ESA Space Weather Network of Federated Services

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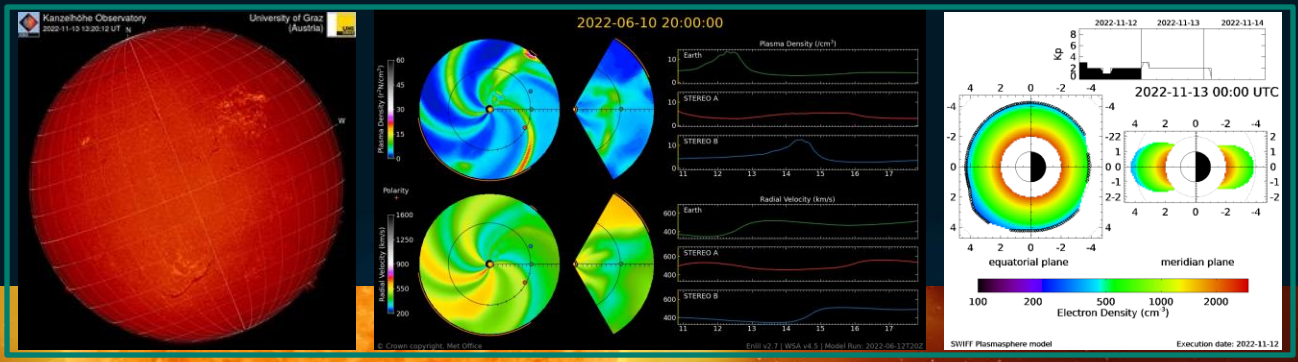
T-FORS Second Innovation Day

04.12.2024

ESA Space Weather Service Network

https://swe.ssa.esa.int



Service Network Provides:

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

Who uses the services?

- >5000 registered users
- >2M hits on portal monthly
- All affected sectors, plus national & regional agencies

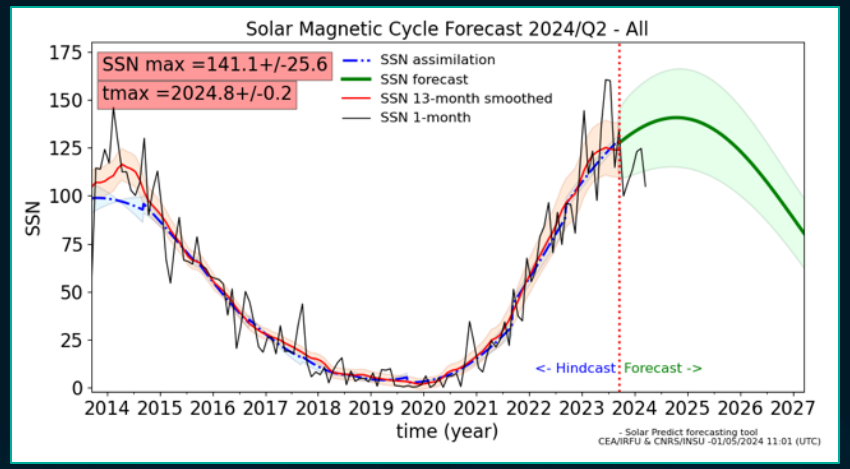
Who participates?

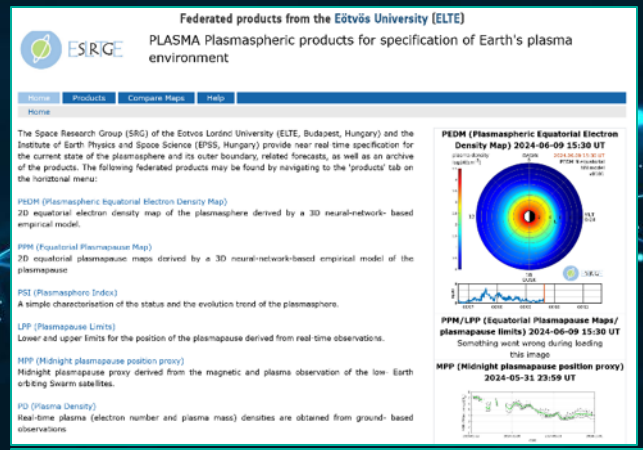
- >50 institutes, industry, academic groups
- Building on & strengthening European assets & expertise

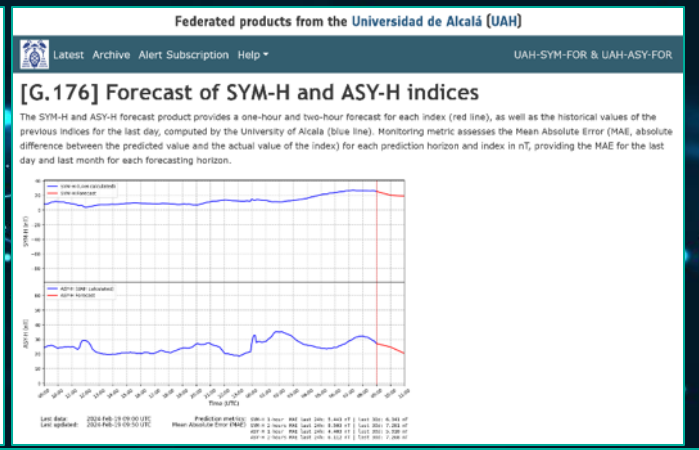
Service Enhancements

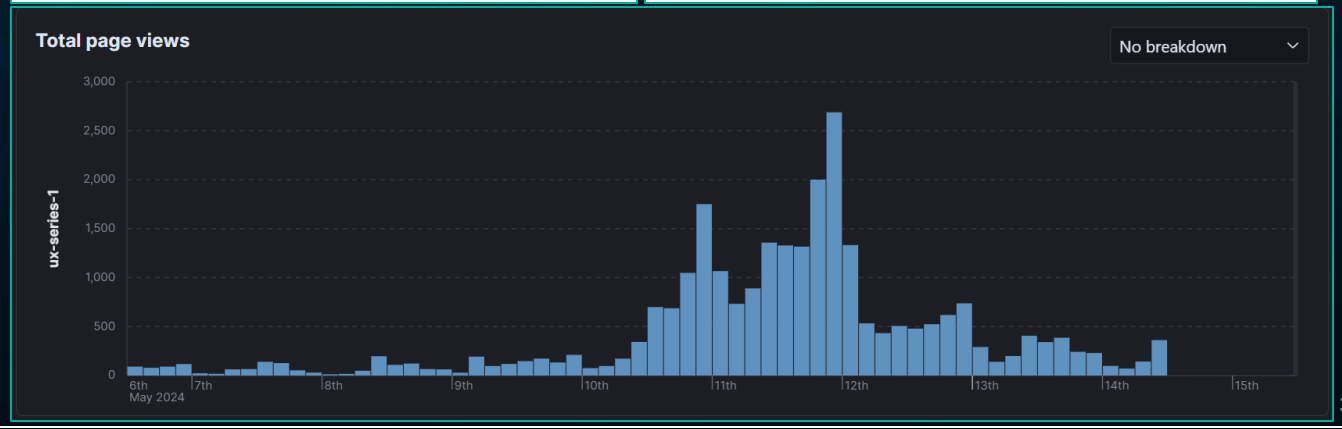
- SWE portal releases 3.9.0 – 3.11.0
  - New and updated products from the Expert Service Centres including solar cycle forecasting
  - SWE Products for Southern Europe Phase 1 (P3-SWE-XXXVII) [Lead: UAH]
  - P3-SWE-LII Plasmaspheric products for Space Weather Services [Lead: SSE ltd]
  - New data from ICARE-NG instruments accessible via SWE Data Browser & API

- Excellent performance during events of May 2024!
  - Peak in page hits and new registered users
  - user feedback collection ongoing

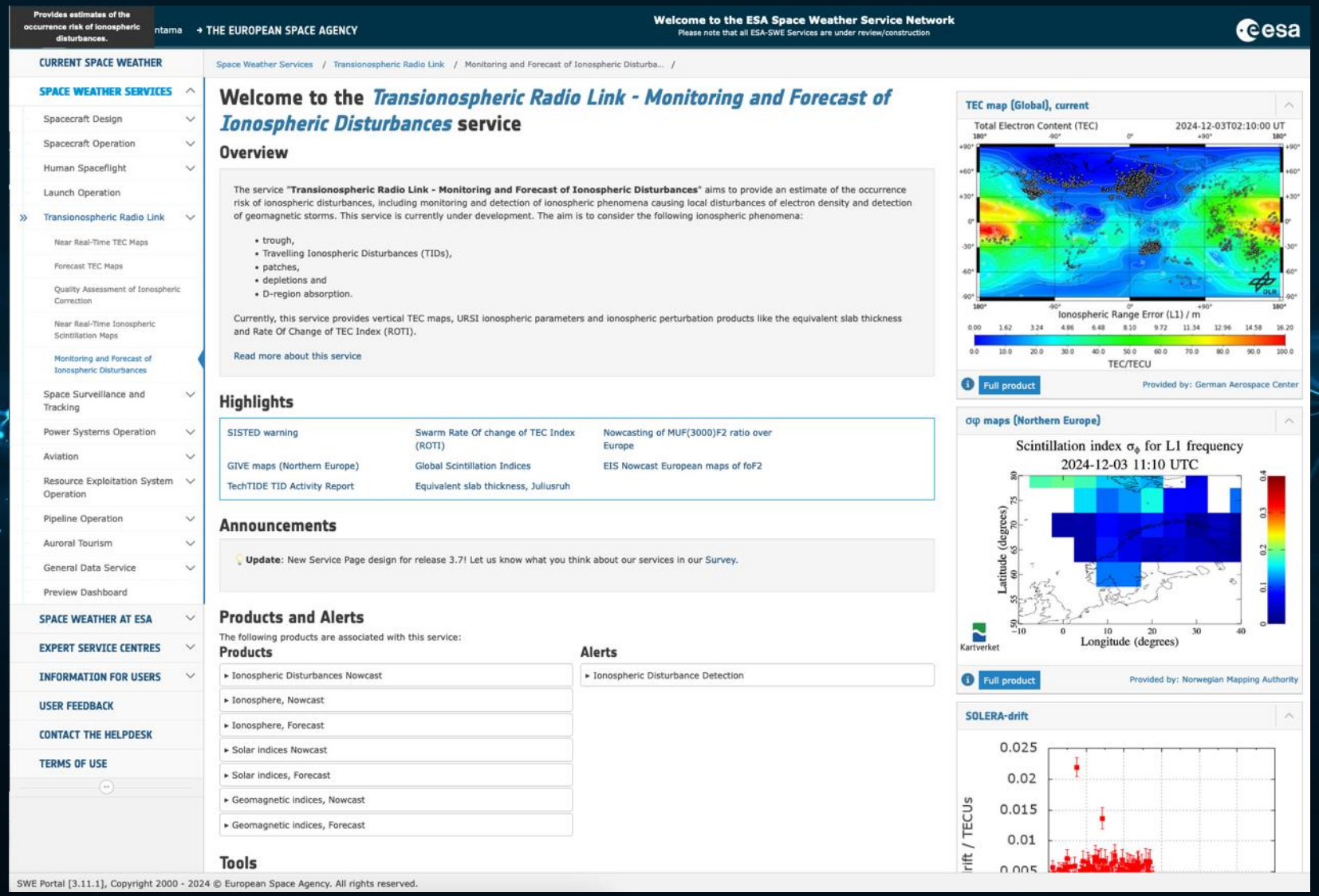








Service Portal: Monitoring and Forecast of Ionospheric Disturbances



The TechTIDE is provided by the National Observatory of Athens.

View TID Activity | Reference Date: 2024-12-03T11:12:00 UTC

TID Indicators	Date	Critical Characteristic	Current value of critical characteristics	Activity level	Activity icon
AATR	2024-12-03T11:00:00	AATR at polar, high, medium and low latitudes	0.083	LOW	
GNSS TEC Gradient	2024-12-03T10:55:30	TEC gradient amplitude in high latitudes	4.768	STRONG	

LSTID Detection	Date	Critical Characteristic	Current value of critical characteristics	Activity level	Activity icon
HF Interferometry (HF-INT)	2024-12-03T11:05:00	Spectral Energy Contribution	0.1	LOW	
$LSTID_{idx}$	2024-12-03T10:40:00	Relative Std Dev of Ne	0	LOW	

MSTID Detection	Date	Critical Characteristic	Current value of critical characteristics	Activity level	Activity icon
CDSS	2024-12-03T09:30:00	Doppler shift detected in the Czechia network	0.165	STRONG	
$MSTID_{idx}$	2024-07-11T06:40:00	$MSTID_{idx}$ at polar, high, medium and low latitudes	0.309	STRONG	

Legend

Low Activity Level | Medium Activity Level | Strong Activity Level | No Data

S2P Period 2: Upcoming Developments

- Currently preparing Evolutionary Maintenance (S2-SW-05) and pre-operational extension (S2-SW-07) with SWESNET project team

- S1-SW-19 Virtual Space Weather Modelling Centre (ITT just closed)
- S1-SW-21 Space Weather Impact on GNSS Performance (ITT to be released soon)

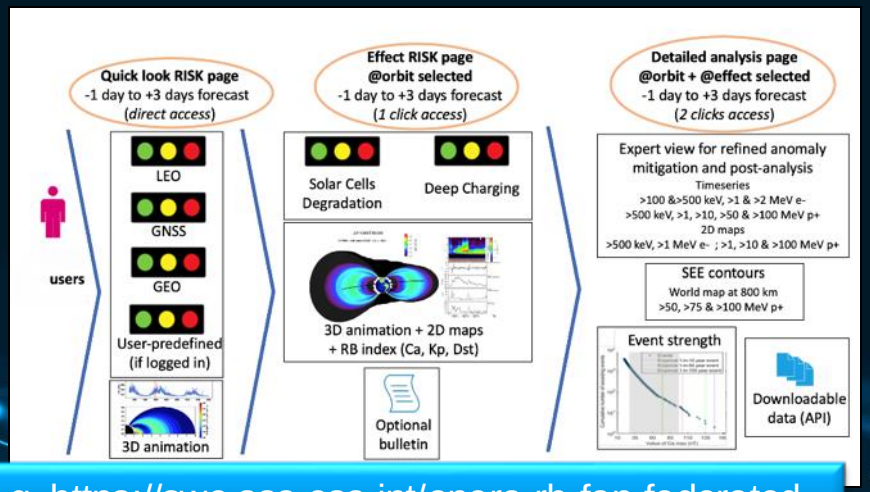
- ITTs in Q1/Q2 2025 (total budget 3,610kEuro):
  - S2-SW-06.A Virtual Space Weather Modelling Centre
  - S2-SW-06.B Space Environment Characterisation, Nowcast and Forecast
  - S2-SW-06.C Space Weather Capability Development for Ionospheric and Geomagnetic Conditions
  - S2-SW-06.D Solar and Heliospheric Weather Toolkit Development
  - S2-SW-06.E Advanced Validation for the SWE Service Network

- New and improved service component deployments throughout 2025 as ongoing projects mature

S2P P3: Service Portal Evolution and Targeted Application Developments

SWE portal evolution

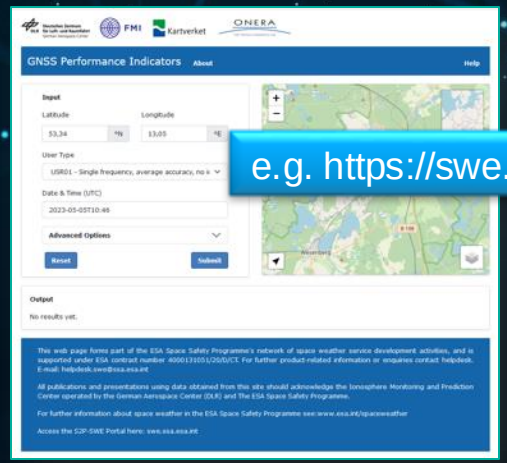
- Layered approach portal-wide catering for different levels of user expertise
- Technology upgrade enabling interactive, customisable presentation
- Leverage underpinning data system improvements for API data access
- Improved SWE Portal navigation and search for better usability



e.g. https://swe.ssa.esa.int/onera-rb-fan-federated

Targeted Application & Tool Development

- Combining individual products into overarching user-driven consolidated product/applications.
  - Target domains including Spacecraft Operators, GNSS, electricity transmission grid operators & others.
- SWE Data Utilisation: advanced Level-2 processing pipelines and toolkits including preparation for Vigil.



e.g. https://swe.ssa.esa.int/GPI-federated

S2P P3: World Class R2O(2R) Framework Targeting End User Needs

- Demonstration and testing space weather service capabilities with end users: pre-operational service model
- Continuous evolution with opportunities to include new and improved products every 3 months
- Continuous reliable provision with user in the loop enables:
  - Understanding of user workflows and terminology
  - Feedback on products and tools, understanding of highest priorities for users (O2R process)
  - Identification of promising business cases
- **Performance assessment** establishing community standards
- Fostering commercial solutions

- Tailored to use cases or domain on request
- How to navigate & utilise key tools
- At users premises or online webinars

- Bespoke dashboards
- Content tailored together with test users
- Individual product adaptation

- Outreach to registered user community
- Feedback on service content and presentation

- At users' premises or part of a conference or workshop e.g. European Space Weather Week

S2P P3: Space Weather Core – Enhancements and New Technologies

Virtual Space Weather Modelling Centre (VSWMC)

- End-to-end Space Weather modelling, simulation and NRT data processing
- Verification and validation of end-to-end simulation with further models
- Support for OSSEs and OSEs
- Advanced user interfacing and data visualisation

Software development

- Phase 2 of the Space Weather Payload Data Centre
  - ➢ Implementation of Vigil Level 1 data processing
  - ➢ Enhancement of the Data Hub
- One-stop-shop for space weather data

Enhancement of space weather models

- Empirical, physics based, DL, AI and combined models
- Utilisation of data from space weather system
- Advanced onboard data processing
- Feasibility studies for new technologies

Instruments and mission studies

- New instrument developments/procurements
  => instrument pipeline
  => utilisation of advances in sensor technology
- OSSEs and OSEs
- Operationalisation of ground based observations

Space Weather Training Course – Third Edition!

- One week residential course targeting Master/PhD students organised by SWE Office together with ESA Academy team, ESEC-Galaxia, Belgium 24-28th March 2025
- Lectures delivered by internationally recognised experts
  - Fundamentals of space weather science through modelling, forecasting, different application areas and socio-economic impacts
- Hands-on tutorials using the SWE portal and key tools
- Group project to design a space weather service concept
- Tours of the operations centre at ESEC-Redu with introduction to PROBA mission operations and visit to Space Pole in Brussels including the SSCC premises
- Applications deadline for students: 6 January 2025.

THANK YOU

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European Space Agency