International Association of Geomagnetism and Aeronomy

(IUGG)

Activity Report - Year 2024

Delegate: Giuseppe Consolini

International Association of Geomagnetism and Aeronomy

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on behalf of the IAGA Italian Committee

1. Introduction.

IAGA is concerned with the understanding and knowledge that result from studies of the magnetic and electrical properties of:

- the Earth's core, mantle and crust
- the middle and upper atmosphere
- the ionosphere and the magnetosphere
- the Sun, the solar wind, the planets and interplanetary bodies

and their possible interconnections.

Research activities in these fields are developed in Italy at several universities and major national research organizations, such as the National Institute of Geophysics and Volcanology (INGV), the National Institute for Astrophysics (INAF), the National Research Council (CNR) and the National Institute for Nuclear Physics (INFN). These activities are usually conducted in the frame of international projects and collaborations and in the context of the traditional Divisions, Interdivisional Committees and Working Groups of IAGA. They involve relevant numbers of researchers, technicians, doctoral students; this broad involvement of institutions, facilities and networks testifies the high degree of interdisciplinarity and the need for a relevant expertise.

IAGA-Italia is a coordinating group among the scientific community that insists on IAGA issues and assists the Delegate Nationale in gathering and providing information to and from the national scientific community. In this respect, IAGA-Italia promotes the coordination of IAGA related activities in Italy, the development of new ones, the organization of workshops, meetings and schools. For these scopes, the IAGA-Italia National Committee is currently composed as follows:

IAGA Italian Committee

President:
G. Consolini: INAF-IAPS, Roma – Delegate.

Members:
L. Vigliotti: CNR/ISMAR, Bologna – Vice-Delegate, Coordinator Division I “Internal Magnetic Field”,
A. Pignalberi: INGV, Roma, - Coordinator Division II “Aeronomic Phenomena”,
S. Benella: INAF-IAPS Roma, - Coordinator Division III “Magnetospheric Phenomena”,

D. Telloni: INAF-OATo Roma, - Coordinator Division IV “Solar Wind and Interplanetary Magnetic Field”,
S.Lepidi: INGV, L'Aquila, - Coordinator Division V “Geomagnetic Observatories, Surveys, and Analyses”,
A. Siniscalchi: University of Bari, - Coordinator Division VI “Electromagnetic Induction in the Earth and Planetary Bodies”,
F. Berrilli: University of Tor Vergata, Rome - Coordinator Interdivisional Commission on “History”,
L. Giovannelli: University of Tor Vergata, Rome - Coordinator Interdivisional Commission on “Education and Outreach”.

IAGA-Italia has also its own website at http://www.iagaitalia.it for the dissemination of information, data, news and documentation related to IAGA.

2. Main activities carried on by IAGA-Italian Community during 2024.

a) *Management of Observatories and related activities*.

- Management of a new continuous magnetotelluric monitoring station in the Gargano Promontory.

- Management of geomagnetic observatories at Duronia, Castello Tesino, Lampedusa (all three in Italy), Mario Zucchelli (Antarctica, 74.4 S, 164.1 E), Concordia (Antarctica, 75.1 S, 123.2 E) and publication of yearbooks, bulletins, and K indices. Management of magnetic stations at L’Aquila and Gagliano (both in Italy) and of the autonomous monitoring station at Talos Dome (Antarctica, 72.8 S, 159.2 E).

- The magnetic survey over the Italian territory has been carried out at the end of 2024 (to be finished at the beginning of 2025) to obtain the maps of the magnetic field element at epoch 2025.

- Management of the permanent magnetic network of Etna volcano area, with the aim to detect and isolate local magnetic variations related to volcanic activity.

- Management of SEGMA (South European Geomagnetic Array) and ULF magnetic stations at Terra Nova Bay and Concordia (Antarctica).

- Management of paleomagnetic laboratory at Rome (INGV), Peveragno (Ciman-ALP CIMAN - Centro Interuniversitario di Magnetismo Naturale "Roberto Lanza”, Universities of Milano, Torino, Urbino, Parma, RomaTre, Chieti-Pescara, and INRIM Institute of Turin), Bologna (ISMAR-CNR).

- Management of the Italian cosmic ray observatory of Rome, SVIRCO, and publication of monthly/annual reports of cosmic ray measurements, multiplicity and diurnal wave.

Data are also provided in real time to the Neutron Monitor Database web site (www.nmdb.eu) and to ESA SSA Space Radiation Expert Service Centre (swe.ssa.esa.int/space-radiation) for space weather applications.

- Management of ITACA auroral all-sky camera at Ny-Alesund (Svalbard). This is the Italian contribution to MIRACLE network.

- Management of five AIS-INGV ionosondes: two in Italy (Rome and Gibilmanna) ,two in Argentina (San Miguel de Tucumán and Bahia Blanca) and one in Kenya (Malindi). Two DPS4D digisondes are managed in Italy (Rome and Gibilmanna). Another AIS-INGV ionosonde is going to be installed in Liguria, near La Spezia, within April 2025.

- An All-Sky camera is about to be installed at Gibilmanna in collaboration with the Boston college (June 2025).

- Managements of multi-constellation receivers for measuring TEC and ionospheric scintillations: Africa (Abuja, Nigeria; Kilifi, Broglio Space Centre and Nairobi, Kenya); Mediterranean (Pizzi Deneri and Lampedusa (2), Italy; Nicosia, Cyprus; Chania, Greece); Antarctica (Dome C (3), SANAE IV, MZS); Arctic (Ny Alesund (2), Norway; Thule, Greenland); South East Asia (Hanoi, Vietnam; Kenting, Taiwan; KLUniversity, India; Dhaka, Bangladesh); Europe (Helsinki, Sodankyla and Suomussalmi, Finland); Central America (Saba and St. Eustatius, Caribbean Sea); South America (Sao Paolo, Brazil; Tucuman, Argentina).

- Management of continuous magnetotelluric monitoring in a site in Southern Italy (Val d'Agri).

- Management of DCE and DCN ionospheric radars of the SuperDARN international network at Concordia station (Antarctica, 75.1 S, 123.2 E).

- Participation to the activities of the International Consortium ULTIMA (Ultra Large Terrestrial International Magnetic Array).

- Underwater monitoring of the geomagnetic field in portual environment (high artificial noise) and development of the singularity measurements technique for the detection of local anomalies due to hostile operators (anti-intrusion system, anti-terrorism purposes, Min. Difesa financing) in the frame of the LAMA2.0 project.

b) ***Projects of interest in the framework of IAGA*****.**

IAGA-Italia community is involved in several international programs. In what follows a list of the main projects is reported:

- **AGATA** Antarctic Geospace and ATmosphere reseArch (AGATA) Scientific Research Programme endorsed by SCAR in 2024 and funded from 2025 to coordinate worldwide effort to monitor, investigate and better understand the physics of the polar atmosphere and the impact of the Sun-Earth interactions on the polar regions (scar.org/science/research-programmes/agata).

- **ARISTIDE** "Artificial Intelligence based Forecasting of Large-Scale Travelling Ionospheric Disturbances over Europe" funded by Regione Lazio 21/11/2023-21/05/2025

- **ASI/CUSP.** The CUbesat Solar Polarimeter (CUSP) project has the goal to measure the linear polarization of X rays during solar flares in order to improve the knowledge of physical phenomena responsible for the acceleration of particles originated from the Sun impacting the Earth.

- **ASPIS/CAESAR.** Realization of the ASPIS prototype data center in SSDC for the Italian community involved in Space Weather and Heliophysics Science. It includes the multidisciplinary studies of the chain of Space Weather phenomena occurring from the Sun to the Interplanetary medium, solar wind-magnetospheres-ionospheres at the Earth and the planets, as well as, cosmic rays modulation and impact of space weather events on technological and anthropic systems.

- **ASI-Helianthus.** Feasibility Study (Phase-A) for a Space Weather mission with "Solar Photonic Propulsion" (solar sail). INAF leads the definition of the strawman payload comprising a suite with "in situ" and "remote-sensing" instruments.

- **ASI/SEE** The Cubesat mission Sun CubE OnE (SEE) deals with the investigation of Gamma and X-ray fluxes and UV (Mg II Imager) solar emission to support studies in Sun-Earth interaction and Space Weather.

- **CARTRICAT** (El final d''una Era i el sorgiment dels ecosistemes moderns: les faunes de vertebrats del Carbonífer al Triàsic de Catalunya). PI: Josep Fortuny Terricabras,Institut Català de Paleontologia, Catalonia, Spain. 2022-2025.

- **CRT** "La scienza è dei cittadini: Monitoraggio attivo del particolato magnetico nella Città Metropolitana di Torino". Funded by Fondazione CRT 2024 I Tornata.

- **CSIC iLINK** nº LINK22057, P.I. Javier Pavón Carrasco, CSIC PI, Universidad Complutense de Madrid, Spain. 2022-2024

- **DRAGON5 2020 – 2024** international project (ID. 59236) " The cross-calibration and validation of CSES/Swarm magnetic field and plasma data" in the frame of the 2020-2024 cooperation between ESA and NRSCC of China (https://eo4society.esa.int/2020/02/20/dragon-5-cooperation-call-for-proposals/).

- **ECORD-IODP Italia** "The origin and evolution of crustal magnetic signature at the Mid-Atlantic Ridge: The influence of prolonged low-temperature interaction with seawater in slow- to intermediate spreading ridges" funded through MUR, 2024-present.

- **EMSO and EPOS ERICs.** Some of the IAGA activities are performed within the framework of these two European Research Infrastructure Consortia that have their main centre at INGV.

- **EPOS**, TCS Multiscale Laboratories, EPOS MIUR.

- **ESA-BEPI-COLOMBO**, the community participates with several PI-ships MPO/SIMBIO_SYS, MPO/SERENA, MPO/ISA, MPO/MORE) and CoI-ships (MPO/SIXS, MPO/PHEBUS e MMO/MPPE).

- **ESA-Cluster**, the community participates with several CoI-ships for the ion spectrometer, CIS, and actively in the analysis of data and related scientific works.

- **ESA-Venus Express**, the community participates as Co-I at the ASPERA-4 instrument package

- **ESA-Mars Express**, the community participates as Co-I at the ASPERA-3 instrument package

- **ESA-PROBA-3**, the community participates with one Lead CoI-ship and several CoI-ships for the coronograph ASPIICS.

- **ESA-Solar Orbiter**, the community participates with one PI-ship and several CoI-ships for the coronograph spectrometer METIS, one CoPI-ship and several CoI-ships for the plasma suite SWA.

- **ESA** "Space Weather Service Network Development and Pre-Operation Part 1 – PreOperational Activity Extension.). Development of INGV and INAF Space Weather products available on the ESA Space Weather Service Network portal.

- **ESA-ICTP** "Deep Learning for Screening Propagation Data" (DLProp).

- **ESA - AMIC** "Low Cost Ionospheric Monitoring and Observable Characterization: Proof of Concept"

- **ESA-Venus Express**, the community participates as Co-I at the ASPERA-4 instrument package

- **ESA for the "Campaign: Nanosatellites for Space Weather Monitoring"** called "CUBE (CME Catcher Carousel)" (IDEA: I-2021-04591) – Cubesat mission selected for

Implementation which will study the energy transfer from the magnetopause to the ionosphere during reconnection process.

- **ESA** "Space Weather Service Network Development and Pre-Operation Part 1 – PreOperational Activity Extension"

- **ESA M7 – Plasma Observatory (PO)**: PO is one of the three ESA M7 candidate missions selected in 2023 for the competitive Phase A study. Final selection of the ESA M7 mission will be announced in 2026. Plasma Observatory will unveil plasma energization and energy transport in the near-Earth plasma environment through the first multiscale observations in the Earth's Magnetospheric System. The communitity participates as Leading Proposer Scientist (Dr. M.F. Marcucci – INAF) with also the involvement of several Co-investigators.

- **EST** (European Solar Telescope), is a ESFRI European Project; the community participates for the design and realization of several subsystems, including: Fixed-Band Imager, Spectropolarimeter, Heat rejector, Multi-Conjugate Adaptive Optics, Telescope Control, Data Handling and VO, with the leadership in some of these.

- **EU Horizon Europe project "Active Region Classification and Flare Forecasting (ARCAFF)"**, aimed to develop a beyond state-of-the-art flare forecasting system utilizing end-to-end deep learning (DL) models to significantly improve upon traditional flare forecasting capabilities.

- **FWF** (Austrian Science Fundation). Cyclostratigraphy and the astronomical time scale for the Tethyan Campanian (Late Cretaceous).

- **H2020-MSCA-RISE-2018.** "BE ARCHAEO-Beyond Archaeology: An advanced approach linking East to West through science, field archaeology, interactive museum experiences". 2019-2023.

- **HEliospheric pioNeer for sOlar and interplanetary threats defeNce (HENON)**: HENON will realize a quantum improvement in our capabilities to predict Space Weather, by proving that a revolutionary extension of the forecasting horizon can be enabled by the use of Distant Retrograde Orbit (DRO), which has never been explored before. The HENON mission is part of the Agenzia Spaziale Italiana ALCOR program and it is currently in Phase C within the European Space Agency GSTP program. ARGOTEC is project Prime and the community participates with the scientific PI-ship (INAF-IAPS) and several Co-investigators.

- **ICETOFLUX** (HydrologIcal changes in ArctiC Environments and waterdriven biogeochemical) funded in the frame of the Italian Arctic Research Programme PRA 2021, led and managed by CNR-IGG. The geophysical (geoelectric and electromagnetic) campaigns were accomplished in 2022in Arctic. Data integration and interpretation are ongoing. The CNR's "Dirigibile Italia" research station supported the activities

- **iFURTHER** (high FreqUency oveR The Horizon sensors' cognitivE netwoRk), funded by the European Community, to perform a feasibility study of a OTH (Over the Horizon) radar over Europe.

- **iMAG** "implementation of Machine learning techniques to reconstruct the Ancient Geomagnetic field". Project i-LINK (no ILINK22057) funded by Consejo Superior de Investigaciones Cientificas, Ministero de Ciencia e Innovacion, Spain (1/01/2023-31/12/2024).

- **INGV Department Strategic Project 2019 (Earthquake Department) FURTHER** (The role of FlUids in the pReparaTory pHase of EaRthquakes in Southern Apennines), in which a WP addresses the study of the different geolayers coupling (LAIC) before intermediate-large earthquakes using ground (seismic), atmospheric and satellite (magnetic field and plasma density) data.
- **INGV Strategic Project MACMAP** (A Multidisciplinary Analysis of Climate change indicators in the Mediterranean And Polar regions) in which a task addresses the identification of possible correlations between long-term trends in ionospheric/thermospheric parameters and the troposphere.

- **INGV Department Strategic Project 2019** (Environment Department): **TROPOMAG** - Influence of geomagnetic storms on the TROPOsphere dynamics: Can the Earth's MAGnetic field be considered a proxy of climate changes?

- **INGV Department Strategic Project 2019** (Environment Department): **AMUSED** - A MUltidisciplinary Study of past global climatc changes from continental and marine archives in the MeDiterranean region.

- **INGV Department Strategic Project:** The middle Eocene orbitally driven climate record at Gubbio (Umbrian Apennines, Italy): integrated astrochronology and environmental impact (EoGu_astro).

- **INGV Institutional Project "Rete Multiparametica" MARGE**. "Space Weather: Mappa di Rischio Geoelettromagnetico per l'Italia centrale" (A Magnetotelluric Survey in Central Italy).

- **INGV Institutional Project "Pianeta Dinamico 2023-2025". Theme ET - SESAR**: Space weather Effects on South Atlantic anomaly Region.

- **INGV Institutional Project "Pianeta Dinamico 2023-2025". CHIOMA:** Cultural Heritage Investigations and Observations: a Multidisciplinary Approach).

- **INGV Institutional Project "Pianeta Dinamico 2023-2025". MOSAICMO:** I MOlise SAnnio Integrated Crustal Model.

- **INGV Institutional Project "Pianeta Dinamico 2023-2025". Theme ST - UNITARY**: EarthqUake harbiNgers in the world from ground to space, with particular attention to ITAlian territoRY.

- **INGV Institutional Project "Rete Multiparametica" SPACE WEATHER PECASUS**. The project aims to realize a research infrastructure to provide Space Weather information service to Civil Aviation and society.

- **INGV Institutional Project "Pianeta Dinamico 2023-2025". MOSAICMO:** MOlise SAnnio Integrated Crustal Model

- **IODP Expedition 405: Pacific Ocean** – Tracking Tsunamigenic Slip Across the Japan Trench, Paleomagnetist (Team 2 Paleomagnetist group leader) 2024 (Oct-Dec).

- **IRIDYA** (Integrated Reconstruction of Ice sheet DYnamics during late quaternary Arctic climatic transitions), PRNRA-Programma di ricerche in Artide. 0012PROGRAMMA DI RICERCHE IN ARTICO.

- **ISSI** Project "Unravelling Solar Wind Microphysics in the Inner Heliosphere", https://www.issibern.ch/teams/unravelsolwind/

- **ISSI** Project "Solar sources and evolution of the Alfvénic slow wind", https://teams.issibern.ch/alfvenicslowwind/

- **ISSI** Project "Turbulence at the Edge of the Solar Corona: Constraining Available Theories Using the Latest Parker Solar Probe Measurements" https://teams.issibern.ch/turbulencesolarcorona/

- **ISSI** Project "Complex Systems Perspectives Pertaining top the Research of the Near-Earth Electromagnetic Environment".

- **ISSI** Project "Step forward in solar flare and coronal mass ejection (CME) forecasting".

- **ISSI** Team participation: "Modelling Mercury's Dynamic Magnetosphere in Anticipation of BepiColombo" (PI J Deca)

- **ISSI-Bj** project "The electromagnetic data validation and scientific application research based on CSES satellite" (http://www.ief.ac.cn/laimc_issi_bj/team.php.html)

- **ISSI** Project "Evolution of Turbulence in the Expanding Solar Wind" (PI L. Sorriso-Valvo (https://teams.issibern.ch/turbulencesolarwind)

- **LIMADOU SCIENZA +**: An Italian Space Agency funded project for exploiting CSES (Chinese Seismo-EM satellite) satellite electromagnetic data, which is the continuation of the former "LIMADOU SCIENZA" project. The aim of the project is the investigation of the Lithosphere-Ionosphere-Atmosphere-Magnetosphere coupling in search for earthquake related anomalies, and the characterisation of Magnetosphere-Ionosphere system in connection with solar activity.

- **MeCeMiBaCa.** The record of Meso-Cenozoic Milankovitch cycles in the Basque-Cantabrian area: astrochronology and environmental impact of orbitally driven climate change. Date: 2021-2024 Ente finanziatore: Ministerio de Ciencia, Innovación y Universidades, MICINN (Spain).

- **MIUR PRIN 2017 #2017W2MAR** "A new global volcanic-driven carbon cycle perturbation at the Norian/Rhaetian Boundary, Late Triassic" funded by the Italian Department for University Research and Education, 2019 – 2024

- **MIUR PRIN 2020, Dynasty**: Neanderthals dynamic pathway and resilience in central europe through the chronometric sustainability. Magnetostratigrafia e RPI di sezioni di Loess da polonia e Ungheria.

- **MUR PRIN PNRR 2022, GREEN**: Geological stoRagE of hydrogEn and carboN: clean and efficient monitoring methods

- **MUR PRIN PNRR 2022, SUBGEO:** SUBmarine groundwater discharge analysis with an innovative and integrated GEOphysical approach".

- **MUR PRIN 2022, Modelling Interplanetary Coronal Mass Ejections**

- **MUR PRIN 2023-2025, "Inverse Problems in the Imaging Science" (PRIN 2022 ANC8HL):** the goal to push forward the state-of-the-art of imaging sciences, with specific focus on approaches inspired by inverse problems (IPs) theory.

- **MUR S-P-HERITAGE:** variazioni del livello del mare nel passato e nel futuro.

- **NASA-MMS**, the community participates as Team Member of the FIELDS instrument and Scientist in the loop

- **NORISK**: New observatory for real-time ionospheric sounding over Kenya. Funded by ASI.

- **PAGINA**: Pan-Arctic GNSS INfrastructure for Atmospheric Science project funded by Italian Arctic program.

- **PECASUS** (Partnership for Excellence in Civil Aviation Space weather User Services) global space weather service center designated by ICAO (Council of International Civil Aviation Organization).

- **"Physics-based AI for predicting extreme weather and space weather events (AIxtreme)**" project funded by the Italian Fondazione Compagnia di San Paolo and Unit Leader, aimed to integrate the most innovative numerical and deep learning techniques with physical models to simulate highly complex dynamics, as the ones of solar flares and coronal mass ejections (CMEs).

- **"Physics-driven numerical methods for space weather"**, sponsored by GNCS-INdAM

- **PITHIA-NRF** (Plasmasphere Ionosphere Thermosphere Integrated Research Environment and Access services: a Network of Research Facilities), Call H2020-02 INFRAIA (2021-2025) Progetto dedicato all'integrazione in un'unica infrastruttura federata delle infrastrutture di ricerca europee, e di alcune altre extra-europee, dedicate al monitoraggio e allo studio e modellazione della plasmasfera, ionosfera e termosfera.

- **PNRA.** CHIMERA (CryptotepHra In Marine sEquences of the Ross Sea, Antarctica: implications and potential applications).

- **PNRA** COLLAPSE (Cook Glacier-Ocean system, sea LeveL and Antarctic Past Stability). PNRA19_00022-A1. Coord. L. De Santis, INOGS-Trieste. 2021-2024).

- **PNRA 22/50** "Upper Atmosphere Observation and Space Weather". The permanent observatory "Upper atmosphere observation and Space Weather" deals with the multiinstrumental monitoring of the ionized upper atmosphere over Antarctica and Arctic.

- **PNRA 22/00086** "SuperDARN: HF ionospheric radars, DCE e DCN, at Concordia" (Antarctica).

- **PNRA 15/00135 "**"ESCAPE: Solar Coronography fron Antarctica for Space Weather studies".

- **PNRA18_00289** "Space weather in Polar Ionosphere: the Role of Turbulence" (SPIRiT)

- **PNRA 2022/36** "Italian geomagnetic permanent observatories for solid Earth and Space Weather studies in Antarctica".

- **PNRA18_00282** "Antarctic Thermosphere Retrieved from Ionospheric Observations" (ATRIO).

- **PNRR-MEET** is a Next Generation EU project - WP9 aims to realize a common platform of data and products of Earth observation and space weather.

- **PON InSea "**Iniziative in Supporto al consolidamento e potenziamento dell'infrastruttura EMSO e delle sue attività", 2019 – 2022. Potenziamento delle infrastrutture a mare e in prossimità della costa italiana con deposizione di SMART cable per scopi di monitoraggio geofisico e marino.

- **ReCliAME.** Climatic-environmental feedback under global warming conditions: lessons from the Maastrichtian-Eocene of the Iberian peninsula. Ministerio de Economía y Competitividad, (Spain), Univ. Pais Vasco, UPV/EHU

- **RETURN (**multi-Risk sciEnce for resilienT commUnities undeR a changiNg climate). Date: 2022-2026. Piano Nazionale di Ripresa e Resilienza. Ente finanziatore: EU.

- **SIRENE** Project (Serpentinite/mud diapIRs along ExtensioNal faults in the Ionian sEa). Oceanographic expeditions led and managed by CNR-ISMAR in the Mediterranean Sea. Multibeam, Chirp and magnetic surveys were accomplished. The research was supported by CNR. The expedition was held on the Gaia Blu research vessel on Summer 2024.

- **SPACE IT UP!** project**,** funded by the Italian Space Agency e the Ministry of University and Research, aims at developing innovative ideas and disruptive solutions to make Italy one of the leading countries in space exportation and exploitation. It promotes collaboration and innovation in the space sector on nine lines of research, from observation and protection of the Earth to extraterrestrial exploration, from artificial satellites to remote sensing. The synergies fostered in the project between academy, industry, and research centres are expected to have a strong impact on the Italian space sector

- **Swarm-VIP-Dynamic** (Swarm Space Weather: Variability, Irregularities, and Predictive capabilities for the Dynamic ionosphere), funded by the European Space Agency, period: 2024-2026. The project aims to develop advanced dynamic models of the Earth's ionosphere, with a particular focus on the ESA Swarm mission in combination with other space assets.

- **SWERTO** (Space-Weather at the University of Rome Tor Vergata) financed by LazioInnova Regione Lazio. On-line data-base for space (e.g., PAMELA, ALTEA) or ground-based instruments (e.g., IBIS, MOTH) relevant to the determination of Space-Weather conditions (www.spaceweather.roma2.infn.it).

- **SWEATERS** (Space WEATher Radiation Sensors) An Italian Space Agency funded project (ASI contract 2020-14-HH.0) for ENA (Energetic Neutral Atoms) instrument development devoted to Space Weather monitoring via ENA detection technique.

- **T-FORS** (Travelling Ionospheric Disturbances Forecasting System), funded by the European Community, aimed at developing a prototype system for Travelling Ionospheric Disturbances (Medium and Large scale) forecasting.

3. Italian attendance to international conferences.

- XIV COLAGE - Conferencia Latinoamericana de Geofísica Espacial, April 2024, Monterrey, Mexico
- European Geosciences Union General Assembly, April 2024, Wien, Austria
- Worskshop "The South Atlantic Transect 2nd Post-Expedition Meeting" May 2024, Reykjavik, Iceland
- URSI (International Union of Radio Science) AT-RASC 2024, May 2024, Gran Canaria, Spain
- AGU Chapman Conference 'Advances in Understanding Alfvén Waves in the Sun and the Heliosphere', May-June 2024, Berlin, Germany
- AOGS 2024 - 21th Asia and Oceania Geoscience Society annual meeting, June 2024, Pyeongchang, South Korea
- 50th EPS Conference on Plasma Physics, July 2024, Salamanca, Spain
- 45th COSPAR Scientific Assembly, July 2024, Busan, South Korea
- IRI Cospar workshop 2024, September 2024, Kilifi, Kenya
- SGI-SIMP Conference 2024, September 2024, Bari, Italy
- 2nd workshop MAThematical CHallenges to and from new technologiES (MATCHES), September 2024, Rome, Italy
- 2024 Arcetri Workshop on Plasma Astrophysics, October 2024, Arcetri (Fi), Italy
- ESWW 2024 - 20th European Space Weather Week, November 2024, Coimbra, Portugal
- AGU24, 9-13 December 2024, Washington Convention Center, Washington D.C.

4. Education, Outreach and Workshops.

IAGA-Italia pays particular attention to educational aspects and outreach.

a) Collaboration with the *International School of Space Science*.

In collaboration with other institutions the IAGA-Italy community has launched a program of schools dedicated to the training of young researchers in the area of the Solar Terrestrial Physics and Space Weather. During 2024 the following course has been organized:

Course on "*Operational Space Weather Fundamentals"*

A Course on "Operational Space Weather Fundamentals", directed by Domenico Di Mauro (Istituto Nazionale di Geofisica e Vulcanologia, Italy), Stefania Lepidi (Istituto Nazionale di Geofisica e Vulcanologia, Italy), Mauro Messerotti (Istituto Nazionale di Astrofisica, Italy), and Tamitha Skov (Millersville University, USA) was held in L'Aquila, Italy, 13-17 May, 2024. The course was organized in cooperation with the Consorzio "Area di Ricerca in Astrogeofisica". The school served as a comprehensive introduction to the multi-faceted field of Space

Weather, covering solar-heliospheric, magnetospheric, and ionospheric weather, with a specialized focus on operations and forecasting. By establishing the links from research to operations (R2O) and from operations to research (O2R) and by highlighting the effects of space weather on technological systems and society, this curriculum aimed at stimulating the involvement of the next-generation researchers in this rapidly growing discipline.
Lectures on phenomenology were complemented by laboratory activities and applications with the direct and active involvement of the attendees. Another practical aspect was covered by the "career section", which aimed at illustrating which skills were desirable for a job in the frame of space weather research and surveillance centres, and how good strategies were used for educational and communication purposes.
This school was addressed to PhD students and young scientists in space physics, planetary sciences, aerospace engineering, or related fields. Early-career stage professionals from monitoring agencies and industries related to space weather were invited to apply as well. For more information visit https://www.astrogeofisica.it/oswf/

b) Collaboration with the *Space Weather Italian Community*.

IAGA – Italia continues to promote IAGA scientific interests to the national community. This activity is supported by the different institutions (universities, observatories, institutes) through individual initiatives towards the general public and towards high-school and secondary school students. In the field of the Space Weather, on a national level, the activity is coordinated by the *Space Weather Italian Community* (*SWICo*; www.swico.it) which organized monthly webinars on topics mainly related to Space Weather and Sun-Earth relations. The *SWICo* group of Outreach and Media Public Relations is composed of: Lucilla Alfonsi (INGV), Raffaella D'Amicis (INAF-IAPS), Paola De Michelis (INGV; coordinator), Maria Chiara Falco (INAF) Luca Giovannelli (UNITOV), Antonella Greco (UNICAL), Mauro Messerotti (INAF-OATS). In this framework a certain number of Webinars has been given (see below).

Webinars held:

18/03/2024 **Giuseppe Ciardullo** (Università della Calabria) - "**Spatio-temporal analysis of turbulence: From Sun to planetary atmospheres"**.
08/04/2024 **Paolo Pagano** (Università degli Studi di Palermo) - **"Identifying Eruptive Solar Active Regions for Space Weather Warnings with S2WARM".**
13/05/2024 **Maria Federica Marcucci** (Istituto di Astrofisica e Planetologia Spaziali dell'INAF) - "**The ESA M7 candidate mission Plasma Observatory**".
17/06/2024 **Simone Benella** (Istituto di Astrofisica e Planetologia Spaziali dell'INAF) - "**A perspective on the multidisciplinary exploration of space plasma dynamics through stochastic processes".**

SWICO community also organized the **Third Meeting of the Italian Space Weather Community** in Rome (27-29 November, 2024) as a moment of encounter and discussion of the entire Italian community engaged in the disciplines in question. It was also open

to researchers and technologists not members of SWICo and registered the active participation of students, PhD students and young researchers. At the meeting successfully participated more than 100 attendants.

SWICo, via the commission “National and International Collaborations” coordinated by Michele Piana, submitted the Italian candidacy to host the 2026 edition of the ESWW, and the candidacy has been approved. The city selected to host the event is Florence.

c) **Collaboration with the Consorzio Area di Ricerca in Astrogeofisica.**
In collaboration with other institutions and within the framework of the Consorzio Area di Ricerca in Astrogeofisica, it has been organized the course **"Operational Space Weather Fundamentals"** which took place in L'Aquila in the period 13 - 17 May 2024 under the direction of Drs. D. Di Mauro (INGV), S. Lepidi (INGV), M. Messerotti (INAF), T. Skov (Millersville University, USA). The school had the patronage of IAGA, IUGG, E-SWAN, Millersville University. The school has achieved excellent success; 50 students from 13 countries participated.

d) Other activities.
Additional tutoring/teaching activities of IAGA members have been the following.

Claudio Cesaroni - Course on “Ionospheric modeling and monitoring” for National PhD on “Space Science and Technology”, Università di Trento.

Teaching at the Master course “Science and technology in space” Università di Tor Vergata, Dip. Fisica on ‘Plasma instrumentation, solar wind observations and space missions’

Seminar and Outreach for the “ECORD School of Rocks” organized by IODP Italy onboard the research vessel JOIDES Resolution. 9 FEB 2024 (Naples, Italy)

SEMINAR - Evolution of the magnetic signature of MORBs from 7 to 61 Ma along the South Atlantic Ridge Flank 22 MAY 2024 the Magnetic NetworkZ (MagNetZ) seminar series. https://earthref.org/ERDA/2735/

Participation to SHARPER, Researchers' Night, L’Aquila, 27 September 24, as a scientific guide for the INGV exhibition on geomagnetism and for virtual educational games such as GEOQUEST TROPOMAG: CONOSCERE LA TERRA

Participation in the Genoa Science Festival as a scientific guide and contributor to the setup of the EarthSKOPIO exhibition section dedicated to geomagnetism, Genoa, 22–25 October 2024

Participation in the “New Space Economy 2024” Expo Forum at the Fiera di Roma, with presence at the INGV stand for science outreach activities, 16–18 December 2024.

Sabrina Guastavino - “Physics-driven kernels for machine learning: applications to space weather”, PhD course at Department of Mathematics, University of Genova.

e) Collaboration with international entities.

- Collaboration with the University of Birmingham, the George Mason University, the Institut de Physique du Globe de Paris, the International Center of Theoretical Physics to develop a new NeQuick topside modelling.

- INGV in collaboration with International Centre for Theoretical Physics (ICTP), Boston College (BC), Pwani University (PU, Kenya) and United Nation Office Outer Space Affair (UNOOSA) organized the African Capacity Building Workshop on Space Weather Effects on GNSS held in Trieste (3-14 October 2022)

- ICTP in collaboration with Universidad Nacional de Tucumán (Argentina) and sponsored by UNOOSA, BC and SCOSTEP, organized the International Workshop on Machine Learning for Space Weather: Fundamentals, Tools and Future Prospects in Buenos Aires, Argentina (7-11 November 2022).

- ISWI, the International Space Weather Initiative, supported by the United Nations. Among the others activities ISWI organizes schools and workshops.

- In the framework of the NORISK project, INGV (Claudio Cesaroni) in collaboration with ICTP (Bruno Nava), ASI (Giancarlo Santilli), Boston College (Keith Grooves), UNOOSA (Sharafat Gadimova) and ION (Jade Morton) organized the “African Capacity Building Workshop on Space Weather and Ionospheric Research” held from 22 to 31 October 2024 in the ICTP (Trieste, Italy). The Capacity Building Workshop faced different aspects of Space Weather and ionospheric physics giving the possibility to more than 50 students from all over Africa to interact with more than 20 experts from all over the world.

- In the framework of the Ionospheric Network Advisory Group (INAG), a Working Group of Commission G “Ionospheric Radio and Propagation” of the International Radio Science Union (URSI), a tutorial day “Ionogram Interpretation and Scaling Tutorial Day”, with lectures and hands-on sessions, was organized at URSI AT-RASC meeting, Gran Canaria, Spain, 19-24 May 2024. (https://www.atrasc.com/programme.php).

- ICTP-SCOSTEP-ISWI Workshop on the Predictability of the Solar-Terrestrial Coupling - PRESTO | (smr 3898), 30 May - 2 June, 2023.

- Final Workshop of the CAESAR project, ASI, 24 May 2024, Rome

- Italy is again a member of SCOSTEP. Lucilla Alfonsi sits in the Bureau and acts as national delegate.

- 2023 – 2024 Visiting: International Ocean Discovery program, Texas A&M University, College Station, TX (12 months) – Sara Satolli

- New Scientific Program Committee Meeting, SCOSTEP (Scientific Committee on Solar Terrestrial Physics), 14-17 October 2024, INGV, Rome

- L. Sorriso-Valvo is an ESA Astronaut Basic Training instructor, for the topics "The Sun" and "Earth-Sun Interactions" at the ESA/European Astronaut Center (EAC), Cologne, Germany.

5. Activities carried on by the Italian Delegate and National Committee during 2024 and impact on the Italian scientific community.

As in the past, the Italian Delegate and the National Committee have developed their activity paying attention mainly to the following aspects: participation of IAGA - Italia to scientific programs and international meetings; development of new initiatives at national level, with particular reference to the cooperation between universities, research institutions and industries; tutoring and training of young researchers and students, encouraging their participation to IAGA activities**.** In this framework, the Italian Delegate participate at the SWICo2024 Conference presenting the IAGA and the providing information on its activities and opportunities.

6. Italian experts with important roles within the Union or within related Commissions and Programs.

- Members of the IAGA National Committee are in the IUGG Network of Italian Experts.

- U. Villante (University of L'Aquila) is President of SWICo (Space Weather Italian Community).

- M. Casolino (INFN), D. Del Moro (U. Tor Vergata), M. Laurenza (INAF), S. Lepidi (INGV) M. Piana U. (Genova), M. Piersanti (U. L'Aquila), R. Tozzi (INGV) are members of the Directive Board of SWICo (Space Weather Italian Community).

- I. Coco, M. Laurenza, L. Marcelli, M. Messerotti, M. Piana, M. Piersanti are members of the SWICo Committee "Commissione Collaborazioni Nazionali e Internazionali".

- A. Greco (University of Cosenza), P. De Michelis (INGV), P. Romano (INAF), L. Giovannelli (University of Rome Tor Vergata), L. Alfonsi (INGV), M. Messerotti (INAF) and R. D'Amicis (INAF) are members of the SWICo working group 'Outreach and Media Public

Relations'.

- I. Ermolli, M. Laurenza, M. Messerotti, A. Pellizzoni, R. Susino are members of the INAF Advisory Committee for "Meteorologia e Climatologia dello Spazio" (Space Weather and Space Climate.

- D. Di Mauro (INGV) is the Italian reference for the Italian magnetic network which contributes to the European network. He also acts as reference for the Italian geomagnetic observatories at Castello Tesino (North Italy), Duronia (Central Italy) and Lampedusa (South Italy).

- G. De Franceschi (INGV) is the INGV Representative in the National Scientific Committee for Arctic.

- V. Romano (INGV) is the Italian co-expert on Space Weather at ONU COPUOS (Committee on the Peaceful Uses of Outer Space), he is National co-coordinator for Italy in ISWI (International Space Weather Initiative), he is the Italian delegate in the Steeering Committee of the PECASUS Consortium, he is the INGV delegate in the COSPAR Panel for Space Weather.

- C. Scotto is the Italian National Deputy Delegate to Commission G of URSI (Union Radio-Scientifique Internationale).

- Y. Migoya Orue' (ICTP) is National co-coordinator for Italy in ISWI (International Space Weather Initiative).

- F. Berrilli (University of Rome Tor Vergata) is Delegate for Space Science in ASI Planetary Science Board, and SPIN-IT/CTNA Delegate in "PROTECTION of European assets in and from space" in ASI-H2020 Team.

- R. D'Amicis (INAF-IAPS) is Vice-Chair of the Cospar Capacity Building and CoPI of the Solar Wind Analyser (SWA) onboard Solar Orbiter. She participated in the following proposals for future missions in response to the ESA call 2021 with the following roles: PI of the Particle Processing Unit (PPU) of the plasma instruments on board Plasma Observatory, proposed as M7 mission, selected for phase 0 studies; PI of the Data Processing Unit (DPU) of the plasma instruments on board M-MATISSE, proposed as M7 mission, selected for phase 0 studies; PI of the Particle Data Processing Unit (PSCU) of the plasma instruments on board Alfvén, proposed as M7 mission; PI of the Particle Data Processor (PDP) of the plasma suite on board Debye, proposed as F2 mission.

- F. Zuccarello (University of Catania) is member of the Board of the European Solar Physics Division of the European Physics Society.

- B. Nava (ICTP) is Italian member of the International Reference Ionosphere Working Group and Co-Chair, Beacon Satellite Studies Working Group, URSI Commission G.

- M. Vellante is Co-PI of EMMA (European quasi-Meridional Magnetometer Array).

- A. Bemporad (INAF) is the Scientific Discipline Representative in the Scientific Committee on Solar-Terrestrial Physics (SCOSTEP).

- M. Pezzopane (INGV) is an Italian member of the International Reference Ionosphere Working Group. He is an Associate Researcher at the Universidade do Vale do Paraíba (UNIVAP), Sao José dos Campos, Brasil. He is member of two boards and leader of another board established by the Ionospheric Network Advisory Group (INAG), a Working Group of Commission G "Ionospheric Radio and Propagation" of the International Radio Science Union (URSI), for reviewing the ionogram validation rules.

- I. Coco (INGV) is member of the Electric Field Instrument Science Discussion Group of the Swarm ESA mission, and of the ESA Swarm-CSES working group.

- C. Cesaroni (INGV) is the chair of the URSI Commission G working group "Capacity Building and training" and co-chair of the inter-commission (FCGEH) working group "Risk and Disaster Management (Inter URSI Commissions)". He is also member of the SWICo working group "Technological developments". He is member of the IGS Ionospheric working group and advisor for Space Weather to the italian member of the ICAO MET Panel. He is the Commission G representative in the URSI inter-commission working group (FCGEH) about Risk and Disaster Management (Inter URSI Commissions).

- D. Sabbagh (INGV) has been elected URSI Early Career Representative (ECR) of the Commission G for the years 2021-2026, and he is the Commission G representative in the URSI "Radio Science School for Young Scientists" Committee for the years 2023-2026. He is a member of the Science group of the PECASUS Consortium, for the HFCOM domain.

- L. Spogli (INGV) is the Vice-President of the European Space Weather and Space Climate Association (E-SWAN) since 20 November 2023. He is also the advisory for the Italian Member of the Meteorology Panel (METPANEL) of the International Civil Aviation Organization (ICAO) in the frame of the Meteorological Information Service Development Working Group (WG-MISD) (now WG-MOG) for Space Weather. He is member of the mission advisory group (MAG) of Keystone, one of the four candidate mission concepts for the twelfth Earth Explorer (EE-12) of the European Space Agency. Keystone would provide the first direct observations of atomic oxygen in the altitude range of 50-150 km using a unique combination of limb-sounding techniques.

- L. Alfonsi is member of the Polar Expert Group (PEG) of the EU-PolarNet2 project (eu-polarnet.eu/) aiming at establishing a permanent European coordination of polar research. She sits in the SCOSTEP Bureau.

- A. Milillo (INAF) is member of ISWAT-COSPAR Cluster H4 team H4-01

- M. Piersanti (UnivAQ) is the Italian PI of the " The cross-calibration and validation of CSES/Swarm magnetic field and plasma data" in the frame of the 2020-2024 DRAGON 5 cooperation project (ID. 59236) between ESA and NRSCC of China (https://eo4society.esa.int/2020/02/20/dragon-5-cooperation-call-for-proposals/). He is also is the PI of the calibration/validation of the Electric Field instrument on board CSES-01 satellite in the frame of the SWARM/CSES satellites cal-val group and PI of the commissioning phase of the Electric Field instrument (EFD) on board the satellite CSES-02 in the frame of the CSES-Limadou collaboration.

- R. Bruno (INAF-IAPS) is one of the members of the Scientific Council of ISSI/ISSI-Beijing (2020-2023)

- L Perrone is the coordinator of the working team on 'MUF/foF2 depression' attended by representatives of the 4 Space Weather Global Centers-SWXC, selected by ICAO to emit real time advisories on space weather events which influence the communication, navigation and the health of the passengers and the crew.

- A. Pignalberi (INGV) is the coordinator of the IAGA-ITALIA division II on "Aeronomic Phenomena", and the co-chair of the IAGA Working Group II-E: Ionospheric Irregularities, Fields and Waves. He is an Italian member of the International Reference Ionosphere Working Group, and of the GGOS (Global Geodetic Observing System) Joint Study Group 1 – Understanding Ionospheric and Plasmaspheric Processes. GGOS is a component of the International Association of Geodesy (IAG). He is a member of the NanoMagSat Science Advisory Group, NanoMagSat is an ESA scout satellite mission.

- L. Sorriso-Valvo is Coordinator of the Solar Orbiter "In-Situ" Working Group: "Kinetic Physics, Turbulence, Waves, and Reconnection", and he is an ESA Astronaut Basic Training instructor, for the topics "The Sun" and "Earth-Sun Interactions".

7. Awards and Prizes.

PREMIO PER PROGETTI SULLA FAIR-IFICAZIONE DEI DATI DELLA RICERCA per il progetto "FAIR-IT: Fairifying Archaeomagnetic Intensity Research data from ITaly", 2024, Dipartimento di Informatica, Università di Torino

8. Concluding remarks.

As for previous years IAGA- Italian community pursued its activity supporting the Italian participation in international programs and promoting the involvement of young

researchers and doctoral students in the IAGA activities. IAGA-Italia is also pursuing in the organization of specific training paths for young researchers and PhD students.

As previously reminded, IAGA is one of the most important organizations in the field of the Earth's core, mantle and crust; the middle and upper atmosphere, the ionosphere and the magnetosphere, the Sun, the solar wind, the planets and interplanetary bodies. The Italian community is involved in several international programs in these fields in several cases with leading roles (PI-ships). So, it is important that the Italian community continues to have a strong participation in this association.

To stimulate a wider participation of PhD students, Post-Doc fellows and young researchers to IAGA activities, it might be useful a dedicated award to support the participation to the IAGA Scientific Assemblies.

The IUGG/IAGA Delegate
Dr. Giuseppe Consolini
(On behalf of the IAGA Italian Committee)