ABSTRACT VOLUME

O16-1 Geomagnetic world: from measurement to theory

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Over centuries, the convergence of many different approaches has led to considerable progress in our understanding of the geomagnetic field characteristics and properties. The geomagnetic ground observatories have provided continuous measurements, and over a long period these data were the main sources of information on geomagnetic field spatial and temporal variations. A radical shift takes place in the late '70, with the launch of MAGSAT, the very first satellite carrying a vector magnetometer to measure the full magnetic field. The state-of-the-art has dramatically changed over the last decades due to measurements obtained from the Oersted, CHAMP, SAC-C satellites, and mostly with the recent Swarm mission.

Here, an overview of our present knowledge and understanding of the geomagnetic field is given. The main aim of this contribution is to underline how geomagnetic field observations have been crucial in developing new insights and new theories, with a special emphasis on the temporal variations of the core field, on timescales from months to a few hundred years. A few aspects of the Earth's deep and shallow processes grasped by the magnetic field are also presented, in closest relation with some other geophysical data.

O16-2 The global observatory network and its application to research and commerce in 2018

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There are currently over 170 absolute magnetic observatories in operation around the world, 126 exchanging data in real time via the INTERMAGNET network. In the 185 years since the first observatories were established to track changes in magnetic variation (declination) for navigation, the network has not only expanded but has also evolved to meet new applications in research and industry. Over those 185 years, magnetic observatories have provided us with a developing understanding of geomagnetic fields and the processes that cause these fields to change with time – from the dynamics of the Earth's core to the effects of the solar wind. Long-term, high accuracy, absolute data, such as those from Surlari Observatory, compliment short-term, high coverage data from satellite missions to further all aspects of geomagnetic research. Here, we provide an overview of the global observatory network in 2018, how it is evolving to meet future science requirements and highlight some of the areas of contemporary research that rely on geomagnetic observatory data. As an example, geomagnetic research in the last two decades has alerted industry to the natural hazard from space weather to the extent that the potential impact of an extreme event is now considered at a national government level. Geomagnetic observatory data have been key to monitoring and understanding such events, but are also essential in developing our ability to forecast and estimate the impact of space weather events on the power distribution, communications and navigation technology sectors.

O16-3 INTERMAGNET at 30: past developments and future plans

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The INTERMAGNET programme exists to establish a global network of cooperating digital magnetic observatories, adopting modern standard specifications for measuring and recording equipment, in order to facilitate data exchanges and the production of geomagnetic products in close to real time. Surlari observatory

has been contributing to INTERMAGNET since 1998. We will review how INTERMAGNET has developed over this time and what INTERMAGNET is planning for the future, in particular focussing on the development of new data products such as quasi-definitive and 1-second data and the challenges of data publication in the digital age.

O16-4 75 Years Surlari National Geomagnetic Observatory – 75 Years of Collaboration with Niemegk Adolf Schmidt Geomagnetic Observatory

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Systematic geomagnetic measurements were initiated around 1830 by Alexander von Humboldt and set into operation by Carl Friedrich Gauss and Wilhelm Weber in the frame of the "Göttingen Magnetic Union". Geomagnetic observatories were established in many countries. The Potsdam Magnetic Observatory started its operation in 1890. Artificial noise required the outsourcing of the variometer recordings to Seddin in 1907 and the complete movement to Niemegk in 1930. The Niemegk Adolf Schmidt Geomagnetic Observatory owns an almost uninterrupted geomagnetic measurement series of 128 years, operates the International Kp Index Service and services the operation of 19 international observatories.

Surlari National Geomagnetic Observatory was established in collaboration with the Niemegk observatory. The Romanian authorities consulted with Richard Bock and Gerhard Fanselau in the building construction and in the instrumentation. Richard Bock installed the instruments, made by the Potsdam Schulze mechanical workshop. The collaboration was continued over long term. Upgrades of the Surlari instruments were done on the base of consultations with the Niemegk staff, comparison measurements were regularly carried out and joint scientific projects took place.

Finally a complete variometer set with the GFZ Potsdam data logger MAGDALOG was installed in 2009. It was completed by a backup variometer system in 2014. Mutual regular visits took place to train the Surlari personnel in the handling of the hardware and in the data processing. The last hardware upgrade took place in 2018.

016-5 Consideration about forecasting analysis of geomagnetic disturbances

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Forecasting analysis of geomagnetic disturbances use different ways like us observations on Solar activity, application the concept of air mass climatology to solar wind for probabilistic forecasting of geomagnetic indices, probabilistic analysis of geomagnetic data from observatories and so on.

Space weather and terrestrial weather are influenced by the changes the Sun undergoes during its solar cycle. The most important impact the Sun has on Earth is from the brightness or irradiance of the Sun itself. The Sun produces energy in the form of photons of light, with different wavelength and high variability.

At Ultraviolet wavelengths (120 - 400 nm), the solar irradiance variability is larger over the course of the solar cycle, with changes up to 15%. At the other end of the light spectrum, at Infrared wavelengths (0.8 – 10 μm), the Sun is very stable and only changes by a percent or less over the solar cycle.

In this paper we evaluate how the geomagnetic storms forecast by the Space Weather Prediction Center from National Oceanic and Atmospheric Administration are correlated with the geomagnetic recordings at different observatories on the Earth.

Also, we make some considerations regarding the geomagnetic events that preceded the major geomagnetic perturbations.

017-1 The geomagnetic investigation of the Western Black Sea (Romanian and Bulgarian sector). Main results and specific issues of the research.

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The first geomagnetic investigation of the western Black Sea, carried out by Romanian geoscientists, dates back in 1969-1970. The next phase of the process, carried out during 1980 and 1990 summed around 13,400 km of marine magnetic lines. Both these mappings have covered most of the Romanian offshore, but totally

lacked in the near shore. Starting from 2003 a new systematical geomagnetic investigation of the offshore begun, it continues and sums up today over 48,000 km of marine magnetic lines, which cover the entire Romanian offshore, most of the Bulgarian one and extended sectors of the littoral and lagoon shallow waters. Based on the raw marine magnetic data acquired, numerous maps of the marine and continent-sea transition zones, at scales ranging from regional to very high detail, were obtained. In combination with other geophysical, petrophysical, drilling and geological data, the magnetic information was used to decipher the deep geological structure of the western Black Sea continental margin and built up 2D and 3D simulation models of the deep and shallow subsurface. The magnetic research also brought up essential contributions for the geo-ecological and geotechnical study of the offshore drilling locations, dumping zones, to identifying the presence and precise localization of pipelines, submerse cables, ship wrecks and many other ferrous objects, e.g. anchors, chains, containers, pipes and last but not least UXOs lying on the sea bottom or buried in sediments.

017-2 GEOMAGNETIC MAPPING OF THE ROMANIAN TERRITORY IN THE CONTEXT OF WDMAM. CHALLENGES AND SOLUTIONS

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The paper deals with challenges the geomagnetic mapping of large areas (as national territories or continental regions) are facing. Among the others, distortions provoked by the secular variation of the geomagnetic field, systematically monitored at the geomagnetic observatories and within dedicated networks play a major role.
The case-study of the geomagnetic mapping of the Romanian territory is analysed. Various inconsistencies in both the ground vertical component geomagnetic map and regional total intensity scalar airborne map of Romania are revealed, and solutions for providing consistency are discussed. Special attention is paid to DYGEF project, a joint venture of the Institute of Geodynamics, Geological Institute of Romania, University of Bucharest and Politechnica University. Funded within the national programme for excellence in research, it was aimed at the rehabilitation of the national airborne geomagnetic map and the integration of the geomagnetic model over the Romanian territory into continental

and world-wide geomagnetic maps targeted by WDMAM programme. The Romanian contribution to the WDMAM, and its added value to the international programme is briefly discussed.

017–3 Long term and short term variations of geomagnetic field recorded at Muntele Rosu Seismological Observatory, Romania

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The Earth's magnetic field has existed since the beginning of Earth creation and his variability is correlated with changes in internal and external magnetic field. Monitoring the Earth Geomagnetic field over a period of time is necessary to distinguish the nature of these variations.
Studying the geomagnetic field from MunteleRosu Seismological Observatory, providing the opportunity to identify the short-term variations of the geomagnetic field like diurnal variations, geomagnetic storms and substorms, pulsations and geomagnetic bays. The MunteleRosu magnetometer was installed during the fall of 1996 and almost continuously recorded the geomagnetic field. The long operating time of the magnetometer of more than 20 years, gives the opportunity to identify the long-term variations like Solar cycles which have a periodicity of 11 years and change the levels in solar radiation and ejection of solar material.
Monitoring in time of the geomagnetic field variation is aimed to separate the ionosphere/magnetosphere variation by seismo-electromagnetic variation possibly presented in a seismic area like Vrancea zone.

017-4 Practical problems associated with observations of the natural geomagnetic field

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National Institute of Earth Physics has a multidisciplinary monitoring network resulted from implementation of several projects for the analysis of the interaction of the lithosphere – atmosphere-ionosphere with applications in the seismic forecast. The main part is concentrated in Vrancea seismic area characterized by intermediate

depth earthquakes. The geomagnetic field is permanently monitored in MunteleRosu since 1996 and Surlari since 2006. Other temporary stations were in Plostina, Bisoca and Vrancioaia. Magnetic field is correlated with radon concentration, earth radiation, air ionization, telluric currents, ULF radio waves disturbance, temperature in borehole and acoustic waves. Practical problems encountered in geomagnetic monitoring are anomalies introduced by crust deformation, temperature and the dependence of vertical component of magnetic field with latitude. Our analysis uses information from our stations, INTERMAGNET network and NOAA (DGD, DPD, and DSD). Sometimes radon indicates an increase in tectonic stress, in other situations the electromagnetic field or the temperature in borehole. The conclusion is that only a multidisciplinary network and analysis helps us to understand the precursor phenomena. Seismic active zones have particularities generated by geological structure. For this reason seismic precursors and analysis methods differ. Tectonic stress is permanent and generates increasing effects when an earthquake occurs. Prediction is not possible but sometimes short-term forecast might be.

017-5 Surlari Observatory – a revised standard procedure for navigational purposes as a response to societal needs

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The nearly real-time availability of geomagnetic declination information is crucial for the safety of the air navigation over the national territory. This activity represents an interesting application of geomagnetic data gathered by magnetic observatories, repeat stations and satellites. In the frame of the National Research Program PN 18 47 03 01 the main objective of our observatory is to fulfill the national and international safety requirements in accordance with the ICAO Annex 15. Some of them are depicting the area around the airport and give up-to-date declination information. Here, for some sorts of aeronautical charts like Instrument Approach, SID, STAR, Visual Approach Charts or runway azimuth determination, periodic geomagnetic measurements are requested. The methodology and the periodicity of these declination measurements represent the aim of the 2018 project.

017-6 Romanian secular variation network in the context of the 75 years of SUA geomagnetic observatory

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The space-time evolution of the geomagnetic field over the Romanian territory has been monitored for more than 50 years. Since about 1964 systematic studies on the secular variation have been carried out by measurements in the national network of repeat stations. The network consisting of 26 stations, at present, is being reoccupied as much as possible every year, supporting the international scientific community efforts in creating and maintaining a repeat station database to be used together with satellite and observatory data in complex geomagnetic field modelling at regional and global scale.

The study reports the results of geomagnetic measurements carried out in the last years (2016-2017) at repeat stations of the Romanian secular variation network. The absolute values of declination, D, and inclination, I, have been taken by means of a LEMI-204 DIFlux instrument, of total intensity, F, by a G-856 Geometrics proton magnetometer. The values obtained for the geomagnetic elements have been reduced to the middle of the year (geomagnetic epoch year.5) using Surlari observatory (SUA) data. Maps with geographical distribution on the Romanian territory are presented.

017-7 It is necessary to use the applied geophysis in territory planning and transport's design infrastructure in Romania

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To meet the growing demands of the world's expanding population for natural resources, to resolve problems created by our misuse of the land, to provide critical data to engineers and to forecast the effects of natural disasters, it is necessary for us acquire detailed information on the structure, composition and condition of the outer skin of the Earth. Applied geophysicists provide this essential information in a non-destructive manner.

Applied geophysics is based on physics principles (e.g. gravity, magnetics, electromagnetic etc.), collect and interpret data to extract info about the subsurface conditions for practical purposes (e.g.

engineering applications, archaeological and environmental interests etc.)
Applied geophysics uses almost all the current geophysical methods (electrical, magnetic, electromagnetic etc.)

017-8 Impact of landslides caused by earthquakes reflected on the environment and civil society. Case study.

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Worldwide, landslides are responsible for nearly 10,000 victims/year. Nearly 60% of all landslides are triggered by earthquakes. Landslides are the third-largest contributor to earthquake deaths, after building collapse and tsunamis. Damaging quakes often occur in remote and mountainous regions with limited transportation and communication networks, where landslides can block roads and impede emergency-response and relief efforts. However, the mechanisms of these movements under seismic forcing are little known because there is limited data recorded in situ during earthquakes.
Anti-disaster measures must be taken by any national and prefectural governments and should include long-term steps to contain damage from major disasters by restricting land use for residences in high-risk areas. In the Kumamoto quakes, the severely damaged houses in Mashiki were located on active faults in the zone where the quakes were focused. 211 people were killed and thousands injured.
In June 2018, a new model was developed by researchers at Indiana University that can help experts address such risks by estimating the likelihood of landslides that will be caused by earthquakes. Behavior, location, size, and mobility of earthquake-triggered landslides are all controlled by physical properties and hydrologic conditions of near-surface materials and the characteristics of ground shaking during an earthquake.

017-9 The geomagnetic signature in the measurement of radio signals from ultra-high energy cosmic rays induced air showers

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Origin of ultra-high energy cosmic rays is still a mystery after a century since they were discovered. Innovative detection techniques were developed meanwhile, within the effort of international collaborations worldwide; in order to perform indirect measurements of cosmic rays induced air showers in the Earth's atmosphere. Radio detection technique is one of the methods used in the detection of radio signals from extensive air showers in the low frequency regime. Geomagnetic emission is one of the production mechanisms of the radio waves, where the Earth's magnetic field plays an important role by deflecting the charged particles in the shower body and thus generating the geo-synchrotron effect.

Geomagnetic angle, the angle between the Earth's magnetic field and the shower axis, makes a good correlation with the shower geometry and the amplitude of the radio signals. The higher the geomagnetic angle, the higher the amplitude. A simplified geomagnetic model will be discussed, with the highlight on the geomagnetic contribution in the radio emission process of cosmic rays induced air showers radio signals.