International Association of Geomagnetism and Aeronomy

Activities' Report - Year 2019

Delegate: U. Villante

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). 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 promotes the coordination of such activities, the development of new ones, the organization of workshops, meetings and schools. For these scopes, the IAGA-Italia community is coordinated by a National Committee, currently composed as follows:

IAGA Italian Committee

President: U. Villante: University of L'Aquila – National Delegate.

Members:

- L. Vigliotti: CNR/ISMAR, Bologna – Vice-Delegate, Coordinator Division I "Internal Magnetic Field";
- M. Pezzopane: INGV, Roma, - Coordinator Division II "Aeronomic Phenomena";
- G. Consolini: INAF-IAPS,Roma, - Coordinator Division III "Magnetospheric Phenomena";
- R. Bruno: INAF-IAPS 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”;
- A. De Santis: INGV, Roma, - Coordinator Interdivisional Commission on “History”;
- F. Berrilli: University of Tor Vergata, - Coordinator Interdivisional Commission on “Education and Outreach”.

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

2. Main activities carried on by IAG-Italia during 2019.

The main activities carried on by IAGA Italia have been the following:

a) Issue of Annals of Geophysics dedicated to the IAGA National Conference. A special issue of Annals of Geophysics 62, 4, 2019 has been published. Entitled "From the Sun to the Earth's interior" it collects most of the papers presented at IAGA National Conference held during 2018. The volume is available at:
https://www.annalsofgeophysics.eu/index.php/annals/issue/view/570.

b) Participation to the Workshop “Stato dell’arte e prospettive nella prevedibilità degli eventi naturali”. On behalf of the IAGA-Italy community, the following invited papers have been presented at the National IUGG Workshop “Stato dell’arte e prospettive nella prevedibilità degli eventi naturali” (Consiglio Nazionale delle Ricerche, Roma, 26-27 novembre 2019):

- Meteorologia spaziale: convivendo con una stella attiva: U. Villante
- La Terra: un pianeta magnetico a rischio**:** A. De Santis

c) International conferences with a relevant Italian participation:

- European Geophysical Union General Assembly (Vienna, Austria).
- AGU General Assembly (S. Francisco, USA).
- 16th European Space Weather Week (Liege, Belgium).
- 105° Congresso Nazionale della Società Italiana di Fisica (L’Aquila, Italy).
- International Reference Ionosphere Workshop (Nicosia, Cyprus).
- 27th IUGG Assembly (Montreal, Canada).
- Swarm 9th Data Quality Workshop (Prague, Czech Rep.).
- International Space Weather Initiative, ISWI Workshop (Trieste, Italy).
- Polar Night Week (Longyearbyen, Svalbard).
- Living Planet Symposium (Milano, Italia).
- 4th International workshop of CSES mission (Changsha, Cina).
- Space Climate Symposium 7, The future of solar activity (Montreal, Canada).
- Flux Emergence Workshop 2019 (Tokyo, Japan).

d) Management of Observatories and related activities.

- Management of magnetic 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, K indices, SSC and solar flare list.

- Plan of an instrumental upgrade at the Italian observatories

- National magnetic cartography: the complete survey was started with measurements on 12 repeat stations over Italy, in order to up-to-date the 2015 complete and 2017.5 reduced magnetic cartography.

- 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).

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

- Participation to the Core Proposing Team for the White Paper "Particle Energization in Space Plasmas: Towards a Multi-Point, Multi-Scale Plasma Observatory" in response to the "Call for White Papers for the Voyage 2050 long-term plan in the ESA Science Programme".

- Magnetic and electromagnetic surveys in archeological area of Hadrianopolis and Antigonea (Albania).

- 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.

- 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 radars of the SuperDARN international network at Concordia station (Antarctica, 75.1 S, 123.2 E).

- 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^2 auroral all-sky camera at Ny-Alesund (Svalbard). This is the Italian contribution to MIRACLE network.

- Management of four AIS-INGV ionosondes: two in Italy (Rome and Gibilmanna) and two in Argentina (San Miguel de Tucumán and Bahia Blanca). One DPS4 digisonde is managed in Italy (Rome).

- Managements of multi-constellation receivers for measuring TEC and ionospheric scintillations at Baia Terra Nova, Concordia and SANAE IV (in collaboration with SANSA) (Antarctica), at Ny Alesund and Longyearbyen (Svalbard, Norvegia), Lampedusa and Rome (Italy), Tucumán (Argentina), Crete (Greece), Malindi (Kenya) (in collaboration with Embry-Riddle Aeronautical University and Pwani University), Sao Paulo (Brazil) (in collaboration with INPE).

- South Pole Solar Observatory installed at Amundsen–Scott South Pole Station (NSF project with Italian participation) for the multispectral observation of solar magnetic field and dynamics.

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

- Antarctica – Italian-French Concordia Station: Installed a coronagraph – AntarctiCor - for the observation of the solar corona and the study of the coronal magnetic field's The book has ben published on 2020, (PNRA).

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

- Research topic 'Improving the Understanding of Kinetic Processes in Solar Wind and Magnetosphere: From CLUSTER to MMS' appeared in Frontiers in Space Physics edited by a IAGA member (Antonella Greco)

- Book "The Dynamical Ionosphere", Elsevier, in which Italian IAGA members are involved (M. Materassi -Editor, L. Alfonsi, G. Consolini, P. De Michelis, M. Piersanti, L. Spogli and R. Tozzi). The book has ben published on 2020 and is intended as the statement of a future vision of Space Weather and ionospheric science.

- Book "Extreme Events in Geospace, Predictability and Consequences", Editors: N. Buzulukova, ISBN: 9780128127001; contains the chapter "Solar Particle Events and Human Deep Space Exploration: Measurements and Considerations" in which Italian IAGA members are involved (F. Berrilli and D. Del Moro).

3. Projects of interest in the framework of IAGA.

IAGA-Italia community is involved in several international programs such as:

- **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.

- **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.

- **ENI-INGV**. For scientific research on Paleomagnetism.

- **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-INTENS** (characterization of IoNospheric TurbulENce level by Swarm constellation), supported by ESA for the characterization of the ionospheric turbulence by means of measurements of the magnetic field and plasma of Swarm satellites.

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

- **ESA-SAFE** (Swarm for Earthquake study): to study Swarm satellite electromagnetic data for searching earthquake related anomalies with INGV leadership.

- **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-TEMPO:** to study the South Atlantic anomaly and its future evolution.

- **ESA Space Situational Awareness (SSA) Programme**. (contract no. 4000113184/15/D/MRP).

- **Response to ESA call for F mission**, the community is proposing the Debye project with a PI-ship (PDP) at INAF-IAPS and several CoI-ship for PDP related studies and mission science support.

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

- **FISR** "New insights on the biomagnetic monitoring of air pollution: applications to selected environmental contexts in Central Italy".

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

- **GENIUS** (GNSS TEC and Scintillation monitoring under the Cusp), project funded by Svalbard Integrated Arctic Earth Observing System (SIOS).

- **GRAPE** (GNSS Research and Application for Polar Environment) Expert Group funded by SCAR.

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

- **INSIEME** (Induced Seismicity in Italy: Estimation, Monitoring, and sEismic risk mitigation), Project supported by the SIR-MIUR research program.

- **ISSI** Project "Multi-technique characterization of near-Earth space environment".

- **ISSI** Project "Current Sheets, Turbulence, Structures and Particle Acceleration in the Heliosphere".

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

- **LIMADOU-SCIENCE**: An Italian Space Agency funded project for studying CSES (Chinese Seismo-EM satellite) satellite electromagnetic data for searching earthquake related anomalies.

- **MINISTERIO DE ECONOMÍA Y COMPETITIVIDAD, (Spain**). Climatic-environmental feedback under global warming conditions: lessons from the Maastrichtian-Eocene of the Iberian peninsula (ReCliAME).

- **MINISTERIO DE ECONOMÍA Y COMPETITIVIDAD, (Spain**)**.** PALEOTRANS (Paleoenvironmental dynamics of transitional settings from Cretaceous to Eocene in the Southcentral Pyrenees).

- **MIUR FISR.** New insights on the biomagnetic monitoring of air pollution: applications to selected environmental contexts in Central Italy.

- **MIUR PRIN 2018.** Oceanic Megatrasforms: a New Class of Plate Boundaries.

- **MIUR PRIN,** A new global volcanic-driven carbon cycle perturbation at the Norian/Rhaetian Boundary, Late Triassic.

- **MIUR PRIN 2017: 2019-2022.** CEI6: Circumterrestrial Environment: Impact of Sun-Earth Interaction.

- **MIUR PRIN 2015-2019.** Geochemical and isotopic budget of highly metasomatised sub-continental mantle in the Africa and Europe geodynamic systems: modern and fossil analogues.

- **MIUR PRIN 2017.** Detection and tracking of crustal fluid by multi-parametric methodologies and technologies.

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

- **PON-GRINT.** Infrastruttura di ricerca italiana per le Geoscienze (PON Ricerca e Innovazione 2014-2020).

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

- **PNRA**. **ODYSSEA** "Paleoclimatic reconstructions and Ocean DYnamics from the Sediment drifts of the ross SEA"

- **PNRA.** Progetto di perforazioni Friis Hills (FHDP): Variazioni climatiche e dinamiche glaciali del continente Antartico durante il Miocene inferiore-medio. Collaborazione scientifica tra NZ, IT e USA" 2017-2019.

- **PNRA16/00055**. **TRACERS** (TephRochronology and mArker events for the CorrElation of natural archives in the Ross Sea, Antarctica.

- **PNRA WHISPER** (West Antarctic Ice Sheet HIstory from Slope Processes – Eastern Ross Sea)

- **PNRA14_00097** - Linea A1 "Osservatorio geomagnetico presso la Stazione Concordia, Dome C, Antartide.

- **PNRA14_00106** - Linea A1 "Osservatorio Geomagnetico a Stazione Mario Zucchelli".

- **PNRA 14/110** "Upper Atmosphere Observation and Space Weather".

- **PNRA 14/00133** "Bipolar Ionospheric Scintillation and TEC".

- **PNRA 14/00085** "SuperDARN: HF ionospheric radars, DCE e DCN, at Concordia" (Antarctica).

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

- **PNRA16_00204 "**Temporary magnetometer network for longitudinal and latitudinal monitoring in Antarctica".

- **PNRA** National Antarctic Data Center – Project to define the data and metadata infrastructure for Antarctica observations, 2019-2021

- **PON InSea "**Iniziative in Supporto al consolidamento e potenziamento dell'infrastruttura EMSO e delle sue attività". 2019 - 2022

- **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).

- **TREASURE** Training REsearch and Applications network to Support the Ultimate Real time high accuracy EGNSS solution), is a prestigious Marie Skłodowska-Curie Actions (MSCA) Innovative Training Network (ITN), funded through the European Union's Horizon 2020 Research and Innovation Programme.

- **Università di Camerino - Università di Macerata**: Acquisizione, processing e modelling di dati magnetici e GPR dei siti archeologici di Adrianopolis, Antigonea ed Urbs Salvia.

- **Università di Torino.** "From rocks to stones, from landforms to landscapes". Funded by Compagnia San Paolo.

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

4. Activities carried on by the Italian Delegate and National Committee during 2019 and impact on the Italian scientific community.

a) 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. It should be stressed that the Italian presence, often with major responsibilities, is particularly active and qualified in international programs devoted to the study of the Earth and the circumterrestrial space, to space missions related to Earth Observations, to the physics of the Sun, to the Interplanetary Space, to the Sun-Earth Relations.

b) The Italian Delegate actively participated to the IAGA Conferences of Delegates held during the 27th IUGG General Assembly, Montreal (July, 2019).

c) The Italian Delegate cooperated to the organization of the National IUGG Workshop "Stato dell'arte e prospettive nella prevedibilità degli eventi naturali"

(Consiglio Nazionale delle Ricerche, Roma, 26-27 Novembre 2019); he was member of the Scientific Committee.

d) In collaboration with other institutions and within the framework of the International School of Space Science (L'Aquila), directed by the Italian delegate, the IAGA-Italy community has launched, for the next three years, a program of schools dedicated to the training of young researchers in the area of the Solar Terrestrial Physics and Space Weather. The following courses will be organized in the next three years

- Dynamical Systems and Machine Learning Approaches to Sun-Earth Relations
June 2020.
Directors: G. Consolini, D. Del Moro

- The different spatio-temporal scales of the solar magnetism.
June 2021.
Director: M. Zuccarello

- Radiation belt dynamics and remote sensing of the Earth's plasmasphere
June 2022.
Director: M. Vellante

5. Evaluation of Italian attendance and how to improve interest and involvement.

The Italian attendance at the 27th IUGG General Assembly, Montreal (July, 2019) was good and several Italian researchers were convenors of sessions, meetings and working groups.

In order to develop among young researchers and doctoral students more interest and involvement in attending IAGA meetings and conferences it should be permanently established an award for their participation at the General Assembly.

To improve the relationships with other IUGG Associations is one of the challenges of the IAGA-Italia strategy: for this scope, IAGA-Italy actively participated to the National IUGG Workshop "Stato dell'arte e prospettive nella prevedibilità degli eventi naturali".

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.

- F. Florindo (INGV) is the chairman of the Working Group I.2 "Paleomagnetism" of the IAGA Division I - Internal Magnetic Fields and President of the Earth Magnetism and Rock Physics Division of European Geophysical Union.

- A. De Santis (INGV) is Member in the ASI Committee on ESA satellite Earth Observation Missions.

- A. Meloni is President of the National Scientific Commission for Antarctica.

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

- F. Zuccarello (University of Catania), F. Berrilli (University of Rome Tor Vergata), G. Consolini (INAF), M. Messerotti (INAF), R. Tozzi (INGV) and S. Lepidi (INGV) are members of the Directive Board of SWICo (Space Weather Italian Community).

- 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'.

- 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 leader of the SCAR expert group GRAPE (GNSS Research and Application for Polar Environment). She has been appointed URSI (International Union of Radio Science) delegate to SCAR since 2014. She has been elected URSI Commission G vice chair for the triennium 2017-2020. She is the INGV Representative in the National Scientific Committee for Arctic. Lucilla Alfonsi (INGV) is her Deputy.

- V. Romano (INGV) is the Italian co-expert on Space Weather at ONU COPUOS (Committee on the Peaceful Uses of Outer Space) and Italian co-coordinator of ISWI (International Space Weather Initiative).

- M. Materassi is the Italian National 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.

- 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).

- A. Bemporad (INAF), F. Berrilli (UNITOV), P. De Michelis (INGV), M. Laurenza (INAF), F. Marcucci (INAF), S. Orsini (INAF), V. Romano (INGV) are members of the ASI Working Team for the Italian Roadmap for Space Weather.

- M. Pezzopane (INGV) is Italian member of the International Reference Ionosphere Working Group and Co-chair of IAGA WGII-E: Ionospheric irregularities, Fields and Waves.

- 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.

7. Conclusions.

As underlined in previous activities reports, supporting the Italian participation in IAGA is an important strategic decision for our Country. This participation should be encouraged by supporting Italian scientists in international programs. This aspect is particularly important for young Italian researchers who should be encouraged with fellowships and awards, supporting their participation to international schools and courses and facilitating their international mobility. For this scope, IAGA-Italy collaborated in the organization of a specific training path for young researchers.

It is also important to create awareness in the national scientific community about the role that Italy can play internationally on the basis of the remarkable scientific skills and of the availability of high standard instrumentations and observational networks. To improve the visibility of the Italian scientific community it would be useful to provide the co-financing of IAGA initiatives and thematic workshops to be organized in Italy. As already requested, in order to develop among young researchers and doctoral students more interest and involvement it should be permanently established an award for their participation at the General Assembly.

The success of the National IUGG Workshop “Stato dell’arte e prospettive nella prevedibilità degli eventi naturali” testifies to the need and the interest for a deeper exchange of skills and comparison within the entire Italian IUGG community. Initiatives of this nature must certainly be encouraged and supported.

The National IAGA Delegate
Prof. U. Villante