

# **International Association of Geomagnetism and Aeronomy**

## **Activities' Report - Year 2018**

**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 “Aeronomical 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”;
- L. Cafarella: INGV, Roma, - 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 activated 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 IAGA during 2018 relevant for Italy.**

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

**a) IAGA National Conference.** The IAGA Italian Committee has organized the National Conference: "From the Sun to inside the Earth" (21-22 February, 2018), hosted by INGV in Rome and organized in cooperation with CNR and Area di Ricerca in Astrogeofisica. The specific intent of the Conference was to stimulate the participation of young researchers, their mutual knowledge, the possibility to meet and discuss with more experienced researchers. To this end, the Committee has also provided a prize for the best scientific contributions presented by young researchers. The Conference was highly successful: it was attended by about eighty researchers who discussed themes and presented results in the sectors in which IAGA operates, both with oral contributions (mostly reserved for young people) and with posters sessions. A volume of Annals of Geophysics has been dedicated to the Conference.

**b) Electro-Magnetic Studies of Earthquakes and Volcanoes (EMSEV) Conference.** Electromagnetic Studies of Earthquakes and Volcanoes (EMSEV) is an Inter-association IAGA-IASPEI-IAVCEI. Several Members of the IAGA Italian Committee have contributed in the Scientific Committee of the Conference titled “Integrating Geophysical Observations from Ground to Space for Earthquake and Volcano Investigations” that was held in Potenza (17-21 September, 2018) and was hosted by the University of Basilicata and the CNR Institute of Methodologies for Environmental Analysis (IMAA) with a strong support of INGV. The 2018 EMSEV workshop focussed on the observation and understanding of various kinds of electromagnetic phenomena associated with earthquakes and volcanic eruptions particularly from a multidisciplinary point of view. More than 110 participants from 25 different countries coming from 4 continents attended the meeting and presented their most up-to-date results in oral presentations and with posters. The Conference has been a great opportunity for students and young researchers to present their scientific research and achievements as well as a valuable occasion for the building of interdisciplinary co-operation among researchers worldwide in this hot topic of geosciences.

### **c) International conferences with a relevant Italian participation:**

- European Geophysical Union General Assembly (Vienna, Austria).
- AGU General Assembly (Washington, USA).
- 15<sup>th</sup> European Space Weather Week (Leuven, Belgium).
- 104<sup>o</sup> Congresso Nazionale della Società Italiana di Fisica (Cosenza, Italy).

- 4th International Conference on Continental Earthquakes (The 4<sup>th</sup> ICCE) and 12th General Assembly of the Asian Seismological Commission (ASC), Chengdu, China.
- COSPAR 2018 42nd Assembly, Pasadena, California, USA.
- European Space Agency Phi-week on EO Open Science and Future EO, ESRIN, Frascati, Italy.
- Second URSI Atlantic Radio Science Meeting, Gran Canaria, Spain.
- 3<sup>th</sup> CSES workshop (Pechino)
- UN/Argentina Workshop on the Applications of Global Navigation Satellite Systems, Falda del Carmen.
- 8th Swarm Data Quality Workshop (SDQW) (Frascati, Italy).
- Third meeting of the Italian Solar and Heliospheric community (Torino, Italy).
- EST Science Meeting (Giardini Naxos, Messina, Italy).

**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.
- National magnetic cartography: the reduced survey was performed on about 30 repeat stations over Italy, in order to up-to-date the 2015 magnetic cartography.
- Management of the reduced surveys for the updating of the Italian magnetic cartography. Publication of the new magnetic cartography in collaboration with Istituto Geografico Militare (IGM).
- 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).
- Magnetic and electromagnetic surveys in archeological area of Hadrianopolis and Antigonea (Albania), and Villa Adriana, Tivoli.
- 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](http://www.nmdb.eu)) and to ESA SSA Space Radiation Expert Service Centre ([swe.ssa.esa.int/space-radiation](http://swe.ssa.esa.int/space-radiation)) for space weather applications.

- Management of ITACA<sup>2</sup> 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 (Tucumán and Bahia Blanca). One 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 Longyearbean (Svalbard, Norvegia), Lampedusa and Rome (Italy), Tucumán (Argentina), and Crete (Greece). A multi-constellation receiver, formerly installed at the Brazilian base in Antarctica, has been moved to 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.

- In the framework of the international “SuperDARN” project, during the 2018-2019 Antarctic Campaign a new radar (Dome C North - DCN) has been installed at the Concordia station in Antarctica. This is a collaboration between the INAF-IAPS and CNR under the support of the PNRA. Moreover, the management of Dome C East SuperDARN Radar has continued.

- 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 is expected to be published within 2019, 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. Activities carried on by the Italian Delegate and National Committee during 2018 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. As previously reminded, the IAGA Italian Committee has organized the National Conference: "From the Sun to inside the Earth" (21-22 February, 2018), hosted by INGV/Rome.

b) Regarding the training activities, in the frame of the International School of Space Science, it was organized the course: "The Polar Upper Atmosphere: From Science to Operational Issues". Sponsored by EGU and directed by G. De Franceschi (INGV, Italy), M. Mendillo (Boston University, USA), C. Mitchell (University of Bath, UK), the school offered specialist-training opportunities to 30 students at graduate, PhD and Post-Doc level and early career scientists, by assembling a group of expert lecturers in Geospace of Polar Regions.

#### **4. Evaluation of Italian attendance and how to improve interest and involvement.**

One of the priorities of IAGA-Italia is to give a better visibility of the Association within the scientific world and toward the young scientists. To improve the relationships with other IUGG Associations is one of the challenges of the IAGA-Italia strategy; for this scope, the Electro-Magnetic Studies of Earthquakes and Volcanoes (EMSEV) Conference (IAGA-IASPEI-IAVCEI) has been organized in Italy.

#### **5. 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.
- A. De Santis (INGV) is President of Earth Magnetism & Rock Physics Division of European Geophysical Union and 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).
- 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 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), 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.

## 6. Projects of interest in the framework of IAGA (and related IUGG Associations).

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

- **ASI-INAF 2015-039-R.O.** ESA M4 Mission: Italian participation to the assessment of the THOR mission.
- **ATMOSFILLER**, (ICTP under ESA contract): Completing the Atmospheric Sounding with GNSS and Platform Integrated Sensors.
- **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-ICTP TECA** (“Total Electron Content Characterization Study over Africa and Application to BIOMASS mission”) is a Pilot Study in the framework of the ALCANTARA Studies that involved ICTP and African researchers.
- **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 coronagraph 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 coronagraph 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).

- **ESA-THOR** (M4 candidate), the community participates with a PI-ship and several Co-ships for the PPU (Particle Processing Unit) and PIship and several Col-ships for numerical simulations.
- **Response to ESA call for F mission**, the community is proposing the Debye project with a PI-ship (PDP) at INAF-IAPS and several Col-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.
- **INSIEME** (Induced Seismicity in Italy: Estimation, Monitoring, and sEismic risk mitigation), Project supported by the SIR-MIUR research program.
- **IPS** (Ionospheric Prediction Service)-EC project to translate the prediction and forecast of the ionosphere into tangible results and user-devoted metrics. Realization of ionospheric prediction service prototype and provision of a service, with early warning and predictions on the ionospheric events.
- **ISSI** Project “Investigating the Magnetosphere through Magnetoseismology”, supported by the “International Space Science Institute” (ISSI, Bern).
- **ISSI** Project “Multi-technique characterization of near-Earth space environment”.
- **ISSI** Project “Current Sheets, Turbulence, Structures and Particle Acceleration in the Heliosphere”.
- **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).** 'Rapid geomagnetic field intensity events in the Mediterranean: trends from Late Bronze settlements and Late Roman fine wares'. Programa Estatal de I+D+i Orientada a los Retos de la Sociedad.
- **MINISTERIO DE ECONOMÍA Y COMPETITIVIDAD, (Spain).** Evolució dels ecosistemes amb faunes de vertebrats del Permià i el Triàsic de Catalunya.
- **MIUR PRIN.** GSSP (Global Stratigraphic Section and Point) del Piano Burdigaliano: il tassello mancante all'intervallo Neogenico della Scala del Tempo Geologico.
- **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.
- **PECASUS** (Pan-European Consortium for Aviation Space weather User Services) global space weather service center designated by ICAO (Council of International Civil Aviation Organization).
- **PNRA. TRACERS** (TephRoChronology and mArker events for the CorrElation of natural archives in the Ross Sea, Antarctica).
- **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.
- **PNRA. TRACERS** (TephRoChronology and mArker events for the CorrElation of natural archives in the Ross Sea, Antarctica).
- **PNRA WHISPER** (West Antarctic Ice Sheet Hlstory 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).
- **PNRA16\_00204** “Temporary magnetometer network for longitudinal and latitudinal monitoring in Antarctica”.
- **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](http://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 Camerino - Università di Pavia - Oxford University**: Acquisizione, processing e modelling di dati magnetici, paleomagnetici e GPR del Sito archeologico di Villa Adriana, Tivoli.
- **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.

## 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. 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, 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. In this sense IAGA-Italy has organized during 2018 a National Conference, with awards for young scientists.