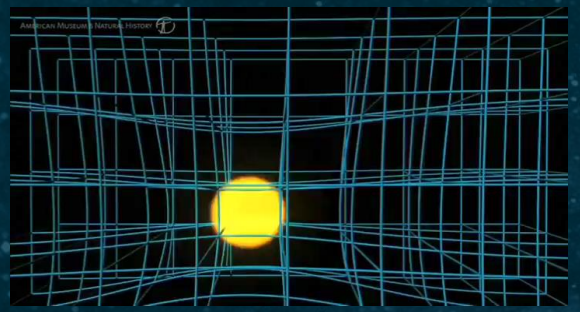


ESA evolution



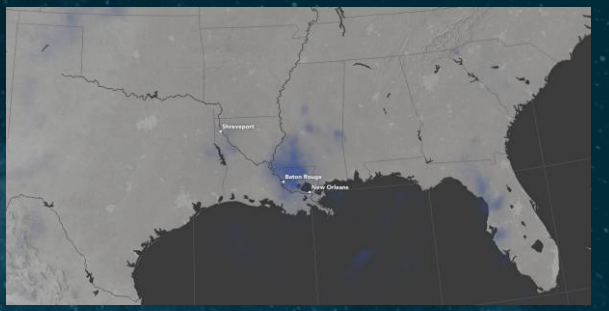
Four pillars. One ESA.

Science and Exploration

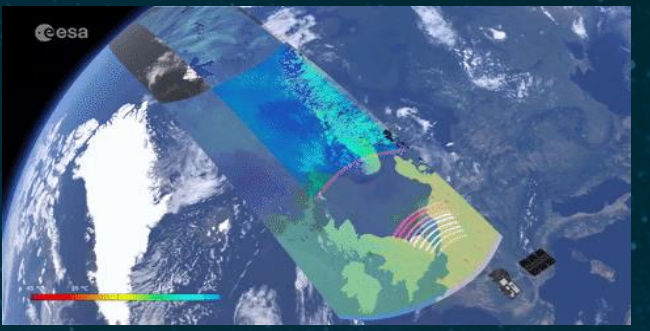


Enabling and Support

Safety and Security



Applications



INSIDE ESA

Four pillars. One ESA.

SCIENCE

SPACE TRANSPORTATION

EARTH OBSERVATION

NAVIGATION

COMMERCIALISATION, INDUSTRY & COMPETITIVENESS

HUMAN & ROBOTIC EXPLORATION

OPERATIONS

TECHNOLOGY

CONNECTIVITY & SECURE COMMUNICATIONS

SPACE SAFETY

Who benefits?

applications

BUSINESS APPLICATIONS AND SPACE SOLUTIONS

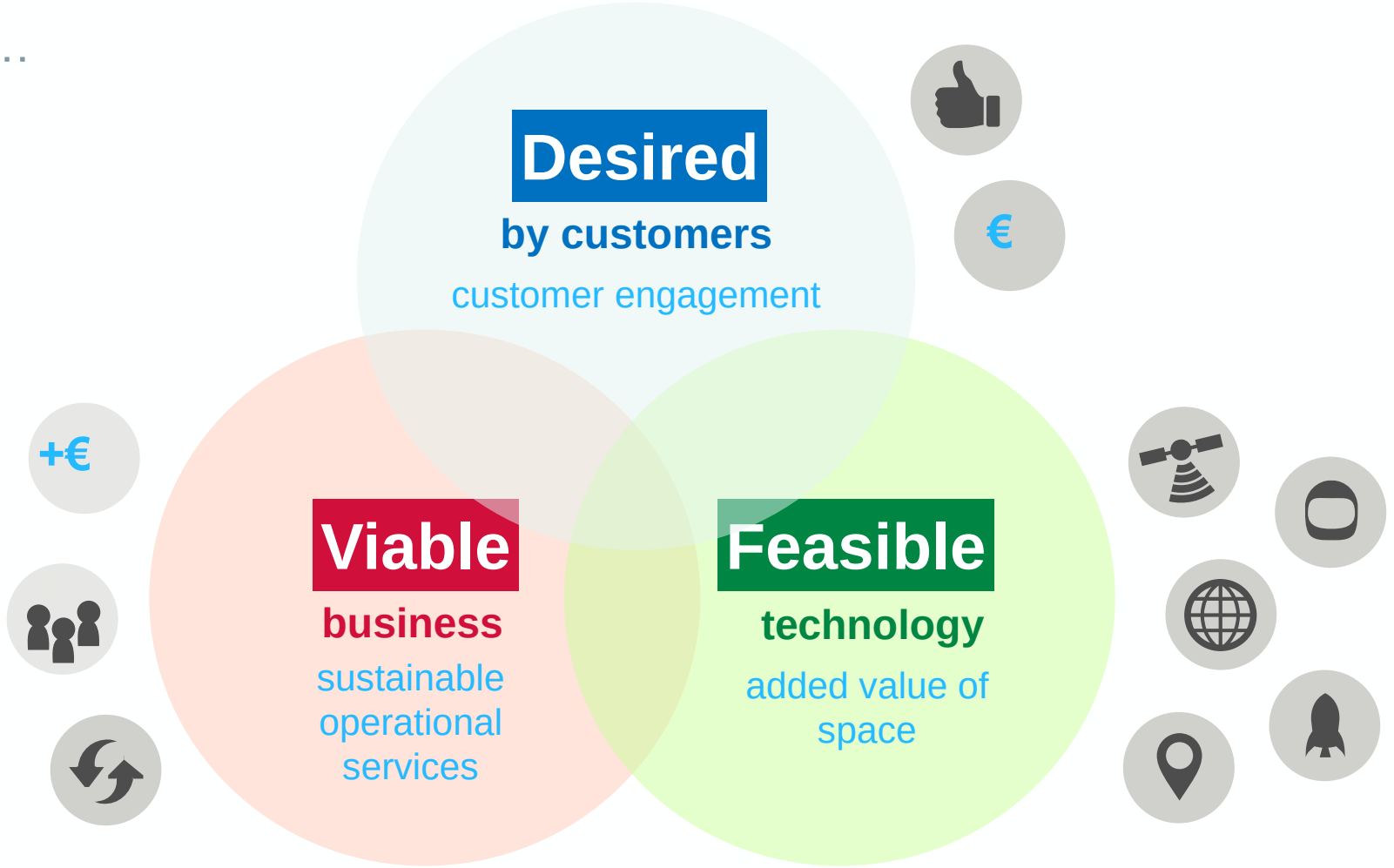
Supporting European companies to develop businesses using space technology and data.

Using any space asset(s) and integrating them with terrestrial assets for the benefit of life on Earth

Space Technology…	X	… non-Space Technology…	=	… more applications, more value …
Earth Observation		Big Data Analytics		Maritime
Satellite Positioning		VR/AR/XR		Agriculture
Satellite Communication		Artificial Intelligence		Environment
Spaceflight Technologies		Distributed Ledger Technology		Healthcare
Space Weather		Robotics		Financial
		Internet of Things		Transport
		Digital Twins		Education
		Drones		Media
		Cloud Technologies		Energy
		5G (https://artes.esa.int/esa-5g6g-hub)		Aviation

What are we looking for?

Services that are…



What ESA Space Solutions Offers…

Our aim is to work together to make your idea commercially viable, with:

- Zero-Equity Funding (€50K-€2M+)
- Tailored Project Management Support
- Access to our Network and Partners
- Use of ESA Brand for Credibility

Demo Projects: Mature value proposition & business plan and demo your service with customers

Feasibility & Enabling Studies: Explore ideas, create a business plan & connect with potential users

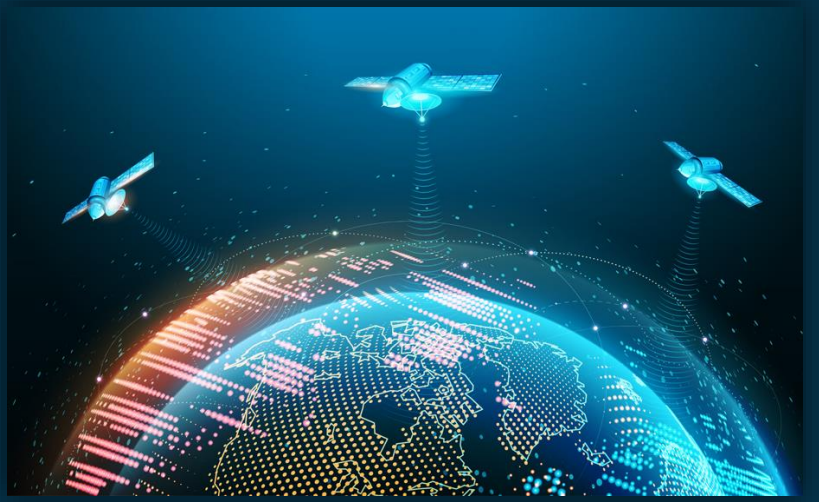
What's in it for us?

SOCIO-ECONOMIC IMPACT

Deliver social value and economic sustainability

USE OF SPACE TECHNOLOGY AND DATA

Expand the utilisation of space in new markets and user communities

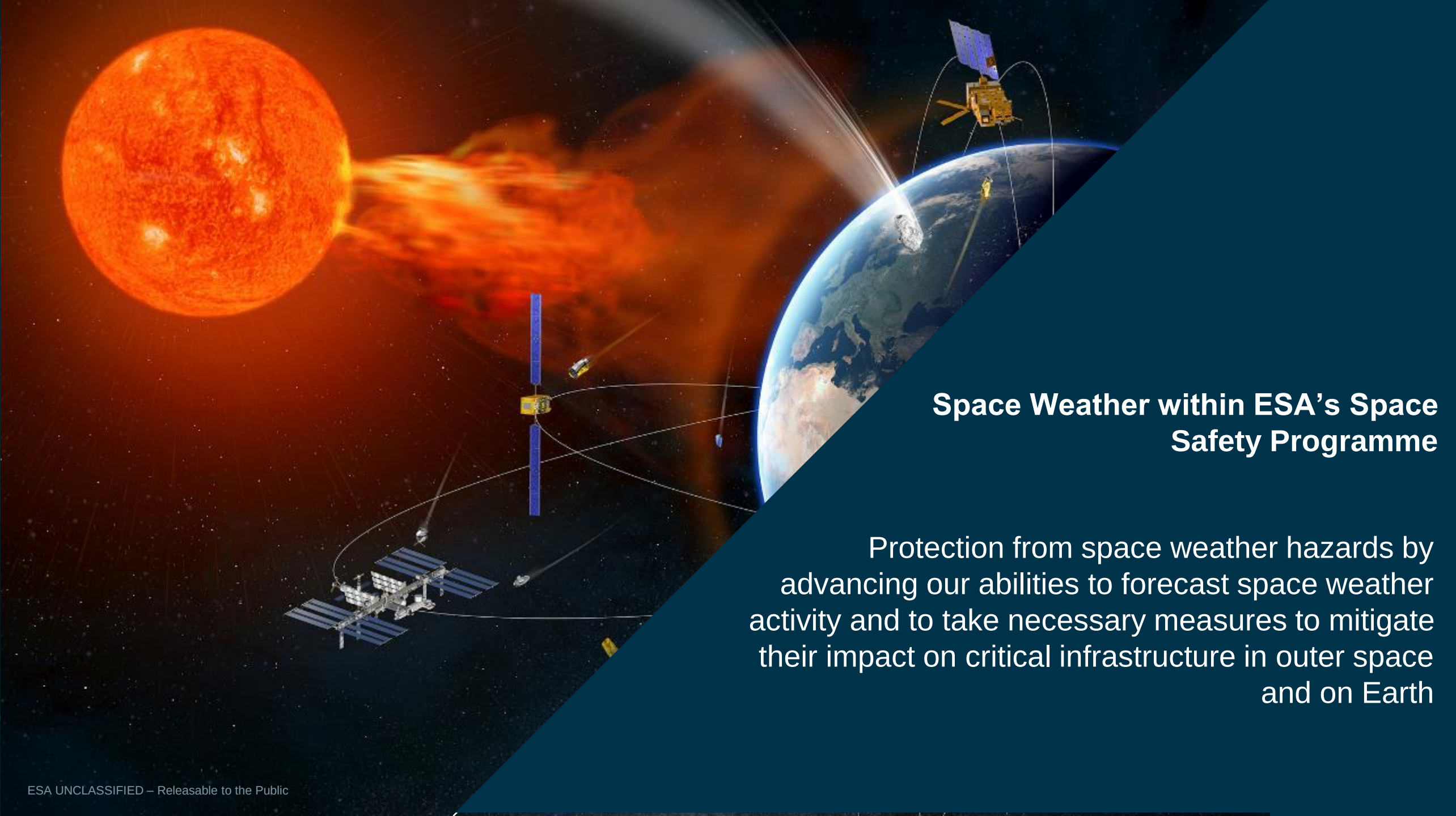


INDUSTRY COMPETITIVENESS

Strengthen European Industry competitiveness on the global space and non-space markets

SPACE SAFETY

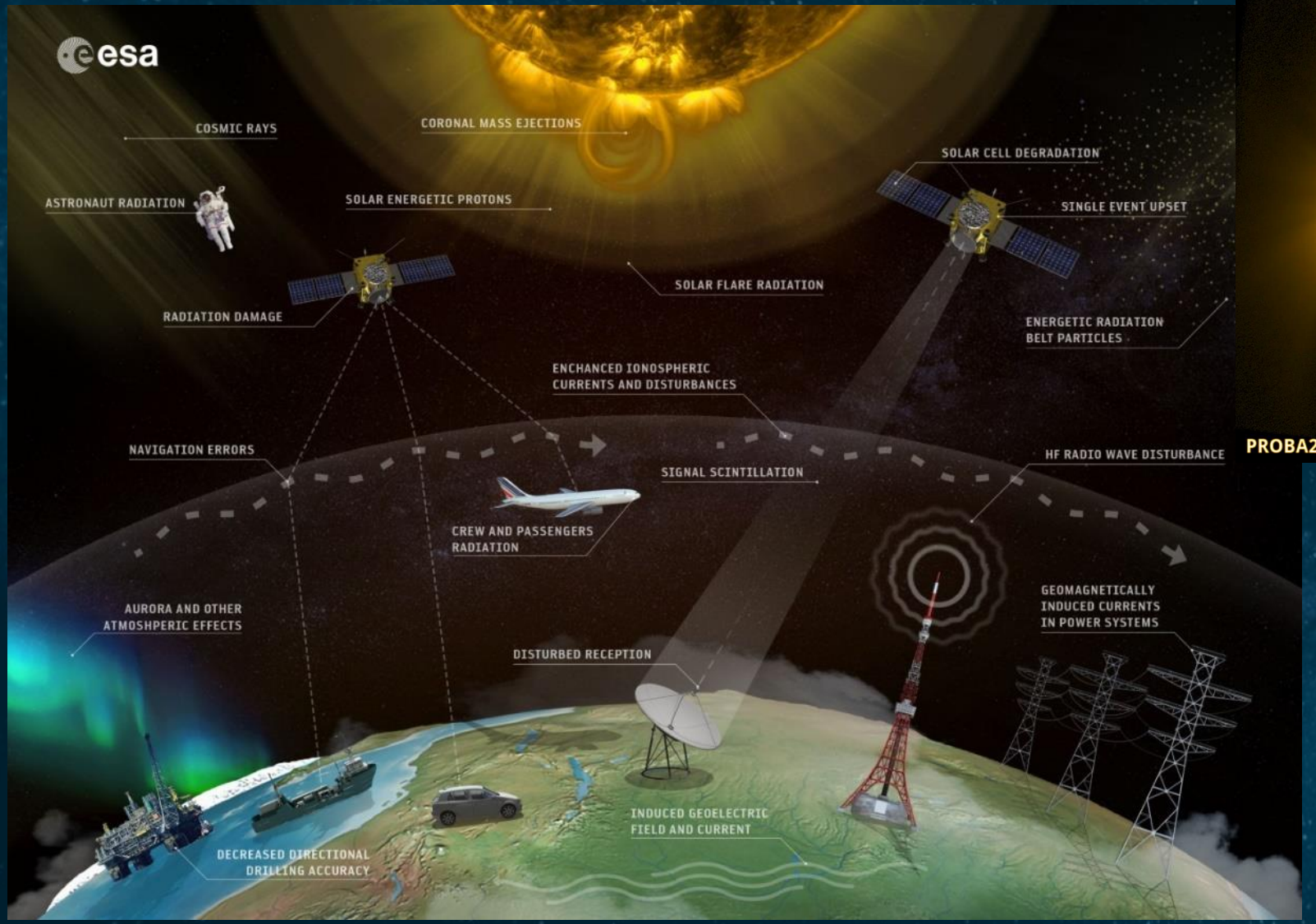
Alexi Glover
Space Weather Service Coordinator
European Space Agency

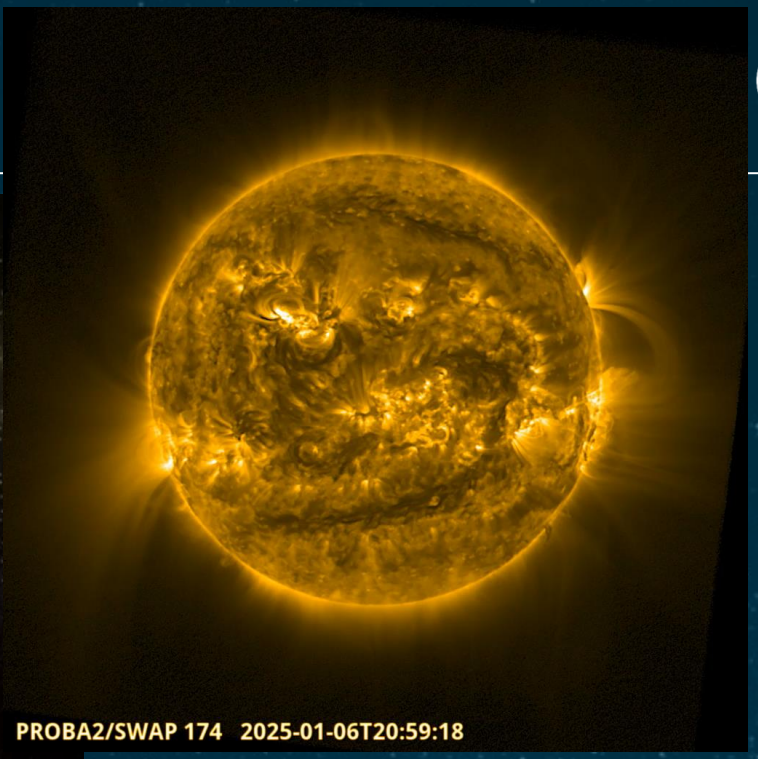


Space Weather within ESA's Space Safety Programme

Protection from space weather hazards by advancing our abilities to forecast space weather activity and to take necessary measures to mitigate their impact on critical infrastructure in outer space and on Earth

Space Weather Impacts





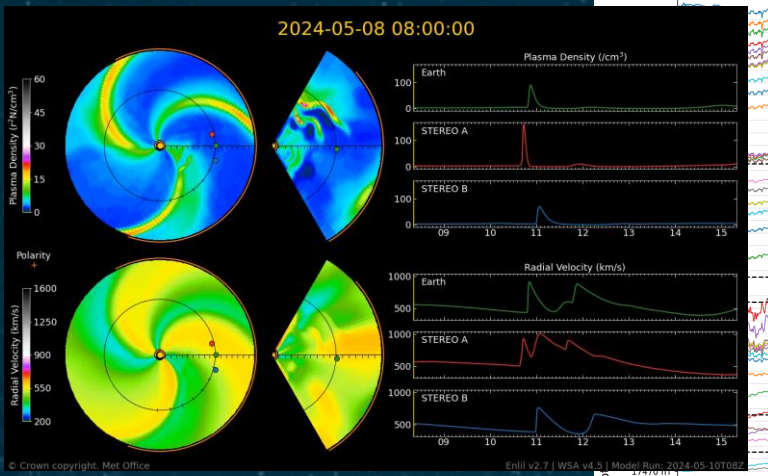
Space Weather - May 2024

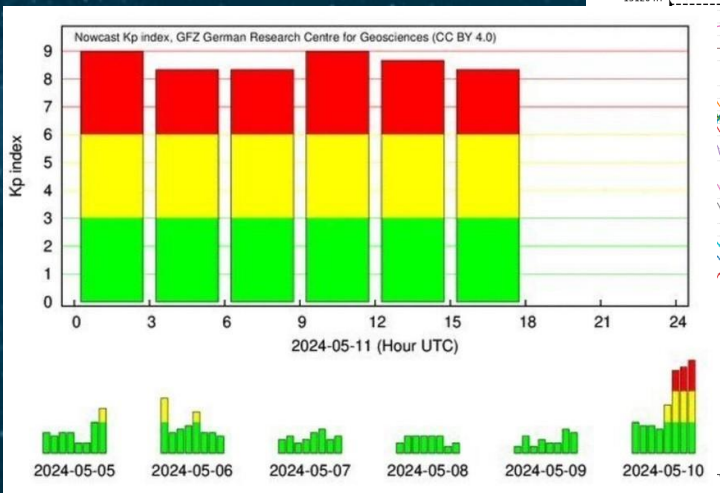
Observed activity:

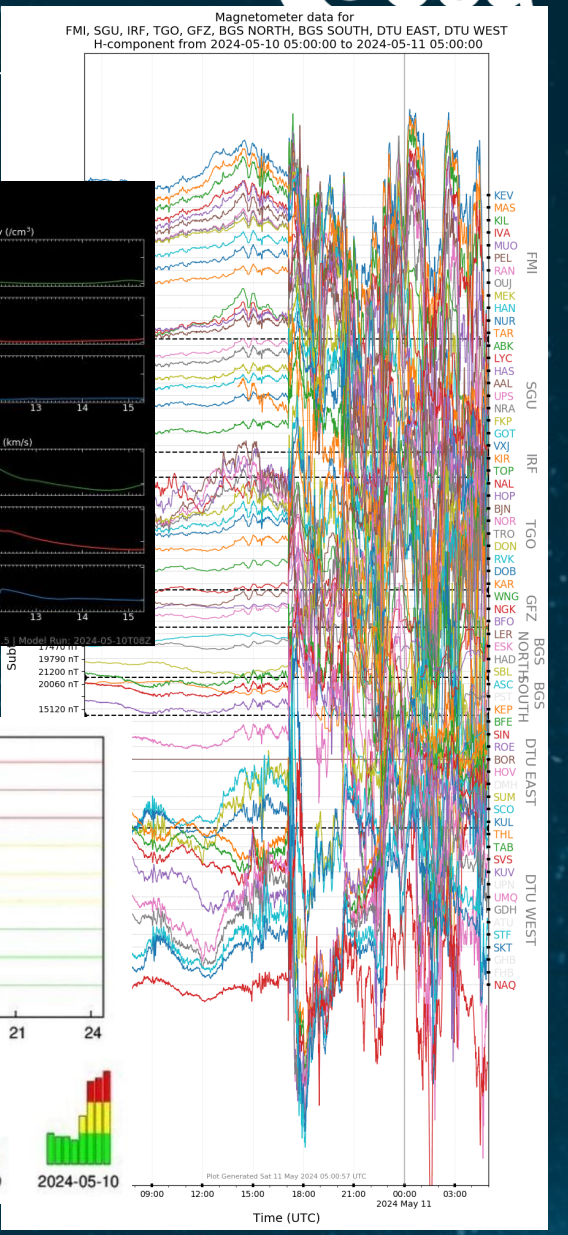
- 25 >M5 class flares between 3-14th May including 14 X-Class
- Multiple Coronal Mass Ejection onsets 8-9th May
- First arrivals on 10th May triggered largest geomagnetic storm since 2003
- Aurora visible across much of continental Europe

Impact summary:

- Disturbances recorded across multiple sectors
- Significant power transmission system impacts
- GNSS-dependent solutions impacted
- Payloads offline as protective measure by some satellite operators







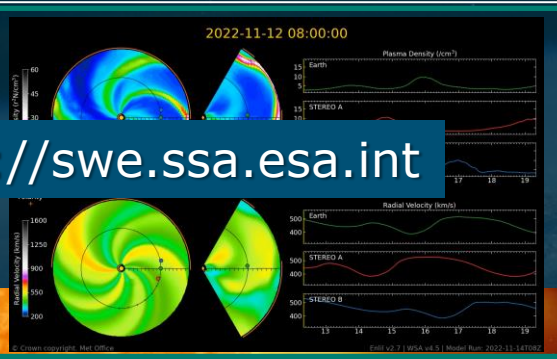
Space Weather within ESA S2P – Objectives

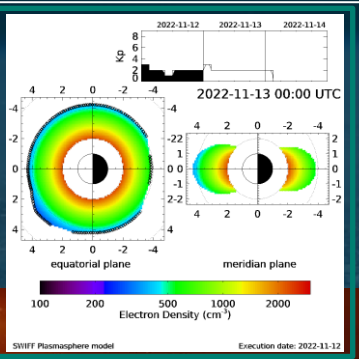
ESA will contribute in a coordinated European context to:

- Development of an operational **space weather monitoring system**
- Development of **capability to provide services tailored to European user needs**
- Definition of **long term maintenance and enhancement plan**
- Implementation of **tested and exercised early warning system** enabling prompt responses
- Development of **world class R2O/O2R (Research-to-Operations and Operations-to-Research) framework**

ESA Space Weather Service Network

https://swe.ssa.esa.int





Who uses the services?

- >5500 registered users
- >2M hits on portal monthly
- All affected sectors, plus national & regional agencies

SWE Service Network Provides:

- 29 services built on >300 data products & tools
- 95% overall availability & NWH helpdesk support
- Full Sun-Earth chain, coupled modelling
- Timely & reliable user tailored notifications & alerting

Who participates?

- >50 institutes, industry, academic groups
- Building on & strengthening European assets & expertise

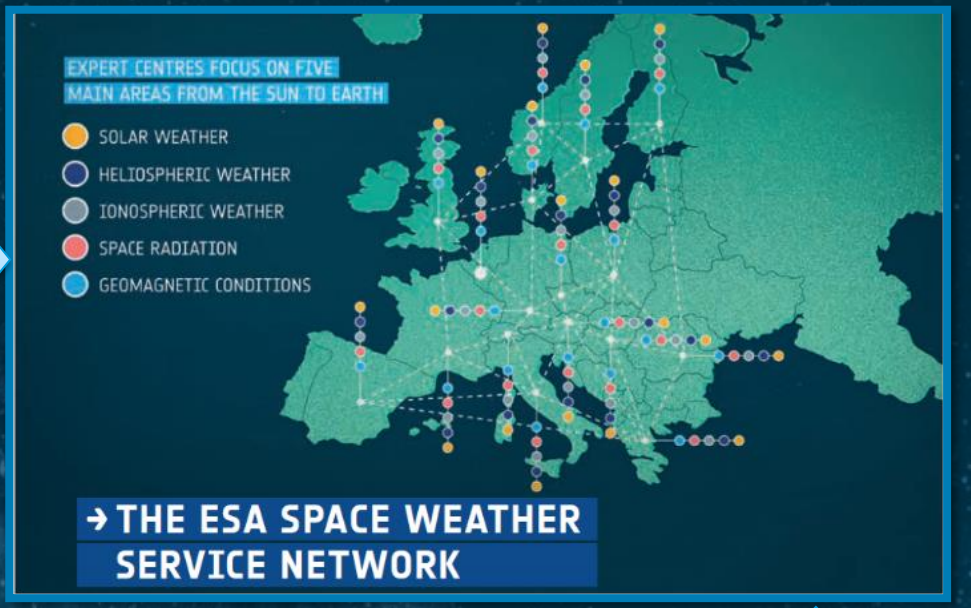
Space Weather services to end users

Layer 1: Data acquisition → Layer 2: Data Processing → Layer 3: Services

Ground stations

MOC

Space Weather Payload Data Centre



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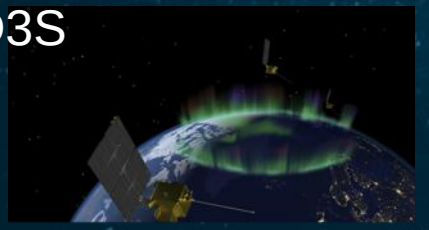


Collaborating missions

Ground based observations

Commercial Applications of Space Weather Data

Invitation to Tender

Objectives

- Explore and evaluate opportunities for tailored commercial services that use space weather data to protect critical infrastructure and services on Earth. Space Weather data would be used for monitoring, modelling, and/or predicting impacts.

- Engage with prospective customer/user communities, analyse their needs, and gather/produce evidence for and/or against the technical and economic viability of the given service/s.

- If proven viable and opportune, pursue the development and demonstration of the service through a follow-up ESA demonstration project, before commercialisation.

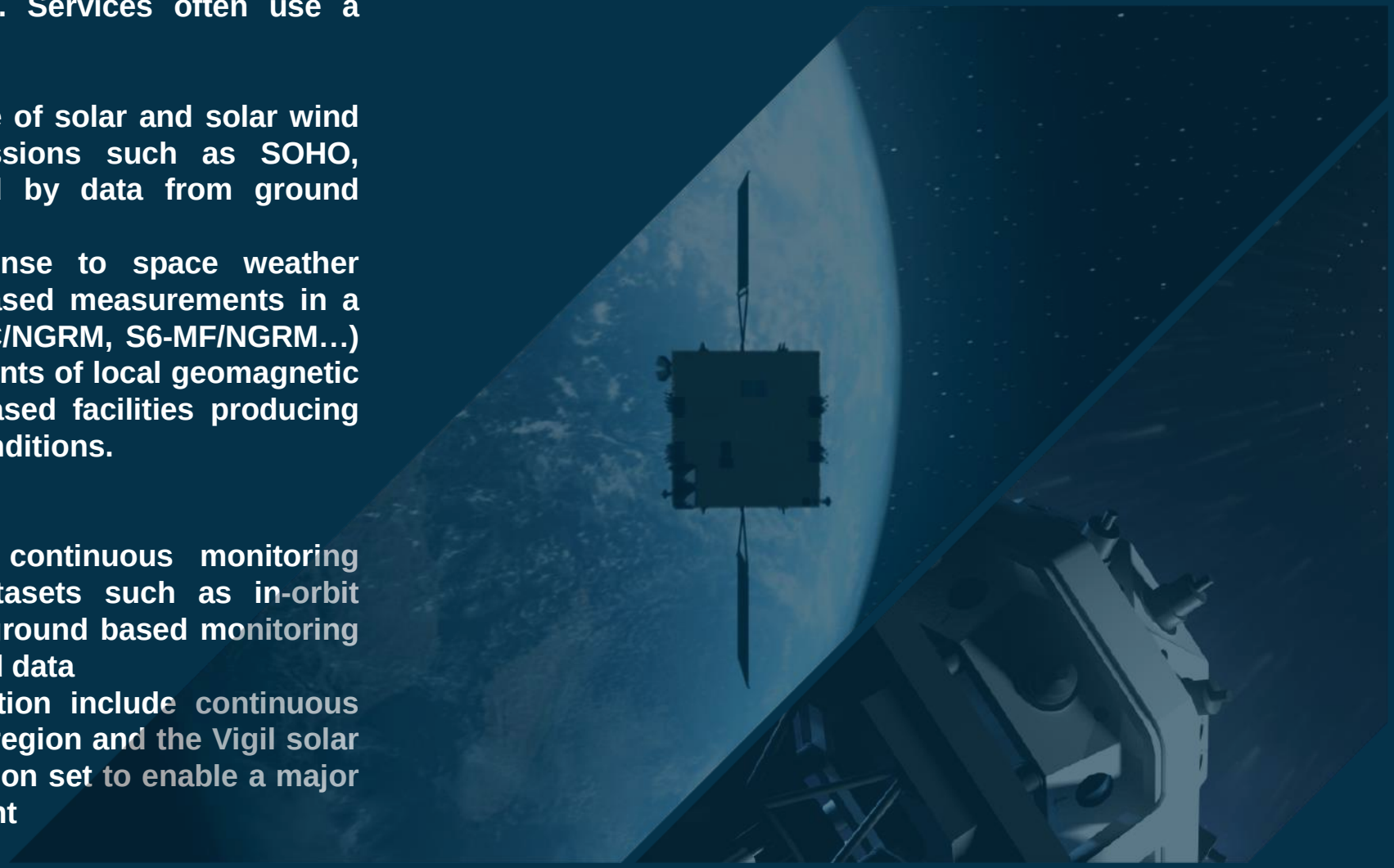
- Study → Demonstration → Go-to-Market

Space Weather Data

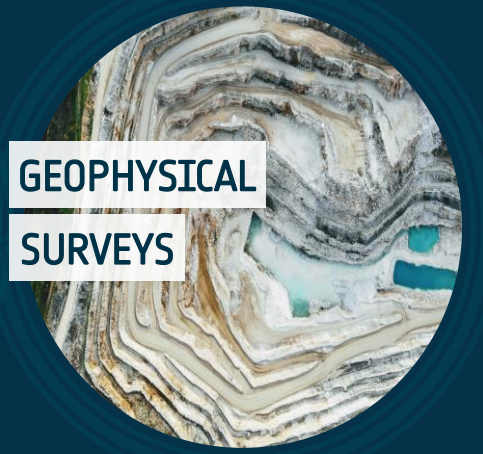
Space weather phenomena may be monitored from a range of vantage points using different techniques. Services often use a combination of multiple sources…

- **Forecasting typically requires knowledge of solar and solar wind conditions with data from space missions such as SOHO, DSCOVR, SDO, Proba-2 complemented by data from ground based solar observatories.**
- **Characterising the geomagnetic response to space weather events may include data from space based measurements in a range of orbits (e.g. GOES/SEM, EDRS-C/NGRM, S6-MF/NGRM…) combined with ground based measurements of local geomagnetic fluctuations and networks of ground based facilities producing data used to characterise ionospheric conditions.**

- **New opportunities:**
  - **ESA/S2P data sources enable continuous monitoring including availability of key datasets such as in-orbit radiation monitoring, space and ground based monitoring of near real-time geomagnetic field data**
  - **Future S2P missions in preparation include continuous monitoring of the Earth's auroral region and the Vigil solar and heliospheric monitoring mission set to enable a major forecasting capability enhancement**



Areas of Interest



Study Tasks

1. Market Landscape and Stakeholder Mapping
2. Customer Engagement and Value Proposition Definition
3. Technical Feasibility Assessment
4. Commercial Viability Assessment
5. Proof-of-Concept
6. Roadmap for Future Implementation

Terms

- The studies are fully funded by ESA at a price of 200kEuros.
- Studies are 12 months duration.
- The prospective commercial service provider must be a part of the bidding team. Research institutions (if involved, and without commercial interest) are limited to 30% of total budget. In the case of single entity bidding teams, they must be the prospective service provider.
- Minimum of two Letters of Intent (LoIs) from prospective users/customers must be provided with the proposal submission.
- Companies may propose additional Areas of Interest to pursue with justification, however, they must be Earth-based markets.
- Applicants seeking funding from ESA must be registered in ESA Member States, targeting of European customers/users is encouraged but customers can be based internationally.
- There must be a source of expertise in space weather impacts and data analysis in the team.

Guest Speaker

Bob Arritt

Addressing Space Weather Impact in the Power Sector

Commercial Applications of Space Weather Data

Addressing Space Weather Impact in the Power Sector

Robert Arritt, PE
Technical Executive

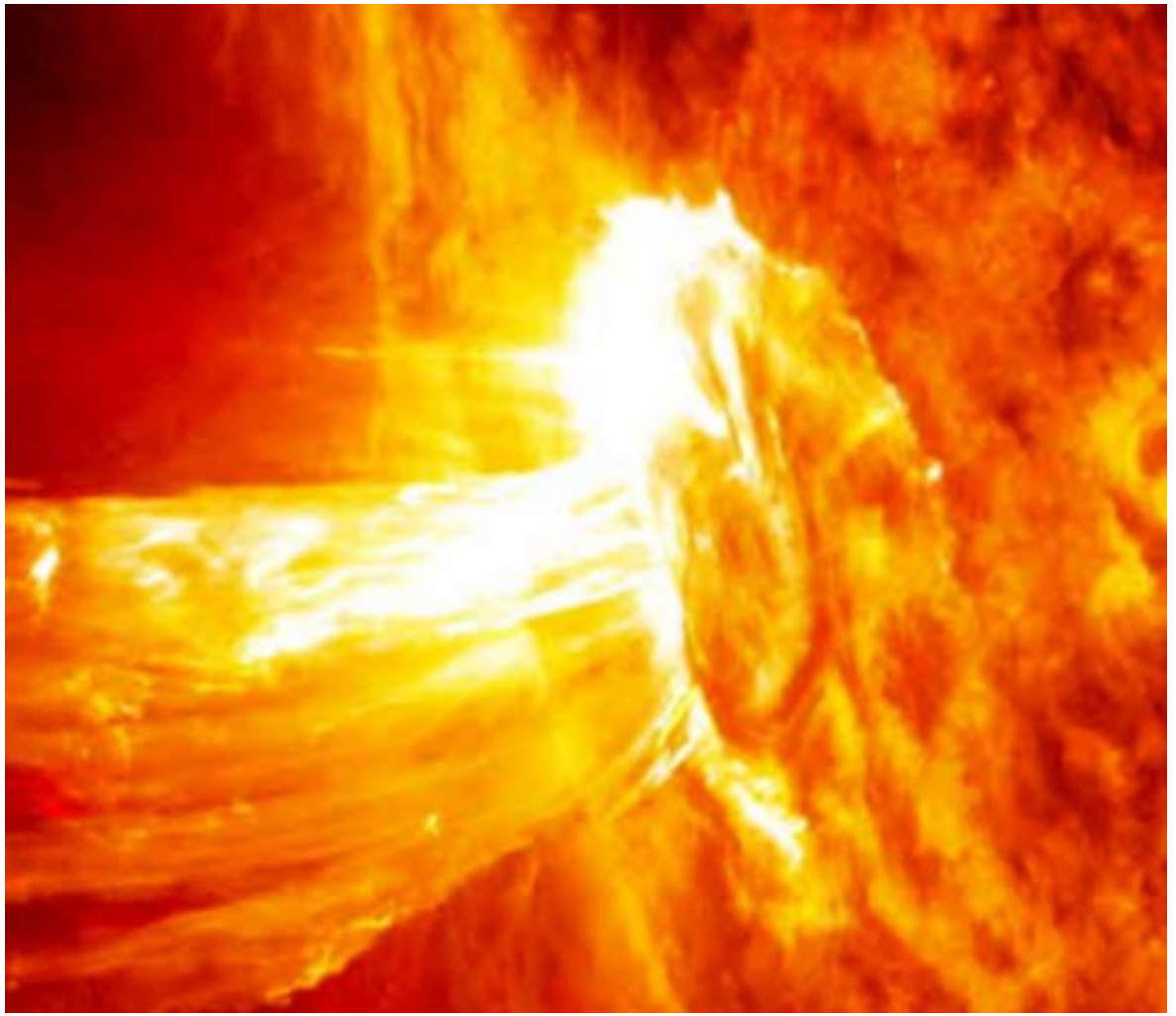
ESA - European Space Agency
February 18, 2025

Background

- Extreme space weather has demonstrated its capability to disrupt normal power delivery.
- EPRI has been performing GMD-related research since the late 1970's.
- Research areas include:
  - GIC Calculation and System Modeling
  - Software Tools
  - Vulnerability Assessments
  - Mitigation Measures
  - Measurement (EPRI SUNBURST Network)

Summary of Events Reported During May 10-11 Storm

- Numerous Grid Operation Procedures
- Several Top Oil Temperature Alarms
  - Transformer tripping reports
- High GICs led to reduced operations on transformers
- Tripping of harmonic filters on a 345 kV transmission line
- Capacitor Bank Tripping
- Transmission Line Tripping
- HVDC link tripping
- Solar PV inverters exhibiting some unusual oscillations
- Noticeable voltage drop during peak events

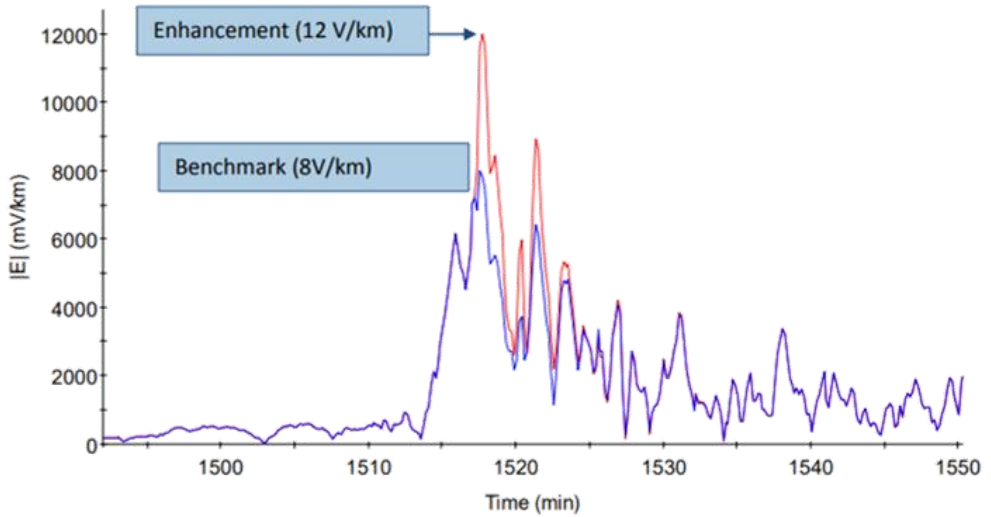


The reliability of the bulk power system stayed intact. This is a testament to the work that you have done to prepare for these events.

What do we prepare against?

How big of a storm should we prepare against?

- NERC TPL-007 – GMD Vulnerability Assessment – Regulatory Compliance
  - GMD Vulnerability assessment begins with 1-in-100-year GMD Storm Definition

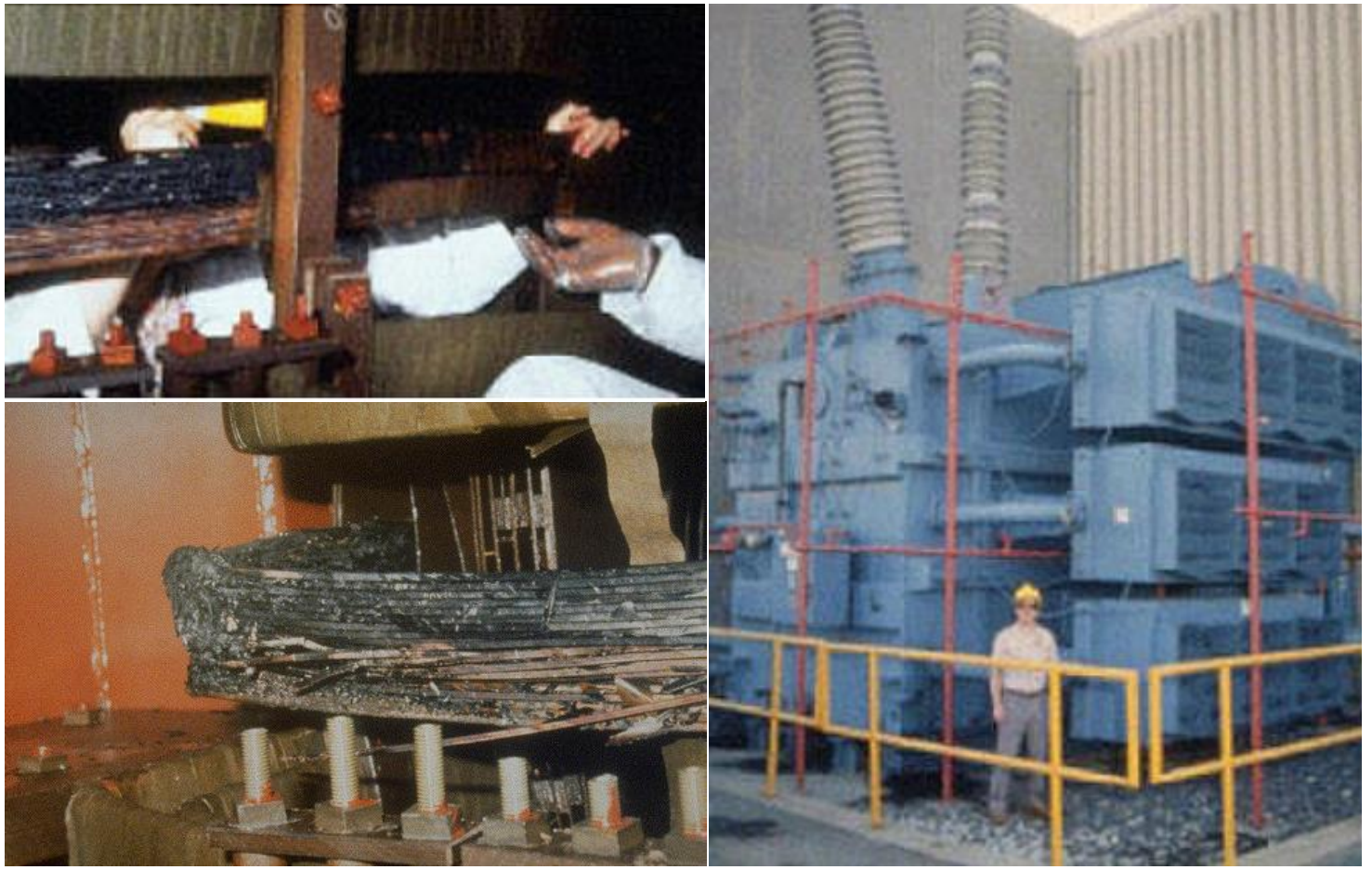


How soon can we know?

- Long-term and short-term forecast capabilities
  - Increase time to assess the system
  - Time to implement safe-posturing

Industry Questions

- What do we prepare against?
  - How big of a storm can we have?
  - How likely is this event?
- How soon can we know if a big event is happening?
- Do we know the impacts?
- Are we doing everything we can?



Salem Nuclear Plant GSU Transformer damaged by the GMD event of March 1989. (Photos courtesy of PSE&G.)

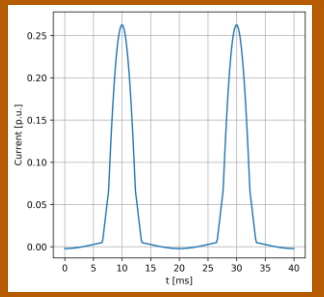
Do we know everything we need to know?

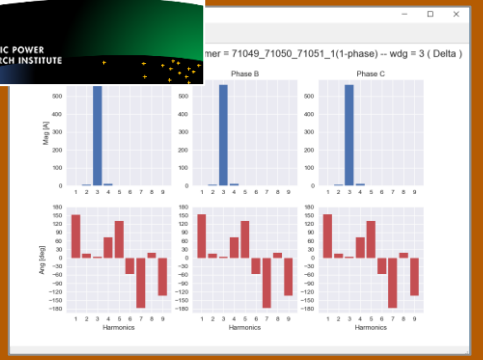
Do we know the impacts?

Harmonic Analysis

GIC harm

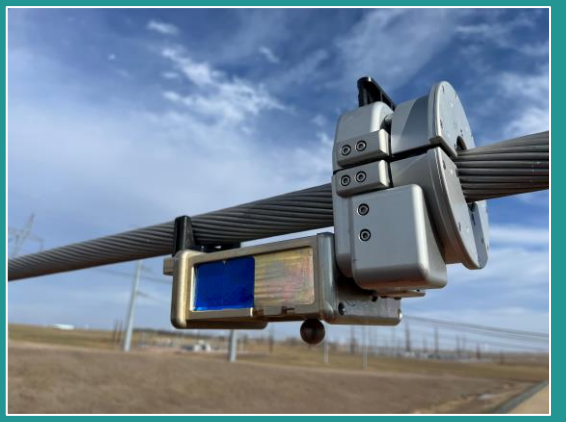
EPRI ELECTRIC POWER RESEARCH INSTITUTE





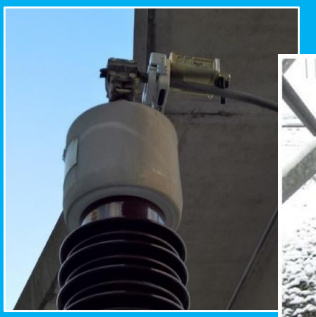
Validating GIC-related harmonic responses.

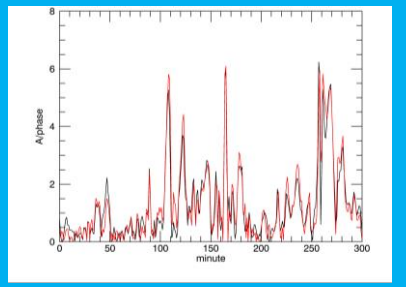
Monitoring



Obtaining GIC monitor data from planning area

GIC Model Validation



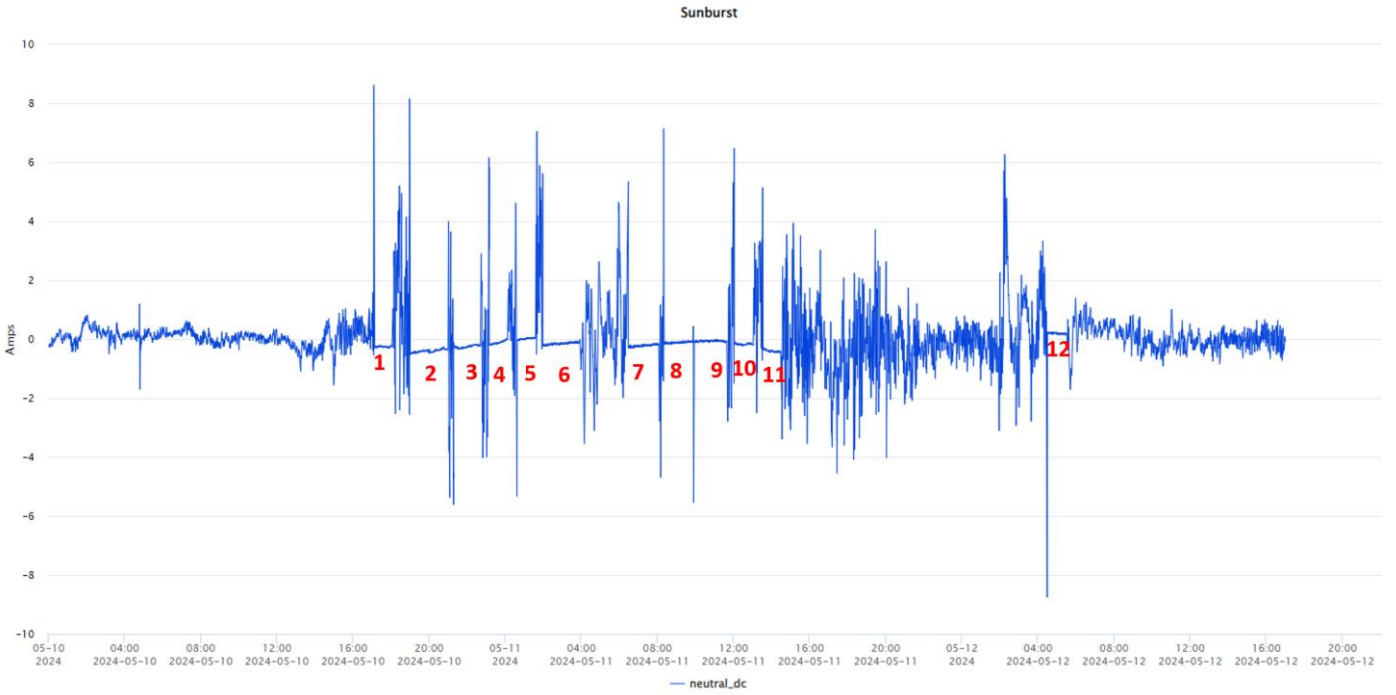


GIC and magnetometer data to validate GIC models.

Answering Key Compliance Requirements for the 1-in-100-year Event.

Space Weather Needs

- Long-term (>2hrs ahead) and short-term forecast capabilities
  - Increase time to assess the system
  - Time to implement safe-posturing for storm preparedness
- Accuracy of predictions
  - Maintain operational awareness



Planning to Operations key to GMD mitigation methods.

www.epri.com

How to Apply…

How to Apply (1/2)

Register	Register by completing online questionnaire on ESA-STAR Registration (minimum 'light registration') (Doing Business with ESA)
Download	Download the official tender documentation (Invitation to Tender) via ESA Star Publication 'AO 12676' from 19th February 2025.
Create	Create 'Bidder Restricted Area' in ESA-STAR Tendering
Write	Write your proposal and *request* Authorisation of Funding Letter from National Delegation.
Submit	Submit your proposal via 'Bidder Restricted Area' in ESA-STAR Tendering (Doing Business with ESA) before 2nd May 2025. (don't wait until the last minute!)

How to Apply (2/2)

The Tender Package is published on ESA-Star Publication (Doing Business with ESA) under 'AO 12676' and includes:

eli	**Letter of Invitation**
ews	**Statement of Work**
ecc	**Draft Contract**
etc	**Tendering Conditions for Procurement Procedure**
ept	**Proposal and Cover Letter Template**

Proposal Template

Your Proposal shall include the following information:

1. TECHNICAL PART
2. MANAGEMENT, ADMINISTRATIVE AND IMPLEMENTATION PART
3. FINANCIAL PART
4. CONTRACTUAL PART

Authorisation from National Delegation

- Please note that funding participation is open to groups, organisations and businesses which reside in ESA member states that have subscribed to the BASS programme.
- To date, these countries include Austria, Belgium, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Lithuania, Ireland, Italy, Luxembourg, The Netherlands, Norway, Poland, Portugal, Romania, Slovenia, Spain, Sweden, Switzerland and the United Kingdom.
- The authorisation of funding from the National Delegation will be required for submission of full proposals thus prospective applicants must contact their National Delegation as early as possible.
- The contact information of the National Delegations can be found at https://business.esa.int/national-delegations

Questions?