ESWW26 - Abstract Booklet

PLENARY SESSIONS

P1 - Insights from an Operational Perspective: Challenges and Lessons Learned from Severe Events in Solar Cycle 25

Conveners: Yana MANEVA; Carina ALDEN; Claudio CORTI; Krista HAMMOND

Description: Severe solar events pose significant challenges for space weather operations, forecasting, and mitigation strategies. It is the responsibility of operational entities to monitor, model, forecast, and communicate risks for the community to make necessary mitigation decisions. These are especially crucial when it comes to high impact events such as the May 2024 storms. However, it is rare for the end-users and research communities to see the full picture from an operational perspective. In this Plenary Session, we focus on the operational experience gained during the present solar cycle (SC25), highlighting how severe space weather events were detected, monitored, forecasted, and managed in near-real-time operational environments. This session will begin with a short overview of the most significant events which occurred so far in the ongoing solar cycle. We will then open the floor to panelists from different institutions and sectors to discuss the operational aspect of handling these events with specific examples. Discussions will focus on the practical experiences, including the challenges encountered monitoring, modeling, forecasting, and reporting of expected high-impact events with an emphasis on lessons learned. This session aims to identify both successful monitoring to mitigation instances as well as providing examples of where improvements can and need to be made. Additionally, this session offers the opportunity to discuss with different operational centers on how operational workflows, forecasting capabilities, and collaborative efforts can evolve to accommodate the challenges expected in upcoming solar cycles.

P2 - The Future of Space Weather Prediction: Integrating Artificial Intelligence, Physical Models, Data and Operations

Conveners: Sabrina GUASTAVINO; Dario DEL MORO; Veronique DELOUILLE; Hannah RUDISSER

Description: Predicting Space Weather across multiple spatial and temporal scales remains one of the central challenges for the community. While physics-based models provide the fundamental framework for understanding the coupled Sun-heliosphere-magnetosphere-ionosphere system, the rapid growth of observational datasets, increasing computational power, and advances in artificial intelligence (AI) are opening new opportunities to enhance predictive capabilities across all scales. At the same time, operational forecasting services demand robust, reliable, and interpretable tools capable of supporting real-world decision making. A key challenge is how to effectively integrate observations, data infrastructures, AI, and physics-based models, into coherent predictive frameworks that serve both scientific progress and operational needs. This plenary session brings together experts from observations, modeling, AI, and operational forecasting to discuss recent advances and future directions in next-generation Space Weather prediction. Following short scene-setting contributions, the session will focus on a structured panel discussion addressing the exploitation of large multi-mission datasets, data assimilation strategies, hybrid and physics-guided machine learning approaches, and pathways toward operational implementation through Research-to-Operations-to-Research (R2O2R). The session aims to stimulate community discussion on how the combined use of data-driven and physics-based approaches can improve the accuracy, reliability, and operational relevance of Space Weather forecasting.

PARALLEL SESSIONS

SOL1 – Magnetic fields in the lower solar atmosphere - the engine behind solar wind and eruptive events

Conveners: Ivan MILIC; Rebecca CENTENO; Ricardo GAFEIRA; Mariarita MURABITO

Description: The solar photosphere and chromosphere are the deepest directly observable layers of the Sun, and serve as the interface and the energy conduit between the solar interior and the heliosphere. The lower solar atmosphere hosts magnetic fields structured on a vast range of spatial scales, with strengths ranging from just a few to several thousand Gauss. This magnetism is the surface anchor of the heliospheric field and the origin of the solar wind. It is also single-handedly responsible for active regions, flares, eruptive filaments, and other solar phenomena that drive powerful space weather events. Serendipitously, this region of the Sun can be observed at the highest spatial and temporal resolutions, enabling a close look into

the physical processes that drive these impactful phenomena. This parallel session will focus on the diagnostics, modeling, and understanding of the magnetic field permeating the lower solar atmosphere, as well as on its role in shaping solar wind, heliosphere, and space weather. We invite all researchers studying the photosphere and chromosphere, but also those making use of lower solar atmosphere data products as a starting point for their models, to attend the session and contribute to lively discussion and explore the connections between the solar physics and space weather communities.

SOL2 - Solar Orbiter Cross-Scale Observations of the Origins of Space Weather

Conveners: Paolo MASSA; Daniele TELLONI; Luciano RODRIGUEZ; Daniele CALCHETTI

Description: The ESA Solar Orbiter mission has opened a new window into the dynamic processes occurring in our star's atmosphere, offering a unique suite of remote-sensing instruments - including Metis, EUI, STIX, PHI, and SPICE - to probe the origins of Space Weather events. Recent observations obtained with high-resolution imaging and spectroscopy have provided new insights on phenomena occurring before and during solar eruptions. Therefore, this session invites contributions that exploit the advanced observational capabilities of Solar Orbiter, as well as of other space- and ground-based missions, to investigate precursors and origins of strong Space Weather events, with a focus on flaring activities, Coronal Mass Ejections and other eruptive events. We encourage the submission of work that uses a multi-instrument approach, as combining data from diverse sensors can yield comprehensive insights into the physical mechanisms at play and the inherent cross-scale processes. Furthermore, we invite modeling studies that integrate these observational datasets to simulate the initiation and evolution of Space Weather events. The topic of the proposed Parallel session is particularly timely as we are currently around the maximum phase of the current solar cycle, a period characterized by increased solar activity, and as coordinated "Solar Flare Campaigns" involving several Solar Orbiter instruments are currently being performed. These campaigns provide high-resolution, unsaturated images of solar flares and eruptive events, which form a unique dataset of observations advancing our understanding of flare initiation and evolution.

SOL3 - Bridging the inner solar atmosphere to the heliosphere: Integrating low-atmospheric physics into next-generation Space Weather forecasting

Conveners: Quentin NORAZ; Sven WEDEMEYER; Boris GUDIKSEN; Stefaan POEDTS

Description: Recent advances in modelling and observing the low solar atmosphere, from the chromosphere to the inner corona, have revealed strong couplings between kinetic and magnetic energy deposition, wave dynamics, and mass/energy flux injected into the outer corona and heliosphere. Yet operational space-weather models still treat this region through simplified boundary conditions or parameterisations, limiting the accuracy of forecasts of solar wind structures, eruptive events, and radio/particle environments near Earth. This session aims to bring together observers, theorists, and modellers to explore how improved understanding of the low-atmospheric drivers of the solar wind and eruptions can inform next-generation space-weather forecasting models. Contributions will address new insights from observations and numerical simulations, strategies for incorporting low-atmospheric physics into global solar wind and CME models, and approaches for constraining or assimilating these processes in forecasting frameworks. The goals will be 1) to establish a shared understanding of capabilities, from modelling of the inner solar atmosphere to its integration into space weather operations, 2) to identify and prioritise required improvements in the physical modelling underlying future forecasting frameworks, 3) to trigger discussions for collaborative model development and observational campaigns.

HEL1 - Advancing Cross-scale Space Weather at the Moon, Mars, and Beyond in Support of Science, Operations, and Exploration

Conveners: Gina DIBRACCIO; Beatriz SANCHEZ-CANO; Fabrice CIPRIANI

Description: Understanding space weather at the Moon, Mars, and beyond is essential for robotic and human exploration. The increasing availability of data throughout the inner heliosphere makes it possible to improve predictions and assess solar activity impacts on different planetary environments across both small, localized scales and large, global scales. The current fleet of spacecraft, as well as future missions, on the surface and in orbit at the Moon and Mars, provide opportunities to analyze the evolution of solar transients beyond 1 AU, track the impact of these events through the planetary space environment down to the

surface, and assess any technological effects. More recently, tools utilizing artificial intelligence and machine learning have further expanded our ability to characterize and predict planetary space weather. Collaborations across international space agencies and various missions have enabled exploration of space weather at the Moon and Mars. Research and operational space weather capabilities are rapidly emerging, and future opportunities are being identified in areas such as recognizing and filling data, infrastructure, and forecasting needs; developing and validating models; and more. This session will highlight advances in understanding space weather at the Moon, Mars, and beyond with a cross-scale perspective. We welcome abstracts that showcase cutting-edge developments utilizing machine learning, analyses related to recent solar activity impacts, and demonstrations of capabilities that improve our understanding of space weather impacts on different planetary environments.

HEL2 - Cosmic Rays in the Heliosphere

Conveners: Alexander MISHEV; Mateja DUMBOVIC; Athanasios PAPAIOANNOU

Description: Cosmic rays in the heliosphere include both solar energetic particles (SEPs) produced by solar flares and coronal mass ejections (CMEs), and galactic cosmic rays (GCRs) that originate outside the heliosphere. Both populations are important for space weather because they influence radiation exposure to astronauts, satellites, and technological systems. This session will focus on cosmic ray variability in relation to space weather, including (but not limited to) Forbush decreases, anisotropic cosmic ray enhancements (ACREs) and SEPs. We invite abstracts on the modelling, observation, data analysis and phenomenology of cosmic rays in the heliosphere and their associated space weather effects. We especially encourage contributions that employ or combine novel multi-spacecraft and/or ground-based observations, numerical models and nowcasting and/or forecasting methods.

HEL3 - Radio instruments and diagnostics: from source regions to space weather applications

Conveners: Nicolina CHRYSAPHI; Henrik EKLUND; Hamish A. S. REID

Description: Radio signals are a key diagnostic for space weather applications. Starting from the highest frequencies (GHz), radio observations are used to study solar atmospheric dynamics and identify the solar origins of accelerated particles, whereas measurements down to very low frequencies (kHz) reveal the ionosphere's response to solar eruptions and enable its diagnosis. Solar radio bursts (MHz – kHz) are used to track the trajectories of flare- and shock-accelerated particles, diagnose the heliospheric environment, cover distances where other remote-sensing and in-situ measurements are unavailable, and also act as warning signs for space weather forecasting models. Meanwhile, radio interference and blackouts caused by solar storms affect vital services, reflecting our dependence on radio-based infrastructure. The aim of this session is to showcase the wide-ranging space weather diagnostic abilities of heliospheric radio emissions. We encourage contributions from stand-alone (radio) studies or as part of multi-wavelength investigations, whether focused on fundamental research or operational applications. We also encourage contributions showcasing current and future radio detectors relevant to space weather monitoring and forecasting applications.

HEL4 - All about the solar wind and CMEs

Conveners: Stephan G. HEINEMANN; Manuela TEMMER

Description: Coronal mass ejections (CMEs) are the primary drivers of severe space weather, yet their propagation, arrival time, and geoeffectiveness are fundamentally dictated by the background solar wind. As CMEs traverse interplanetary space, they exist in a state of constant feedback: they are shaped by the ambient medium while simultaneously altering the heliospheric structure, effectively preconditioning interplanetary space. The background solar wind is defined by a complex interplay between slow and fast streams. These interactions manifest as Stream Interaction Regions (SIRs) and Co-rotating Interaction Regions (CIRs), creating shocks, compression, and rarefaction regions that contribute significantly to recurrent geomagnetic activity. A comprehensive understanding of these dynamics and their solar origins is critical for advancing space weather forecasting. This session unites the solar wind and CME communities, recognizing that separating steady and transient processes limits scientific insight. While organized into two focused parts, its structure ensures both communities engage with each other. We invite contributions covering: • Ambient Wind: Origin, acceleration, and evolution of slow and fast streams. • Transients: Physics of CME

initiation, propagation, and internal evolution. • Interactions: Coupling of CMEs with CMEs, SIRs, CIRs, and the HCS. • Space Weather: Predictive modeling and observations of geomagnetic effects. We encourage submissions utilizing observational data, theoretical frameworks, and numerical modeling, particularly "observation-to-modeling" studies that push the boundaries of heliospheric physics.

MIT1 - Solar Wind Forcing and Coupled Magnetosphere–Ionosphere–Thermosphere Dynamics

Conveners: Giulia D'ANGELO; Denny OLIVEIRA; Chao XIONG; Colin WATERS

Description: The near Earth environment responds to the solar wind (SW) forcing through a chain of multi-scale processes that link the magnetosphere, ionosphere and thermosphere. Capturing how energy and momentum flow across these regions is essential for interpreting and predicting space weather effects. This session focuses on the mechanisms that regulate the coupling between solar wind and Magnetosphere-Ionosphere-Thermosphere (MIT) system, including reconnection-driven dynamics, current systems, particle precipitations, ion–neutral interactions, and ionospheric/thermospheric responses. We welcome studies addressing both persistent and rapidly evolving phenomena, such as geomagnetic storms, substorms, auroral activity, and SW discontinuities, across spatial scales ranging from global circulation to mesoscale and kinetic structures. We encourage contributions based on observations, models, theory, and data driven approaches, especially those combining multiple instrument al satellite and coordinated ground based networks. Work that explicitly connects the solar wind drivers to the coupled MIT system response, or that advances space weather monitoring and forecasting capabilities, is particularly valued. The session aims to bring together diverse perspectives to advance our understanding of the coupled SW–MIT system and its role in shaping the Earth’s geospace environment.

MIT2 - Cross-scale GNSS-based monitoring of ionospheric irregularities: from physics to operational space weather services

Conveners: Sarah BEECK; Tibor DURGONICS; Cathryn MITCHELL

Description: Ionospheric irregularities span a wide range of spatial and temporal scales and remain a major source of uncertainty for space-weather monitoring and forecasting, particularly for systems relying on GNSS-based positioning, navigation, and timing. Their impacts are especially pronounced at high latitudes, where auroral and polar processes produce strong ionospheric structuring, but similar challenges also arise at equatorial and mid-latitude regions during disturbed conditions. Improving the detection, characterization, and prediction of irregularities is therefore essential for both scientific understanding and operational space-weather services. This session invites contributions on the observation, characterization, modeling, and operational use of GNSS-based measurements of ionospheric irregularities across scales. We welcome studies using scintillation indices, TEC and ROTI products, multi-frequency and multi-constellation GNSS observations, dense receiver networks, radio occultation, and data assimilation or fusion approaches. Contributions addressing the generation, morphology, and dynamics of ionospheric irregularities are encouraged, as well as studies focusing on GNSS-based diagnostics of scintillation, phase fluctuations, and TEC gradients. We also invite work integrating ground based GNSS with complementary observations such as radio occultation, ionosondes, and radars, as well as efforts on regional and global mapping, nowcasting, forecasting, validation, and uncertainty quantification. Particular emphasis is placed on translating research advances into robust operational monitoring capabilities and user-oriented space-weather services.

MIT3 - Radiation Belts and plasma in the Magnetosphere

Conveners: Dario RECCHIUTI, Sebastien BOURDARIE, Hugh David REES EVANS

Description: The magnetosphere is a structured and dynamic region where energetic electrons and ions interact with cold plasma populations through a rich spectrum of wave modes, producing rapid and extreme variations in radiation belt fluxes and plasmaspheric morphology. These variations are coupled with solar wind driving and magnetospheric convection, making the magnetosphere a key region for understanding the circumterrestrial space response to space weather disturbances. Therefore, energetic particles and plasma populations in the inner magnetosphere are at the core of space weather hazards, directly threatening satellite operations, astronaut safety, and technological infrastructure in near-Earth space. This session invites contributions on the physics, modeling, and forecasting of

energetic particles and plasma in the magnetosphere, including particle acceleration and loss mechanisms, wave–particle interactions, radial diffusion, and the influence of cold plasma density on relativistic electron dynamics. We encourage studies addressing extreme geomagnetic events and their consequences for radiation belts structure. Contributions based on observational analyses from multi-mission satellite constellations, as well as ground-based and complementary datasets, are welcome. We particularly value works advancing physics-based and data-assimilative radiation belt models, empirical specification tools, and machine learning approaches aimed at improving nowcast and forecast accuracy. By bringing together diverse methodologies and communities, the session aims to enhance our understanding of magnetospheric dynamics and support the development of robust space weather monitoring and prediction capabilities.

SWI - Advances in the assessment of geomagnetically induced currents and ground geoelectric fields

Conveners: Juliane HUEBERT; Neesha SCHNEPF; Vanina LANABERE; Darcy CORDELL

Description: Rapid variations in the Earth’s magnetic field, driven by solar wind interactions, generate large ground electric fields that can induce currents (GICs) in conductive infrastructure. These currents can disrupt operations, cause equipment damage, and pose significant risks to industry and society. Recent advances in geoelectric field forecasting and GIC modelling have been enabled by increasingly comprehensive datasets, including magnetometer networks, large-scale magnetotelluric surveys, detailed network models, and direct GIC measurements. Modelling approaches are now strongly shaped by data availability, while the validation of existing models remains limited by the completeness and accessibility of these datasets. This session welcomes contributions that advance the understanding of ground geoelectric fields and GICs, with a particular focus on data usage, data limitations, and their implications for assessing this geohazard.

SCL1 - Long-term Solar Variability: Observations, Proxies, and Models

Conveners: Theodosios CHATZISTERGOS; Sabrina BECHET; Mathew OWENS; Natalie KRIVOVA

Description: Understanding long-term solar variability is essential for placing present-day space weather in a broader space climate context and for improving predictions across solar-cycle and longer timescales. While direct measurements of solar irradiance and magnetic fields now span several decades, extending these records further back in time relies on other types of solar observations or indirect proxies, as well as their integration into physics-based models. This session will bring together contributions addressing solar variability over decadal, centennial and millennial timescales. Topics include, but are not limited to, the recovery, preservation, processing, and analysis of historical and pre-historical records and proxies of solar activity. (e.g., historical sunspot records, white-light and chromospheric observations in Ca II K and Hα, as well as cosmogenic isotope records), cross-calibration of these heterogeneous datasets, methods for building consistent long-term records, understanding of grand minima and maxima patterns, as well as advances in reconstruction techniques and uncertainty quantification. This topic is timely given the increasing availability and processing of historical datasets, and advances in data analysis and modelling approaches, which together enable more consistent and physically grounded long-term reconstructions of solar variability. Florence provides a particularly relevant setting for this session, as it is home to the Arcetri Observatory with its extensive archive of Ca II K and Hα observations spanning much of the 20th century.

SCL2 - Extreme Solar Events: From Solar Origin to Cosmogenic Isotope Signatures

Conveners: Kseniia GOLUBENKO; Francesco BERRILLI; Nina DRESING; Fusa MIYAKE

Description: Extreme solar events are among the most energetic manifestations of solar activity and represent a key component of space weather. The most powerful events can accelerate large fluxes of solar energetic particles (SEPs) and induce significant changes in the near-Earth radiation environment. While modern observations provide detailed insight into recent events, our understanding of their long-term occurrence and upper limits relies on indirect evidence preserved in natural archives of cosmogenic isotopes (etc., ice cores and trees). This session focuses on the full chain of processes linking extreme solar eruptions to their signatures in Earth. We aim to connect studies of solar sources and particle acceleration with modelling of SEP transport and atmospheric isotope production and transport, as well as

measurements of cosmogenic radionuclides (10Be, 14C, 36Cl) in terrestrial archives. Particular emphasis will be placed on integrating physical modelling and isotope data to better constrain the magnitude, frequency, and impacts of extreme events beyond the instrumental era. By bringing together expertise from solar physics, particle transport modelling, and cosmogenic isotope research, this session seeks to improve the physical interpretation of isotope anomalies and to advance a coherent framework for studying extreme solar events across disciplines.

IOM1 - Preparing for L5 and Beyond: Operational and Scientific Readiness for the ESA Vigil Mission and Future Heliospheric Observations

Conveners: Matthew WEST; Jeffery NEWMARK; Steph YARDLEY; Valentina ZANCAN

Description: We invite the community to contribute to the second European Space Weather Week session dedicated to the ESA Vigil mission. Vigil will be the first dedicated space weather mission positioned at the Sun–Earth L5 Lagrange point, providing a unique side-on vantage point for monitoring solar activity and the inner heliosphere. By complementing observations from the Sun–Earth line, Vigil will enhance early-warning capabilities for space weather forecasting while delivering a valuable dataset for the scientific community. Vigil's six baseline instruments will provide high-quality, low-latency observations spanning the solar photosphere, corona, heliosphere, and the local solar wind environment, supporting both operational services and heliophysics research. This session will focus on community readiness for L5 observations, including data product development, L5-oriented research, modelling integration, research-to-operations (R2O) pathways, and tool development. We particularly welcome contributions that: • Explore the use of L5-perspective observations in operations, science, and modelling • Present AI and machine learning approaches using L5 data • Combine L5 observations with complementary datasets (e.g. L1 monitors, Solar Orbiter, STEREO, ground-based observations) • Advance modelling, data assimilation, and forecasting frameworks incorporating L5 data • Address operational requirements and user-driven data products • Investigate cross-scale Sun–heliosphere–Earth coupling enabled by the L5 vantage point

---

IOM2 - Space Weather Missions - From Science to Operations

Conveners: Melanie HEIL; Matthew TAYLOR; Anja STROMME

Description: Space missions are entering a new era of diversity, innovation, and operational maturity with science, exploration, Earth observation, telecommunications and satellite navigation missions complementing dedicated operational space weather missions in delivering high quality data. These missions are institutionally and commercially funded. With a new generation under development, the European and international space weather communities are poised for major advances in monitoring, modelling, and forecasting solar and heliospheric activity. This session invites contributions on current and upcoming dedicated space weather missions, and science-driven missions providing data for use in space weather applications. We welcome presentations covering mission concepts, measurement strategies, technology developments, and early or mature data products. Comparative perspectives between heritage missions and next generation platforms are encouraged, highlighting how new capabilities expand operational readiness and scientific understanding. Topics of interest include: • Missions currently in flight, including their latest data products, lessons learned, and evolving operational roles • Upcoming missions and concepts such as Lagrange point sentinels, small satellite constellations, hosted payloads, and rapid deployment platforms • Synergies between missions in building a robust global space weather observing system By bringing together mission teams, instrument developers, data users, and service providers, this session aims to foster a comprehensive dialogue on the future of space weather monitoring.

IOM3 - Operational and Prototype Data Products Derived from Low-Earth Orbit, Near-Earth, and Upstream Observations

Conveners: Guram KERVALISHVILI; Enkelejda QAMILI; Consuelo CID TORTUERO; Matthew WEST

Description: Observations from Near-Earth and Low-Earth Orbit (LEO) missions are essential for space weather monitoring and scientific understanding of the geospace environment. Measurements of magnetic fields, ionospheric plasma and currents (e.g., CHAMP, Swarm), thermospheric density (e.g., GOCE, GRACE-FO), and radio-occultation–derived electron

density and Total Electron Content (e.g., Metop-SG and SMOS TEC measurements) provide vital information on magnetosphere–ionosphere–thermosphere coupling and the near-Earth environment's response to solar forcing. Many missions now deliver near-real-time (NRT) data products that support operational monitoring, modelling, and forecasting of space weather. Data from upstream solar and heliospheric missions, such as those at L1 or the upcoming ESA Vigil at L5, provide early observations that extend forecast lead times, offering context and indicators of conditions soon to be observed in Near-Earth and LEO environments. Establishing links between upstream drivers and downstream measurements remains a challenge for understanding geospace response to solar activity. This underscores the importance of coordinated, low-latency, multi-mission datasets and data products for operational space weather monitoring and forecasting. We invite contributions on operational, prototype, and in-development data products, including NRT datasets, their definitions, quality, latency, processing, instrumentation, and multi-mission integration. Submissions demonstrating how these datasets inform models, services, and forecasts, or how upstream observations can predict downstream geospace conditions, are encouraged.

IOM4 - Radiation Instrumentation for In-Situ Space Weather Monitoring Across the Solar System

Conveners: Sylvie BENCK; Bernd HEBER; Martin Jan LOSEKAMM

Description: All scientific investigations related to solar energetic particles, galactic cosmic rays, and magnetospheric populations (incl. radiation belts) rely on measurements of fluxes of charged and neutral particles. The energy range of interest spans orders of magnitude, from ~10 keV up to GeV levels; spatial and temporal variations of the strongly energy-dependent fluxes lead to similarly large variability in intensity. Measurements are made in-situ by spacecraft and robotic probes in interplanetary space, in Earth's magnetosphere, as well as in the magnetospheres and on the surface of other planetary bodies (for example Jupiter, the Moon, and Mars). Complementary measurements are performed on Earth. The suitability of measurement techniques depends on the location, the target particles, and the available resources (mass, volume, power, and data). Smaller (and simpler) instruments enable much-needed multi-point observations, while more sophisticated ones are critical for validating models and serve as references for a detailed understanding of radiation fields. Examples of measurement techniques include the use of stacked silicon detectors, calorimeters, scintillators, Cherenkov detectors, pixel sensors, proportional counters, and magnetic spectrometers. This session invites presentations on instrument concepts, ongoing

developments (including simulations and ground-test results), in-flight data highlighting the benefits and limitations of the data sets, inter-comparisons between instrument data, and community access.

OTH1 - Validation of Space Weather Models, Forecasts, and Services: From Research to Operations

Conveners: Barbara PERRI; Martin REISS; Daria SHUKHOBODSKAIA; Evangelia SAMARA

Description: As reliance on space weather services grows across sectors like satellite operations, GNSS, aviation, energy, and human spaceflight, the need for reliable and actionable forecasts—whether generated by models or human expertise—becomes ever more critical. Progress in space weather research and forecasting depends on robust validation of both models and operational services. With models becoming more complex and forecasts playing a pivotal role in decision-making, a comprehensive, reproducible, and consistent validation infrastructure, based on agreed protocols, is essential. This requires community-wide collaboration to define essential physical properties, events or time periods, and metrics. This session invites contributions addressing the validation of space weather models, forecasts, and services across the entire chain from research to operations. We welcome studies on: 1/ Methodologies for validating and verifying models, forecasts, and services, including performance evaluation, uncertainty quantification, and benchmarking; 2/ Multi-spacecraft observations 3/ Automated tools for open, reproducible validation; 4/ Strategies for (near) real-time assessment (AI/ML, scoreboards, etc.); 5/ User-centric approaches, including communication of uncertainty, feedback mechanisms, and demonstration of service value in operational contexts; 6/ Community challenges and initiatives to foster best practices and collaboration among researchers, forecasters, service providers, and end users. By bridging scientific, technical, and user perspectives, this session aims to advance the development of reliable space weather services and validated forecasting capabilities.

OTH2 - Operational Space Weather Forecasting: Systems, Workflows, and Coordination Across Forecast Centres

Conveners: Teresa NIEVES-CHINCHILLA; Judith DE PATOUL; Krista HAMMOND; Patrick PERRON

Description: Operational forecasting centres are central to delivering continuous and reliable services to users whose systems depend on timely and actionable information. Across the world, centres operate under diverse mandates, infrastructures, and service models, yet face common challenges in maintaining 24/7 situational awareness, integrating observations and models, and ensuring robust and sustainable service delivery. This session focuses on the structure and functioning of forecasting systems, addressing how centres organise, sustain, and evolve their day-to-day activities. Rather than event-driven analyses, it emphasises steady-state operations, including workflows, toolchains, pipelines, and system architectures supporting continuous service provision. Contributions are invited from operational centres and service providers to present their frameworks, integration of observations and models, operational definitions and thresholds, alert generation and dissemination, and approaches to ensuring reliability, scalability, and resilience. Particular attention will be given to interoperability between systems, coordination across centres, and integration of heterogeneous infrastructures and data sources. We also welcome contributions describing operational platforms, forecasting environments and approaches to improving reproducibility, maintainability, and sustainability. By bringing together forecasters, service managers, tool developers, and researchers, this session aims to provide a structured view of operational forecasting systems in practice, identify common challenges and best practices, and strengthen coordination within the space weather forecasting community.

OTH3 - Machine Learning and Data Science for Geospace and Space Weather

Conveners: Georgios BALASIS; Simon WING; Yuri SHPRITS; Jorge AMAYA

Description: The world is in the midst of an artificial intelligence (AI) and machine learning (ML) revolution. Given its widespread impact, it is not surprising to see an explosion in the applications of ML in academic research, including geospace and space weather research. Over the last few decades, both satellite missions and ground-based networks, along with their associated instruments, are yielding exponentially increasing volumes of data. Concurrently, the growth in computational power is enabling simulations to produce similarly vast datasets. These extensive observational and simulation outputs present significant

challenges to conventional data analysis methodologies. Machine learning is emerging as a valuable tool for facilitating the analysis, classification, characterization, forecasting, and discovery processes within large datasets. Likewise, advanced data and complex system sciences provide robust frameworks for analyzing, mining, and elucidating both linear and nonlinear relationships as well as causal inferences within large complex data sets. Machine learning has also constantly improving the performance of operational space weather models, and thus, the predictions of hazardous space weather effects for the space and ground infrastructures. This session welcomes submissions in the following areas related to Machine Learning integrated into Space Weather research: solar flare prediction, geomagnetic storm forecasts, radiation belt modeling, CME propagation, MIT coupling and its effects etc. The session also aspires to highlight the importance to develop data standards and in particular metadata standards and prepare AI ready data compliant with FAIR principles.

OTH4 - Education and Outreach in Space Weather: Engaging Communities and Shaping the Next Generation

Conveners: Domenico DI MAURO; Stefania LEPIDI

Description: Education and outreach (E&O) play an important role in the space weather community. They help turn scientific discoveries into awareness, skills, and real-world effects. As space weather increasingly impacts modern technology and society, we need better ways to communicate, train, and engage different audiences. This session welcomes contributions from researchers, educators, communicators, and service providers to share their experiences, tools, and ideas for space weather education and outreach. Topics of interest include training schools, innovative teaching methods, citizen science, engagement with stakeholders and end-users, and new communication formats—from digital tools to hands-on activities. We also aim to discuss how to make E&O more inclusive, impactful, and sustainable. We will look at how to better integrate space weather into broader STEM education. The session will encourage an open and interactive exchange of ideas, hoping to inspire collaboration across communities and spark new ways to engage society while supporting the next generation of space weather scientists and practitioners.

OPS - Open Session

Conveners: PC member, TBA

Description: This session welcomes submissions on topics not covered under the selected sessions. Any abstract related to Space Weather and/or Space Climate is welcome. We particularly encourage submissions related to:

Magnetosphere dynamics

Radiation belts

Ground-based solar observations and instrumentation

Defence and security

If any of these subjects receive a sufficient number of high-quality submissions to justify their own time slot, the PC will consider spinning them off into their own session and approaching suitable individuals to convene.

Those submitting to the OPS session should check carefully if their submission does not fit elsewhere. The PC reserves the right to move abstracts to another session where the conveners agree they fit. However, as the conveners will be aware of these abstracts later than for others, they may suffer in being considered for oral selection.

The PC intends to approach suitable individuals to convene the OPS session itself based on the subjects covered by (remaining) abstracts.

TOPICAL DISCUSSION MEETINGS

TDM1 – Atmospheric Impacts of Spacecraft Launches and Re-entries: Consequences for Space Weather Activities (Event impact)

Conveners: Anwesha MAHARANA; Thierry DUDOK DE WIT; Sophie Chabanski CHABANSKI

Description: The near-Earth environment has undergone a fundamental transformation over the past decade. The population of human-made objects in space is growing rapidly, driven by the exponential rise of satellite mega-constellations. Although orbital congestion has received

considerable attention, the physical impact of these assets on Earth's atmosphere throughout their life cycle remains a critical gap in space-weather research. Rocket launches and spacecraft re-entry affect physical and chemical processes across all atmospheric layers. Long neglected, these effects have become increasingly significant with the growing number of launches and re-entries. However, limited observations, large uncertainties, and a general lack of awareness continue to hinder their quantification. The objective of this TDM is to raise community awareness of this rapidly emerging, multidisciplinary research area at the interface of space engineering, space climate, space weather, and atmospheric chemistry. Particular emphasis will be placed on impacts on the ionosphere, with consequences for radio communication and for the fundamental models underpinning space-weather and space-climate research. Understanding these interactions is now essential to ensure the accuracy and sustainable use of satellite-derived data.

This TDM will begin with a novel, interactive initial diagnostic quiz designed to assess participants' knowledge and challenge common assumptions about atmospheric loading and environmental sustainability. A small panel of experts and public contributors will help contextualise the issues raised. Given the novelty of the topic, ample time will be devoted to discussion and audience interaction.

TDM2 - Improving Community-Driven Data and Infrastructure Catalogues for Space Weather and Space Climate (Service/Project Feedback)

Conveners: Ioannis KONTOGIANNIS; Marianna KORSOS; Marie DOMINIQUE; Yana MANEVA

Description: The aim of this topical discussion meeting is to define how our community-driven E-SWAN infrastructure, data catalogues and models can be further improved to better serve researchers, forecasters, modellers, and service providers with diverse objectives and data requirements. The TDM builds on previous E-SWAN TDMs that engaged end users and scientists and explored current practices and challenges in space weather data exchange. Following the 2024 TDM, important progress has already been made, including the development of the E-SWAN node-source website, where users can begin exploring available data resources. However, as the community increasingly relies on a growing multiplicity of data sources, driven by the continuous expansion of available observations and services, important questions remain regarding the adequacy, usability, and consistency of existing catalogues. To address these challenges, this session will collect additional user input and synthesize it with insights gathered from earlier activities to evaluate existing and emerging

solutions, identify gaps and limitations, and discuss whether a more coherent and integrated approach is needed.

TDM3 - International Space Weather Action Teams: A Hub for Bottom-up Coordination in Space Weather and a Driving Force for the COSPAR Space Weather Roadmap (Service/Project Feedback)

Conveners: Masha KUZNETSOVA; Mario BISI; Sean BRUINSMA; Suzy BINGHAM

Description: COSPAR International Space Weather Action Teams (ISWAT) is a bottom-up initiative with more than 750 active members from more than 400 affiliations across more than 50 countries and almost 100 Action Teams working via self-guided topical collaborations addressing challenges across the field of space weather. ISWAT is an effort multiplier maximizing return on national investments in space weather. ISWAT initiative formed the backbone for the community-driven 2025+ Space Weather. Roadmap. The TDM will start with a scene setting introduction summarizing outcomes from the 2025-2026 working meetings and satellite events (mini-ISWATs). The brief update will be followed by open discussion on Roadmap recommendations, high priority actions and community-wide campaigns, and approach to improving international coordination. The special focus of the discussion is on improving the cross-cluster working, establishing a new user-focused space weather training network, energizing planetary space weather cluster activities with focus on Mars, and exploring opportunities for collaborative shared environments and community modeling.

TDM4 - Mission concepts and ideas for filling the observational gaps in the mesosphere and lower thermosphere (Service/Project Feedback)

Conveners: Claudia BORRIES; Luca SPOGLI; Theodoros SARRIS; Elisabetta IORFIDA

Description: The Mesosphere and Lower Thermosphere-Ionosphere (LTI) regions are critical interface regions between atmosphere and space. They host complex electrodynamic

coupling processes involving neutral gas, plasma, magnetic and electric fields. These processes are central to the vertical coupling of the whole atmosphere, mediating geospace forcing from above and atmospheric dynamics from below. The Very Low Earth Orbit (VLEO, within the LTI) is increasingly attractive to satellite operators, due to orbital congestion and strict deorbiting policies. However, VLEO mission planning must account for severe atmospheric drag and material erosion. Improving the accuracy of atmospheric models in the LTI region is an urgent research priority.

Today, our knowledge of these complex neutral-charged and electrodynamic couplings is still insufficient. The LTI is currently suffering from the highest uncertainties in thermosphere-ionosphere models and severe scarcity of geophysical observations.

This TDM will elaborate on the need for relevant observations, emerging technologies, new observational options and the challenges connected with mission planning in VLEO.

Key Questions:

1. What are the necessary key observables in the LTI? What are the user needs connected to them in the LTI? What are the achievable observation uncertainties with remote sensing and in-situ observations and how can they advance whole-atmosphere models?

2. What challenges do satellite operators face when targeting VLEO? How can the knowledge of the Space Weather/upper atmosphere community help address these challenges?

3. What are the key ground-based observations that can at best complement the space-based observations?

TDM5 - Open Access and Scientific Impact in Space Weather & Space Climate: A Community Dialogue with JSWSC (Event impact)

Conveners: Anna BELEHAKI; Ilya USOSKIN; Natalie KRIVOVA

Description: This proposed TDM will focus on the evolving landscape of Open Access publishing in Space Weather and Space Climate, with particular emphasis on the role of the Journal of Space Weather and Space Climate (JSWSC).

Open Access is increasingly recognized as essential for ensuring visibility, accessibility, and societal impact of scientific results. However, it also raises important questions regarding publication costs, editorial standards, peer-review quality, and journal competitiveness. This

session aims to foster an interactive discussion on these topics, bringing together researchers, editors, and publishers.

Invited contributions from Associate Editors and the publisher will provide additional perspectives on editorial processes, publication workflows, and Open Access models. The core of the session will be an open forum encouraging participants to share experiences, expectations, and concerns.

Key discussion points will include:

• The benefits and challenges of Open Access publishing for authors and institutions

• Maintaining high scientific standards in an Open Access environment

• Journal visibility, impact, and community trust

• The role of JSWSC within the broader publication ecosystem

The goal of this TDM is not only to present information but to actively engage the community in shaping the future of publishing in Space Weather and Space Climate, ensuring that it aligns with scientific excellence, transparency, and inclusivity.

TDM6 - Sharing is caring: Mapping the challenges in data sharing to strengthen space weather services to aviation (Panel Forum)

Conveners: Kasper VAN DAM; Kirsti KAURISTI; Yana MANEVA; Louis RICHARD

Description: The International Civil Aviation Organisation (ICAO) has designated four global space weather centres to issue advisories on conditions affecting civil aviation. These include NOAA's SWPC, CRC (China/Russia), and two European-affiliated consortia: PECASUS (Finland, Belgium, UK, Germany, Italy, Poland, Austria, Cyprus, Netherlands) and ACFJ (Australia, Canada, France, Japan).

These centres rotate operational duties every two weeks, using diverse data sources, models, and procedures, which can lead to inconsistencies in advisories. To improve transparency, interoperability, and service robustness, harmonising data, models, and practices is essential.

Enhanced global data sharing would foster consistent situational awareness, validate forecasts, and strengthen system resilience. Given geopolitical challenges, harmonisation may require a stepwise process, such as bilateral agreements or targeted collaboration

between consortia like PECASUS and ACFJ. Shared funding frameworks, like the Single European Sky programme, could further encourage integration.

This Topical Discussion Meeting aims to identify technical, political, and financial barriers to data sharing among ICAO centres. We invite the global community, including all four centres, to discuss challenges and lay the foundation for a unified approach toward a more resilient global space weather service.

TDM7 - Solar Storms: Flares, Coronal Mass Ejections (CMEs) and Solar Energetic Particles (SEP) events (Other)

Conveners: Olga MALANDRAKI; Volker BOTHMER; Michalis KARAVOLOS

Description: This TDM covers topics from the ESA SWWT Topical Working Group ‘Drivers of Space Weather - Solar Storms’. To-date it is well known that the most severe space storms are caused by fast CMEs driving shock waves in the heliosphere. The shocks lead to particle acceleration and to strong compressions of the ambient solar wind. Often multiple fast events are observed to interact with each other and to form compound streams. Specific studies have shown that the turbulent sheath region following shocks play a key role in the onset phase of geomagnetic storms. The turbulent plasma and magnetic field in these sheath regions also play a central role in accelerating energetic particles. SEP events are another major component of severe space weather. Timely SEP forecasting is therefore of great importance, not only in relation to CME- and shock-driven events, but more generally with respect to the processes that govern particle release, transport, and magnetic connectivity in the heliosphere. In this TDM, the physics of shock and sheath regions in space storms and their effects at Earth and moon and at more distant planets, such as Mars will be discussed to elaborate the importance of shock parameters and their drivers for their heliospheric impacts, including recent advances achieved by the Solar Orbiter and Parker Solar Probe missions, as well as other worldwide SEP forecasting capabilities supporting space weather operations. The TDM will start with brief introductions into the addressed subjects followed by an open discussion. A summary of the TDM will be provided following the ESWW2026.

TDM8 - Solar–Stellar Perspectives on Space Weather and Exoplanet Habitability (Panel Forum)

Conveners: Camilla PEZZOTTI; Maria Giuseppina DI MAURO

Description: Space weather research is evolving from a Sun-centric discipline into a key component of exoplanetary science. The long-term stability and erosion of Earth-like atmospheres strongly depend on stellar magnetic environments. As stars evolve from highly active T-Tauri phases to quieter main-sequence stages, their varying magnetic activity shapes the habitable zone and influences planetary atmospheric retention. However, a major challenge remains in bridging the gap between the high-resolution observations and detailed modelling available for the Sun and the magnetic dynamos operating in solar-type stars at different evolutionary stages. At the same time, these stars provide key laboratories for probing dynamo processes under physical regimes distinct from those of the present-day Sun.

This session aims to foster collaboration between the solar, stellar, and exoplanetary communities, focusing on three major themes:

1.The Solar–Stellar Connection: extending solar dynamo models to stars with different rotation rates and internal structures, and using observations of exoplanet host stars to constrain dynamo processes.

2.Space Weather through Time: assessing the cumulative impact of magnetic activity on planetary systems across evolutionary stages.

3.Mission Synergy: integrating refined space-weather modelling into optimised pipelines for the exploitation of data from upcoming missions (PLATO, ARIEL).

By promoting multidisciplinary dialogue, the session will identify key gaps in solar-stellar dynamo modelling and discuss the implications for the characterization of exoplanetary systems.

TDM9 - Space Safety 2040 – Space Weather objectives (Other)

Conveners: Juha-Pekka LUNTAMA; Alexi GLOVER; Quentin VERSPIEREN

Description: The ESA Space Safety Programme (S2P) launched in the spring 2026 a community consultation process to collect inputs from the global space safety community on what should be the main goals and capabilities to include in S2P's long-term strategy, Space Safety 2040. The first round of inputs in this consultation will be collected until 22 May 2026. All inputs will then be analysed and initial results will be used for targeted consultations, including with the space weather community on the occasion of the European Space Weather Week.

The results from this consultation will used as part of ongoing dialogue with S2P stakeholders including the community and S2P Participating States. The consultation and the outcome from the dialogue will form key inputs towards shaping the future of S2P, influencing, in particular, the S2P Programme Proposals for the next few ESA Councils at Ministerial level (2028, 2031, etc.).

The objective of this TDM is to enable a dialogue with the European Space Weather Week participants about the results of this first round of consultation regarding the space weather objectives of Space Safety 2040. The TDM will contain a presentation from ESA about the analysed consultation inputs and initial considerations of how these results could be taken into account e.g. in preparation for the S2P Period 4 starting in 2027, and in the long term towards S2P activities reaching 2040. This short introduction will be followed by a dialogue with the TDM participants. The outcome of the TDM will be summarised and will also form a key input to the Space Safety 2040 community consultation before the results are presented to the ESA Member States in December 2026.

TDM10 - Space weather and Heliophysics: Research to Operations and back again (Other)

Conveners: Matt TAYLOR; Anja STRØMME; Matthew WEST

Description: Operational Space weather is underpinned by Heliophysics science and research to set the requirements for what key measurables are needed to improve our space weather capabilities and this in turn drives further science and research. This feedback between science and operational space weather is often referred to as the Research to Operations to Research R2O2R pipeline.

These activities can address either a direct need, where mature research exists but no operational application has yet been implemented, or a longer-term need, where an operational requirement has been identified but the supporting research is not yet sufficiently

mature. The latter case may require additional research funding and/or technological development.

This TDM aims to discuss where we are in Europe in terms of linking the research aspects to operational space weather, how this is fedback into research and vice versa. In particular we wish to examine how the various entities that have the capability to provide science measurements are positioned to facilitate this flow of information, including ground based facilities, space based assets, simulations, data access and tools, including use of AI. This Topical Discussion Meeting is offered with an intent of identifiying how we can better communicate promoting gainful collaboration and coordination of projects across the various areas of the Heliophysics and Space Weather community.

TDM11 - Space Weather Impacts on GNSS Performance - Discussion of user needs (Service/Project Feedback)

Conveners: Jaroslav URBÁŘ; Veronika HABERLE; Balazs ASZTALOS; Eugeniu Mihnea POPESCU

Description: As the GNSS signals are nowadays used not only for positioning and navigation purposes, but also in timing and synchronisation, a broad range of services which can experience degradations or outages due to Space Weather Effects are truly of cross-disciplinary interest. Many user communities experienced negative impacts of the significant May 2024 events, requesting the Space Weather service providers to provide simple to understand, but accurate nowcasting or ideally forecasting services for various use cases. However, what is considered as "simple to understand" may vary significantly from domain to domain and even among end-users within the same domain. The idea of this User Engagement TDM is to showcase the interaction between service providers and end-users based on a specific, GNSS domain.

In addition to the GNSS-based services, numerous users of various radio signals (e.g., satellite communications, LOFAR radioastronomy) also rely on undisturbed Trans-ionospheric operations, and the disturbances observed in GNSS can indicate problems in their operations.

In the first part of the TDM, experts will give a brief introduction to SWESNET products as one example of GNSS services and how these are mapped to the most common use cases and challenges experienced by GNSS users. Based on this example, we will discuss satisfied and not-met needs from the users' point of view. How can space weather service providers

effectively support risk mitigation, assuming the users will integrate their real-time service outputs?

TDM12 - Space Weather Impacts on the Mediterranean Region: Bridging Scientific Understanding and Operational Services (Service/Project Feedback)

Conveners: Georgios BALASIS; Alessio PIGNALBERI; Emanuele PICA; Adamantia Zoe BOUTSI

Description: Space weather disturbances affecting the near-Earth environment pose increasing risks to technological infrastructures, not only at high latitudes but also at mid- and low latitudes through magnetosphere-ionosphere-thermosphere coupling. Ionospheric variability driven by geomagnetic disturbances can produce large perturbations in Total Electron Content, ionospheric irregularities, and modifications of electrodynamic processes, affecting systems relying on trans-ionospheric radio propagation such as GNSS positioning and satellite communications for aviation operations. Geomagnetic disturbances can also induce electric fields in the ground, leading to Geomagnetically Induced Currents that may impact power transmission networks and other ground-based infrastructures even at mid-latitudes.

Recent ESA Space Weather initiatives highlight the importance of the development of capability for products and services related to the monitoring and forecasting of ionospheric and geomagnetic conditions in the Mediterranean region.

This meeting discusses the impacts of space weather in the Mediterranean region, including the following topics: impacts on power grids and communication systems; monitoring and mitigation strategies; and the development of products and services supporting resilience and risk awareness in affected regions.

By bringing together researchers, service providers, and stakeholders, this meeting aims to sustain a more comprehensive view of space weather impacts across Mediterranean latitudes and to promote collaboration toward improved understanding, forecasting, and mitigation of space weather hazards beyond the traditional high-latitude focus.

TDM13 - Space weather in polar regions: challenges and opportunities for the next International Polar Year (Panel Forum)

Conveners: Lucilla ALFONSI; Wojciech J. MILOCH; Kseniia GOLUBENKO

Description: Polar regions are highly sensitive to space weather due to their direct magnetic coupling to the geospace, making them key areas for studying solar-terrestrial interactions and their impacts on the atmosphere and technological systems. At the same time, these regions remain observationally sparse and operationally challenging. With the upcoming International Polar Year (IPY, www.ip5.info), taking place in 2032-33, there is a timely opportunity to reassess priorities in polar space weather research, monitoring, and services.

This Topical Discussion Meeting will address the current status, key challenges, and future opportunities in understanding and predicting space weather in polar regions. The discussion will focus on both fundamental science and practical implications, including impacts on communication, navigation, aviation, and atmospheric processes and their operational countermeasures.

Key questions to be addressed include: What are the main gaps in observations and modeling of polar space weather? How can coordinated measurements and infrastructures be improved in the context of IPY? What are the main limitations in warnings, mitigations and forecasting capabilities at high latitudes? How can interactions between space weather, astrophysics, atmospheric chemistry and physics be better integrated? What are the needs of end users operating in polar environments?

Through a panel-led discussion and active audience engagement, this session aims to identify community priorities and stimulate interdisciplinary collaboration across space weather, space climate, atmospheric, and climate research.

TDM14 - Specifying the Radiation Environment for Moon and Mars Mission Support: Closing the Gaps for Safe Human and Robotic Exploration (Other)

Conveners: Yihua ZHENG; Jingnan GUO; Salman KHAKSARI; Giovanni SANTIN

Description: Discuss how to best specify the radiation environment (GCR, SEP, and local effects) during transit and in the vicinity of the Moon and Mars. Review current data sources and modeling/specification tools, then seek community inputs on:

1) the most critical observational and modeling gaps, and

2) prioritized next steps (e.g., measurements needed, validation approaches, coordination/standards).

TDM15 - Towards a Coordinated European Space Weather System: From Fragmentation to Integration (Panel Forum)

Conveners: Marina SKENDER; Judith DE PATOUL; Elena DRIVER; Jaroslav URBÁŘ

Description: Europe has made significant progress in developing space weather capabilities, with growing policy recognition, operational services, and coordination initiatives led by ESA, E-SWAN, and national actors, and supported by global frameworks such as WMO, ISES, and COSPAR. However, a key question remains: are these elements forming a coherent and operational system, or a collection of partially connected initiatives?

This Topical Discussion Meeting addresses this question by confronting policy ambitions with operational reality. Forecasting centres, service providers, and coordinating bodies operate under different mandates, infrastructures, and constraints, while users increasingly expect reliable, actionable, and interoperable services.

The discussion will be structured around three key questions: Where are we today? Are we operating as a coordinated system? Where do we need to go?

Key issues include the alignment of governance and coordination frameworks across ESA, the European Union, EUMETSAT, and national actors; the role of infrastructure and system design in enabling sustainable services; the constraints of operational service provision; and the integration of user needs, including aviation, civil protection, and defence and security communities.

The goal is to establish a shared diagnosis, identify critical gaps between coordination frameworks and implementation, and define priorities and actionable pathways towards a more integrated, interoperable, and resilient European space weather system.

TDM16 - Validation techniques for time-dependent solar wind modelling (Panel Forum)

Conveners: Tinatin BARATASHVILI; Evangelia SAMARA; Nicolas WIJSEN; Myrthe FLOSSIE

Description: Ambient solar wind (SW), originating from the solar corona, fills the entire heliosphere and constitutes the fundamental background upon which more severe space weather phenomena propagate. Coronal mass ejections (CMEs), for example, while key drivers of space weather disturbances, evolve within this structured and magnetized SW and are strongly influenced by it. Their trajectory, speed, and geoeffectiveness are largely governed by their interaction with the SW. Similarly, solar energetic particles (SEPs) propagate along the magnetic field lines embedded in the SW, making their transport inherently dependent on it. Consequently, an accurate representation of the SW is essential for reliable space weather forecasting, including predictions of CME and SEP arrival times and impacts. The goal of this TDM is to discuss the validation techniques for the SW modelling to determine the most accurate approach.

Recently, multiple modelling tools have been upgraded to the time-dependent driving of the SW. As a consequence, the inner boundary conditions are continuously updated throughout the simulation. The modelled heliospheric conditions are significantly more dynamic than in the case of the steady driving of the SW. Differentiating between the numerical artifacts and the real dynamic processes in the SW is challenging based only on the simulation outcomes. This TDM aims to answer the following questions:

1. How can observations be integrated into the inner boundary conditions?

2. In addition to the in-situ measurements, what other techniques can be used to validate the modelled dynamic SW?

3. How can SEPs be used for estimating the accuracy of the modelled global magnetic field?

TDM17 - Next generation Space Weather information services for security purposes (Panel Forum)

Conveners: Daniele BIRON; Adriana MARCUCCI; Angelo Vittorio Maria ROMITO; Patrizio EMILIANI

Description: In order to develop and strengthen a next generation Space Weather capability, for security purposes, it is essential to set up an operational service that ensures real-time automatic processing of information gathered form different sources, allowing continuous monitoring of space conditions and producing reliable and accurate early-warning messages towards the users. Autonomy in data collections and hardening of the operational systems are mandatory, and within that scope a cooperation in Italy has been established between the Italian Air Force and national scientific and research organisations as data provider, Istituto Nazionale di Geofisica e Vulcanologia (INGV) and National Institute for Astrophysics (INAF). The goal is to achieve a robust and stable national capability, ready for operations as a standard tool for decisions making, also in the landscape of security missions. The proposed Topical Discussion Meeting aims at active and engaging participation and interaction between the scientists and operatives involved in the continuous provision of reliable information towards decision making at any level, strategic, operational, tactical, discussing how an efficient and robust service can be built in a field where many observations still belong to the research sector, and when the space has already become a domain congested, contested and competitive From user needs to operational requirements and to systems deployments for security and defence purposes, with the possibility of sharing approaches and experiences, that is the focus of the proposed TDM.

Space Weather scientist, governmental space agencies, meteorological and space weather military personnel, civil defence agencies, space industries, telecoms industries, aviation industry, railway industry, transportation industry, electric power supply industry, precision farming industry.

Immediate outcome: sharing of idea and experiences in the provision of operational Space Weather information, especially for security purposes. Long term impact: activate a network of contacts to further enhance the Research to Operation (R2O) in the field of Space Weather.