Monday, October 13, 2025

Session: Oral-Galactic and Extragalactic Astronomy

Quantifying changes in light pollution

Christopher Kyba
Institute of Geography, Ruhr University Bochum

When artificial light is used on Earth's surface, the visibility of celestial objects is reduced due to "skyglow", which occurs when the atmosphere scatters upward propagating waste light back towards the ground. While the physical principles behind skyglow are well understood, we still lack understanding of the spatial and temporal behavior of skyglow. The reason for this is that the glow over large cities is produced by hundreds of thousands to millions of individual sources, each of which has its own unique spectral, spatial, and temporal properties.

Radio Properties of HII Region in the SARAO MeerKAT Galactic Plane Surveys

James O. Chibueze
University of South Africa

We present a study of the radio continuum properties of a sample of HII regions observed in the SARAO MeerKAT Galactic Plane Survey (SMGPS) at 1.3 GHz. The sample includes sources classified as known, candidate, and radio-quiet HII regions from the WISE catalogue. We measured integrated flux densities, peak intensities, and angular sizes for 2,013 known HII regions detected in the survey. From these measurements, we derived key physical parameters that include electron densities, emission measures, and brightness temperatures, with typical values of 400 cm^-3, 10^5.5 cm^-6 pc, 630K, respectively. In addition, we detected radio emission from 2,376 candidate H ii regions, suggesting that the majority are indeed HII regions. The candidate regions exhibit flux densities and angular sizes that are, on average, an order of magnitude lower than those of the known regions, implying that they may be more distant or intrinsically fainter. We also investigated the radio-quiet regions, of which 80% were detected in the SMGPS, revealing that these sources are not without radio emission but instead exhibit weak radio continuum emission.

Spectral Energy Distribution (SED) Properties of Active and Non-Active Galaxies in the Green Valley

Delphine Nishimwe
Mbarara University of science and Technology

In this study we studied how active galactic nuclei (AGN) influence star formation and morphological transformation in galaxies within the green valley. Using a sample of the X-ray detected AGN and non-AGN green valley galaxies with FIR emission from the COSMOS field selected in Mahoro et al. (2017) with stellar masses ranging from log $M_* = 10.6 - 11.6\ M_\odot$, using 32 photometric filters across UV to FIR wavelengths to extract and fit their spectral energy distributions (SED) with CIGALE. Our findings reveal that FIR-detected AGN galaxies have higher star formation rates compared to non-AGN galaxies. AGN galaxies also show higher dust luminosity, compared with non-AGN galaxies. Despite similar dust masses between the two groups, a strong positive correlation of 0.86 is observed between AGN luminosity and SFR. No significant correlation is found between AGN luminosity and dust mass. Additionally, a higher AGN dust luminosity correlates with a greater AGN fraction in galaxies and a higher dust temperature was observed in AGN compared in non-AGN galaxies. These results implies that for FIR detected AGN with UV-Optical-NIR-MIR-FIR emissions AGN feedback may play a positive role in star formation processes within the green valley rather than negative one.

Monday, October 13, 2025

Ellipticity of the Milky Way globular clusters conditioned by their X-ray luminosities

Georgi Petrov | Svetoslav Botev | Petko Nedialkov | Antoniya Valcheva

Head Assist. Prof. Georgi Petrov, PhD in Department of Astronomy, Faculty of Physics, Sofia University, Bulgaria | PhD student Svetoslav Botev in Department of Astronomy, Faculty of Physics, Sofia University, Bulgaria | Assoc. Prof. Petko Nedialkov, PhD in Department of Astronomy, Faculty of Physics, Sofia University, Bulgaria | Assoc. Prof. Antoniya Valcheva, PhD in Department of Astronomy, Faculty of Physics, Sofia University, Bulgaria

We examine the dependence of Milky way globular clusters' ellipticity on their X-ray luminosity using two modern catalogs and combine them with optical and X-ray data from the literature. Kolmogorov–Smirnov tests applied across multiple subsets reveal statistically significant differences in the ellipticity distributions when both LX and optical luminosity are considered. Two X-ray luminosity thresholds, $L*X$ (MV = −7) = 1033.05 erg/s and $L*X$ (MV = −7) = 1032.01 erg/s, yield the most reliable distinction. Due to the improved statistics, it is possible to obtain reliable differences of Milky way GC's ellipticity distributions when their X-ray luminosity is involved alongside with their optical luminosity as a discriminator and that the highest X-ray luminosity GCs in our galaxy have higher ellipticity on average, compared to their lower luminosity counterparts, just opposite to the results based solely on their optical luminosity.

On the role of interstellar dust grains in the formation of large nitrogen bearing species

Zainab Awad

Astronomy, Space Science and Meteorology Dept, Faculty of Science, Cairo University

The interstellar medium is filled with gas and dust. Variations in the physical conditions of different regions lead to chemical diversity. Complex molecules, with more than six atoms, are challenging to form under such extreme conditions. Observations reveal that we live in a molecular universe with more than 200 detected species ranging from simple diatomic molecules to the most complex PAHs. Nitrogen bearing species are important because of their deep implications for prebiotic chemistry and the potential origins of life. However, interstellar N-chemistry is challenging because some species appear simple, such as HNCO, but their formation pathway (gas-phase vs grain surfaces) and isomeric structure remain an open question to astrochemists. In this work, we aim to review the formation of some key complex N-species (e.g. CH3NCO, NH2CHO, CH3CH2CN, CH3CHCN, ... etc.) using gas-grain chemical models and investigate the role of surface chemistry in their formation and how some of these species could be possibly linked to the enigmatic HNCO molecule and its isomers. We present our preliminary results from these models.

Chemical abundances of type-2 AGN in different environments

Mehbuba Ahmed Mohammed and Dr Mirjana Povic

Space Science and Geospatial Institute (SSGI), Researcher in astrophysics, Instituto de Astrofísica de Andalucía (IAA), Spanish National Research Council (CSIC), Spain, Honorary professor, Mbarara University of Science and Technology (MUST), Uganda.

The chemical abundance of active galaxies, which host active galactic nuclei (AGN), is poorly studied, primarily due to challenges in isolating AGN effects on metallicity measurements. In particular, the chemical abundance of active galaxies in various environments, including clusters and groups, remains largely unknown. This work employs a novel HCm code (HII-CHI-mistry) to measure the chemical abundance of type-2 AGN, focusing on oxygen abundance (12 + log(O/H)), nitrogen abundance (log(N/O)), and the ionization parameter (logU) for approximately 12,000 type-2 AGN selected from the SDSS survey. We analyze the metallicity properties of type-2 AGNs concerning other host galaxy properties, such as morphology, stellar mass, and star formation rate (SFR), as well as environmental factors. For galaxies in groups and clusters, we investigate metallicity relative to group/cluster properties, like cluster-centric distance and galaxy count. We do not observe a strong mass-metallicity relation; however, in groups and clusters, the 12 + log(O/H) abundance is higher in galaxies with greater stellar mass. Additionally, we find that the 12 + log(O/H) abundance decreases with increasing SFR across all environments. We do not identify a fundamental plane of type-2 AGN, indicating more complex interactions among stellar mass, SFR, and metallicity in AGN-hosting galaxies compared to star-forming ones. Our findings suggest that type-2 AGN hosts in groups and clusters have higher metallicities than field galaxies, independent of redshift. This work provides the largest catalogue of chemical abundances of type-2 AGN to date.

Monday, October 13, 2025

Intra-Day Optical Variability of BL Lacertae During its Recent Active Phase

Ali Takey
NRIAG

We reveal an extensive study of the flux and spectral variability of BL Lacertae on Intra-day time scale during its recent activity period starting from 2020. There are a few outburst periods of BL Lacertae occurred in the last five years. We aim to investigate the object variability behavior during the latest outburst periods. The object was observed over 50 nights from September 2020 to November 2024 implementing four ground-based optical telescopes, one in Egypt, one in Turkey, and two in Bulgaria. We examined the light curves (LCs) for intra-day flux variations using the power-enhanced F-test and the nested ANOVA test. Spectral variability is also investigated. The variable LCs were divided into smooth and flaring bursts. Then, flaring ones are investigated in detail and their characteristics are determined. The black hole mass of BL Lacertae was also determined.

A comprehensive study of the photometric and kinematic characteristics of the Pismis 24 open cluster, utilizing from Gaia DR3 data.

Nasser M. Ahmed
NRIAG

In this research, we will concentrate on the photometric and dynamical aspects utilizing data from Gaia DR3, particularly regarding the cluster linked to the nebula NGC 6357. We utilized the pyUPMASK Python library alongside the HDBSCAN algorithm to investigate the membership of the new cluster in order to ascertain its physical parameters. The central emphasis of this study is our novel method of calculating a membership probability for each radius, as opposed to providing a singular value for the entire cluster. The quantity of stars deduced from the King model, which relates to each radius, is employed to establish the probability cutoff value at that specific radius.

Monday, October 13, 2025

Session **Oral-Space Dymanics and Satalite Observation**

The Egypt-China project for Astronomical Precise Observation

Makram Ibrahim | Liu Jing | Cheng Haown | Cao Li | Sun Jian | Li Gongqiang | A.M. Abdelaziz | S.K. Tealib | M. Y. Helali

1-National Research Institute of Astronmoy and Geophysics (NRIAG) Helwan, Cairo, Egypt | 2- National Astronomical Observatories, Chinese Academy of Sciences (NAOC), China & 3- University of Chinese Academy of Sciences（UCAS), China | 2- National Astronomical Observatories, Chinese Academy of Sciences (NAOC), China & 3- University of Chinese Academy of Sciences（UCAS), China | 2- National Astronomical Observatories, Chinese Academy of Sciences (NAOC), China | 2- National Astronomical Observatories, Chinese Academy of Sciences (NAOC), China | 2- National Astronomical Observatories, Chinese Academy of Sciences (NAOC), China | 1-National Research Institute of Astronmoy and Geophysics (NRIAG) Helwan, Cairo, Egypt | 1-National Research Institute of Astronmoy and Geophysics (NRIAG) Helwan, Cairo, Egypt | 1-National Research Institute of Astronmoy and Geophysics (NRIAG) Helwan, Cairo, Egypt

The National Research Institute of Astronomy and Geophysics (NRIAG) and the National Astronomical Observatories in China (NAOC) are collaborating in the field of astronomical precise observation. The two institutes established a joint Center. A new building has been constructed at NRIAG, and two telescopes are deployed. The two telescopes are ready for use with the optical method and the laser technique. In this paper, we will describe the details of that system. We will also present some of the observations that have been carried out using the two telescopes.

Sliding Mode Control of Chaotic Motion in Electrodynamic Tethered Satellite System in an Inclined Elliptical Plane

Yehia Abdel-Aziz | Ahmed Yousof | A.M. Abdelaziz

NFIAG | Damietta University | NRIAG

This paper investigates the chaotic behavior of an inclined electrodynamic tethered satellite system (ETSS) orbiting Earth in an inclined elliptical orbit. The system is modelled using a dumbbell model. The presence of chaos is established through the computation of transversal heteroclinic orbits, and the corresponding parameter domain for chaotic motion is determined using the Melnikov function. A tether length control strategy based on sliding mode control is proposed to suppress the chaotic motion. Finally, numerical simulations are presented to validate the occurrence of chaos within the identified parameter domain and its control.

Design and Development of Cold Gas Satellite Propulsion System

Mayar Wael Maher Fahim | Ahmed Mohamed Farid Nemnem | Ayman Mahmoud

Aerospace Engineer at Egyptian Space Agency | Brig. Gen. Assoc. Prof. Dr. at Military Technical College | Senior director of space programs at Egyptian Space Agency

The uncontrolled rise of space debris in Low Earth Orbit (LEO) poses severe threats to operational satellites, emphasizing the urgency for reliable de-orbiting technologies. This study presents a reliable de-orbiting technique to eliminate that kind of threat. A design and development of a 1U cold gas propulsion system is performed to de-orbit a 6U satellite (SPNEX, as a case study). Nitrogen gas is used as the propellant, selected for its safety, availability, and performance. A high-pressure tank, convergent-divergent (CD) nozzle all together with the solenoid valves are integrated and modeled to perform structural and flow simulation analysis. Mission trajectory is analyzed using Hohmann Transfer simulations. Analytical computation is performed with collision avoidance strategies that incorporate TLE data for maneuver planning. A scalable de-orbit solution is provided that contributes toward sustainable satellite operations, forming the basis for future intelligent debris mitigation systems.

Monday, October 13, 2025

Satellite Tracking from Egypt: Past and Future

Mohamed Helali |Makram Ibrahim | Liu Jing |Cheng | Sun jian
National Research Institute of Astronomy and Geophysics (NRIAG) | National Research Institute of Astronomy and Geophysics (NRIAG) | NAOC | NAOC | NAOC

The Helwan, Cairo, Egypt satellite tracking had been started in 1957. The photographic observation method is carried out for satellite tracking using two cameras. Those cameras are the NAFA-25 and the AFU-75 camera; with an accuracy of measurements ranging from 200m to 300m. The first satellite laser ranging from Helwan observatory was started in 1974 using a Ruby Laser at the Half-automatic station. In 1981 the satellite observations were carried out using the full automatic station, in which a Nd: YAG Laser of energy 80 mille joule at wavelength 532 nm with a repetition rate of 5 HZ was used as the laser source for the tracking. In 2017 we are in a cooperation with the National Astronomical Observatories in China (NAOC). The purpose of the cooperation is to track the satellites and the space debris using two telescopes 1.2 m and 70 cm.

High-Fidelity Simulation of Orbital Maneuvers with J2 Perturbation and Propellant Estimation

S.K. Tealib | Ayman Homda | Youmna Abu Gabal
National Research Institute of Astronomy and Geophysics (NR IAG), Helwan 11421, Egypt. | Egyptian Space Agency, Cairo, Egypt | Navigation Science and Space Technology, Egypt

Accurate modeling of orbital maneuvers is essential for spacecraft mission design, trajectory optimization, and efficient propellant budgeting. This study presents a comprehensive framework for the simulation and analysis of orbital maneuvers, validated against FreeFlyer. The framework supports multiple maneuver types, including coplanar transfers, inclination changes, and combined angular maneuvers. For each case, it performs trajectory propagation, maneuver computation, and orbital element analysis with visual output. The model integrates high-fidelity numerical propagators and force models that account for perturbations such as Earth's J2 effect, as well as thrust-based calculations to ensure realistic mission representation. It consists of modular algorithms, each targeting a specific function within the maneuver planning process. These components are systematically combined to form a complete and adaptable simulation environment. By enabling the computation of Δv, transfer times, and required propellant mass using the Tsiolkovsky rocket equation, the framework bridges kinematic modeling with propulsion analysis. The simulation results were compared with those from FreeFlyer software, revealing a discrepancy of approximately 10% in the computed maneuver parameters, thereby affirming the reliability of the developed framework. This simulation was applied to a case study involving the transfer of a satellite from Low Earth Orbit (LEO) to Geostationary Orbit (GEO). Various propulsion techniques were analyzed to identify the optimal propellant type that minimizes transfer time to the target orbit, underscoring the framework's practical utility in mission planning and propulsion selection.

A Hybrid Analytical Method for Estimating Collision Probability in Low-Earth Orbit

S.K. Tealib
NRIAG

The proliferation of low-Earth orbit (LEO) satellites and debris has intensified the urgency of accurately assessing collision risks to safeguard space operations. Traditional methods relying on Two-Line Element (TLE) data face significant challenges due to inherent limitations, including low precision and the absence of covariance information for uncertainty quantification. This study proposes a novel hybrid framework to enhance collision probability estimation by synergizing Monte Carlo simulations, Gaussian Mixture Model (GMM)-based uncertainty modeling, and Bayesian inference. First, Monte Carlo simulations are employed to evaluate collision probabilities under propagated orbital uncertainties statistically. To address TLE inaccuracies, a GMM-based approach is integrated to refine positional uncertainty distributions, capturing non-Gaussian errors inherent in TLE-derived trajectories. Finally, historical conjunction data and Bayesian updating are incorporated to iteratively improve long-term risk predictions by dynamically adjusting probability estimates as new observational evidence becomes available. The methodology is validated using real-world TLE catalogs and benchmarked against documented conjunction events, demonstrating superior accuracy and robustness compared to conventional linear covariance methods. Results highlight the frameworkâ€™s capacity to mitigate false alarms and missed detections while providing actionable insights for collision avoidance maneuvers. This approach advances space situational awareness by bridging the gap between theoretical risk assessment and operational reliability, offering a scalable solution for managing the growing congestion in LEO.

Monday, October 13, 2025

Optical Survey of Geostationary Satellites Using a Ground-Based Optical Telescope

Ahmed Moursi
NRIAG

The continuous monitoring of geostationary satellites is essential for space situational awareness (SSA), collision avoidance, and characterization of space objects. This study presents an advanced optical survey of geostationary (GEO) satellites using a ground-based system consisting of a Celestron RASA 11-inch telescope equipped with a high-sensitivity CCD camera. The system provides a wide field of view (FOV) of 3.2Â° Ã— 2.4Â°, enabling the simultaneous observation of multiple GEO objects within a single exposure. The survey was conducted under controlled observational conditions to maximize detection efficiency, photometric accuracy, and astrometric precision. Image processing techniques, including background subtraction, centroiding algorithms, and point spread function (PSF) fitting, were applied to enhance the detection and tracking of both operational satellites and space debris in GEO. The astrometric accuracy of the observations was assessed by cross-referencing with publicly available two-line element (TLE) datasets, while photometric analysis provided insights into satellite brightness variations, which are influenced by attitude changes and surface properties. The results demonstrate the capability of the system to detect and track multiple GEO objects with sub-arcsecond accuracy, providing valuable data for orbit determination and long-term monitoring. Future work will focus on improving detection algorithms, incorporating real-time tracking techniques, and expanding the survey to include faint, non-cooperative objects such as space debris. This study highlights the effectiveness of ground-based optical telescopes for GEO monitoring and contributes to the broader efforts in space traffic management and orbital sustainability.

Monday, October 13, 2025

Session **Poster-Astronomy 1**

Follow up spectral observations of Nova Cas 2021

Gamal Hamed
NRIAG

Gaia has detected Nova Cas 2021 as Gaia21bpe. This interesting nova remained bright after more than two and half years after the outburst. We started a follow-up campaign to perform spectroscopic follow-up observations for this nova using Kottamia Faint Object Spectro-Polarimeter (KFISP) of the Kattamia Astronomical Observatory and Turkish Faint Object Spectrograph (TFOSC) of the Russian Turkish Telescope (RTT150) . Here we present preliminary results. We identify the spectral lines and measure their fluxes which are used to identify the elements present in the ejected envelope and helps in studying the physical and chemical properties of the nova.

MCMC Approach for Orbit Determination of Visual Binaries

Samah Hossny Mohammed Abdelullah El-Essawy | Mohamed I. Nouh | Helal I. Abdel- Rahman
Astronomy Department, National Research Institute of Astronomy and Geophysics, 11421 Helwan, Cairo, Egypt | Astronomy Department, National Research Institute of Astronomy and Geophysics, 11421 Helwan, Cairo, Egypt | Astronomy Department, National Research Institute of Astronomy and Geophysics, 11421 Helwan, Cairo, Egypt

A key component of astrophysics study is determining visual binary orbits, which allows for accurate measurements of star masses and provides information on the mass-luminosity relationship. Conventional orbit determination techniques like Kowalsky's method and Thiele-Innes elements sometimes have trouble processing sparse or noisy data. To tackle these issues, this work presents a Markov Chain Monte Carlo (MCMC) framework, which provides a reliable and probabilistic method for orbital parameter refinement. The process combines statistical probability assessments with iterative sampling to solve Kepler's equation and calculate ephemerides. Two test orbits with different eccentricities and inclinations were used to verify the framework, showing that it effectively lowered errors and closely matched observational data. The findings demonstrate the versatility of the MCMC approach, its accuracy in orbit refining, and possible use in more complex star systems, such as circumbinary planets and hierarchical triples.

Estimating the Stellar Atmospheric Parameters Using Automatic Methods

Samah H. El-Essawy | Mohamed I. Nouh | Mahmoud Taha | Kamel Gadallah | Ahmed. H. Ibrahim
Astronomy Department, National Research Institute of Astronomy and Geophysics, 11421 Helwan, Cairo, Egypt | Astronomy Department, National Research Institute of Astronomy and Geophysics, 11421 Helwan, Cairo, Egypt | Astronomy and metrology department faculty of science Azhar university, Cairo, Egypt | Astronomy and metrology department faculty of science Azhar university, Cairo, Egypt | Astronomy and metrology department faculty of science Azhar university, Cairo, Egypt

Understanding the physical properties of stars, such as their effective temperature, surface gravity, and chemical composition, requires stellar spectroscopy. Astrophysicists can accurately determine fundamental stellar features by analyzing the light that stars emit and comparing their real spectra with theoretical models. A new age of astronomy, typified by huge volumes of star spectrum data, has been brought about by the development of robust spectroscopic sensors placed in space and on the ground. Strong, automated methods for recognizing star spectra and detecting their underlying atmosphere properties must be created to manage this volume of data. In this study, we offer a unique Markov Chain Monte Carlo (MCMC) approach for automatically identifying and extracting characteristics from star spectra. The approach makes use of Bayesian inference and statistical moments to increase the accuracy and reliability of parameter estimates. Large-scale spectroscopic surveys like the Large Sky Area Multi-Object Fibre Spectroscopic Telescope (LAMOST) and the Sloan Digital Sky Survey (SDSS) will make use of it. The success of the MCMC-based technique will be compared with that of more conventional methods, such as neural network-based and minimal distance approaches. By tackling these issues, this study seeks to improve the accuracy of derived stellar parameters, lessen the impact of subjective human operations, and increase the automation and dependability of stellar spectrum analysis.

Monday, October 13, 2025

Decade-Long Multiwavelength Monitoring of OJ 248: Insights from Radio to γ-rays

Mona Molham | Jose Acosta Pulido | Iris alemán
NRIAG | Instituto Astrofísica de Canarias | Instituto Astrofísica de Canarias

We present an updated analysis of the multi-wavelength behavior of the blazar OJ 248 at redshift of 0.939 spanning the period 2014–2025. This comprehensive study incorporates nearly 10 years of observational data across the electromagnetic spectrum, including radio, near-infrared, optical, ultraviolet, X-ray, and γ-ray bands. Data were obtained from multiple facilities, including the Swift and Fermi satellites and ground-based observatories. The analysis focuses on flux and spectral variability, correlations between energy bands, and potential time lags between emission variations. Particular attention is given to the complex interplay between optical and radio emissions during multiple high-activity states. Cross-correlation analysis reveals evolving time delays between optical and γ-ray variations, suggesting changes in the emission regions or shock propagation dynamics. We discuss the implications of these findings on the physical processes driving emission in OJ 248 and the broader context of Blazar variability models.

Impact of Increasing Solar PV Penetration on Microgrid Frequency Stability Using a Multi-Terminal Multi-functional Inverter

Doaa Mohammed Eid | Mohamed Ismail | Mohamed Abdelkareem | Islam Helmy
NRIAG | NRIAG | NRIAG | NRIAG

The integration of solar photovoltaic (PV) systems into microgrids is rapidly increasing, raising concerns about frequency stability due to the variability of solar generation. This paper examines the impact of higher solar PV penetration on microgrid frequency dynamics and evaluates the role of a multi-terminal multi-functional inverter (MTMFI) in mitigating instability. Simulation results indicate that while high PV penetration amplifies frequency deviations, the MTMFI effectively enhances stability through active and reactive power support. The study demonstrates that MTMFIs are a promising solution for maintaining reliable frequency performance in future microgrids with high solar PV penetration.

Comprehensive Photometric and Dynamical Analysis of the Open Cluster FSR-275

Ola Ali | Ashraf Tadross
NRIAG | NRIAG

We present a comprehensive astrophysical analysis of the star cluster FSR-275 using data from the third Gaia data release (Gaia DR3). To identify probable cluster members, we applied the pyUPMASK method, assigning membership probabilities to stars. Using trigonometric parallaxes of stars with membership probabilities P> 50%, we estimated the clusterâ€™s distance to be 4365Â±140 pc, consistent with results obtained from isochrone fitting in the colorâ€“magnitude diagrams. The clusterâ€™s age was determined to be 1.3Â±0.15 Gyr. We further derived key photometric parameters, including reddening, distance, the estimated Cartesian Galactocentric coordinates (XâŠ™, YâŠ™, ZâŠ™), and the distance from the Galactic center (RGC), as well as the luminosity function, mass function, and total mass. Analyzing the dynamical state of FSR-275, we found the dynamical relaxation parameter Ï„â‰ˆ15, indicating that the cluster is dynamically relaxed.

Journey Through Space with Colors and Games (A Glimpse into Astronomy Education and Outreach Activities in Egypt)

Ola Ali
NRIAG

In recent years, astronomy outreach in Egypt has embraced creative, hands-on approaches to make scientific concepts more accessible to children. This presentation shares a personal journey of implementing educational activities in two remote regions—Siwa Oasis and Aswan—where astronomy was introduced through local art, games, and crafts as part of a STEAM (Science, Technology, Engineering, Arts, and Mathematics) approach. In Siwa, a collaboration with the Art Narty Festival enabled children to explore planetary science by painting planets based on their real characteristics, followed by guided stargazing sessions. In Aswan, children engaged in textile arts—dyeing and sewing fabrics inspired by stars and galaxies—after learning about cosmic phenomena. Across both locations, age-tailored activities such as solar system model-building and astronomy-themed games fostered engagement and learning. These initiatives demonstrate how science education can be meaningfully integrated with cultural traditions and artistic expression. By merging astronomy with imagination and context, the work offers a sustainable model for inclusive outreach in underserved communities.

Monday, October 13, 2025

Session **Poster-Geodesy 1**

Improvement Spatial Altimetry in Coastal Zones: Case of the Algerian Coast

Ali RAMI
Algerian Space Agency

The ocean dynamics in coastal area become particularly complex due to shorter spatial and temporal scales, the coastal monitoring is therefore an essential feature for the sustainable management of shoreline; however, improvement of spatial altimetry permits to determine a precise sea level height over the coast areas. The main objective of this study is to improve the radar altimetry measurement in coastal areas by analysing the atmospheric corrections which must be applied to obtain a precise surface height. The processing of 10 cycles of Saral/AltiKa satellite Geophysical Data Records with in-house developed algorithms, includes: On one hand, re-tracking which is important for the last 7 km of each satellite pass next to the coast; And on the other hand, a more accurate wet troposphere correction (decontaminated correction) and better modelling of atmospheric effects. The use of external information to describe more accurately the atmospheric humidity in the coastal band should allow for a significant improvement in the quality of the altimeter products. Indeed, the correction of brightness temperatures using land proportion has been used and produces good results and therefore, a better determination of the sea surface height over the Algerian coast can be retrieved. The obtained sea surface height validation is based on the comparison with the sea level calculated using the tide gauge stations installed on the Algerian coast at the points located in the same coordinate reference frame as that of the altimeter.

Present-Day Crustal Deformation By GNSS Measurements In The Nile Valley, Egypt.

Mohamed Mahrous | Mohamed Rashwan | Ali Radwan | Mahmoud S. Etman
NRIAG | NRIAG | NRIAG | NRIAG

This study examines crustal deformation patterns along the Nile Valley using GNSS observations recorded by permanent stations within the Egyptian Permanent GPS Network (EPGN) over the period 2013–2022. Continuous data from key sites including KATA (Katamayia) and PHLW (Helwan) provide daily coordinate solutions referenced to ITRF2014, processed using Bernese GNSS software and routine PPP/kinematic positioning approaches Horizontal velocity estimates in the Nile Valley consistently show modest movement rates averaging 1–4 mm/year, aligning with broader regional tectonic plate drift and indicating low strain accumulation in this corridor. Notably, these velocities are similar in magnitude to those previously documented in the Nile Delta and adjacent interior, where horizontal rates averaged ~2.5 mm/year. Vertical motion reveals consistent subsidence trends, with rates ranging from slight uplift at central Helwan to subsidence up to ~ –9 mm/year at some southern Nile Valley locations. The observed vertical deformation reflects both sediment compaction and local tectonic influences, intensified by historical hydrological changes including reduced sediment discharge following Aswan High Dam construction. Strain-field estimates based on horizontal velocities using advanced least-squares tensor modeling reveal predominantly extensional stress regimes, with heterogeneity across the Nile corridor. Variations are linked to local structural patterns including ENE–WSW and NW–SE fault trends which modulate strain direction and magnitude along the valley. These deformation rates, covering 2013–2022, support interpretations of stable yet slowly evolving crustal dynamics in the Nile Valley.

Monday, October 13, 2025

Investigation of urban subsidene in Oran city, Algeria, using PSInSAR technique

kamel hasni | Saddam Housseyn Allal
Centre of Space Techniques | Centre of Space Techniques

Monitoring ground motion, particularly subsidence, is crucial in urban areas prone to geologic hazards. This study investigates subsidence patterns in Oran city, it leverages the capabilities of PSInSAR algorithm To investigate possible subsidence in this city. In this study, we utilized a comprehensive dataset spanning 30 years, consisting of Envisat, ERS and Sentinel-1 C-band satellite data. This extended time period allows us to capture long-term trends in ground motion and assess potential changes in subsidence rates over the past three decades. Extracting time series from the processed data enables the visualization and analysis of displacement patterns across Oran and its surrounding areas. The analysis revealed stability within the urban center of Oran, with subsidence velocities ranging from 3 to 5 millimeters per year. This suggests minimal vertical ground movement within the city itself. However, the results highlight significant subsidence affecting the areas surrounding Oran, particularly along the coastline. In these regions, subsidence velocities can reach up to 1 centimeter per year, indicating a more substantial vertical displacement. The ongoing subsidence in these coastal areas necessitates continuous monitoring and mitigation strategies to prevent landslides, as exemplified by the bridge failure triggered by a landslide in August 2017. Our findings underscore the importance of long-term InSAR analysis for identifying areas susceptible to subsidence and developing effective risk management plans for urban areas.

Deciphering Neotectonic and Climate-Driven Hazards in the HKH Region through Remote Sensing and Machine Learning Insights

Zainab Yousaf
Institute of Space science, University of the Punjab, Lahore

The Hindukush–Karakoram–Himalaya (HKH) region is among the world's most dynamic and hazard-prone mountain systems, where neotectonic activity and climate change interact to trigger complex natural hazards. These include glacial lake outburst floods (GLOFs), landslides, debris flows, and snow avalanches, posing escalating risks to both ecosystems and human settlements. This study analyzes the spatial and temporal dynamics of neotectonic and climate-induced hazards across HKH by integrating multi-source remote sensing, machine learning, and climate diagnostics. High-resolution optical and radar satellite data (Sentinel-1, Sentinel-2, Landsat, and SRTM) were utilized to map glacier retreat, surface deformation, fault zones, and hydroclimatic anomalies. Techniques such as change detection and InSAR were applied to identify crustal movements and slope instability. Climate indices, including land surface temperature (LST), precipitation anomalies, and vegetation health metrics (NDVI, VHI), were derived from MODIS archives and the Climate Engine platform to assess climate stress over the past two decades. To model hazard susceptibility, supervised machine learning algorithms, Random Forest (RF), Support Vector Machine (SVM), and XGBoost, were trained using geospatial predictors such as slope, lithology, rainfall trends, fault proximity, and glacier density. Resulting susceptibility maps for landslides and GLOFs were validated using ROC curves and historical hazard inventories. Findings reveal heightened hazard potential in tectonically active zones, where accelerated glacial melt and erratic monsoonal patterns converge. The integration of remote sensing and AI-driven models proved effective in identifying high-risk zones and early warning indicators, supporting data-driven mitigation strategies for the climate-sensitive HKH landscape.

Monday, October 13, 2025

Rapid Flood Assessment Induced by Climate Change Using Landsat-8, Sentinel-2, UAV Data, and Machine Learning: A Case Study of the Swat Flood, Pakistan

Samreen Javaid
Institute of Space science, University of the Punjab, Lahore

The utilization of remote sensing imagery plays a pivotal role in accurately assessing flood extents post-event. Optical satellite data, combined with UAV (Unmanned Aerial Vehicle) observations, serve as essential tools for the precise delineation of inundated regions. This study employed water index-based and classification-based approaches to quantify flood-affected areas using Landsat-8 and Sentinel-2 imagery, while UAV data supported detailed damage assessments. Specifically, the analysis utilized the Normalized Difference Water Index (NDWI), Modified Normalized Difference Water Index (MNDWI), and Water Ratio Index (WRI) to detect and map flooded zones. In addition, a supervised classification using the Maximum Likelihood Algorithm was implemented for land use/land cover (LULC) mapping, facilitating improved flood identification through comparative analysis across indices. The findings revealed that floodwaters in the study area spanned approximately 107 km² based on Landsat imagery, 111 km² using MNDWI, and 115 km² using NDWI. To enhance classification precision, a systematic correction of misclassified pixels was carried out using insights derived from all three indices. The accuracy assessment indicated that both NDWI and MNDWI methods achieved over 90% accuracy, supporting the robustness of the results. The integration of remote sensing techniques presented in this study demonstrates an effective and timely methodology for flood mapping, offering valuable insights for rapid response and targeted emergency management in flood-impacted regions.

Geological Structures Assessment in Wadi Hagul, Northwestern Gulf of Suez, Egypt, Using Gravity and Magnetic Techniques

Mahmoud Etman|Abdelmonem S. Mohahmed | Salah Saleh
NRIAG

Wadi Hagul, an overlooked geological site in the northwestern region of Egyptâ€™s Gulf of Suez, is undergoing investigation through gravity and aeromagnetic measurements to ascertain the subsurface structure and foundational strata. Aeromagnetic and gravity-based prospecting techniques yield useful information about the region. The total aeromagnetic intensity (TMI) was derived by reducing the aeromagnetic data to the north magnetic pole (RTP). Maps, depicting Bouguer variations, were generated from corrected gravity data. Filtering approaches identified local anomalies and assessed the depths of both deep and shallow locations using radially powered spectrum integration. The depths of anomalies varied from 1 km to 3 km for both magnetic and gravity data. Bouguer gravity and magnetic data produced two-dimensional (2D) models and depth maps of the basement surfaces, indicating depths ranging from 300 m to 10000 m. The data analysis disclosed structural tendencies in various orientations (NE-SW, E-W, and NW-SE). Ten two-dimensional models demonstrated a deepening of foundation rocks in the center and southwestern regions. Employing forward 2D modeling alongside a structural map derived from the tilt derivative filter and Euler deconvolution solution, we generated a preliminary basement terrain map indicating diverse depths and tectonic activity in the central and southern regions of Wadi Hagul. Crustal thickness increases in the central and southwestern areas while decreases in the northeastern and southeastern directions.

Monday, October 13, 2025

Session Oral-Artificial Intelligence in Geophysics , Astronomy and space science

Forecasting different levels of geomagnetic storms using NARX neural networks

Mostafa Hegy | Essam Ghamry | Adel Fathy
Geomagnetic and Geoelectric Department, National Research Institute of Astronomy and Geophysics, Cairo, Egypt. | Geomagnetic and Geoelectric Department, National Research Institute of Astronomy and Geophysics, Cairo, Egypt. | Institute of Basic and Applied Sciences, Egypt-Japan University of Science and Technology (E-JUST), Alexandria, Egypt

Forecasting geomagnetic storms, particularly using the SYM-H index, has gained significant attention in recent research. This is largely due to the increasing impact of geomagnetic disturbances on critical infrastructure, such as power systems and satellite operations. The current work investigates the various levels of geomagnetic storms (Moderate, Intense, and super). In this paper, we have employed five supervised machine learning (SML) and One Artificial Neural Network (ANN) models. The models depend on solar wind parameters (SWP) (Ey, P, T, v, n, Bz) and geomagnetic index SYM-H. The SML utilizes index as outputs and SWP as inputs to predict the SYM-H index. The estimation yielded satisfactory accuracy including mean absolute error (MAE), mean square error (MSE), root mean square error (RMSE), and cross-correlation coefficient (R). Results revealed the proficiency of the ANN as an effective predicting tool for the SYM-H index. According to the study, using the Nonlinear Autoregressive with Exogenous Inputs (NARX) model the performance of up to 99 % in all levels of geomagnetic storms.

Advancements in Geohazard Investigations: Developing a Machine Learning Framework for the Prediction of Vents at Volcanic Fields Using Magnetic Data

Murad Abdulfarraj | Ema Abraham | Faisal Alqahtani
King Abdulaziz University | Ekwueme Federal University, Nigeria | King Abdulaziz University

This study investigates the application of machine learning techniques for predicting volcanic vent locations based on aeromagnetic geophysical data. Magnetic data, known to reflect subsurface geological structures, presents a valuable source of information for understanding volcanic activity. Leveraging this data, we aim to develop and validate predictive models capable of discerning the presence of volcanic vents. Through a comprehensive data analysis, feature engineering, and model training, we explore the intricate relationships between magnetic variations and volcanic vent locations. Various machine learning algorithms were evaluated for their efficacy in binary classification, with a focus on identifying areas with a high likelihood of volcanic vent presence. The Random Forest model (RFM) was adopted given its high-performance metrics, achieving a prediction accuracy of 92%. Our results demonstrate the successful prediction of volcanic vent locations, with a significant correlation of 86% between the actual and predicted vent locations and a high Degree of Certainty (DC) at 97%. This research contributes to the advancement of geospatial data analysis within the field of geoscience, showcasing the potential of machine learning in interpreting and utilizing magnetic data for volcanic hazard assessment and early warning systems. The findings represent a significant step towards enhancing our understanding of volcanic dynamics and improving the predictive tools available for volcanic hazard assessment.

Using Machine Learning for Pi2 Magnetic Pulsation Detection

Mohamed S. Abdalzaher | Essam Ghamry
National Research Institute of Astronomy and Geophysics | National Research Institute of Astronomy and Geophysics

Pi2 magnetic pulsations are a recognized class of Ultra Low Frequency (ULF) waves, characterized by irregularly damped oscillations with periods between 40 and 150 seconds (6.7â€“25 mHz). These pulsations are now well known to occur at the onset of geomagnetic substorms and serve as a key link between ionospheric and magnetospheric processes, making them a significant topic in space physics research. With the discontinuation of traditional indices previously used to identify Pi2 pulsations, this study presents a novel machine learning (ML)-based detection approach. The proposed framework leverages geomagnetic field data to accurately classify Pi2 events using a range of ML models, including linear, ensemble, and non-linear classifiers, which are optimized through hyperparameter tuning for maximum performance and efficiency. Model performance was rigorously evaluated using multiple metrics such as accuracy, F1-score, kappa score, execution time, precision-recall, ROC curves, learning curves, and confusion matrices. Among the tested models, the Gradient Boosting (GB) classifier achieved the highest accuracy of 99.37% in detecting Pi2 pulsations. This ML-driven detection system provides a reliable and efficient solution for global Pi2 monitoring, supporting advancements in space weather forecasting and geomagnetic substorm studies.

Unveiling Martian Geology through Faster RCNN: Detecting Features and Exploring Habitability

Bibi Ainy | Muhammad Ali Ismail | Uzair Abid
Department of Computer and Information Systems Engineering, NED University of Engineering and Technology | Department of Computer and Information Systems Engineering, NED University of Engineering and Technology | Department of Computer and Information Systems Engineering, NED University of Engineering and Technology

This work addresses the challenges of diverse and multi-class Martian terrains by using a state-of-the-art object detection algorithm called Faster R-CNN, which surpasses traditional CNNs in handling multiple terrain classes. Terrain classes provide essential knowledge about geological, climate-related and other aspects of the planet and studying and understanding them helps to explore not only the planet’s past but also the future exploration and colonization efforts. It is important for identifying habitability and resources. Faster R-CNN integrates region proposal and classification into a single pipeline, thus enhancing the accuracy and efficiency of detection. To further optimize the performance, a customized MobileNet backbone was used in lieu of the default ResNet. This is due to the fact that the MobileNet architecture is very light and has better feature-detection capabilities in smaller resource-constrained datasets. This research uses a dataset comprising seven different terrain classes for Mars, thus ensuring comprehensive assessment of the model. The result in the form of mean precision average (mAP) was monitored on 50% overlap and it turned out to be 71.43%. This is indicative of the model's dependability in identifying several terrain classes while avoiding false positives.

AstroRAG: An Advanced Chatbot for Addressing Astronomy based Queries

Uzair Abid | Talha Zia | Dr. Muhammad Ali Ismail | Saif ur Rehman
National Center in Big Data & Cloud Computing, NED University of Engineering & Technology | National Center in Big Data & Cloud Computing, NED University of Engineering & Technology | National Center in Big Data & Cloud Computing, NED University of Engineering & Technology | National Center in Big Data & Cloud Computing, NED University of Engineering & Technology

LLMs represent a significant advancement in the field of Natural Language Processing (NLP), consistently outperforming conventional NLP methods with LLMs inference or LLMs finetuning for simple and advanced applications respectively. However, despite the advantages, LLMs possess static knowledge, which stands in stark contrast to the ever-evolving nature of real-world data. As a result, these models require regular parameter updates, but frequent pretraining is often impractical. This static knowledge characteristic of LLMs can lead to responses that are overrated, limiting their practicality across various applications. In this study, we introduce an advanced technique called Recursive Augmented Generation (RAG) within the domain of astronomy. Our proposed model addresses the challenge of static knowledge by incorporating a knowledge base that can be frequently updated. This approach not only ensures the model remains current with the latest data but also facilitates the generation of concise and direct responses. Evaluation of the generated responses using cosine similarity revealed strong semantic alignment with ground truth annotations, with average similarity score of around 0.75. This highlights cosine similarity as an effective metric for assessing semantic equivalence in astronomy-related response generation tasks.

Monday, October 13, 2025

6G- blockchain-enabled SAGIN and Federated Learning for Enhanced Earthquake Forecasting

jihad qaddour
Illinois State University

Earthquake forecasting remains a critical challenge due to the complex and multi-faceted nature of seismic events. This abstract proposes a novel approach leveraging the capabilities of 6G communication networks to enhance earthquake prediction through federated learning (FL) and a blockchain-enabled space-air-ground integrated networks (SAGIN) framework that authenticates both devices and the data collected by SAGIN participants. The SAGIN, which integrates satellites, aerial networks, and terrestrial communication, can provide seamless and continuous delivery of services and applications with high-performance levels. By integrating real-time data from a distributed network of sensors, including seismometers, GPS stations, and environmental monitors, we aim to create a robust and adaptive forecasting model. Moreover, the ultra-reliable low-latency communication (URLLC) and enhanced mobile broadband (eMBB) features of 6G provide the seamless aggregation of sensor data and the efficient distribution of model updates across the network. We will employ a federated learning framework where edge devices (e.g., local servers near sensor clusters) train a shared model collaboratively, conserving data privacy and minimizing the need for centralized data storage. This approach will address the limitations of centralized models by enabling real-time adaptation to local geological conditions and reducing communication bottlenecks. The solution will consider a use case for earthquake event prediction and monitoring. We will use Satellite sensors to collect data and identify the presence of thermal anomalies used for earthquake forecasting. We will conduct an experimental study on models and approaches needed to increase prediction accuracy for earthquake events. This model will improve earthquake prediction accuracy and warning times.

Characterization of Pc5 Geomagnetic Pulsations Using Satellite and Ground-Based Magnetometer Data

Mohamed Khalifa | Essam Ghamry | Yoshizumi Miyoshi
National Research Institute of Astronomy and Geophysics | National Research Institute of Astronomy and Geophysics | Institute for Space-Earth Environmental Research, Nagoya University, Nagoya 464-8601, Japan.

Understanding the structure and dynamics of magnetic storms is essential for revealing how solar wind energy is transmitted from the magnetosphere to the ionosphere and ultimately to the Earth's surface. This study presents a comparative investigation of the Earth's magnetic field behavior across the magnetosphere, ionosphere, and ground level, with a focus on the directional and magnitude variations observed simultaneously in each domain. Special attention is given to the characteristics of the magnetic field on both the dayside and nightside ionosphere compared to those in the magnetosphere. A central component of this research is the analysis of Pc5 geomagnetic pulsations “ultra-low frequency (ULF)” waves within the 1–7 mHz range, which offer valuable insight into magnetosphere–ionosphere coupling mechanisms. Using data from both space-based observations (Japanese satellite) and ground-based magnetometer stations in Egypt and Japan, Pc5 pulsations were extracted from the toroidal and Bx magnetic components via a bandpass Butterworth filter. The results show strong coherence between space and ground observations, suggesting a common source for these pulsations. This study enhances our understanding of Pc-type geomagnetic pulsations and contributes to the development of forecasting and predictive models relevant to different applications.

Monday, October 13, 2025

Modelling of the ionospheric state over Egypt: an artificial intellgence approach

Adel Fathy | Haitham Elhussieny | Ahmed Arafa | Ayman Mahrous | Ahmed Islam | Okoh Daniel | Yuichi Otsuka | Patrick Mungufeni

Egypt-Japan University of Science and Technology | Egypt-Japan University of Science and Technology | Egypt-Japan University of Science and Technology | Egypt-Japan University of Science and Technology | Alexandria University | Nigeria | Nagoya University - Japan | Uganda

In the present work, we introduce a novel artificial intelligence (AI)-based approach for modeling the ionosphere over Egypt. Our aim is to develop an accurate and reliable model utilizing satellite data, particularly targeting regions with limited ground-based observations, such as North Africa-including Egypt. A key novelty of this study lies in its focus on modeling the ionospheric state during geomagnetically active conditions, which remains a significant challenge for researchers striving for high-accuracy models. The proposed approach incorporates multiple geophysical features known to influence ionospheric behavior, and leverages the International Reference Ionosphere (IRI) model as a reference standard to guide the learning process using spaceborne observations. Such modeling techniques are crucial for improving ionospheric monitoring and forecasting, as well as for mitigating space weather impacts on trans-ionospheric signal propagation.

Efficient Python-Based Analysis of Long-Term UV Radiation Data over Egypt

Ahmed Abulwfa | Ashraf Khamees | Heba Zenhom

National Research Institute of Astronomy and Geophysics | National Research Institute of Astronomy and Geophysics | National Research Institute of Astronomy and Geophysics

Long climatological archives of satellite-retrieved ultraviolet (UV) radiation are crucial for public-health risk assessments, renewable-energy planning, and atmospheric-chemistry studies in arid regions such as Egypt. Yet scientists often move and reshape terabytes of NetCDF files with sub-optimal scripts that consume excessive CPU time, random-access memory (RAM), and disk I/O. We present a resource-aware Python workflow that shortens wall-clock time by 52 %, lowers peak RAM by 73 %, and cuts network traffic by 65 % compared with a naïve baseline, while reproducing reference statistics (mean UV-B dose, 95 th-percentile erythemal irradiance, trend slopes) within ±0.1 %. The workflow is demonstrated on daily OMI-L3 UVB data (0.25° × 0.25°; 2010-01-01 → 2024-12-31) limited to Egypt's land area. Techniques include chunked lazy loading via xarray+dask, on-the-fly sub-setting, Zarr caching, XESMF exactly-conservative regridding, and snakemake-controlled orchestration. We provide reproducible code snippets and an open-source repository template.

Multi-Instrument Detection of Travelling Ionospheric Disturbances During Geomagnetic Storms Over Egypt

Hassan Nooreldeen | Abdalla Shaker | Amira Hussien | Ahmed S Farahat | Lobna H Basmsm | Ahmed Aboulftouf | Afaf M. Abd El-Hameed

EgSA-Egyptian Space Agency | EgSA-Egyptian Space Agency | EgSA-Egyptian Space Agency | Beni-Swif University, Faculty of Navigation Science and Space Technology (NSST), | Beni-Swif University, Faculty of Navigation Science and Space Technology (NSST), | National Research Institute of Astronomy and Geophysics (NRIAG), Solar and Space Research Department

Building on initial observations of storm-driven ionospheric disruptions, this study focuses explicitly on detecting and characterizing Travelling Ionospheric Disturbances (TIDs) over Egypt during intense geomagnetic storms (2024–2025). We employ a synergistic approach combining: (a) High-resolution Vertical Total Electron Content (VTEC) from the Egyptian Space Agency's High-end GNSS network, (b) Wide-coverage VTEC measurements from the ICTP Low-Cost GNSS network, (c) SWARM in situ observations of plasma bubbles and electron density to correlate TIDs with equatorial instability processes. Storm drivers are quantified using Geomagnetic indices (e.g., Kp, Dst, AE). Advanced spectral methods (e.g., 2D Fourier transforms) applied to GNSS-TEC data reveal medium-scale TIDs during storm main phases., SWARM detects coincident plasma depletions. Results demonstrate the efficacy of multi-platform synergy in disentangling TID generation mechanisms and their impacts on regional navigation systems.

EM waves and GPR method; Processing, topographic migration and 1D Modeling

Maksim BANO
EOST/ITES, Strasbourg University; 5 Rue René Descartes, 67084 Strasbourg, France

According to Maxwell's equations, a time-varying electric field (E) generates a time-varying magnetic field (H) and vice versa. An EM wave corresponds to a simultaneous propagation of the electric and magnetic field. The magnetic and electric fields of an EM wave are perpendicular to each other, and the vector product E x H indicates the direction of propagation of the wave or the direction of the wave number vector (k). EM waves can travel in a vacuum, air, and solid objects, making them very useful for many technologies. The ground penetrating radar (GPR) method is a geophysical method, based on the propagation, reflection/diffraction of high frequency EM waves within the Earth. The frequencies used are in the range between 10 MHz and 2.5 GHz (wave length = 10 m and 4 cm, for a velocity of V = 0.1 m/ns). The GPR method works for medium with low electrical conductivity < 1 mS/m. GPR data processing is carried out with Radlab software written in Matlab and developed in our laboratory. The sequence of the processing is as follows: Time-zero correction, DC (or running average over time) filter, amplification (AGC or Envelope), flat reflection (or running average over x) filter. After the last filter, we can also apply a frequency band-pass filter and continue the velocity analysis and finally topographic migration, which is necessary when the variation in topography is comparable to the depth of investigation. We show some processed GPR profiles (Ecuador and Chad) obtained with a 250/500 MHz antenna.

Re-evaluating the J-Field in the Niger Delta, Nigeria, through Seismic and Well data integration before production resumption

Ohakwere-Eze Michael Chidozie
National Open University of Nigeria

J-field, discovered in 1982 and producing since 1993, is situated in the shallow offshore area of OML-X, about 13 km southwest of Bonny Terminal in the Eastern Niger Delta. The discovery well, J-01, encountered oil in four sands. Nine wells have been drilled in total, of which two were plugged and abandoned due to being wet. This study re-evaluates J-field's hydrocarbon potential with the aim of generating structural maps for the oil-bearing reservoirs and estimating their volumes for further development. Data from composite logs, well headers, checkshots, deviation surveys, and a 152 sqkm post-stack 3-D seismic volume were used. After quality checks to reduce uncertainties, findings revealed that J-field is primarily composed of marginal marine sediments with well-sorted blocky sands, facilitating reservoir connectivity likely influenced by tidal forces. Stratigraphic units date back to the late Miocene/Pliocene era. A total of 45 faults, including normal, listric, synthetic, and antithetic, were interpreted as part of the trapping mechanism. Four reservoir tops (A-04, B-04, C-01, and C-05) were mapped to create time and depth structure maps. Volumetric estimates showed significant hydrocarbon potential, with base-case results indicating A04=5MMBO, B04=90MMBO, C01=3MMBO, and C05=90MMBO, suggesting development benefits for stakeholders.

Tuesday, October 14, 2025

Integrating aeromagnetic data and Landsat-8 imagery for delineating the Mineralization zones in North Wadi El Allaqi Area, Eastern Desert, Egypt

Sary A. Shamraza | Faisal A. Ali | Mohamed M. Khalifa | Ahmed S. Mohamed
Mining and Petroleum Engineering Department, Faculty of Engineering Al-Azhar University, Qena. | Mining and Petroleum Engineering Department, Faculty of Engineering Al-Azhar University, Cairo. | National Research Institute of Astronomy and Geophysics, Helwan, Egypt. | Mining and Petroleum Engineering Department, Faculty of Engineering Al-Azhar University, Qena.

The study focuses on the North Wadi-Allaqi district, located approximately 220 km southeast of Aswan City in Upper Egypt, covering an area of about 4,702 km². This region experiences an extremely arid climate with minimal rainfall and is historically renowned for gold mining, with activity dating back to the Pharaonic Era. The area hosts over 11 gold mines, along with copper, chromite, talc, quartz, and granite quarries. To identify new mineralization zones, this study integrates aeromagnetic data and Landsat-8 imagery to map potential minerals-rich areas. Aeromagnetic data were enhanced using the Center for Exploration Targeting (CET) grid analysis to reveal key structural controls on hydrothermal alterations. Meanwhile, Principal Component Analysis (PCA) and spectral band ratios were applied to Landsat-8 data to detect hydrothermal alteration zones linked to mineralization. Structural trends extracted from Reduced-to-Pole (RTP) magnetic maps, CET analysis, and Landsat-8 data were statistically analyzed using rose diagrams. Results show dominant NW and NE trends in the RTP map, with CET-derived intersections aligning along NW-oriented structures. In contrast, Landsat-8 maps highlighted NNW, WNW, and NE trends. The combined findings reveal new high-potential mineralization zones, demonstrating that gold and other minerals-associated hydrothermal alterations are strongly influenced by NW, NE, E-W, and WNW-trending lineaments. This integrated approach enhances exploration efficiency in the Wadi-Allaqi district.

Integrated Subsurface Screening: Assessing the CO_2 Storage Potential in Abu Qir Field, Nile Delta, Egypt

Yousef Ahmed Moustafa Mohamed | Hanafy Mahmoud Holail | Moutaz Alriahy
Alexandria University fresh graduate | Professor, Geology Department, Faculty of Science, Alexandria University | CEO at CRETA Group

Addressing the critical challenge of greenhouse gas mitigation in alignment with international climate goals and Egypt's Vision 2030 and 2050, this study investigates the carbon dioxide (CO_2) storage potential within Abu Qir Field's Abu Madi depleted gas reservoir in the Nile Delta Basin, Egypt, which exhibits substantial promise for CO_2 geosequestration. Encompassing petrophysical, geomechanical, and geological structural parameters, as well as CO_2 thermodynamic behavior under reservoir conditions, the research aims to deliver a precise preliminary assessment of the fundamental criteria for a successful and safe CO_2 storage program: capacity, containment integrity, and injectivity. Using various integrated methodologies, both the Upper and Lower Abu Madi members emerge as prime candidates for long-term geological sequestration, demonstrating reservoir properties conducive to secure and sustainable CO_2 retention. The study reveals the area's promising effective storage capacity of 565.443 million tons—both theoretical and effective capacity have been assessed—equivalent to nearly two and a half times Egypt's 2022 CO_2 emissions from fuel combustion, as reported by the International Energy Agency. Multiple trapping mechanisms are incorporated in the evaluation with highlighting the influence of hysteresis over time and the potential for Enhanced Gas Recovery (EGR), offering a dual benefit: offsetting sequestration costs while recovering remnant hydrocarbons. The findings provide a scientific foundation to accelerate Egypt's CCUS ambitions, reinforcing its leadership within Africa and the Middle East, and bearing impact across the broader landscape of regional anthropogenic carbon management. Ultimately, this research contributes meaningfully to the global energy transition and the realization of net-zero carbon emissions.

Tuesday, October 14, 2025

A multi-disciplinary Approach to understanding Waterlogging Propagation in Structurally Complex Arid Zones: A study site at Cairo-Suez District, Egypt

Mohamed Attwa | Ahmed Henaish | Sara Zamzam | Fatma Ramadan | Sara Naeem
Zagazig University; National Authority for Remote Sensing and pace Sciences (NARSS) | Zagazig University | Zagazig University | Zagazig University | Zagazig University

New urban developments in arid regions, such as those along Egypt's Cairo-Suez district (CSD), frequently encounter significant environmental challenges, notably waterlogging from the seepage of wastewater. Understanding the complex relationship of local geology and existing structural features is a substantial task for effective mitigation strategies. This study presents a multi-disciplinary approach to characterize and understand the mechanisms waterlogging in El Shorouk City, as a test site within the highly structural CSD. Our approach integrates remote sensing (RS), detailed structural geology data analysis and 2D electrical resistivity tomography (ERT). RS data is utilized to delineate local geological features and to monitor the spatio-temporal propagation of waterlogged areas providing direct evidence of seepage pathways. Moreover, a detailed structural analysis is performed to establish critical relationships between observed waterlogging patterns and surface structures demonstrating their control over water flow. 2D-ERT surveys were conducted using a joint dataset inversion of Wenner-Alpha, Wenner-Gamma, and Dipole-Dipole arrays. This multi-array acquisition ensures high data coverage and robust imaging of the subsurface geology and structures. An advanced inversion scheme using BERT software with finite element forward calculations was applied to get highly accurate and representative subsurface resistivity images, crucial for understanding water flow. This integrated approach effectively delineates the shallow subsurface composition, identifies controlling structures, and clarifies their influence on wastewater flow and waterlogging appearance. The findings of this research offer a transferable and effective methodology for studying similar environmental problems in areas with comparable geological and structural conditions throughout the CSD and other arid urban environments globally.

Numerical Approach to Assess Ait Idriss Landslide Triggered by Kherrata Earthquake (Northeast Algeria)

Mohamed Djabri
Department of Earth and Universe Sciences, Echahid Cheikh Larbi Tebessi Tebessa-University, Algeria

Landslides are geomorphological phenomena that affect natural embankments and slopes; they can cause significant damage to structures and engineering projects, with a significant economic impact, and sometimes cause casualties. Landslides occur following a several natural event including heavy rain, volcanic processes, bank erosion, height relief and also earthquakes. Their spatial distribution is guided by topography, geomorphology, geology (nature and fracturing of outcrop formations) and also hydrogeological condition. This paper deals to assess the stability of Ait Idris landslide triggered by earthquake (Mw=5.3) where the seismic epicenter was located near the Kherrata city (Wilaya of Bejaia, northeast Algeria). Two dimensional numerical stability analysis based on Finite Elements Method (FEM) integrated in the PLAXIS 2D V8.2 code was performed. In particular, this stability is evaluated by calculating the Factor of Safety (Fs) which is found to be less than 1 showing that the ground is unstable.

Crosshole seismic tomography for the potential site of the Iconic Tower at the New Administrative Capital, Cairo, Egypt.

Ashraf Khozym
NRIAG

A geophysical investigation using direct seismic cross-hole testing and cross-hole seismic tomography was conducted at the largest skyscraper in Africa, the Iconic Tower in the New Administrative Capital, using P-waves to evaluate the geotechnical properties and dynamic elasticity of subsurface materials to a depth of approximately 80 meters below ground level. Measurements were conducted between wells BH-IC-11C and BH-IC-11D, reaching depths of 73 meters for direct testing and 79 meters for cross-hole tomography. The results showed P-wave (Vp) velocities ranging from 0.748 to 3.980 km/s and S-wave (Vs) velocities from 0.364 to 2.179 km/s. Poisson's ratio values ranged between 0.279 and 0.345. Based on these values, dynamic elastic moduli—including shear modulus, bulk modulus, and Young's modulus—were calculated. Tomographic analysis revealed a three-layer subsurface model. The uppermost layer (to ~13 m) consists of fill material and loose soils with Vp between 0.4–1.5 km/s. The middle layer (13–52 m) comprises moderately to highly weathered basalt, with velocities of 1.5–4.5 km/s. Higher velocities (>2.5 km/s) indicate better rock quality, while lower values suggest weak or fractured rock. The lowest layer (52–79 m) consists of highly weathered sandstone, hard clay, and very dense sand, with Vp ranging from 1.0–2.5 km/s. Velocities below 1.3 km/s point to relatively loose sand. No significant P-wave velocity drops indicative of open cavities were detected; however, localized zones with lower velocities suggest potential weakness due to weathering or fracturing. The findings reflect significant lateral and vertical variability in subsurface conditions, contributing to a clearer understanding of site-specific geotechnical characteristics.

High-Resolution Seismic Refraction Tomography to Delineate Subsurface Structures, Dead-Sea, Jordan

Fathy Bahloul
Ex DMT GmbH

High-resolution Seismic Refraction Tomography (SRT) was conducted at the most northern section of the Araba Stream Channel, Dead Sea, Jordan. The survey area is the former seabed of the Dead Sea which evaporated strongly over the last decades and years. The scope of the survey is mainly to map geological structures in the surveyed areas (Stratigraphy, faults and cavities etc). The request investigation depth is 60m. The total line length is 10 kilometer. The layout comprises three lines in south-north direction (parallel to the Araba stream) and nine lines in west-east direction. The Seismic Refraction Tomography (SRT) data are acquired and recorded along profiles just like the standard seismic refraction method. However, the SRT method is involving a considerably higher measuring effort than the standard seismic refraction. The geophones and shot-points distances are very dense to enable a high resolution description of the velocity distribution within the underground. The used geophone station spacing is 1 m and the shot position is each 2 m (each second geophone). The SRT processing provides a continuous underground section showing 2D velocity distribution of seismic waves horizontally and vertically along the surveyed lines. The interpretation describes the structural setting on the basis of first arrivals of the seismic signal and its inversion to detect lithological interfaces with distinctive impedance contrast . The processed 2D sections show a high resolution model of the underground and reveal a lot of structures according to the P-wave propagation velocities. And also reveal a lot of faults and sinkholes.

Tuesday, October 14, 2025

Session **Oral-Solar Physics**

Interplanetary radio emission due to CME-CME interaction

Diyorbek Pulatov | Zavkiddin Mirtoshev
Samarkand State University, Uzbekistan | Samarkand State University, Uzbekistan

We analyzed the interaction between two CMEs observed in the interplanetary medium at 18:06 UTC and 19:30 UTC on 6 April 2001, respectively, and the associated long-wavelength radio observations using DH type II burst. We identified the first (CME1) and second (CME2) CMEs and their associated DH type II burst using the SOHO/LASCO catalog and the Wind/Wave catalog, respectively. CME1 traveled through the SOHO FOV at a linear velocity of 648 km/s at an position angle (PA) of 106º. CME2 is a halo-CME, traveled much faster than the CME1, at a linear speed of 1270 kms−1 and interacted with CME1 at 20:42 UTC at a distance of 11.82 Rs. The CME that separated at 19:30 UTC reached Earth on 8 April and caused a geomagnetic storm (Dst = -59 nT). Both CMEs ejected from the NOAA AR9415 active region in the eastern part of the Solar surface and did not trigger a Solar Energetic Particle (SEP) event. As a given Gopalswamy et al (2008), space weather events are more likely to trigger a SEP event if a CME originating in the western hemisphere is accompanied by a DH type II burst. The DH type II burst began at 19:35 UTC on 6 April and ended at 01:50 UTC on 7 April and duration for ~6 h. The center frequency of the emission in the DH spectrum during the interaction appears to decrease with increasing interaction height.

Coronal Mass Ejections' Evolution and Geoeffectiveness During Solar Cycles 23, 24 and Early 25: A Focus on Homologous Events

Alshaimaa Saad Hassanin
Astronomy, Space Science and meteorology Dep. - Faculty of Science - Cairo University

This study presents a comprehensive analysis of the correlation between coronal mass ejections (CMEs) and geomagnetic storms during (1999-2024). An investigation of the features of CMEs that have a higher probability of being highly geoeffective through different observations is provided. Furthermore, we highlight the significance of CME-CME interactions and their influence on the properties of geomagnetic storms. Our results indicate that the activity of the geoeffective CMEs and associated flares exhibits higher frequency in early solar cycle 25 than in cycle 24. If this trend continues, it could indicate a return to higher solar activity similar to cycle 23, leading to increased space-weather events. Additionally, hemispheric asymmetry is observed in geoeffective CMEs across cycles, with cycle 24 favoring the northern hemisphere at the initial half and early cycle 25 showing a possible return to southern dominance. This asymmetry reflects differences in magnetic flux dynamics across different solar cycles. Our study of "homologous CMEs" confirms that the interaction between successive CMEs, was often responsible for the most intense geomagnetic storm and long durations of the resulting geomagnetic disturbance. The analysis indicates that powerful ICMEs generate extended geomagnetic impacts, with peak durations of approximately 30 to 35 hours, while moderate events generally persist for 15 to 20 hours. Our findings show that homologous ICMEs maintain plasma heating in compression zones, but non-homologous ICMEs display reduced durations and weaker thermal impacts. The ability to forecast such space weather phenomena will greatly be improved by a better understanding of their initiation mechanism(s)

Scientific Preparations and Observational Strategy for the August 2, 2027 Total Solar Eclipse in Luxor, Egypt

Yasser A. Abdel-Hadi
Solar and Space Research Department, National Research Institute of Astronomy and Geophysics (NRIAG), Helwan, Cairo, Egypt

his study outlines a comprehensive pre-eclipse strategy for the total solar eclipse occurring on August 2, 2027, with a focus on Luxor, Egypt. We present predictive modeling of eclipse geometry, forecasts of coronal structures at solar maximum, site-specific instrumentation plans, and collaborative frameworks aimed at maximizing scientific output from this rare celestial event.

Solar Observations in Bulgaria and collaborations in space weather research

Momchil Dechev | R. Miteva | P. Markishki | G. Latev | Susan W. Samwel
Institute of Astronomy and NAO, BAS, Bulgaria | Institute of Astronomy and NAO, BAS, Bulgaria | Institute of Astronomy and NAO, BAS, Bulgaria | Institute of Astronomy and NAO, BAS | National Research Institute of Astronomy and Geophysics, (NRIAG), Egypt

Solar observation initiatives at the Belogradchik Observatory and St. George International School and Preschool in Sofia, Bulgaria, represent a collaborative effort bridging professional astronomical research with educational outreach. We outline the methodologies, instruments, and first observations of solar activity phenomena that can be conducted at these two sites, emphasizing their complementary roles in advancing both scientific understanding and education. The Belogradchik Observatory, equipped with specialized solar telescopes (including H-alpha and white-light filters), provides high-resolution imaging capabilities for tracking dynamic solar phenomena such as sunspots, prominences, and flares. Concurrently, Saint George School in Sofia integrates solar observation into its curriculum, utilizing portable solar telescopes and digital imaging tools to engage students in hands-on data collection and analysis. The Bulgarian-Austrian project ‘Joint Observations and Investigations of Solar Chromospheric and Coronal Activity’ served as a foundation for establishing solar observations in Bulgaria. The possibilities for joint observational campaigns and space weather studies with Egypt are discussed under a new collaboration effort.

Understanding the Effects of Source Extent and Pitch-angle Distribution on SEP Transport with the new EPREM-CPP Global Model

Artem Epifanov | Kamen Kozarev
Institute of Astronomy and NAO, BAS | Institute of Astronomy and NAO, BAS

Solar energetic particles (SEP) are coronal ions and electrons, accelerated to high energies in solar flares and coronal mass ejections (CME). They are transported throughout the solar system along and across large-scale interplanetary magnetic fields, but the details of how they propagate depend on the small-scale local magnetic field turbulence and waves. SEPs pose a significant space radiation hazard for manned and robotic solar system missions, and are thus of great interest to physicists and space stakeholders alike. Recently, we have developed a new global SEP transport model, EPREM-CPP, based on the Energetic Particle Radiation Environment Module (EPREM) code, but significantly improved its computational efficiency for low- and medium-sized runs, and added significant flexibility in specifying boundary conditions. We have used EPREM-CPP to study how the transport of SEPs and heliospheric distribution of particles varies with varying the inner boundary source position, temporal behavior, and pitch angle distribution, in a realistic solar wind model. Additionally, we have addressed the question of how the heliospheric current sheet affects the cross-equatorial SEP transport, and how the off-equatorial propagation of CMEs affects the transport of SEPs near the equator.

Using color indices to determine true dawn in different locations in Egypt

Nasser M. Ahmed | A.H. Hassan
NRIAG | NRIAG

Morning twilight observations were carried out in the period 2015- 2019 in different sites in Egypt (Kottamia, Fayum, Aswan and Kharga) mainly to deduce the true dawn. Two Cameras was used to measurements of light (Nikon and Cannon).Â All observations in this research were taken horizontally towards the east direction; the depression of the sun below the horizon was calculated from the local time of each scan. The devised is fixed is at altitude, a= 5 and at azimuth of sunrise, A). Â A Python program was used to decompose the images into B (blue), G (green), and R (red) colors. The values â€‹â€‹and signs of the color indices (Bâ€“G), (Bâ€“R), and (Gâ€“R) vary depending on the depression of the sun below the horizon at morning twilight, which depends on atmospheric components and wavelength range. The purpose of these measurements was to determine the sun vertical depression of the sun below the horizon, Do (Do=-altitude of the sun) at which the normal eye can discriminate the true dawn (strong horizontal white thread).

The Sun-as-a-Star in an Extended Low-Order Solar Dynamo Model

Katia Becheker | Mohamed Reda Bekli | Abdeldjalil Zaidi | Abdelghani Hadj Hammou | Zahir Belhadi

Université de Bejaia, Faculté des Sciences Exactes, Laboratoire de physique théorique, 06000Bejaia, Algérie | Université de Bejaia, Faculté des Sciences Exactes, Laboratoire de physique théorique, 06000Bejaia, Algérie | Université de Bejaia, Faculté des Sciences Exactes, Laboratoire de physique théorique, 06000Bejaia, Algérie | Laboratoire de physique théorique, Département de Technologie, Faculté de Technologie, Université de Bejaia, Bejaia, 06000 Béjaïa, Algérie | Université de Bejaia, Faculté des Sciences Exactes, Laboratoire de physique théorique, 06000Bejaia, Algérie

In recent decades, flux-transport-dynamo models have emerged as a promising and crucial framework for understanding the dynamics of the Sun's magnetic field and solar cycle (Choudhuri et al. (1995); Dikpati et al. (2009); Wang et al. (1991)). Their importance lies in their ability to reproduce key features of the solar cycle and provide valuable insights into the Sun's magnetic field behaviour. In the present communication, we show how by applying spatial truncation on the axisymmetric mean-field dynamo model, two coupled differential equations can be deduced. Then, we employ the solutions of these equations obtained by homotopy and Poincaré–Lindstedt perturbation methods (Chadou et al.(2024)), to propose a new model that describes the true mean magnetic field of the sun. An interesting breakthrough that emerged from our analysis is that when confronted with the measurements of the sun's mean line-of-sight field, our model allows us to reconstruct important parameters linked to other solar indicators, suggesting that the key to the underlying dynamics of the sun's magnetic field lies in the sun-as-a-star magnetic field measurements.

Tuesday, October 14, 2025

Session **Oral-Stellar Astronomy**

Ground-Based Spectrophotometric Survey of RR Lyrae Stars at Oukaimeden observatory : Linking Atmospheric Variability to Space-Based Pulsation Signatures

BENHIDA Abdelmajid
CadiAyyad Univrsity/Oukaimeden Observatory

We present the results of an ongoing spectrophotometric campaign of RR Lyrae variable stars conducted at the Oukaimeden Observatory (Morocco), with a particular focus on RR Lyr Star. This ground-based effort, initiated to complement high-precision space photometry from Kepler and TESS, aims to provide a comprehensive view of pulsation dynamics by combining simultaneous light and spectral data. Over multiple observing seasons, we acquired time-series photometry and medium-resolution spectra using local instrumentation adapted to long-term monitoring. Our spectroscopic observations, synchronized with photometric maxima, reveal radial velocity variations consistent with the pulsation period and permit the reconstruction of atmospheric parameter variations over the cycle (e.g., temperature, gravity, line asymmetries). This enables the detection of phase-dependent modulations potentially linked to the Blazhko effect, which is independently confirmed in satellite photometry through the identification of side-lobe frequency structures and amplitude/phase modulation.This study illustrates the critical role of ground-based observatories like Oukaimeden in the modern era of time-domain astronomy. The combination of spectrophotometry with space-based photometry allows for a more complete physical characterization of RR Lyrae stars, bridging the gap between photometric variability and stellar atmospheric dynamics. It also highlights the importance of site-based campaigns in the Global South as strategic complements to large-scale space missions.

OAE-Egypt: New Frontiers in Astronomy Outreach, Education and Development

Somaya Saad
NRIAG

In the past decade, astronomy outreach and Education showed significant development in Egypt. The establishment of the center of astronomy education OAE-Egypt and the work in cooperation with Â the IAU offices, IAU-OAO and IAU-OAE helped us to be visible and to cooperate widely on the national, regional and international level. The talk therefore focuses on the role of the center of astronomy education in Egypt in contributing to astronomy education and outreach activities development and will highlight the current development in astronomy education and outreach activities.

Photometric Analysis of four δ Scuti Stars: AE Uma - CW Ser-Cy Aqr-RV Ari

Mohamed Abdel Sabour
NRIAG

A depth photometric study of four Delta Scuti stars was performed. We used time-series data from the 1.88 m telescope of Kottamia Astronomical Observatory (KAO, Egypt), SuperWASP database, and Transiting Exoplanet Survey Satellite (TESS) that are available in different sectors. We estimated the physical parameters of the target stars using the Gaia Data Release 3 (DR3) parallax method. The results obtained for the surface gravity of the stars are consistent with the reports of the TESS Input Catalog and the Gaia DR3. We estimated the pulsation constant based on the physical parameters and periods of the stars. We analyzed their light curves and applied the Discrete Fourier Transform to determine the pulsation frequencies. As shown in the Hertzsprung-Russell (H-R) diagram, the stars are located in the instability strip of the Delta Scuti stars region. Four target stars were found to be of the high-amplitude δ Scuti star type. The peak-to-peak amplitude is determined using the first mode present frequencies with the number of harmonics for the four stars. We obtained the period change 1/P dP/dt for the four stars. We compared all stars in the Teff – log g diagram with known δ Scuti stars, and the global physical parameters of the star were presented.

Tuesday, October 14, 2025

Light Curve Analysis of a Recently Discovered Eclipsing Binary Star: KAO-EGYPT J214258.21+440520.2

Ahmed Essam | Gamal M. Hamed
NRIAG | NRIAG

New CCD light curves in the V, Rc, and Ic bands of the W UMa-type eclipsing binary system KAO-EGYPT J214258.21+440520.2 were obtained using the 1.88 m reflector telescope at Kottamia Astronomical Observatory (KAO), Egypt, on September 27 and 28, 2016. Based on these observations, new times of minima and a revised ephemeris have been determined. The geometric and photometric parameters of the system were derived using Binary Maker 3.0 (BM3) and the PHOEBE program. Light curve analysis indicates that KAO-EGYPT J214258.21 +440520.2 is a semi-detached binary system with an orbital period of P = 0.617898 days and a mass ratio q = 0.5419. Based on the estimated temperatures of the primary (T_1 = 6555 K) and secondary (T_2 = 5500 K) components, the spectral types are classified as F6 and G6, respectively. Abstract here with out any formatting.

The first light curve Solutions and Evolutionary Status of Some Contact Binary Stars using ZTF and TESS data

Ahmed Shokry Abouelfoetouh Elshaer
National Research Institute of Astronomy and Geophysics

In the present study, we investigate a sample of contact binary stars (CBs) using photometric data obtained from the Zwicky Transient Facility (ZTF) and the Transiting Exoplanet Survey Satellite (TESS). We perform light curve analysis to derive orbital parameters for each system. Using the obtained results and Gaia DR3 parallaxes, we calculate the stellar components' absolute parameters, including masses, radii, and luminosities. We adopted the systems on mass-radius and mass-luminosity diagrams to evaluate their evolutionary status.

Monte Carlo Modeling of Composite Polytropes

Mona M. Foda | Samah H. El-Essawy | Mohamed Aboueisha | Mohamed I. Nouh
1Astronomy Department, Faculty of Science, Cairo University | Astronomy Department, National Research Institute of Astronomy and Geophysics, | Astronomy Department, National Research Institute of Astronomy and Geophysics, | Astronomy Department, National Research Institute of Astronomy and Geophysics,

Direct measurements of the interior physical state of stars and planets are impractical owing to the severe environments and depths involved. Thus, theoretical models are essential for elucidating their internal structure and behaviour. Polytropic models have shown efficacy in characterising self-gravitating gaseous spheres in hydrostatic equilibrium. This paper presents a new category of composite polytropic models intended to replicate the interior structure of compact stars and planets characterised by non-uniform matter distributions. These models are generated by concurrently solving the Einstein field equations and the polytropic equation of state, integrating a spatially variable polytropic index. This variability enables the model to adjust to fluctuations in density and pressure inside the star or planetary interior, offering a more accurate depiction than conventional uniform-index polytropes. This study uses the Monte Carlo (MC) numerical approach to address the relativistic Lane-Emden-type equations related to these composite setups. The MC method provides adaptability and efficacy in addressing the intricate, non-linear characteristics of the governing equations, particularly in relativistic contexts. Applications to planetary interiors and compact stellar objects, including white dwarfs and neutron stars, are examined. The findings underscore the importance of variable-index models in accurately representing the intricate physics of dense astrophysical entities and illustrate the effectiveness of stochastic numerical techniques in contemporary theoretical astrophysics.

Quantitative Spectroscopy of Early-Type O5 Dwarf Stars

Diaa, A. Fouda | Mohamed I. Nouh
National Research Institute of Astronomy and Geophysics (NRIAG) | National Research Institute of Astronomy and Geophysics (NRIAG)

We present a synthetic spectra of galactic early-type O5 dwarf stars, with high signal-to-noise ratio (S/N) ~ 200-300, medium- resolution R ~ 2500 optical spectra of O5 dwarfs stars from Galactic O-Stars Spectroscopic Survey (GOSSS). Stellar Parameters (Teff, Surface gravity, rotational velocity) will be determined using non-LTE line-blanketed photospheric models with TLUSTY200 and SYNSPEC49. Additionally, we will model the spectra with the NLTE line-blanketed wind code CMFGEN to derive wind parameters. Stellar parameters, and chemical abundances, obtained with the two codes will be compared.

Tuesday, October 14, 2025

Custom-Built Software Solutions for Coordinated Telescope-Dome Operation and Monitoring of NEOs.

Mohamed Ismail | Farag elnagahy | Islam Helmy | A.M. Abdelaziz
National Research Institute of astronomy and geophysics | National Research Institute of astronomy and geophysics | National Research Institute of astronomy and geophysics | National Research Institute of astronomy and geophysics

This paper explores the development and integration of specialized software for telescope control, dome synchronization, image processing, and visualization in astronomical observatories. With the advancement of automation technologies, observatories are increasingly relying on software systems to manage telescope movement, align dome rotation, and process captured images for enhanced clarity and scientific accuracy. Special attention is given to the importance of designing and implementing custom-built software solutions, which allow better adaptability to local requirements and more efficient system integration. The research highlights key software tools used for these purposes, discusses the communication protocols enabling synchronization between telescope and dome, and reviews methods for real-time and post-processing image enhancement. The system's ability to support fast-response observations is particularly crucial in tracking and monitoring near-Earth objects (NEOs), which demand both accuracy and rapid adaptability. The findings demonstrate that the use of such integrated systems significantly improves observational efficiency, data quality, and operational reliability.

Tuesday, October 14, 2025

Session **Oral-Geodesy 1**

GRACE and GRACE-FO for assessing watershed response to climate variability

Karem Abdelmohsen
National Research Institute of Astronomy and Geophysics

Our analysis of multi-source satellite data (GRACE, GRACE-FO, Landsat 5/7/8, radar altimetry) and land surface models over the Tigris-Euphrates watershed reveals a significant recovery following a prolonged drought (2007–2018; AAP: ~400 km³). An extreme precipitation event in 2019 (~726 km³)—unmatched in the past century—replenished ~113±11 km³ of terrestrial water storage (TWS), compensating for ~50% of prior losses by filling reservoirs (individual capacity up to 60 km³; total ~250 km³). However, dry years followed (2020–2021), during which GRACE TWS remained near 2019 levels, likely due to strategic reservoir releases. By 2022–2023, TWS declined again to near pre-2019 levels. A similar pattern is observed in Egypt's Dakhla Basin, where GRACE showed depletion (2002–2018) followed by full recovery after a major Nile flood event. Excess runoff filled Lake Nasser, with >40 km³ discharged to desert depressions. Unlike the Tigris-Euphrates system, where moderate dam capacity supports short-term buffering (2–3 years), the Aswan High Dam's large storage capacity enabled a near-complete recovery of GRACE TWS. These findings highlight that watersheds with large storage dams can fully buffer extreme climate impacts, whereas those with smaller capacities offer only partial, short-term resilience.

Geospatial Analytics for Sustainable Development of the Urbanâ€“Rural Interface in Lahore through Remote Sensing and Machine Learning Approaches

Syed Amer Mahmood
Institute of Space Science, University of the Punjab, Lahore, Pakistan

Urban centers like Lahore, Pakistan, are increasingly facing challenges related to rapid urbanization and climate change, necessitating innovative solutions for sustainable development. This study harnesses big data analytics to evaluate land use and land cover (LULC) changes in Lahore from 2004 to 2024, providing insights into urban growth patterns and their implications for climate resilience. Utilizing remote sensing (RS), Geographic Information Systems (GIS) and Machine learning (ML), we identified significant LULC shifts, including a 29% increase in built-up areas and a corresponding 17% decrease in green spaces over the two decades. Projections for 2029 to 2040 indicate a further escalation in urban sprawl, potentially reaching 40% of the total land area. Concurrently, climate change factors such as rising temperatures and increased precipitation variability are analyzed from 2000 to 2024, with predictions extending to 2040 suggesting an average temperature increase of 1.5Â°C and altered rainfall patterns contributing to urban flooding risks. By correlating LULC changes with climate variables, the study reveals a critical link between urban expansion and climate vulnerability at micro-levels, highlighting the need for data-driven urban planning strategies. The findings underscore the importance of leveraging big data to inform sustainable urban policies, aiming to enhance Lahore's resilience to climate change while fostering responsible urban growth, that poses a great threat to agriculture in the suburbs and extensive groundwater depletion in the urban-rural continuum. It emphasizes the need for sustainable urban planning practices that enhance green spaces, manage urban heat, and improve water quality.

Tuesday, October 14, 2025

Triple Time Integration for Unifying the Arab Vertical Reference Frame

Abdelrahim Ruby | Wenbin Shen | Ahmed Shaker | Zhang Pengfei | Mostafa Ashry | Shen Ziyu

State Key Laboratory of Information Engineering in Surveying, Mapping and Remote Sensing, Wuhan University, Wuhan 430079, China | Time and Frequency Geodesy Center, School of Geodesy and Geomatics, Wuhan University, Wuhan 430079, China | Geomatics Engineering Department, Faculty of Engineering at Shoubra, Benha University, Cairo 11629, Egypt | Time and Frequency Geodesy Center, School of Geodesy and Geomatics, Wuhan University, Wuhan 430079, China | Civil Engineering Department, Faculty of Engineering, Minia University, Minia 61111, Egypt | School of Resource, Environmental Science and Engineering, Hubei University of Science and Technology, Xianning, Hubei 437100, China

Several Arab countries, including the Kingdom of Saudi Arabia (KSA), Oman, and the United Arab Emirates (UAE), have made significant progress in developing unified national geodetic reference frames. Regional efforts are also underway to establish the Arab Geodetic Reference Frame (ARAB-GRF) under the United Nations Committee of Experts on Global Geospatial Information Management (UN-GGIM) Arab States. However, no parallel initiative has yet been launched to define a unified Arab Vertical Reference Frame (ARAB-VRF), which is critical for geodetic, engineering, and navigation applications across the region. The ARAB-VRF requires precise measurement of potential differences at reference stations, but traditional methods, combining leveling and gravimetry, have limitations like cumulative errors over long distances and inability to reliably connect points across challenging terrains or sea areas. This study proposes a novel approach based on Einstein's theory of General Relativity (GR), which predicts that clocks in higher gravitational potentials run faster than those in lower ones. Using this principle, the optical triple time integration method is applied to determine the geopotential difference between any two ground stations. This relativistic technique allows accurate comparison of height differences between local vertical datums in Arab countries. The method provides a strong basis for realizing and unifying the ARAB-VRF, supporting the broader ARAB-GRF initiative. A major challenge is building a regional laser ranging network among Arab countries. To address this, a simulation experiment will be conducted. This study is supported by National Natural Science Foundations of China (NSFC) (No. 42030105, 42388102, and 42274011) and Space Station Project (2020-228).

Towards a New National Geodetic Reference Frame for Oman: Insights from Six Years of GPS Monitoring

Amir M. Abolghasem | Faisal Al-Balushi | Yousuf Al-Wardi | Ismail Al-Sheidi | Zaid Al-Habsi

Ludwig-Maximilians-Universitaet Munich | National Survery and Geospatial Information Authority, Oman | National Survery and Geospatial Information Authority, Oman | National Survery and Geospatial Information Authority, Oman | Ludwig-Maximilians-Universitaet Munich and Sultan Qaboos University, Oman

In 2016, the National Survey and Geospatial Information Authority (NSGIA) of the Sultanate of Oman established a network of 47 Continuously Operating Reference Stations (CORS) across the country. This network has since been widely utilized for national mapping and geospatial projects. In 2017, NSGIA introduced the Oman National Geodetic Datum 2017 (ONGD17), derived from one to two weeks of CORS data. ONGD17 represents a regional densification of the International Terrestrial Reference Frame (ITRF2014) and serves as a static reference frame. The positions were determined for the epoch January 1, 2017, and transformation parameters were calculated accordingly. By the end of 2022, six years of continuous CORS data had been accumulated. In collaboration with the Department of Earth and Environmental Sciences at Ludwig-Maximilians-Universität Munich (LMU), NSGIA developed a new dynamic reference frame to replace ONGD17. This updated frame, ONGD23, includes both positions and site velocities, allowing for precise coordinate computation and transformation at any desired epoch. The reference epoch for ONGD23 is January 1, 2023. ONGD23 is currently undergoing testing and is expected to officially replace the static ONGD17 frame as the national geodetic reference in the near future.

The investigation of the accuracy for the transformation between KSA-GRF17 and MTRF2000

M. GOMAA | R. ALDURAIBI | S. ALZAHRANI
Doctor of Geophysics, Geodynamics Dep. NRIAG, Egypt | Geodesy Dep, Ministry of Municipalities and Housing | Geodesy Dep, Ministry of Municipalities and Housing

The accuracy of transformation between geodetic reference frames is a crucial aspect in geodesy. There are several geodetic reference frames in the Kingdom of Saudi Arabia (KSA). Among these geodetic reference frames is the Ministry of Municipalities and Housing's MTRF2000, with a reference epoch of 2004. The General Authority for Survey and Geospatial Information (GEOSA) has calculated an updated new reference frame (KSA-GRF17), reference epoch 2004. The Authority has calculated the transformation parameters between this updated reference frame and various geodetic frames in the Kingdom and has developed a tool for transformation between geodetic references. In this article, the transformation parameters between the two main references in the Kingdom (MTRF 2000 and KSA-GRF 17) are examined. The results show that the transformation parameters between MTRF2000 and KSA-GRF17 have an accuracy range from 5 to 10 cm, except in some regions as the JOFF region.

Long-term Variability of the Climatic Patterns Under Expanding Tropics in the Mediterranean Region

Mohamed Darrag | Shuanggen Jin | Aalaa Samy | Ali M. Radwan
National Research Institute of Astronomy and Geophysics-NRIAG | Henan Polytechnic University | National Research Institute of Astronomy and Geophysics-NRIAG | National Research Institute of Astronomy and Geophysics-NRIAG

The Mediterranean region's climatic parameters are undergoing substantial changes as a result of climate change and tropical belt extension. This paper explores the long-term variability of the climatic parameters (tropopause, temperature, precipitation, and Standardized Precipitation Evapotranspiration Index (SPEI)) over the Mediterranean region and their relationship and interaction with tropical belt expansion by employing observational and reanalysis data from January 1980 to December 2022 and through applying comprehensive analysis (correlation, linear regression, Single Value Decomposition (SVD), wavelet coherence (WTC), and principal component analysis (PCA)). The lapse-rate tropopause height (LRT-H) depicts upward trends of about 80.58 m/dec, reflecting the increasing warming over the Mediterranean region. In addition, the tropical belt shows poleward expansion of about 0.14 Â°/dec and 0.27 Â°/dec for both applied subjective and objective methods, respectively, with a clear longitudinal variation for tropical edge latitudes (TELs) locations. The TELs of both definitions are in phase and have a strong positive correlation with LRT-H, surface temperature, and tropospheric temperature while being of strong negative correlation and out of phase with precipitation. However, there is no substantial correlation between the SPEI and TELs or other climate factors. The results of SVD analysis exhibit that the surface temperature and lower tropospheric temperature (TRP-1) have evident coupling with the TELs in the eastern Mediterranean region. The upper tropospheric temperature (TRP-2) depicts fluctuations of the same sign to that of the TELs in the southernmost of Europe and the northernmost of Africa.

An Up-to-Date Crustal Deformation Map of Northern Aswan, Egypt Using Geodetic and Remote Sensing Data

Hanan Genidi | Mohamed Saleh | Abdel-Moneam Mohamed
National Research Institute of Astronomy and Geophysics | National Research Institute of Astronomy and Geophysics | National Research Institute of Astronomy and Geophysics

Aswan, located in southern Egypt which, contain one of the most strategic engineering structures in Egypt, the High Dam. After its full operation of the dam in 1971, a series of micro-earthquakes occurred around the High Dam. The largest seismic event recorded in the region was in November 14, 1981, earthquake with a magnitude of 5.6 ML, located 60 km to the southwest of the dam. Due to the great importance of this area, a combination of remote sensing (InSAR) and terrestrial data (precise leveling) was used to shed light on the current state of crustal deformation in this area. The data collected from three leveling lines (six campaigns) covering the period 2013–2022 in addition to 107 SAR scenes (2017–2021) from the Sentinel-1 mission were used to estimate the up-to-date ground deformation of the study area. The results from both Small Baseline Subset (SBAS) and leveling measurements show that the fault normal velocity of the Spillway fault is approximately 3 ± 0.15 mm/yr. The obtained results coincide with the seismicity pattern recorded in the study area, as the seismic events close to the dam are characterized by normal fault mechanisms. Outcomes show the importance of combining terrestrial (leveling) and space geodetic techniques (InSAR) to map the active faults and estimate the deformation rates along these faults.

Tuesday, October 14, 2025

Integrated Geospatial Assessment of Coastal Vulnerability in Egypt's Nile Delta: Sea Level Rise, Shoreline Change, and Land Subsidence

Mohamed Saleh Ahmed | Soha Reda ibrahim | Karim wagih marcos
Earth dynamics department, National Institute of Astronomy and Geophysics. | National Institute of Astronomy and Geophysics . | Ain Shams University.

Over the past several decades, remote sensing technologies have become essential tools in environmental monitoring, particularly in coastal regions exposed to both natural and anthropogenic pressures. Egypt's Nile Delta has experienced considerable shoreline retreat and environmental degradation, largely due to disruptions in sediment supply and increasing coastal vulnerability. The region faces escalating threats from sea level rise driven by climate change, as well as land subsidence caused by factors such as sediment deficiency, urban expansion, hydrocarbon extraction, and excessive groundwater withdrawal. These challenges emphasize the critical need for integrated monitoring and assessment of coastal dynamics. To tackle this concern, the current study adopts a multidisciplinary geospatial methodology, combining satellite altimetry, shoreline change analysis, and InSAR-based subsidence monitoring. Long-term sea level trends were evaluated using satellite altimetry data from January 1993 to December 2023. Shoreline dynamics were analyzed through Landsat imagery (Landsat 7, 8, and 9) spanning from 2000 to 2024, while land subsidence was assessed using SBAS-InSAR techniques based on 334 ascending Sentinel-1 (A and B) scenes from 2016 to 2024.Initial altimetry results indicate sea level rise of approximately 3.54 ± 0.5 mm/year along the Mediterranean coastline of the Nile Delta. The analysis of Landsat data quantified shoreline change by calculating the displacement between the earliest and latest shoreline Significant erosion was identified along the Damietta and Rosetta branches, whereas Brullus exhibited signs of sediment accumulation.These combined findings highlight the increasing exposure of the Nile Delta to coastal risks linked to sea level rise and land subsidence.

HYDROLOGICAL PATTERN OF NASSER LAKE USING SATTELITE DATA (2002-2025)

Mohamed Hussein and Dr Khaled Zahran
NRIAG

There is a general agreement that deep aquifers experience significant lag time in their response to climatic variations. The Nubian Sandstone Aquifer System (NSAS) demonstrated a quick reaction of the aquifer to climate change, according to analysis of the Gravity Recovery and Climate Experiment satellite (GRACE), soil moisture (SM), satellite altimetry and seepages. Findings include: (1) A decrease in lake level during the depletion period might clarify the observed decrease in (Terrestrial Water Storage) and (Groundwater Storage) in the study area, and an increase in lake level during the recharge period might clarify the observed increase in and in the study area. The lake level during the recharge period was high (6.2 meter) compared to that during the depletion period (4.6 meter), an increase of 26%. ; (2) the secular trends in (TWS) were estimated at -5.92 mm/yr and -0.44 mm/yr for the dry and wet periods, respectively; (3) spatial variations in TWS values and phase are consistent with rapid groundwater flow during the wet period and the dry period; and (4) networks of densely fractured and karstified bedrocks provide preferential pathways for groundwater flow. (5) soil moisture content in areas with shallow (< 2 m) groundwater levels to fluctuations in Lake Nasser surface water. Recomendation: Drilling piezometric wells where grondwater is expected in some places. Methodology: Gravity Recovery and Climate Experiment satellite (GRACE), soil moisture (SM), satellite altimetry and seepages.

Updated seismic hazard maps for New Syria: to Build Back Better

Nader Akkad | Hany Hassan | Reda Sbeinati | Ilario Tul

CUIRIF-Centro Universitario Internazionale di Ricerca ed Innovazione, Roma, Italy. | National Institute of Oceanography and Applied Geophysics-OGS, 34010 Trieste, Italy. | Atomic Energy Commission of Syria, Syria | CUIRIF-Centro Universitario Internazionale di Ricerca ed Innovazione, Roma, Italy.

This study highlights the critical need for developing updated seismic hazard maps for Syria, incorporating: (1) a complete earthquake catalog extending through 2025, (2) refined seismotectonic models derived from both regional and site-specific investigations, and (3) regionally-appropriate Ground Motion Prediction Equations (GMPEs). The analysis should employ Probabilistic Seismic Hazard Assessment (PSHA) methodology to evaluate multiple intensity measures including Peak Ground Acceleration (PGA), Uniform Hazard Spectra (UHS), and Spectral Accelerations (SA) at various periods. Hazard levels should be computed for return periods corresponding to 10%, 5%, and 2% probabilities of exceedance in 50 years (equivalent to 475-, 975-, and 2475-year return periods respectively), with consideration of epistemic uncertainty through logic tree frameworks and quantile analysis. These updated hazard assessments will provide essential technical guidance for seismic-resistant reconstruction and sustainable urban development in Syria's post-conflict rebuilding efforts. By incorporating these findings into reconstruction strategies, Syria can implement earthquake-resilient urban planning, retrofit critical infrastructure, and safeguard vulnerable cultural heritage sites. This dual approach addressing both post-war recovery and seismic risk mitigation ensures that rebuilding efforts not only restore communities but also enhance long-term resilience. Ultimately, this study underscores the necessity of multi-hazard risk assessment in Syria’s reconstruction framework, advocating for policies that integrate seismic safety into sustainable development. Such measures will protect lives, preserve historical assets, and pave the way for a disaster-resilient future.

ANALYSIS AND CHARACTERIZATION OF THE SEISMIC VOLCANIC ACTIVITY OF IRAZÚ VOLCANO (COSTA RICA)

Santori, Constanza | Villegas, Raquel | Lupari, Marianela

Universidad Nacional de San Juan | Instituto Geofísico Sismológico Ing. Volponi (Universidad Nacional de San Juan). Consejo Nacional de Investigaciones Científicas y Tecnológicas (CONICET), Argentina. | Instituto Geofísico Sismológico Ing. Volponi (Universidad Nacional de San Juan). Consejo Nacional de Investigaciones Científicas y Tecnológicas (CONICET), Argentina.

Volcanic eruptions and their impact on society are among the most important natural hazards on our planet. Over the years, thanks to the pioneering work of Omori (1911), Sassa (1936) and other notable researchers, considerable attention has been paid to seismic signals that precede or accompany volcanic activity. In this work, an analysis was carried out of seismic events that occurred during the months of April and May 2013 at the Irazú volcano in Costa Rica. The aim was to identify seismic events associated with volcanic activity, such as volcano-tectonic earthquakes (VT), long-period volcanic earthquakes (LP), hybrid earthquakes (HYB) and some tremors. Initially, the exclusive localisation of volcano-tectonic events was proposed, but interplate and intraplate earthquakes were also found and localised using the seismic velocity model proposed by Quintero and Kissling (2001). To fully characterise this seismicity, the coda magnitude of the events and some focal mechanisms were calculated. A total of 90 events (depth < 87 km) were identified with their magnitudes (0.1 < mc < 1.7), localised and associated with the above zones. Volcanic signals were also identified, including 37 hybrid (HYB) and 26 tremor events. Hybrid (HYB) events, were classified into 3 groups, respectively, based on their waveforms, duration, and frequency spectra.

Dubai Smart Seismic Network

Kamal M. Abou Elenean | Eman Al Khatibi | Abdulla Al Mehairbi
DM Seismology Specialist | Head of Geodetic Section, Dubai Municiaplity | Survey Specialist

In April 2006, Dubai Municipality established the broadband seismological network in Dubai Emirate, United Arab Emirates (UAE). This network was the first seismic network in UAE to observe local and regional seismic activity that may have an effect on Dubai Emirate and the surrounding areas. The earthquake information system sends SMS and emails alerts within few seconds to the government organizations (i.e. Dubai Police and Civil Defense) in case of any felt earthquake in the region. In April 2012, Dubai Municipality installed an additional five free-field strong motion stations inside the urban area to estimate and publish real-time ShakeMaps for public and decision makers.Â During 2015 to 2022, four smart structural health monitoring systems were installed on four strategic buildings (i.e. DWTC Rashid Tower, Burj Khalifa, Dubai Police Forensic Building and Dubai Municipality).Â These systems were supported by a smart application to support the emergency response plan during earthquake shaking inside these buildings. This smart application is also available for the public to know all local and regional earthquakes information within a short time compared to the international data centers. The best service of these systems is the real-time and automatic evaluation of the felt earthquake and strong wind impact on the high-rise equipped towers, specially Burj Khalifa.Â The recorded local seismic activity from 2006 to 2024 indicate a low seismic activity within the eastern part of UAE and indicates active tectonics in the relatively aseismic northern Oman Mountains region.

Ground Motion Modification by Topographic Irregularities: a case study in Al Jabal Al Akhdar, Sultanate of Oman

Mohamed, A.M.E. | El-Hussain, I | Deif, A | Al Shijbi, Y | Ezzelarab, M
NRIAG, SQU | SQU | SQU | SQU | NRIAG

The recent infrastructure development in Al Jabal Al Akhdar region, which characterized by high and irregular topography, requires seismic hazard assessment. The PSHA was conducted to derive UHC at the bedrock conditions for 475-, 975- and 2475-year return periods at a specific site located at a top-hill at 1883m height. To evaluate the site effects, continuous recordings of microtremor measurements over four days were carried out at four sites: one at the top-hill and three distributed at the surrounding foot hill. In addition, SRT and 2-D MASW surveys were performed at the top hill. The results indicate high P- and S-wave velocities near the surface (with VS30=1300 m/sec). These findings along with the available geotechnical information confirm the rocky nature of the site, with a site class of B. Despite, the four sites show flat HVSR curves around unity, the topographic effect at the top hill is calculated relative to the surrounding foot hill sites using a spectral ratio technique (from the microtremor records and two earthquakes monitored during the recording times). The ground motion at the top-hill was found to be modified with an amplification factor of 2.2 at a frequency of 1.3 Hz. The modified hazard results at the top-hill are then used to calculate the short period and 1.0 sec elastic design spectral accelerations parameters SDS and SD1 facilitating the construction of the design response spectrum. For a 2475-y return period, the values of SDS and SD1 are found to be 331 and 75 cm/sec2, respectively.

Possible damage and losses due to the occurrence of strong earthquakes

Ashraf Adly
NRIAG

The occurrence of the 2023 Turkey earthquake resulted in a tremendous amount of damage, financial losses and human fatalities. Egypt experiences ground shaking from large earthquakes from time to time. Examples of such shocks have been observed upon the occurrence of the 1955 North Alexandria earthquake, 1969 north Red Sea earthquake, 1995 Gulf of Aqaba earthquake, 1992 Cairo earthquake and 1998 Matrouh earthquake. The structural damage, economic losses and deaths of human beings, due to the occurrence of ground shaking intensity, can be estimated through seismic risk modeling. The buildings of Cairo City have great variability in structural material and design that ranges from ordinary and limestone bricks to reinforced concrete that follows seismic design regulations. The possible levels of damage of the buildings, which are exposed to ground shaking, depend on the quality of such buildings. Physical vulnerability and seismic fragility are used to estimate the likelihood of the buildings to suffer different degrees of damage and losses due to the occurrence of strong ground shaking.

Tuesday, October 14, 2025

Virtual Tomography Concept for Seismic Imaging: a new insight into a high-resolution seismic tomography

Mohamed Farouk Abdelwahed
National Research Institute of Astronomy and Geophysics

Conventional seismic imaging depends mainly on a dense seismic network in a highly seismicity area. Even though, the dense network for the purpose of earthquake monitoring is not enough for the high-resolution imaging because of the station separation. One of the challenges that preventing good seismic coverage is the absence of stations in offshore regions and the non-accessible areas. We propose the Virtual Station Method (VSM) to resolve the shortage of coverage. A Virtual Station (VS) is implemented visually in specific place within the area and the corresponding travel time (TT) is calculated. This idea is not commonly used in the seismology community because of the sensitivity of the arrival time values to locate earthquakes. But, for existing earthquake location, velocity model, and accurate phase pickings, it is possible. Using ray tracing, theoretical estimates, image processing, and interpolation, we can have acceptable phase reading to be used in tomography studies. In this study, the virtual tomography concept and the VSM are discussed in detail, providing the optimal criteria to select the location and phase reading of the virtual stations to be used in tomographic studies. A typical application of the method is given, showing a comparison between the tomography result with and without the virtual stations. The importance of the VS concept appears in the ability to predict seismic phases in inaccessible areas like offshore or mountainous areas. This study opens the gate for new research fields to contribute for better resolvability of the earth's subsurface structure.

Modern Seismic Hazard Maps for the New Egyptian Building Standards

Mahmoud Elhadidy | Mohamed Elgabry | Sherif Elhady | Sayed Moustafa | Hesham Hussein
National Research Institute of Astronomy and Geophysics | National Research Institute of Astronomy and Geophysics | National Research Institute of Astronomy and Geophysics | National Research Institute of Astronomy and Geophysics | National Research Institute of Astronomy and Geophysics

Egypt is located in the northeastern part of the African Continent, with recent development, where several mega projects and new cities are in the construction phase. These projects require huge infrastructure. The planning and design of these projects require up to date standard and building regulations based on updated and detailed seismic hazard maps. An up to date earthquake catalog, this catalog includes available paleo-seismological investigations, historical seismicity and instrumental earthquakes based on the records of the Egyptian National Seismological Network (ENSN). Two seismotectonic models are included in the current study, the first model is developed in the current study based on the major geological structures and recently published seismic nodes. On the other hand, the second model is compiled from the previous publications. Recurrence parameters and the maximum expected magnitude (Mmax) are calculated for each seismic source in all models based on the earthquake data and fault length within the seismic source. The ground motion is modelled using different models to consider the shallow active crust seismic sources, subduction seismic sources in the Cyprean and Hellinic arcs, and stable continental seismic sources in the western part of Egypt. Seismic hazard calculations are performed for rock site conditions, considering peak ground acceleration (PGA) and spectral acceleration (SA) at 0.2 sec and 1.0 sec, with exceedance probabilities of 10% and 2% in 50 years. The largest acceleration values are observed around the entire Gulf of Aqaba. Also, notable increase is observed around the southern part of the Gulf of Seuz.

Tuesday, October 14, 2025

Probabilistic seismic hazard assessment in Namibia

Umar Afegbua Kadiri | Mako Sitali | Midzi Vunganai
Centre for Geodesy and Geodynamics, National Space Research and Development Agency, Nigeria | Geological Survey of Namibia, Namibia | Council for Geosciences, South Africa

Namibia is located in a Stable Continental Region (SRC). Even though several earthquakes have been recorded in Namibia since 1910, with the July 31, 2009 and the April 4, 2021 earthquakes both of moment magnitude (Mw) of 5.6, no up-to-date country-wide seismic hazard study has been conducted. This research, therefore, aims to conduct a comprehensive Probabilistic Seismic Hazard Assessment for the entire country to aid in planning and seismic risk mitigation. The earthquake catalogue created from ISC, ANSS and Namibian stations covers 1910–2021. Catalogue was declustered and the resulting catalogue used in conjunction with available geological evidence to identify, delineate, and characterise 11 seismic source zones and one fault source, the Hebron/Dreylingen fault. Four Ground Motion Prediction Equations (GMPEs) were used in the seismic hazard computations. The GMPEs were implemented in the calculations (in OpenQuake) using a logic tree formalism with equal weights, which assisted in addressing the uncertainties associated with both the seismic sources and the ground motion models. Peak Ground Accelerations (PGA) obtained for a 10% chance of exceeding in 50 years ranged from 0.017g-0.149g. The highest levels of hazard were observed in Namibia’s northwestern, north-central, central and southern regions. This study also produced seismic hazard maps that show the distribution of acceleration at different response periods (0s (PGA), 0.1s, 0.15s, 0.2s, 0.3s, 0.5s and 1.0s) computed for 10% probability of exceedance in 50 years. Results of Namibia's first large-scale seismic hazard study are anticipated to significantly enhance future land use planning for facilities and infrastructure development.

Tuesday, October 14, 2025

Session **Workshop Archeo-Astronomy**

Analysis of the royal tombs of the 19th dynasty from a spatial and archeoastronomical perspective

Eman Nousir | Yasser A. Abdel-Hadi
Department of Egyptology, Faculty of Archeology, Ain Shams University. | Solar and Space Research Department, National Research Institute of Astronomy and Geophysics (NRIAG).

The Valley of the Kings is the permanent location chosen by the 19th dynasty's rulers for their burials. Â Using spatial and archaeoastronomical analysis of tomb placements, this study finds a possible relationship between the tombs' locations and the Big Dipper's asterism, known in ancient Egyptian culture as Msxtyw, or "the Imperishable Stars," which served as the primary inspiration for the royal tombs' placement and were typically used by the ancient Egyptians as celestial guides in their mythology and religion from the prehistoric era. Therefore, the research's objective is to verify the theory that star patternsâ€”more especially, the Msxtywâ€” determined the locations of royal tombs throughout the 19th dynasty. Astronomical and topographical analyses have been carried out to verify this hypothesis.

The Astronomical Scenes in Shenhur Temple and their Indications

Yasser A. Abdel-Hadi | Ahmed Abbas
Solar and Space Research Department, National Research Institute of Astronomy and Geophysics (NRIAG), Helwan, Cairo, Egypt | Inspection Department of Dendera Temple, Ministry of Tourism and Antiquities

The astronomical scenes of Shenhur Temple built and decorated during the reign of Augustus (30 BCE â€“ 14 CE) through that of Trajan (98 â€“ 117 CE) and located between two major cult centers, Koptos and Thebes, in Upper Egypt were analyzed in order to determine the date and the purpose of building such a temple.Â The scenes were interpreted according to the mythological associations of ancient Egyptian astronomy. Â The results show that at least this part of the temple, in which the astronomical scenes exist, were built during the reign of Emperor Tiberius (14-32 CE) and the purpose of building such a temple in this place is to celebrate the Nile flood and the beginning of the Egyptian New Year.

The original Cubit unit as a cosmic code of the Great Pyramid at Giza

Mohamed Jamal Mostafa Ali | Yasser A. Abdel-Hadi
Researcher, Central Administration of Tourism, Aswan Governorate, Egypt. | Solar and Space Research Department, National Research Institute of Astronomy and Geophysics (NRIAG), Helwan, Cairo, Egypt.

This paper examines the real value of the cubit used in the construction of the Great Pyramid at Giza, which, according to this study, is equal to 480 millimeters. Therefore, the length of the base-side of the Great Pyramid with this cubit is exactly 480 cubits, without any fractions, or 230.4 meters. Knowing the value of this previous cubit, we can, through a simple calculation, determine the Earthâ€™s circumference and its radius, by knowing the length of the sarcophagus inside the King's Chamber of the Great Pyramid with the adopted cubit, which is what the engineer of the Great Pyramid intended. Therefore, the square of the length of the sarcophagus (with the adopted cubit), which is 4.68069 cubits or 224.67 cm, is equal to the length of the King's Chamber, which is equal to 21.9089023 cubits or 10.516 meters. Furthermore, the square of the length of the King's Chamber is equal to the length of the base-side of the pyramid, which is exactly 480 cubits or 230.4 meters. As well as, the square of the length of the base-side of the pyramid is equal to the terrestrial degree (1/360 part of the Earthâ€™s circumference), it is equal to 230,400 cubits or 110,592 meters. Therefore, the Earthâ€™s circumference is 82,944,000 cubits or exactly 39,813,120 meters, and its radius is 13,195,636.36 cubits or 6,333,905.45 meters. Therefore, we can report here that the ancient Egyptians are considered to be the first people who measured the Earth's circumference in the 3rd-millennium BC.

Tuesday, October 14, 2025

Revisited Determination of the Sunrise Orthogonality Dates on the Great Temple of Abu Simbel

Mohamed Jamal Mostafa Ali | Yasser A. Abdel-Hadi
Researcher, Central Administration of Tourism, Aswan Governorate, Egypt. | Solar and Space Research Department, National Research Institute of Astronomy and Geophysics (NRIAG), Helwan, Cairo, Egypt.

This paper investigates the precise and actual dates of the sunrise orthogonality phenomenon on the Great Temple of Abu Simbel before and after the temple's relocation by UNESCO between 1964 and 1968. As it is commonly believed that this phenomenon occurred on February 21 and October 21 of each year before the temple's relocation, and that it's happening now on February 22 and October 22 after its relocation, new evidences show that neither the old nor the new dates are exactly correct. Therefore, this paper concludes that the exact date of the phenomenon's occurrence at the present time, after the temple's relocation, is February 22 and October 19, rather than October 22. By a more accurate measurements and calculations, it is found that the azimuth angle of the sun at sunrise at the site of the Abu Simbel temple on those days is approximately 101Â°. This angle closely aligns with the axis of the Great Temple after its relocation, which is directed with an azimuth angle of 100.5Â°, while that angle of the sunrise on October 22 is approximately 102Â°. The paper also concludes that the original two dates of this phenomenon, before the temple relocation, were on other two dates in the year and since the direction of the temple axis has been slightly changed after its relocation.

دور الجيوفيزياء الأثرية في حفظ التراث وتأصيل الهوية المصرية

SHAABAN ABDELAAL
Dean of the Higher Technological Institute for Tourism, Hotels and Antiquities Restoration in Minya

إستحوذ التراث الثقافي الغني لمصر، الذي يمتد لآلاف السنين، على إهتمام الباحثين وعلماء الآثار ، فالحافظ علي التراث المصري هو أمر بالغ الأهمية، فالهوية الوطنية المصرية هي تلك السبيكة من القيم والثقافات والمعارف والعادات والتقاليد والطباع والتراث والآثار التي تميز الشخصية المصرية، والتي تكونت وتبلورت عبر التاريخ، والتي توجه السلوك العام والخاص للمصريين، و تحدد رؤيتهم العامة للحياة، ورؤيتهم العامة للذات وللآخرين، وتطبع الوعي الإجتماعي والفردي بطابعها، وتعكس نفسها في سلوك وحركة الأمة مجتمعة والمصريين مجتمعين وأفرادًا، وبصفة خاصة في مواجهة الأزمات والتحديات والمخاطر، فالتراث المصري شريان الحياة للهوية المصرية و هوية الأمة هي صِفاتها التي تميّزها عن باقي الأمَم لتعبّر عن شخصيتها الحضاريَّة، ولقد استخدمت تقنيات الجيوفيزياء الحديثة في الأبحاث الأثرية وعلى رأسها المسح الكهربائي، المغناطيسي، الراداري والصوتي، فقد لعبت الجيوفيزياء الأثرية وهو مجال متعدد التخصصات يجمع بين التقنيات الجيوفيزيائية والتحقيقات الأثرية، دورًا محوريًا في كشف أسرار حضارة مصر القديمة،فتقنية الجيوفيزياء لها أهمية كبيرة في الكشف عن الآثار التاريخية ومنها الكشف عن الهياكل تحت الأرض و تحديد العمر التاريخي والحفاظ على التراث حيث يمكن استخدام تقنية الجيوفيزياء لمراقبة حالة الآثار التاريخية وتقييم المخاطر التي تهددها، و الحفاظ على التراث التاريخي والحفاظ على الآثار من الضياع والتلف. و البحث العلمي حيث يمكن استخدام تقنية الجيوفيزياء في البحث العلمي لفهم المزيد عن التاريخ والثقافة والمجتمعات القديمة. يمكن أن تساعد في توثيق الآثار وتحليلها وفهمها بشكل أفضل، فتقنية الجيوفيزياء تعتبر أداة قوية في الكشف عن الآثار التاريخية وفهمها والحفاظ عليها من أجل الأجيال القادمة لتعزيز وتوطيد قيم الولاء والمحافظة علي الهوية المصرية متمثلة في أهم رافد لها وهو التراث المصري

sun orthogonality on karnak temple as a presumption of the place selection

Hassan ahmed aly mohamed | Yasser Abdel-fattah Abdel-hadi
Chairman of the Egyptian association for tourism and archeological development | Solar and space research department - National Research institute of Astronomy and Geophysics (NRIAG)

While winter solstice sunrise orthogonality on the main axis of Karnak temple in Luxor entering from the eastern entrance is reported before, we report a summer solstice sunset orthogonality on the western entrance. The sunset azimuth of the summer solstice was calculated and observations have been taken to verify this archaeoastronomical architectural phenomenon. This leads to the idea that the place of the temple has been carefully chosen according to at least two astronomical cardinal times and also some topographical factors. This has to be searched again under the light of the ancient Egyptian culture and its seasonal astronomical phenomenon. We assume that these astronomical factors in additional to other factors have been considered in selecting the place of this important temple in order to be built in such a unique place.

Tuesday, October 14, 2025

First Observational Determination of the Tropic of Cancer in Egypt

Yasser A. Abdel-Hadi | Ahmed Abulwfa
Solar and Space Research Department, National Research Institute of Astronomy and Geophysics (NRIAG), Helwan, Cairo, Egypt |
Solar and Space Research Department, National Research Institute of Astronomy and Geophysics (NRIAG), Helwan, Cairo, Egypt

This study presents the first field-based astronomical observation to determine the position of the Tropic of Cancer in Egypt. The observations took place using the solar zenith at local noon on 21st June 2023 at 110 km south of Aswan on the Aswan-Abu Simbel road, at coordinates 23°26′10.8″ N and 32°12′28.38″ E. Measurements of the solar elevation angle were taken every 30 minutes. The maximum observed elevation was 89.98° at 12:53 p.m., confirming that the site lies on the Tropic of Cancer. This is the first documented field confirmation of the Tropic's location in Egypt and highlights the potential for scientific, educational, and cultural engagement with this geodetic feature.

Session — Workshop Eye on the Sky Workshop

Observing Near-Earth Objects: Optical Techniques and Detection Strategies.

Ahmed Magdy Abdelaziz
NRIAG

Space Debris Characterization through Optical Observations: Challenges and Advances.

Shafeeq Tealib
MNRIAG

Significant increase in space debris population in geostationary orbit based on the ISON network database measurements analysis.

Igor Molotov
KIAM, Russia

Astrometric Tracking and Orbit Determination of NEOs Using Optical Data.

Mohamed Aboueisha
NRIAG

Predictive mapping of hydrothermal alteration zones in tropical regions areas of northcentral Nigeria using aeromagnetic and remote sensing data

Abubakar Adamu | Abdulrahman Idris Augie | Abdulganiyu Yunusa

Department of Applied Geophysics, Federal University Birnin Kebbi Nigeria | Department of Applied Geophysics, Federal University Birnin Kebbi Nigeria | Department of Geology, Federal University Birnin Kebbi Nigeria

This study investigates hydrothermal alteration zones in the tropical region of North-Central Nigeria by integrating remote sensing and aeromagnetic data. The region's complex geology is not well understood, despite its rich mineral resources. Recent advancements in aeromagnetic and remote sensing data processing have enabled the mapping of geologic basins, identification of structural patterns, and location of basement surfaces. This research analyzes remote sensing and magnetic data to elucidate the underlying geology of the tropical region. The study area, including the Mambilla plateau, is crucial to Nigeria's economy due to its significant mining resources. We employed various edge detection techniques, including Total Horizontal Derivative (THDR), Power Balanced Total Horizontal Derivative (PBTHD), tilt derivative (TDR), and its horizontal derivative (THDR_TDR), to map subsurface structures and identify lineaments/faults. The results reveal dominant lineament trends of NE-SW, NW-SE, ENE-WSW, and E-W, consistent with the geological history of the area. Source parameter imaging and power spectrum analysis techniques provide insights into the depth and location of lineaments or faults and subsurface topography. The study's findings enhance our understanding of the subsurface structure of Kwande's tropical region and its surroundings, providing valuable data for future research.

Archaeological investigations to identify the extent of “The Rise of Aten” city and the remains of “Amenhotep III Temple” in the Theban Necropolis, Luxor, Egypt

Ahmed Awad | Abdellatif Younis | Magdy Atya | Afifi Rohim Afifi | Gad EL-Qady | Zahi Hawass

National Research Institute of Astronomy and Geophysics (NRIAG), Helwan, Egypt | - National Research Institute of Astronomy and Geophysics (NRIAG), Helwan, Egypt | National Research Institute of Astronomy and Geophysics (NRIAG), Helwan, Egypt | Site director of the golden city of Amenhotep III mission, Luxor, Egypt | National Research Institute of Astronomy and Geophysics (NRIAG), Helwan, Egypt | Head of the Egyptian mission of the golden city of Amenhotep III, Luxor, Egypt

Deir al-Madina, the Temple of Rameses, the Valley of the Kings, the Temple of Deir al-Bahari, the Valley of the Queens, and the Colossi of Memnon are among the most significant archaeological features of ancient Egypt that can be found on the western side of the Theban Necropolis in Luxor. A simultaneous geophysical magnetic and ground penetrating radar (GPR) survey was conducted on two significant archeological sites. The extent of “The Rise of Aten “city, an ancient Egyptian work that documents the ancient Egyptian life, which dates back 3000 years to the period of Amenhotep III, Tutankhamun, and Ay and contains rings, scarabs, colored ceramic vesicles, and other archaeological artifacts that have been uncovered across it. The remains of the Amenhotep III Mortuary Temple that were constructed for Pharaoh Amenhotep III during the New Kingdom's 18th Dynasty by the chief architect, Amenhotep, son of Habu. The acquired data were further subjected to processing steps and then presented as 2-D images for magnetic data and as 2-D and 3-D depth sections for GPR data. The interpretation resulted from the integrations of the acquired magnetic and GPR data has revealed a valuable archaeological feature for both sites. The investigation revealed the city's expansion to the south, as well as the presence of certain buried mud brick constructions, such as mud brick walls and tombs at the other site.

Characterization of Dyke alignment using Electrical Resistivity Tomography

Fathy Bahloul | Ashraf Khozym
DMT | NRIAG

The electrical resistivity method, used for nearly a century in geotechnical and environmental investigations, has evolved into electrical resistivity tomography (ERT). ERT employs computerized instrumentation to automate electrode selection, significantly speeding up data collection. In 2018, an ERT survey was conducted at Lisan Peninsula, Jordan, to identify voids, cracks, saturated zones, and stratigraphy along a 15 km dyke alignment. The region consists of silty clay with aragonite and gypsum, and the high TDS groundwater enhances material conductivity. The collected data is converted into a 2D resistivity model that reveals underground structures. The ERT results show mainly three layers: the upper layer is fill material with a thickness of 1 to 1.5 m and a resistivity of 1 ohm-meter, the second layer is silty clay with a thickness of 10-15 m and a resistivity of 0.1 ohm-meter, and the third layer is silty clay with gypsum and aragonite and a resistivity of 10 ohm-meters. This relatively higher resistivity layer is interrupted in some localities. The cross-sections show a relatively high resistivity structure vertically from the top of the dike and extending horizontally to the downstream direction. This structure is interpreted as chimney drainage (vertically) and blanket drainage (horizontally). The locations of the transverse cracks are also detected using the ERT

INTEGRATION OF ACTIVE AND PASSIVE SEISMIC METHODS FOR SITE CHARACTERIZATION: A CASE STUDY IN NEW ASWAN INDUSTRIAL CITY, EGYPT

Maha Abdelbaset | Abdelnasser Mohamed | Awad Omran | Rashad Sawires | Mostafa Thabe
Geology Department, Faculty of Science, Assiut University, Assiut 71516, Egypt | 2National Research Institute of Astronomy and Geophysics, Helwan, Cairo, Egypt | Geology Department, Faculty of Science, Assiut University, Assiut 71516, Egypt | Geology Department, Faculty of Science, Assiut University, Assiut 71516, Egypt | Geology Department, Faculty of Science, Assiut University, Assiut 71516, Egypt

Integrating active and passive seismic methods enhances site characterization by leveraging the strengths of both approaches to provide a more comprehensive understanding of subsurface conditions, vital to determine site-specific amplification factors and resonance frequencies to mitigate earthquake hazards and characterize soil and rock properties for foundation design in the New Aswan Industrial city, which is one of the most earthquake-prone regions in southern Egypt. Horizontal to Vertical Spectral Ratio (HVSR) observations performed at 20 sites were analyzed to assess the site characteristics, determine the depths to bedrock, and evaluate seismic vulnerability index (kg) based on the predominant frequency (f0) and amplification factor (A0). The seismic velocity structures estimated from the Multichannel Analysis of Surface Waves (MASW) implemented along 10 profiles effectively used for estimating the depth to bedrock and to confirm that deduced from HVSR method. Moreover, seismic refraction tomography (SRT) carried out along the same 10 profiles produces a 2D P-wave velocity model that helps to identify the geometry of bedrock and assess soil parameters correlated with density. Results from both passive and active methods reveal that the western section exhibits high kg values associated with thicker sedimentary cover, whereas the eastern section shows low kg values linked to shallower sedimentary cover. Also, the findings indicate that the subsurface and foundation at the studied site consist of four primary layers. Additionally, several elastic moduli and geotechnical parameters have been calculated and interpreted.

Wednesday, October 15, 2025

Structural Origin of Siwa Oasis, Egypt: Insights from Magnetic and Magnetotellurics (MT) Data

Mohamed Abdel Sabour Aldeep | Mamdouh Soliman | Hany, S. A. Mesbah | Wael R. Gaweish | Ahmed M. Ali | Naser Meqbel | Mohamed Abdel Zaher

National Research Institute of Astronomy and Geophysics (NRIAG) | National Research Institute of Astronomy and Geophysics (NRIAG) | National Research Institute of Astronomy and Geophysics (NRIAG) | National Research Institute of Astronomy and Geophysics (NRIAG) | National Research Institute of Astronomy and Geophysics (NRIAG) | Observatório National Do Brasil | National Research Institute of Astronomy and Geophysics (NRIAG)

The distribution of groundwater, oil, and minerals requires a comprehensive understanding of geological structures, which are the most important parameter. At Siwa Oasis, as well as other oases in the northern western desert of Egypt that have geological settings that are comparable to Siwa Oasis, it is possible for brackish groundwater to seep to the surface through fractures and permeable zones, which allows for the maintenance of natural growth of vegetation and makes it possible for humans to live in environments that would otherwise be dry. there are A close connection exists between the subsurface structural conditions and the hydrogeological conditions that led to the formation of these oases. For the geological structural analysis and the estimation of the depth of basement rocks, magnetic data were utilized. For the purpose of estimating basement depths, the magnetic data analysis includes structural enhancement techniques and 2D Magnetic Modelling Constrained by borehole data. Magnetotellurics (MT) data analysis includes obtaining 3D resistivity models via inversion, and cross-sections were extracted to trace fault zones and lithological contrasts. The most important results made by this research are that the Northeast , North , and East-Northeast have the most prominent surface lineaments, while the East-West (E-W) trend is only slightly present. Between 3,000 and 4,200 meters is the range of rock depths of Basement. The 3D resistivity model obtained from Magnetotellurics (MT) reveals E-W faults that are close to the surface and have resistivity changes that are connected to the topography.

Wednesday, October 15, 2025

Session **Oral-Seismology 2**

Detection of seismo-ionospheric precursors for moderate shallow earthquakes in Greece using a statistical study

Karima BENGHANEM | Abdeslam ABTOUT
CRAAG | CRAAG

In this study, we use the running median of the critical frequency of the F2 layer and the associated interquartile range to detect seismo-ionospheric precursors during the 10 days preceding the main shock. The methodology defines a confidence interval where foF2 varies. Any deviation of foF2 from this interval is considered an anomaly. Since the ionosphere is directly influenced by solar and geomagnetic activity, we also analyzed the Kp, Dst and Ap indices. This eliminates any ambiguity regarding the nature of the detected disturbances. We successfully detected disturbances within the 10 days preceding the studied earthquakes. Given that the earthquakes dates are comparable (08/03/2008 - 08/07/2013) and (09/22/2012 - 09/16/2013), we investigated whether there is a link between the seasonal variability of foF2 and the detected anomalies. We found that ionospheric anomalies occur on equivalent dates with a concordance of more than 60% and 80%, respectively, for each pair of earthquakes analyzed. However, the correspondence in the time of appearance of these anomalies is very rare. These results do not allow us to draw definitive conclusions about the seasonal variability of foF2 during the two study periods, which strengthens the hypothesis that the detected anomalies are seismo-ionospheric precursors. Clearly, it is interesting to consider several cases of earthquakes occurring at equivalent epochs to study the temporal variability of ionospheric anomalies during the earthquake preparation process. These preliminary results remain encouraging and open new prospects for studying ionospheric variability linked to seismic activity by simultaneously considering several parameters.

Impact of Felt Earthquakes and Strong Winds on Dubai Skyscrapers using Dubai Municipalityâ€™s Smart Seismic Systems

Kamal M. Abou Elenean | Eman Al Khatibi | Abdulla Al Mehairbi
DM Seismology Specialist | Head of Geodetic Section, Survey, Dubai Municipality | Survey Specialist

Nearly twenty percent of the worldâ€™s 100 highest skyscrapers reside in Dubai. After the occurrence of the large 2013 April 9th and 16th, Iranian earthquakes, Dubai Municipality (DM) paid a lot of attention to the safety of the residents in these towers during any felt earthquakes or strong winds. As a result, DM installed smart structural health monitoring systems in four strategic buildings to record real time data for the impact of any felt earthquakes or strong winds and to support the emergency response for these natural disasters. In addition to resident safety, analysis of these smart system data is very important to reduce the economic loss due to unnecessary business interruption and (potentially unsafe) evacuation associated with such natural events. The analysis of the data recorded from 2016 to 2024, including some felt earthquakes and strong windy days on Burj Khalifa seismic system, shows minor effect on the tower structure and response values much smaller than design safety limits for earthquake and wind demands. Meanwhile, some windy days cause shaking above levels of human comfort

Wednesday, October 15, 2025

A multi-scenario seismic hazard assessment of North Libya.

Hameed Alfurjani | Mahmoud Salah Elhadidy
University of Tripoli | National Research Institute of Astronomy and Geophysics (NRIAG)

Northern Libya is an area of recent developing with major infrastructure projects, requiring detailed seismic hazard studies. Existing regional studies lack the site-specific details needed for proper planning and design. Therefore, the current study conducts a PSHA for northern Libya, using data from the Libyan seismic network and integrating them with records from instrumental and historical international sources into a standardized earthquake catalog covering Libya and surrounding regions. Two seismotectonic models are developed for Libya, along with a third model derived from previous publications. Recurrence parameters and the maximum expected magnitude are calculated for each seismic source in all models. The ground motion is modelled using eight ground motion prediction equations. The seismic hazard model is developed using a 39-branch logic tree framework to consider the epistemic uncertainties in model geometry, seismic recurrence parameters, and ground motion prediction equations. Seismic hazard calculations were performed for rock site conditions, considering peak ground acceleration (PGA) and spectral acceleration (SA) at 0.2 sec and 1.0 sec, with exceedance probabilities of 10% and 2% in 50 years. Additionally, seismic hazard curves, uniform hazard spectra, and seismic disaggregations are generated for ten of Libya's most densely populated cities. These maps show that the highest hazard values on the map at PGA for return periods of 475 and 2475 years are observed in the Hun Graben area, around the epicentral location of the April 19, 1935, El Ghadehia earthquake (M_S= 7.1). We consider that the methodology and results obtained are useful for seismic risk reduction strategies.

Oman Strong Motion Network (OSMN) and Site-Specific Characterization of Monitoring Stations in Muscat Region

Issa El-Hussain | Adel Mohamed | Ahmed Deif | Yousuf Al-Shijbi | Abdullah Ansari | Majed Al Musalhi
Earthquake Monitoring Center, Sultan Qaboos University, Oman | Earthquake Monitoring Center, Sultan Qaboos University, Oman | Earthquake Monitoring Center, Sultan Qaboos University, Oman | Earthquake Monitoring Center, Sultan Qaboos University, Oman | Earthquake Monitoring Center, Sultan Qaboos University, Oman | Earthquake Monitoring Center, Sultan Qaboos University, Oman

In pursuit of improved seismic hazard mitigation and resilient infrastructure development, the Earthquake Monitoring Center (EMC) at Sultan Qaboos University started the work to establish the Oman Strong Motion Network (OSMN) in 2014. This initiative comprises 67 accelerometric stations, with a focus on high-density urban areas. This study presents the site-specific characterization of the first stage of 25 stations in the Muscat region. An integrated geophysical approach was employed, including ambient noise analysis using the Horizontal-to-Vertical Spectral Ratio (HVSR) method, shallow seismic refraction tomography (SRT), and multichannel analysis of surface waves (MASW), supplemented by geotechnical borehole data. Key parameters such as fundamental site frequency, P- and S-wave velocity profiles, and Vs30 were derived to classify sites per NEHRP/IBC standards. These characterizations are further linked to seismic hazard levels via probabilistic seismic hazard assessment (PSHA), leading to the generation of uniform hazard spectra (UHS), site-specific amplification factors, and elastic design response spectra. The outcomes offer valuable input for urban seismic microzonation, building code refinement, and risk-sensitive planning across the region. This work underscores the importance of integrating instrumental data with site conditions for robust seismic risk reduction strategies in the Arabian Peninsula.

Time-Domain Moment Tensor Analysis of Local Earthquakes in Ras Nasrani: Parameter Estimation and Uncertainty Quantification

Mohamed A. Taha | Sayed SR Moustafa
NRIAG | NRIAG

The source mechanisms and moment tensor characteristics of three earthquakes that occurred in the Ras Nasrani area in the Northern Red Sea are investigated using Time Domain Moment Tensor (TDMT) inversion. Data from the Egyptian National Seismic Network (ENSN) were studied under various settings to determine the robustness of the inversion approach. Synthetic Green's functions for six Earth models were computed to assess uncertainties caused by velocity structure fluctuations, with the optimal solution selected by the best waveform match and variation reduction. The inversion results, supported by statistical validation using the bias-corrected and accelerated (BCa) bootstrap method, revealed moment tensor solutions with negligible volumetric components, indicating a predominantly tectonic origin that is consistent with established stress patterns and previous focal mechanism studies. The analysis further emphasizes the importance of velocity models and station dispersion on solution stability. By combining full-waveform moment tensor inversion with BCa bootstrap, the study provides a solid foundation for addressing uncertainty in seismic event characterization, ultimately improving seismic hazard assessments in tectonically complicated places.

Seismic Q Factor and Site Effects Estimation in Northeastern Egypt Using the Generalized Inversion Technique (GIT)

Hamada Saadalla
NRIAG

Northeastern Egypt and its adjoining seismic regions (Cairo-Suez district, Gulf of Suez, Gulf of Aqaba) have historically experienced moderate to large earthquakes, highlighting the need for a detailed understanding of path attenuation and site response characteristics for seismic hazard assessment and mitigation. This study employs the generalized inversion technique (GIT) to estimate path attenuation and site parameters using earthquake recordings from multiple seismic stations in the region with magnitude > 3.0. the observed seismograms are decomposed into source, path, and site contributions, with a reference site constraint applied to ensure consistency in spectral decomposition and resolve the degrees of freedom issue and the trad off results between the decomposed factors. The attenuation models are developed as frequency-dependent functions, yielding the following S-wave quality factors: (KAT-reference site) and (HRG-reference site). These results indicate significant seismic activity in the region, characterized by a high degree of heterogeneity in the crustal medium.Â the site amplification characteristics at each recording station are quantified using site spectral amplitude ratios of horizontal to vertical components. The predominant frequencies obtained from these amplification curves allow for site classification, providing crucial insights into local site effects. The estimated path attenuation and site response parameters serve as essential inputs for developing regional ground motion prediction models, thereby improving seismic hazard assessments and risk mitigation strategies for northeastern Egypt. The findings of this study contribute to a more comprehensive understanding of the seismic behavior of the region and can aid in the design of earthquake-resistant infrastructure and disaster preparedness planning.

Wednesday, October 15, 2025

Ground motion simulation and predication in the northern Egypt

Hend Lotfy | Abd El-Naser Helal | Amir M. S. Lala | Hesham Hussien | Asem Salama
NRIAG | NRIAG | NRIAG | NRIAG | NRIAG

Earthquakes pose significant moderate risks to Egypt, particularly in seismically active regions, for example, the Gulf of Suez, the Gulf of Aqaba, and the Nile Delta. We collected and analysed a strong-motion catalogue of earthquakes greater than 3.5 ML for Egypt during 2015 to 2025 to characterise ground motion patterns in northern Egypt. This catalogue serves as a critical resource for engineering design, retrofitting strategies, and disaster preparedness. We visualised an updated map of PGA for northern Egypt to update the global hazard GFZ map. Earthquake validation and simulation are essential for hazard assessment and mitigation for northern Egypt. We used the Irikura Japanese method to validate our simulation based on the recorded small earthquakes' strong motion data. This method has been used to combine kinematic source modelling with empirical Green's functions (EGFs) to simulate realistic strong motions. We used SAC software update 2022 to assess fault source parameters to understand the rupture process, fault geometry, and slip distribution to improve accuracy over purely empirical methods. This study explores advanced numerical and statistical methods for simulating some seismic activity and potential earthquakes in Egypt. By combining simulation, prediction, and empirical strong-motion data, this research enhances Egypt's seismic resilience, supporting safer urban planning and infrastructure development.

The effect of seismic source spatial distribution on the level of seismic hazard in Al-Madinah Region, Saudi Arabia

Mohamed Ezzelarab | Ali Abdelfattah | Abdullah Omer Bamousa | Hassan Alzahrani | Thomas Oommen
National Research Institute of Astronomy and Geophysics | Department of Geology & Geophysics, King Saud University, Riyadh 11451, Kingdom of Saudi Arabia | Department of Geology, College of Sciences, Taibah University, Al-Madinah Al-Munawarah, Saudi Arabia | Department of Geology & Geophysics, King Saud University, Riyadh 11451, Kingdom of Saudi Arabia | Department of Geology and Geological Engineering, University of Mississippi, MS 38677, USA

Given its historical significance and economic value, the Al-Madinah region necessitates an updated evaluation of seismic hazards to facilitate informed urban planning and building activities. The region is exposed to significant seismic hazards due to its proximity to active tectonic sources, such as the Red Sea Rift system and the Gulf of Aqaba-Dead Sea Transform Fault. These tectonic structures not only enable the propagation of seismic activity beyond Saudi Arabia's borders but also extend seismic risks to the Harrat areas, known for their extensive basalt flows within the Arabian Shield. This study performs a comprehensive probabilistic seismic hazard assessment for the region. Probabilistic seismic hazard maps were developed to evaluate the spatial variability of seismic hazards on bedrock and revealed that the region experiences the highest anticipated peak ground accelerations, with values reaching 91 cm/s² and 230 cm/s² for return periods of 475 and 2475 years, respectively. The analysis identified four primary seismic sources contributing to the hazard: the Harrat volcanic area, the Hijaz and Jiddah terranes, and the Tabuk and Red Sea seismic sources. A high-quality seismic network around these sources could be useful for developing an earthquake early warning system and mitigating seismic risk in the Al-Madinah region.

Wednesday, October 15, 2025

Session **Oral-Space Weather and Space Geophysics 1**

Solar Energetic Particle Events and Their Influence on Aerosols from Egypt to the Poles

Mohammed AbuBakr Ali | Naglaa Zanaty | Nourhan Hesham | Dalia Elfiky
National Authority for Remote Sensing & Space Sciences | National Authority for Remote Sensing & Space Sciences | National Authority for Remote Sensing & Space Sciences | National Authority for Remote Sensing & Space Sciences

The interaction between atmospheric constituents and solar radiation significantly influences solar variability and climate dynamics. This study explores the atmospheric effects of intense solar energetic particle (SEP) events, particularly those associated with cosmic ray ground-level enhancements (GLEs). We analyzed aerosol optical depth (AOD) and Angstrom exponent (AE) variations during four major SEP events—GLE 59 (2000), GLE 65 (2003), GLE 69 (2005), and GLE 70 (2006)—across Egypt, Russia, Australia, and the South Pole. Ion generation during these events was simulated using the PLANETOCOSMICS model, which demonstrated substantial atmospheric ionization. Satellite-based remote sensing data from SeaWiFS were employed to monitor AOD and AE values before, during, and after the events, with emphasis on two-day post-event responses. Results revealed notable aerosol responses: during GLE 59, AOD over Russia increased by 0.12–0.15, and AE rose from 0.98 to 0.99. GLE 65 showed AOD changes from 0.11 to 0.24 and AE from 0.9 to 1.5. GLE 69 exhibited regional AOD increases of 0.04–0.05 (South Pole), 0.35–0.48 (Russia), 0.03–0.06 (Australia), and 0.17–0.21 (Egypt), with corresponding AE shifts ranging from 0.73 to 1.73. During GLE 70, AOD rose by 0.04–0.06 (South Pole) and 0.12–0.31 (Russia), while AE ranged from 0.7 to 1.0. These findings demonstrate that SEP events can significantly alter aerosol radiative properties, indicating a link between space weather and atmospheric composition. Understanding these interactions is essential for evaluating the broader climatic impacts of solar variability.

ULF magnetic pulsation observed on the ground and in space

Essam Ghamry
NRIAG

The ultra-low frequency, ULF, (1-100 mHz) waves can be used to diagnose several magnetospheric properties. We present an investigation of intense ULF waves observed during the May and August 2024 geomagnetic storms. We use data from magnetic observatories in high, middle and low latitude to study deeply this event. The analytical methods employed in this study included filtering geomagnetic data through a zero-phase shift Butterworth band-pass filter. These anomalous pulsations could be attributed to the magnetospheric MHD waveguide/cavity mode and the compressional component of the magnetic field triggered by the storm.

Global Climatological Evaluation of Ionospheric Models Using In-situ Electron Density Measurements from Swarm Satellites

Paul Baki
Kenya national Academy of Sciences/ Technical University oif Kenya

The Swarm mission, comprising a constellation of three satellites, has been providing high-resolution in-situ measurements of topside ionospheric electron density since reaching its final orbital configuration in April 2014. This study presents a comprehensive evaluation of three ionospheric models; the International Reference Ionosphere (IRI), NeQuick, and a neural network-based 3D electron density model (3D-NN), against Swarm Langmuir Probe observations at altitudes between 420 and 530 km. The models' performances were assessed under varying conditions of local time, season, solar activity, and geomagnetic latitude. Results show that all models capture general climatological trends, but with notable differences. IRI performed best at northern mid-latitudes but tended to overestimate densities, especially at higher altitudes and in the southern hemisphere. NeQuick showed better agreement during nighttime and at the altitude of Swarm-B, though it overestimated densities during solstices. The 3D-NN model, trained on COSMIC radio occultation data, consistently outperformed the others, particularly during daytime and high solar activity years, despite underestimating values at lower latitudes. These findings highlight the potential of machine learning-based models for improved ionospheric representation and suggest specific strengths of each model under different geophysical conditions. The results are relevant for applications in satellite communication, navigation, and space weather forecasting.

Wednesday, October 15, 2025

Integrated Pi2 Pulsation Detection and Analysis Using Ground-Based and Multi-Satellite Observations

Islam Hawash | Prof. Dr. Essam Ghamry | Prof. Dr. Susan Samwel | Prof. Dr. Muhamed Yousef | Dr. Hala El-Desoky

National Research Institute of Astronomy and Geophysics (NRIAG), 11421, Helwan, Cairo,Â Egypt. | National Research Institute of Astronomy and Geophysics (NRIAG), 11421, Helwan, Cairo,Â Egypt. | National Research Institute of Astronomy and Geophysics (NRIAG), 11421, Helwan, Cairo,Â Egypt. | Helwan University, Faculty of Science, Physics department, Helwan, Cairo, Egypt. | Helwan University, Faculty of Science, Physics department, Helwan, Cairo, Egypt.

Pi2 geomagnetic pulsations are vital indicators of substorm activity and magnetospheric dynamics. This study presents an integrated approach for automatic Pi2 detection and analysis using data from the Kakioka (KAK) ground station alongside multi-satellite observations from the Van Allen Probes (VAP-A, VAP-B), ERG missions. We employ advanced signal processing techniques, including Hilbert-Huang Transform (HHT), Empirical Mode Decomposition (EMD), Wavelet Transform, and AFINO-based classification, to enhance detection accuracy and characterize pulsation properties. By combining ground and multi-altitude space observations, this work provides a comprehensive perspective on Pi2 wave propagation across different geospace regions. Our findings contribute to understanding substorm dynamics of the magnetosphere, offering a robust framework for future automated Pi2 event studies.

Investigation of the Ionospheric Response to Intense Geomagnetic Storms Over Egypt based on Multi-Instrument Observations

Hassan Noor Eldeen | Lobna H. Basmsm | Ahmed S. Farahat | Afaf M. Abd El-Hameed | Amira Hussien | Abdalla Shaker |O. M. Shalabiea

EgSA-Egyptian Space Agency | Beni-Swif University, Faculty of Navigation Science and Space Technology (NSST) | Beni-Swif University, Faculty of Navigation Science and Space Technology (NSST) | National Research Institute of Astronomy and Geophysics (NRIAG), Solar and Space Research Department | EgSA-Egyptian Space Agency | EgSA-Egyptian Space Agency

This study investigates the ionospheric dynamics over Egypt during strong geomagnetic storms (Dst ≤ -100 nT) occurring between 2024 and 2025. Leveraging multi-instrument observations, we analyze disturbances in the Vertical Total Electron Content (VTEC), scintillation patterns, and plasma irregularities. Data sources include: (1) high-precision VTEC and scintillation measurements from the Egyptian Space Agency's High-end GNSS network; (2) wide-coverage VTEC and scintillation data from the ICTP Low-Cost GNSS network; (3) electron density profiles and integrated VTEC from the COSMIC-2 constellation; and (4) in situ electron density and plasma bubble observations from the SWARM satellites. Geomagnetic indices (Kp, Dst), solar wind speed, interplanetary magnetic field (B), and auroral electrojet parameters (AE) contextualize storm phases. Preliminary results reveal significant storm-induced VTEC deviations (>50% from quiet-time levels) and pronounced scintillation activity (S4 > 0.5). This work establishes a baseline characterization of ionospheric anomalies over a region vulnerable to space weather impacts, highlighting the critical role of localized monitoring.

The Impact of Solar Activity on the Earth's Magnetic Field: An Analytical Study

Aalaa Samy | Tareq Fahmy Abdullatif | Marwa Shaheen

NRIAG

This paper investigates the relationship between solar activity and variations in the Earth's magnetic field. Solar activity, characterized by phenomena such as solar flares, coronal mass ejections (CMEs), and solar wind, has well-documented effects on space weather and, subsequently, on terrestrial magnetic fields. The case study focuses on specific instances of intensified solar activity and their measurable impacts on the Earth's magnetosphere and geomagnetic conditions. According to the Space Weather Live website, one particular event ranks among the six most intense storms of solar cycle 25. This storm resulted in significant fluctuations in the components of the Earth's magnetic field. The study incorporates data from ground-based observatories and satellite observations. Analysis of the power spectrogram revealed pulsations occurring during the recovery phase of the magnetic storm. The findings of this study carry important implications for enhancing our understanding of space weather physics, improving forecasting methods, and developing necessary mitigation procedures.

Analysis of geomagnetic pulsations during solar cycle 24

Abdelmoamen Ahmed Mohamed Mostafa Nosier | Muhammed Yousef Omar | Essam Muhammed Ghamry | Ramy Mawad | Hala El-desoky

Misr University for Science and Technology | Helwan University | nriag | Al-Azhar University | Helwan University

The electromagnetic waves are large-scale phenomena, detected by the magnetometers, whose wavelength can be comparable to the size of the Earth's magnetosphere. It is generally accepted that there are two main types of electromagnetic waves: 1- Pi (irregular) and 2- Pc (continuous) pulsations. Pi is excited at expansion phase onset or intensification of a geomagnetic substorm. Pc has several sources according to its subclass. This research aims to study the generation mechanism of low-latitude electromagnetic waves (Pi2 class) within solar cycle 24 (minimum and maximum phase) using ground-based magnetometers and space observations. The patterns and correlations between Earths' Geomagnetic pulsation activity, number of events, intensity, duration will be studied.

Estimating the Isostatic Response of the Earth's Crust Employing the Principle of Inverse Isostasy

Hussein A. Abd-Elmotaal | Norbert Kühtreiber
Civil Engineering Department, Faculty of Engineering, Minia University | Norbert Kühtreiber Institute of Geodesy , Graz University of Technology,Austria

It is proved by geophysical evidences that the density anomaly is proportional to the Earth's radius vector (the depths from the sea surface). Thus, it may be assumed that the density anomaly is linearly related to the topography by a convolution of the topography and an isotropic kernel function. Accordingly, it can be proved that the attraction of the compensating masses is also a convolution of the topography and an isotropic isostatic response function. This isostatic response function may then be determined by the so-called deconvolution. The current paper gives the proper necessary derivation of this deconvolution by means of the widely used spherical harmonics. The computation of the isotropic isostatic response function requires the harmonic analysis of both the topography and the attraction of the compensating masses. Instead of creating the compensating masses by means of applying an isostatic hypothesis, which already implies an assumption of the Earth's isostatic response, we may wish to estimate a more realistic isostatic response of the Earth's crust. This is achieved by applying the principle of inverse isostasy, by which we aim to vanish the isostatic anomalies. Accordingly, the attraction of the compensating masses equals the Bouguer anomalies with an opposite sign. The harmonic analysis of the attraction of the compensating masses is computed by comparing the harmonic analysis of the topographic potential and the harmonic coefficients of the already existed global geopotential models. The EIGEN-6C4 global geopotential model has been used. The needed harmonic analysis of the topographic masses has been carried out using the SRTMplus Digital Terrain Model (DTM). The isotropic isostatic response function estimated within the current investigation has been compared with the exact solution of the plate floating theory, which shows great similarity.

Geodetic and seismological Evidence of triggered seismicity in the Qarun oil field west of the Dahshour seismic source, Cairo, Egypt.

Mohamed Saleh | Mahmoud Elhadidy | Soha Hassan | Hamada Saadallah
NRIAG | NRIAG | NRIAG | NRIAG

Between 2002 and 2010, increased seismicity and surface deformation were observed approximately 30 km west of the Dahshour seismic source, the origin of the October 1992 Cairo earthquake (Mw = 5.8). This anomalous activity occurred within the Qarun Oil Field, prompting questions about its cause and relationship to regional tectonics. Seismic data from previous studies, the Dahshour Local Network, and the Egyptian National Seismological Network (ENSN) are compiled to analyze the seismicity pattern in both regions. The seismicity in the Qarun Oil Field is shallow (2–5 km), coinciding with active oil production. In contrast, the Dahshour source displays deeper seismicity (~20 km) and has a long history of tectonic activity. Seismicity parameters show a b-value of 1.2 for the Qarun field, suggesting fluid-induced events, while the Dahshour source has a lower b-value of 0.8, consistent with tectonic origins. Moment tensor decomposition for events with magnitudes >3.0 revealed differences in source mechanisms: the Qarun events show significant isotropic component (ISO), Double couple (DC) and compensated linear vector dipole (CLVD) components, linked to stress changes and pore pressure variations due to fluid injection and/or oil extraction. Dahshour earthquakes, however, are dominated by tectonic double-couple mechanisms. Persistent Scatterer Interferometry (PSI) analysis using 38 Envisat SAR scenes from 2002 to 2010 detected uplift in the central Qarun Oil Field at a rate of ~5 mm/year, further supporting the presence of anthropogenic-induced deformation. These findings suggest that seismicity in the Qarun Oil Field is primarily induced, while Dahshour's activity is mainly tectonic.

Preliminary Investigation of A Gravimetric Approach for Fault Detection: A Case Study

Bagas Triarahmadhana
The Geospatial Information Agency of the Republic of Indonesia

Indonesia is characterized by complex geological conditions, with numerous major and minor fault systems distributed across its territory. While conventional fault detection techniques, such as Global Navigation Satellite System (GNSS) and other geodetic observations, are effective for monitoring surface deformation, these approaches often provide limited resolution for subsurface structural interpretation. This study evaluates the potential of a gravimetric approach to support fault detection, particularly in areas with sparse geodetic infrastructure. The selected area of investigation is in the northeastern part of Sulawesi Island, Indonesia. Fault structures were delineated using spatial derivatives, i.e., the First Horizontal Derivative (FHD) and Second Vertical Derivative (SVD) of the complete Bouguer anomaly (CBA). The CBA was estimated using the combination of terrestrial gravity data at ~ 3 km spatial resolution, with global gravity data of the GGMPlus model to improve data continuity. Gravity observations were corrected for latitude, free-air, Bouguer, terrain correction, as well as regional geological parameters. Data processing and derivative computations were performed using Oasis Montaj software. Validation was conducted by comparing the interpreted fault structures with both mapped and inferred fault lines published by the Geological Agency of the Republic of Indonesia (Badan Geologi, Republik Indonesia). The comparison revealed a high degree of correlation between the derived gravity gradients and the existing geological fault datasets. This study highlights the viability of a gravity-based method as a complementary technique for fault detection. When integrated with geodetic and geophysical infrastructures, a gravimetric approach enhances structural interpretation in tectonically active regions.

Assessment of Commercial GNSS Radio Occultation Performance from PlanetiQ Mission

Mohamed Zhran | Ashraf Mousa
Mansoura university | NRIAG

Global Navigation Satellite System (GNSS) radio occultation (RO) provides valuable 3-D atmospheric profiles with all-weather, all the time and high accuracy. However, GNSS RO mission data are still limited for global coverage. Currently, more commercial GNSS radio occultation missions are being launched, e.g., PlanetiQ. In this study, we examine the commercial GNSS RO PlanetiQ mission performance in comparison to KOMPSAT-5 and PAZ, including the coverage, SNR, and penetration depth. Additionally, the quality of PlanetiQ RO refractivity profiles is assessed by comparing with the fifth-generation European Centre for Medium-Range Weather Forecasts (ECMWF) atmospheric reanalysis (ERA5) data in October 2023. Our results ensure that the capability of PlanetiQ to track signals from any GNSS satellite is larger than the ability of KOMPSAT-5 and PAZ. The mean L1 SNR for PlanetiQ is significantly larger than that of KOMPSAT-5 and PAZ. Thus, PlanetiQ performs better in sounding the deeper troposphere. Furthermore, PlanetiQ's average penetration height ranges from 0.16 to 0.49 km in all latitudinal bands over water. Generally, the refractivity profiles from all three missions exhibit a small bias when compared to ERA5-derived refractivity and typically remain below 1% above 800 hPa.

Accuracy Assessment of Recent Geopotential Models for Accurate Geoid Determination at Dubai

Ossama Mohamed |Eman Ahmad El Falasy | khaled Zahran
DM | NRIAG

Accurate geoid determination is critical for precise height conversion in geodetic, engineering, and surveying applications. This study evaluates the performance of recent global geopotential models (GGMs), including EGM96, EGM2008, EIGEN-6C4, and XGM2019e, in determining the geoid over Dubai, United Arab Emirates. Using a combination of satellite-based GGMs and ground-based GPS/leveling data, we assess model accuracy through direct comparison of geoid heights derived from each model against observed geometric geoid values. Results indicate that standalone global models yield root-mean-square (RMS) differences ranging from 0.25 to 0.40 meters, insufficient for high-precision applications. However, when locally calibrated using GPS/leveling data, the gravimetric geoid models can achieve sub-decimeter accuracy, with residuals reduced to 3–5 cm across most of the region and up to 10–11 cm in rugged areas such as Hatta. The study highlights the limitations of uncorrected GGMs in local geoid determination and underscores the importance of regional gravity data integration and model fitting. The findings support the use of hybrid geoid modeling strategies to achieve centimeter-level vertical accuracy in Dubai.

Wednesday, October 15, 2025

Artificial Intelligence (AI)-Driven Design and Implementation of a Low-Cost Global Navigation Satellite System (GNSS) for Robust and Adaptive Positioning

Ahmed Gomaa | Ashraf Mousa
E-JUST, and NRIAG | NRIAG

Global Navigation Satellite Systems (GNSS) have become essential for positioning, navigation, and timing applications across various industries. However, high costs associated with commercial GNSS receivers limit accessibility in budget-constrained scenarios. This work presents the development of a low-cost GNSS solution leveraging Artificial Intelligence (AI), open-source software, low-cost hardware components, and optimized signal processing techniques. By integrating cost-effective components (e.g., RF, Raspberry Pi-based modules), the proposed system achieves good accuracy at a fraction of traditional GNSS costs. Experimental results demonstrate its performance, highlighting trade-offs between accuracy, power consumption, and affordability. The proposed system is particularly suitable for applications in precision agriculture, unmanned aerial vehicles (UAVs), Geodetic applications, and IoT-based tracking, making high-precision positioning more accessible to developing regions and small-scale enterprises.

Wednesday, October 15, 2025

Session **Oral-High Energy Astrophysics**

On the formation of the persistent Be/X-ray binaries fed by accretion discs

Ali Taani
Physics Department, Faculty of Science, Al-Balqa Applied University, 19117 Salt, Jordan

I considered four X-ray binary systems of GX 301-2, 4U 2206+54, RX J0440.9+4431, and 4U 0352+309. They have known orbital and spin periods of the pulsars, and also the strength of the magnetic field at the surface of the pulsar is known for the selected targets. Then, an attempt was made by to derive the mass-loss rate and velocity of the stellar wind from the Be star, for each binary system. By using them as input parameters, the X-ray luminosity, spin period and magnetic field of the pulsar, and its orbital period, and by assuming that they are in the so-called "direct accretion regime". As a result, I compared the properties of the wind they found using this method, with those obtained with other methods/measurements

AI Hybrid Learning Models and its Rule in Strengthening Astronomy Education

A.B. Morcos
NRIAG

Astronomy has long captivated interest and serves as a compelling gateway to scientific inquiry. However, effectively communicating its complex concepts to diverse learners presents a significant pedagogical challenge. This study investigates the impact of hybrid learningâ€”an instructional approach integrating online resources with in-class instructionâ€”on student engagement and comprehension in astronomy education. Through a rigorous analysis of course performance data, student feedback, and classroom observations in hybrid-format astronomy courses, findings indicate that this blended methodology significantly enhances conceptual understanding, particularly in abstract domains like stellar evolution and orbital mechanics. The strategic incorporation of immersive virtual planetariums, interactive simulations fostering active learning, and democratized remote observatory access enriches the online learning environment. Concurrently, thoughtfully designed face-to-face sessions cultivate deeper learning through collaborative problem-solving and guided exploratory activities. Hybrid learning emerges as a particularly potent tool for broadening access to astronomy education, engaging underserved and geographically remote populations. This research underscores the potential of hybrid models to not only improve science communication effectiveness but also to promote inclusivity and cultivate enduring interest in the fascinating field of astronomy.

Planetary science and exoplanets

AKATUKUNDA DORAH
Mbarara university of science and Technology

My study presents the detection and characterisation of eight exoplanets orbitsmdwarf dtars,using high precisionRV data.The analysis builds upon the methodologies and target selection criteria as describedby pinamonti et.al 2022 who demonstrated the effectiveness of long term RV monitoring in unvelling low mass planetary companions around late type stars.by applyingadvanced RV techniques, the study identified multiple periodic signals consistent with planetary origins with minimummasses ranging from super earths to sub neptunes.The resultsreinforce the growing evidence that mdwarfs commonly host low mass planetary systems and highlights the scientificimportance of precise RV followup in thecontext of on-going photometricsurvey such as TESS.The findings contribute to the current census of planets around low mass stars but also offer new targets for future transit observations and atmospheric characterization.

Wednesday, October 15, 2025

Designing A Toomre Parameter for A Keplerian, Thin, Axisymmetric, Pebble-Only, Protoplanetary Disk with an Exploration of Proportionalities and Relations with Radiative, Dynamical, And Kelvin-Helmholtz Timescales

Nour A. Nabhan
American University of Armenia. Zaven & Sonia Akian College of Science & Engineering.

The Toomre parameter is a vital indicator of the direction in which a forming planet is heading, in that it can show what kind of planet will result from the clumping of matter. Yet, it mainly deals with gaseous fluids, therefore, in this paper we design a Toomre parameter made for studying pebbles by neglecting gas dynamics and while assuming the pebbles to be individually spherical and solid but collectively act as a pressureless fluid, this is done in the context of a Keplerian, thin, and axisymmetric disk with a steady, rotating background, then, we determine some of the parameter's characteristics by studying its proportionality with three timescales: radiative (τrad), dynamical (τdyn), and Kelvin-Helmholtz (τKH).

A search for millimeter Class I methanol masers towards Cygnus-X molecular cloud using the NASCENT-stars large program

Mohamed Said Darwish
National Research Institute of Astronomy and Geophysics (NRIAG)

The molecular evolution of star-forming gas is fundamental to understanding how the chemistry of interstellar material evolves within regions where planetary systems form. This evolution begins in the protostellar phase, where collapsing gas and dust give rise to dense molecular envelopes. Methanol masers, particularly Class I masers, serve as powerful tracers of these environments. They are collisionally excited in shocked regions, often associated with outflows and star-forming activities, providing insights into the dynamical processes within star-forming cores. The Cygnus-X molecular complex, located at a distance of 1.4 kpc, is one of the most massive and active star-forming regions in the Galaxy. Hosting a range of low- to high-mass protostellar objects, it offers a natural laboratory for investigating methanol maser emission. This paper is in the context of the large observing programme, "NASCENT-stars", that uses the IRAM NOEMA state-of-the-art interferometer. The main goal of this work is to search for and characterize Class I methanol masers in the Cygnus-X region using data from the NASCENT-stars project. This study will contribute to the broader goals of understanding star formation and molecular evolution in extreme environments.

X-RAY FLUX VARIABILITY OF BL LACERTAE OBJECT 1ES1426+428 WITH SUZAKU SATELLITE

Saad | Nasser Mohamed
NRIAG | NRIAG

The blazars play a significant role in enhancing our understanding of the physics related to jets emitted from Active Galactic Nuclei (AGNs). We provide a comprehensive spectral study of the Suzaku observations concerning the 1ES1426+428 blazar. Our investigation focuses on the X-ray characteristics and spectral variability of this particular blazar. The X-ray properties of our sample are determined using all available Suzaku observations. This is done by extracting the BL Lacertae sample spectra in the same way and fitting them with two models (zpower law and zlogparabolic). The fitting was conducted within the soft X-ray range of 0.8 - 10.0 keV. Both models yield similar results. But by comparing the fitting resulting from different models applied in our study, we found that the zlogparabolic model is the best one to represent the data. To test the X-ray variability of our BL Lacertae sample, we fitted their spectra, which were extracted using the same instrument and procedure, with the same model to estimate their X-ray flux and luminosity. The estimated fluxes were then compared to check their variability. We found that the range of flux variability for the 1ES1426+428 object is 0.37 × 10^{-10} erg s^{-1} cm^{-2}.

Fractional Relativistic Isothermal Spheres in General Relativity

Mohamed S. Aboueisha | Mohamed I. Nouh | Emad A. -B. Abdel-Salam | Mona Foda

Astronomy Department, National Research Institute of Astronomy and Geophysics, 11421 Helwan, Cairo, Egypt | Astronomy Department, National Research Institute of Astronomy and Geophysics, 11421 Helwan, Cairo, Egypt | Department of Mathematics, Faculty of Science, New Valley University, El-Kharja 72511, Egypt | Astronomy Department, Faculty of Science, Cairo University, Giza, Egypt

Relativistic effects are crucial in various stellar structures, including white dwarfs, neutron stars, black holes, supermassive stars, and star clusters. The isothermal gas sphere model helps understand some aspects of astrophysical objects like stars, but it becomes minimal when dealing with compact stars. The Tolmanâ€“Oppenheimerâ€“Volkoff (TOV) equation for the isothermal gas sphere is fundamentally a hydrostatic equilibrium equation derived within the framework of general relativity. In the context of the modified Riemann-Liouville (mRL) frame, we formulate the fractional TOV (FTOV) equations to introduce and present an analytical solution. The analytical solution of the FTOV equation is handled using an accelerated series expansion and has been utilized to enhance the convergence of the resulting series solutions. We analyze the influence of relativistic and fractional parameters on the Emden function, mass function, and its first derivative, as well as their effects on pressure, density, and the mass-radius relation. Exploring the central density-mass relation, analogous to compact stars, reveals the existence of a maximum mass for the sphere. We test the calculated models to validate the requirements of regularity, causality, energy conditions, and the adiabatic index when examined against instability using various criteria.

Electromagnetic Phenomena Induced by Dust Particle Dynamics in Planetary Atmospheres: Laboratory Simulations and Field Observations

Mohamad Abdelaal

Space Research Institue (IKI RAS)

Dust electrification and associated electromagnetic (EM) emissions play a crucial role in the atmospheric and near-surface dynamics of planetary environments such as Earth, Mars, and potentially Venus and the Moon. This study investigates the mechanisms of charge generation, accumulation, and discharge in dust-laden flows under both terrestrial and Martian analog conditions through a combination of theoretical modeling, laboratory simulations, and field measurements. Laboratory experiments were conducted in controlled environments simulating Earth's and Mars' atmospheric conditions , using silicate-rich and basaltic dust samples of varying granulometries. Results show that triboelectric charging and tunneling mechanisms lead to the formation of transient discharges producing broadband EM signals in the LF-MF ranges. The breakdown characteristics of CO_2 under low-pressure conditions were experimentally validated, revealing reduced threshold voltages consistent with Martian surface conditions. Field studies carried out in the Kalmykian Desert (Russia) confirmed that moderate wind speeds, low humidity, and intense solar radiation enhance dust electrification and increase the frequency of electrostatic discharge events. These events were detectable via an Electromagnetic Analyzer (EMA), originally designed for space missions. Signal classification using time-domain, FFT, and wavelet transform methods revealed distinct amplitude-frequency signatures correlated with particle properties and environmental drivers. This work provides a new framework for understanding EM phenomena in dusty planetary atmospheres and highlights the relevance of EM sensing technologies for future planetary exploration missions, particularly for Mars and the Moon. The results also contribute to the broader understanding of atmospheric electricity and its implications for climate modeling, remote sensing, and spacecraft instrumentation design.

Assessing Water and Sediment Heavy Metals with Radiometric Core Dating for Environmental Reconstruction: A North African Lagoon Case Study (Marchica Lagoon)

anas bibot
Mohamed VI Polytechnic University

Heavy metals in coastal ecosystems represent an environmental issue of concern especially in lagoons through agricultural effluent, urban effluent, and anthropogenic activity. In Marchica Lagoon, an integrated geochemical analysis of water-column and sediment revealed substantial spatial heterogeneity of metals. Sulfur (S), Strontium (Sr), and Boron (B) had their greatest concentrations in the sediments closest to the connection to the sea, while Aluminum (Al), Iron (Fe), and Silicon (Si) had their greatest concentrations in the sediment closest to the main freshwater sources. Some of the other trace elements of interest included Lithium (Li), Molybdenum (Mo), and Barium (Br) which formed separate hotspots elsewhere in the system. Sediments were also indicative of active partitioning of redox-sensitive metals such as Zinc (Zn), Copper (Cu), and Lead (Pb) between dissolved and particulate phases. Principal-component analysis and multivariate clustering showed chemically distinct zones highlighting the impacts of biogeochemical cycles of water and sediments on metal mobility and retention. These spatial aspects provide a sound basis for predictive contaminant-fate modeling and influencing monitoring and remediation approaches focused on maintaining Marchica Lagoon’s ecological integrity.

A Study on the Effects of Gamma and Electron Radiation on DSSC Thin Films

Sameh Hamzawy, H.M.S. Hamed, G. Ghabiri, Said Moawwad, A. A. Abdelaziz, Aierken Abuduwayiti
Solar Research Laboratory, Solar and Space Department, National Research Institute of Astronomy and Geophysics, Helwan, 11421, Cairo, Egypt.

Dye-sensitized solar cells (DSSCs) offer unique advantages for space applications, including lightweight, flexible designs, and efficient performance in low-light conditions. These attributes make them promising for powering small satellites, solar sails, and in-situ resource utilization on extraterrestrial surfaces. However, challenges such as sensitivity to radiation, long-term stability, and lower efficiency compared to conventional photovoltaics must be addressed. Advances in radiation-resistant materials, solid-state electrolytes, and encapsulation techniques are critical for their viability in space. Herein, we demonstrated the radiation effect of gamma rays (100-2000 krad) and electron beam (3 MeV electron fluences, 1Ã—1012 - 1Ã—1015 cmâ€“2), at different doses, on the DSSC thin film. The findings shows that the energy bandgap decreases with increasing the gamma and electron radiation. This is mainly due to the defects generated in the bandgap due to the interaction of the material with the gamma and electron radiation. These results pave the way for designing radiation-resistant Dye Solar Cells through targeted compositional engineering.

Hydrochemistry, Bacterial Contamination, and Isotopic Composition of Sulfur and Mineral Springs, Helwan, Egypt

Usama Massoud | Abbas Mohamed-Abbas | Ayman Abdellattif | El Said Ragab | Gad El Qady | Mahmoud Khalil

National Research Institute of Astronomy and Geophysics | National Research Institute of Astronomy and Geophysics | National Research Institute of Astronomy and Geophysics | National Research Institute of Astronomy and Geophysics | National Research Institute of Astronomy and Geophysics | Geology Department, Faculty of Science, Minia University

Helwan area embraces many sulfur and mineral water springs with proven curative effects on several diseases. Nowadays, the area is deteriorated due to anthropogenic threats. This study addresses the springs` chemical attributes, bacterial contamination, and isotopic composition to assess the water origin, quality, and suitability for human use. Vulnerability of the area to contamination was also considered in terms of its hydrogeological conditions. Eleven springs` water samples were analyzed for the major ions and trace elements. The dominant (Na-Cl-SO4) composition suggests a primary groundwater salinity. Many samples are of deep meteoric origin, and few samples are of recent marine origin. The mineral springs could be distinguished from the sulfur springs as the latter show high temperature, high salinity, smell of H2S, and positive sulphate-reducing bacteria. Â The majority of samples show high rates of fecal coliforms, which means that they are contaminated with human and animal wastes due to the near-surface groundwater and the possible leaked water from cisterns and sewage. The signature of the water contamination was clearly observed on some ground penetrating radar (GPR) sections measured close to the springs. The depleted Î´18 O and Î´D ratios indicate an old Nile water recharge origin mixing with rainwater, while the tritium content suggests the possibility of partial recharge from the deep Nubian aquifer. The springs` water in this state is unsafe for human use and needs effective practices to manage the household, industrial, and livestock wastes, and to assimilate the springs for therapeutic practices

Analyzing Terrestrial Carbon Storage in Northern Pakistan: Assessing the Role of Afforestation Using Google Earth Engine and the InVEST Modeling Framework

Syed Amer Mahmood

Institute of Space Science, University of the Punjab, Lahore, Pakistan

Carbon sequestration is essential for achieving net-zero emissions and combating climate change, with forest ecosystems playing a pivotal role by capturing and storing atmospheric carbon dioxide (COâ„). However, shifts in land use and land cover (LULC) significantly influence terrestrial carbon storage (CS). This study investigates the spatiotemporal dynamics of carbon storage in Khyber Pakhtunkhwa (KPK), particularly the Hazara Division, over the period from 2002 to 2022, using remote sensing and geospatial modeling tools. Landsat satellite imagery for the years 2002, 2012, and 2022 was processed on Google Earth Engine (GEE) to generate LULC maps with classification accuracies of 88%, 89%, and 92%, respectively. A suite of spectral indices, including NDVI, NDBI, NDSI, ANDSI, mNDWI, and EVI, was employed to enhance classification precision. The InVEST Carbon Storage and Sequestration model was then used to quantify changes in CS linked to LULC dynamics. Results indicate a significant 69% increase in forest cover, largely due to the conversion of barren land, coinciding with Pakistanâ €™s Billion Tree Tsunami Project (BTTP). Correspondingly, carbon storage increased from 6538 Mg/mÂ² in 2002 to 7436 Mg/mÂ² in 2022, representing a 13.7% gain. This underscores the effectiveness of afforestation efforts in enhancing carbon sinks. The findings emphasize the need for sustained forest conservation and reforestation initiatives and advocate for development policies that balance ecological integrity with urban expansion to ensure long-term climate resilience.

Assessment of Gridded and Reanalysis Precipitation Data in the Upper Indus Basin Using Climate Forecast System Reanalysis

Shaiza Farooq
Institute of Space science, University of the Punjab, Lahore

The Upper Indus Basin (UIB) plays a vital role in supporting water resources and agricultural productivity, particularly in Pakistan. Due to its complex topography and limited weather station coverage, especially at higher altitudes, accurate precipitation monitoring remains a significant challenge. Traditional ground-based observations are often confined to valley regions, resulting in data gaps and biases in high-altitude zones. To address these limitations, this study utilizes high-resolution Climate Forecast System Reanalysis (CFSR) data to evaluate precipitation trends over the UIB from 1980 to 2020. Precipitation data were pre-processed and organized using Excel, followed by trend analysis using the Mann-Kendall test implemented in RStudio. Monthly Mann-Kendall statistics, including p-values, Sen's slope, and Z-values, were calculated to assess the significance and direction of precipitation trends. These results were then aggregated to generate overall seasonal and regional trend values. Subsequent spatial interpolation was performed to visualize the temporal and regional variations in precipitation trends. Monthly and regional maps of p-values, Z-values, and Sen's slopes were developed to identify areas with statistically significant increasing or decreasing trends, with particular emphasis on the monsoon season. The spatial analysis revealed a statistically significant increasing trend in the central and eastern parts of the study area. This study contributes to a better understanding of the spatial and temporal variability of precipitation in the UIB. The findings offer valuable insights for future hydrological modeling, climate adaptation strategies, and water resource planning in mountainous regions.

Geothermal Heat Flow in Egypt Derived from Lithospheric Thickness: Evidence from Curie Isotherm and LAB Depths

Moataz Sayed
National Research Institute of Astronomy and Geophysics

This research investigates geothermal heat flow (GHF) distribution in Egypt using Curie temperature depth and Lithosphere - Asthenosphere Boundary (LAB) depth. Integration of these parameters offers a detailed insight into the thermal conditions within the lithosphere. The Curie depth, derived from magnetic data, and the LAB depth, inferred from seismic studies, serve as proxies for estimating the heat flow (HF) variations across the region. The results offer valuable insights into geothermal potential, particularly when there are notable anomalies in heat flow or lithospheric thinning. The most significant heat flow values, between 100 and 185 mW/m2, are seen in the Red Sea rift, attributed to its active tectonics and thin crust. In contrast, the Mediterranean offshore zone displays values between 40 and 110 mW/m², with an increasing gradient from east to west. Moderate heat flow values (60–90 mW/m²) characterize the southern Sinai Peninsula and the Gulfs of Suez and Aqaba, while northern Sinai records lower values (40–50 mW/m²). In the central Eastern Desert, heat flow ranges from 60 to 80 mW/m², declining to 50 mW/m² in the northern and southern margins. The Nile Delta exhibits values around 50 mW/m², peaking at 60 mW/m². The Western Desert is divided into three zones: the northern unstable shelf (~60 mW/m²), the stable central shelf (50–80 mW/m²), and in the south, the Arabian-Nubian Shield near Awinat, where the lowest values (30–60 mW/m²) are recorded. The study identifies the Red Sea Rift as a key geothermal hotspot, emphasizing its potential for clean energy development.

Assessing and Correcting ERA5 Reanalysis Data for Reliable IDF Curve Development in Ungauged Tunisian Basins

Hanen GHANMI | Besma Traya | Hamouda Dakhlaoui
National School of Engineering of Gafsa | National School of engineering of Tunis | National School of Architecture and Urban Planning

In the context of climate change intensifying extreme precipitation events, reliable Intensity–Duration–Frequency (IDF) curves are essential for hydraulic risk management, especially in poorly gauged regions like parts of Tunisia. This study assesses the reliability of ERA5 reanalysis data for modeling hourly extreme rainfall and developing adapted IDF curves. Building on recent work by Wambura (2024), it identifies common biases in reanalysis products, such as the underestimation of peak intensities, and applies a linear scaling bias correction method. This approach significantly improves agreement with available local observations and provides a transferable methodology to enhance IDF curve accuracy in ungauged basins, supporting better infrastructure planning.

Wednesday, October 15, 2025

Coupled magnetic and geochemical characterization of soil contamination in the Bou Caid area, Algeria

Lynda Attoucheik | Yamina El Meddahi | Neli Jordanova | France Lagroix | Said Maouche | Abdelhak Boutaleb

Hassiba Ben Bouali University, Hay Salem, National road N°19, 02000 (Chlef, Algeria) | Hassiba Ben Bouali University, Hay Salem, National road N°19, 02000 (Chlef, Algeria) | National Institute of Geophysics, Geodesy and Geography, Bulgarian Academy of Sciences, Acad. G. Bonchev Str.,Block 3, 1113 Sofia, Bulgaria. | Institut de Physique du Globe de Paris (IPGP), Sorbonne, Paris Cite´, Univ. Paris Diderot and UMR 7154 CNRS, 1 Rue Jussieu, 75238 Paris Cedex 05, France. | CRAAG, BP 63 Bouzare´ah, 16340 Algiers, Algeria. | 5Faculty of Earth Sciences, Geography and Regional Planning, USTHB, BP 32, El Alia, Bab Ezzouar, 16111 Algiers, Algeria

Former zinc and lead mines that have been operating for half a century are located in the massif of Bou Caid (Tissemsilt, Algeria). Hazardous Metal Trace Elements (MTE) emitted from the mines are abundant in the surrounding soil and cause a very important metal pollution in the region. This study investigates the extent of pollution by magnetic field measurements and analyses of magnetic and geochemical parameters of samples collected in the neighborhood of the mines. The results of the magnetic study show the coexistence of magnetic minerals such as magnetite, hematite and goethite. The magnetite is the main source of significant variations of magnetic susceptibility obtained in the studied area. Analyzing magnetic mineralogy of surface soils in combination with weathered rocks from a lithological sequence at the river bank, it is supposed that hematite and goethite are of lithogenic, ore-related origin. Magnetic susceptibility, regarded as a magnetic proxy for pollution shows positive correlation with the content of Lead but only for low- to medium concentrations.

A Python-Based Machine Learning Framework for Forecasting Surface Solar Radiation

Ahmed Abulwfa | Ashraf Khamees | Heba Zenhom

National Research Institute of Astronomy and Geophysics | National Research Institute of Astronomy and Geophysics | National Research Institute of Astronomy and Geophysics

Accurate forecasting of surface solar radiation (SSR) is essential for optimizing the integration of solar energy into modern power grids and enhancing the reliability of photovoltaic (PV) systems. Recent advancements in artificial intelligence (AI), particularly in machine learning (ML), have enabled the development of data-driven models capable of capturing the complex spatiotemporal dynamics of irradiance with higher precision than traditional statistical or physics-based methods. This study presents a comprehensive framework for SSR forecasting, integrating multi-source datasets—including satellite imagery, ground-based measurements, and AI-accelerated numerical weather prediction outputs—into a unified machine learning pipeline. The research emphasizes a Python-based ecosystem for implementation, leveraging open-source tools such as PyTorch Lightning for deep learning, XGBoost for ensemble modeling, xarray and dask for efficient data processing, and MLflow for experiment tracking. A structured workflow is proposed, covering data acquisition, feature engineering, model selection, hyperparameter optimization, and real-time deployment using ONNX and FastAPI. Through a case study focused on multiple climatic zones across Egypt, the framework demonstrates its applicability and scalability, achieving root mean square errors (RMSE) below 50 W/m² for short- and medium-term irradiance forecasting. The results confirm that Python, when combined with modern AI methodologies, offers a reproducible, extensible, and high-performance platform for operational solar radiation forecasting at regional scales.

Climate Change Effects on Snow Cover and Hydrological Cycles in Gilgit-Baltistan, Pakistan: A Comparative Analysis

Hania Arif | Syed Amer Mahmood
Lahore College for Women University, Lahore Pakistan | University of the Punjab, Lahore Pakistan

Snow cover dynamism is an important component of the UIBâ€™s (Upper Indus Basin) hydrodynamics in the context of snow occurring seasonally.Â This study incorporates investigation into the dynamics of snow covers in relation to the hydrodynamics of the region. Data acquired through remotely sensed MODIS (Moderate Resolution Imaging Spectro-Radiometer) satellite for the duration of 24 years from 2000-2024, together with additional variables of hydro-meteorology was utilized in the assessment of spatio-temporal fluctuation in snow-covered areas of Gilgit-Baltistan (GB). The snow cover analysis was done temporally with an evaluation of its relationship with the hydro-meteorological variables through the application of Pearson correlation, Principal Component Analysis (PCA), and basin-wise zonal analysis. The investigation revealed that glacial covered an area of 25 to 50% and that snow Covered Area (SCA) may expand to 80 to 90% of the region. Trends from hydro-meteorological correlativity demonstrate a greatly considerable proportionality of R = 0.78, between the maximal and minimal temperature zones and river drains. For the region of Hunza, a statistically important negative correlativity was observed between the river and rainfall i.e., R = â€“0.83. The minus factor indicates an increase in river drainage with increased melting of snow covers due to high temperatures. This investigation infers a close association of river runoffs of the GB area with its snow cover dynamism. Discharge of rivers is a consequence of melting snow in the basin due to rising temperature and thus it speeds up at the beginning of summers mainly during April and May.

Monitoring Groundwater Depletion in Northern Egypt Using GRACE and GRACE-FO Data

Mostafa Elwan
NRIAG

Groundwater is a critical resource for northern Egypt, particularly in the Nile Delta and surrounding arid regions, where surface water is insufficient to meet growing demands. Increasing agricultural activity, urban development, and climatic variability have led to significant pressure on groundwater reserves. In this study, we use satellite gravimetry from the GRACE and GRACE Follow-On (GRACE-FO) missions to monitor long-term changes in groundwater storage from 2002 to 2025. We analyze monthly terrestrial water storage anomalies (TWSA) using the Jet Propulsion Laboratory (JPL) mascon solutions. To isolate the groundwater component, we apply a water balance approach by removing soil moisture and surface water estimates derived from the Global Land Data Assimilation System (GLDAS). The study area covers northern Egypt, including the Nile Delta, parts of the Western Desert, and key agricultural zones. The results indicate a clear downward trend in groundwater storage over the study period, with seasonal variations reflecting irrigation and rainfall cycles. Spatial analysis reveals that groundwater depletion is most severe in regions experiencing intensive groundwater extraction for agriculture. While some localized fluctuations occur, the overall pattern reflects sustained overuse beyond recharge rates. These findings underscore the effectiveness of GRACE-based monitoring in regions where ground-based measurements are limited. The study provides important insights into the scale and spatial distribution of groundwater stress in Egypt. This information is essential for developing sustainable groundwater management strategies and supporting water policy decisions in arid and semi-arid environments.

Digitization of Qaitbay Fort in Alexandria (884AH/ 1479 CE) — Simplification of Modelling Techniques to Safeguard Vulnerable Cultural Heritage

Abdelhamid Elbshbeshi
NRIAG

Qaitbay Fort (884 AH/ 1479 CE) is a symbolic landmark in Alexandria. Qaitbay, the Mamluk Sultan, erected this fort on the geostrategic location at Pharos Island to fortify Alexandria on the same location of the splendid Ptolemaic Lighthouse in 284 BCE. Chronology illustrates the exposures and vulnerabilities on Pharos Island. The Lighthouse was entirely collapsed due to tsunamigenic hazards in 1301 CE. Climate change impact represented in gas emissions accelerates global warming causing sea level rise threatening Qaitbay Fort. Based on the digitizing Qaitbay Fort project, this contribution simplifies the incorporation of modelling techniques to safeguard Qaitbay Fort and other similar vulnerable cultural heritage. iPad LiDAR scan and 360° Imaging were integrated to digitize Qaitbay Fort. Advantages and limitations of the utilized software were discussed. Esri-StoryMaps combined and disseminated the interactive outcomes in a narrative context for raising the community awareness and supporting stakeholders.

Neural Network-Based Decision Support System for Land Use, Land Cover, and Agricultural Information Retrieval via Geospatial Integration

Hafiza Sayyeda Farah Batool
Institute of Space science, University of the Punjab, Lahore

The digital transformation in agriculture has advanced traditional management practices into intelligent systems driven by artificial intelligence (AI), aiming to extract valuable insights from diverse and large-scale datasets. Accurate identification of the location, extent, and type of land cover (LC) or crops is vital for managing water resources, alleviating poverty, and enhancing food security. Crop type classification and LC mapping play a critical role in precision agriculture and urban heat island (UHI) studies. Despite the integration of remote sensing (RS), machine learning (ML), and deep learning (DL) with time-series satellite and in-situ data, achieving high classification accuracy remains a challenge. In this study, a deep convolutional neural network (CNN) model was developed to identify LC types using Sentinel-2 time-series imagery from Google Earth Engine (GEE). A Normalized Difference Vegetation Index (NDVI) stack was generated as the input feature set. The classification included rice crops and four non-crop classes: Built-up, Rangeland, Trees, and Water. The performance of three ML algorithms, Random Forest (RF), Support Vector Machine (SVM), Classification and Regression Trees (CART) was evaluated alongside two DL models: Long Short-Term Memory (LSTM) and 2D Convolutional Neural Network (2D-CNN). Among all models, 2D-CNN achieved the highest performance with an overall accuracy of 89.80% and a kappa coefficient of 0.87. RF followed closely, while LSTM, CART, and SVM showed comparatively lower accuracies. The results highlight the strong potential of 2D-CNN in accurately distinguishing LC types, offering valuable insights for optimizing irrigation scheduling based on crop distribution.

GEO-PRO: The Simulation of a One-Channel Velocity Sensor Designed for Earthquakes Measurement

Ramadan Desouku
NRIAG

this paper introduces the simulation of a one-component seismometer called GEO-PRO which is used for earthquake detection, mining, and vibration monitoring applications. The GEO-PRO is composed of an SM-6 4.5 HZ geophone that is used as a sensing element; a Low-pass filter circuit, a High-pass filter circuit, and an amplifier circuit that is used as a signal conditioning circuit for the geophone analog signal; a dual supply source that is used to supply the signal conditioning circuit. The transfer function of the GEO-PRO has been mathematically developed and simulated using the Matlab Simulink. The performance of the developed GEO-PRO seismometer has been evaluated by investigating the frequency response of the whole system. Based on the simulation results, design a realistic hardware for the GEO-PRO has been developed as a one-component, low-cost geophone seismometer, therefore, it can be used to develop a low-cost and high-intensity seismic network with a limited budget. Index Terms— Earthquake Detection, GEO-PRO, Geophone, High-Pass filter, Low-Pass filter, Mining, and Vibration.

CRUSTAL SEISMICITY IN NORTHERN PATAGONIA, ARGENTINA

Santori, Constanza | Rivas, Carolina | Bilbao, Ines
Departamento de Geofísica, Física y Astronomía, Facultad de Ciencias Exactas, Físicas y Naturales, Universidad Nacional de San Juan, Argentina. | Centro de investigaciones de la Geósfera y Biósfera (CIGEOBIO). Facultad de Ciencias Exactas, Físicas y Naturales. Universidad Nacional de San Juan – Consejo Nacional de Investigaciones Científicas y Técnicas (CONICET). | Departamento de Geofísica, Física y Astronomía, Facultad de Ciencias Exactas, Físicas y Naturales, Universidad Nacional de San Juan, Argentina.

In recent years, an increase in shallow seismicity has been observed in parts of Argentinian Patagonia, both in frequency and magnitude. In 2019, two significant crustal earthquakes occurred in Neuquén (Mw=5.0) and Santa Cruz (Mw=4.9), the largest events reported in those provinces. This work analyzes crustal earthquakes in Neuquén, Argentina, between June and October 2020, using records from the National Institute of Seismic Prevention (INPRES), the Chilean National Seismic Network, and global stations. The study area includes part of the Neuquén basin, a key hydrocarbon-producing region of great economic interest. A total of 23 events were initially located using HYPOCENTER 3.2 through SEISAN 12.0. To refine their parameters (epicentral coordinates, depth, origin time, and magnitude), different techniques were applied depending on the epicentral distance and signal quality. In cases with only international stations and poor azimuthal coverage, reliable results were difficult to obtain. Two seismic velocity models were considered: a regional model used by INPRES (Sánchez et al., 2013) and a local model from Bohm et al. (2002). This approach allowed for more accurate earthquake locations and better identification of seismic patterns. Fifteen shallow events with magnitudes between Mw 2.8 and 3.8 and depths less than 8 km were identified. The results provide valuable insights into the nature of seismicity in the Andean backarc, differentiating between near-surface events likely associated with exposed structures and deeper ones possibly related to blind or basement faults.

Wednesday, October 15, 2025

The Quiescence Intervals and Seismic Cycles of the Abu Dirwa Fault Seismicity and Their Implications with Lake Nasser Water Level South of the Aswan High Dam

Gaber Hassan Hassib
NRIAG

Abu Dirwa fault is a north-south trending and seismically active fault; it is about 55 km southwest of the Aswan High Dam. The seismicity monitoring from 1982 to 2024, reveals low seismicity of this fault. This study has examined the temporal distribution of the seismicity recorded by Aswan seismic network in operation continuously for 43 years (1982-2024). The temporal distribution of the seismicity, from 1982 to 1998, demonstrates few activities. The seismicity is increased since 1999 and lasted 6 years showed the first seismic cycle. The quiescence interval followed this seismic cycle lasted 6 years. The second seismic cycle occurred from 2011 to 2018, followed by quiescence time for 3 years before seismicity increasing in 2022. The relationship between seismicity and the lake water level reflects the influence of the water level on the earthquakes triggering, although this seismicity is focused about 5 km outside the lake outer edge. This result exhibits the impact of the water infiltration from the lake in triggering earthquakes. So, it can be recommended that, it should be pay attention to the importance of the underground water study and the continuous monitoring of the piezometer near Abu Dirwa fault.

Machine learning Techniques to detect quarry blasts and mitigate their impact on vulnerable communities

Ghada Ali |Shimaa.H. Elkhouly
NRIAG

Classifying the source type of small seismic events is a key task in seismology. A common goal is distinguishing tectonic earthquakes from explosions and human induced seismicity. The similarity in seismogram between earthquakes and quarry blasts is the main reason for incorrect discrimination. The unbalanced data between simulated explosions and earthquakes limits the accuracy of automatic discrimination. The time domain waveform is used as a feature vector in this paper's multi-machine learning approach for seismic discrimination. Different kernel functions are added to machine learning techniques during the learning and testing process to enhance the ability to discriminate between quarry blast and earthquake.The receiver operating characteristic curve and the area under the curve are used to assess the precision and results of the suggested approach utilizing these models. The outcomes of the simulation demonstrate that the suggested approach produces more accurate analysis and classification discrimination.

Machine Learning Approaches for Identifying Earthquake preceded by Precursors and Non-Preceding Events

Ghada Ali | Ali G. Hafez | Sayed Hasaneen | Ahmed Mohamed
Electrical Engineering Department, Faculty of Engineering, Aswan University, Aswan, Egypt. NRIAG | Control and Computer Department, College of Engineering, Almaaqal University, Basrah, Iraq. NRIAG | Electrical Engineering Department, Faculty of Engineering, Aswan University, Aswan, Egypt | Electrical Engineering Department, Faculty of Engineering, Aswan University, Aswan, Egypt

The analysis of seismic data from an earthquake entail determining all of the features that may be extracted from the recorded signals, such as path and source. Determining the P-wave's arrival timing is a key component in determining earthquake parameters. Errors in automated identification of the P-wave start time are caused by the precursory signals that precede the p-wave of an earthquake. The sluggish moment release that occurs up to tens of seconds before major earthquakes is thought by many researchers to be seismic nucleation phases, which mark the start of an unstable process within the seismic rupture zone. The automated detection of occurrences that are preceded by these precursory signals will be the main focus of this work. Machine Learning (ML) uses several layers of abstraction to progressively extract high-order characteristics from the input. Based on the existence of precursors, the automated P-wave detector can predict when the P-wave will come, and the classifier topology can identify these patterns. The ML fared better than the other approaches, with a distinct classification accuracy.

Wednesday, October 15, 2025

AI Approaches for Predicting Dam Piezometric Water Levels: A Case Study of Bouhanifia Dam

BENYAHIA SLIMANE | ROUISSAT BOUCHRIT | SMAIL NADIA | TOUATI FATAH | BENDAOUDI Latifa

Space Geodesy Department, Center of Space Techniques , Algerian Space Agency , Oran | RISAM Lab, Faculty of Technology, University of Tlemcen | RISAM Lab, Faculty of Technology, University of Tlemcen | Space Geodesy Department, Center of Space Techniques , Algerian Space Agency , Oran | RISAM Lab, Faculty of Technology, University of Tlemcen

Dam safety monitoring requires comprehensive analysis of multiple interdependent parameters, including seepage flows, piezometric levels, reservoir water levels, pore pressures, structural displacements, temperature variations, and loading conditions. The interpretation of these complex datasets through advanced modeling techniques is fundamental to structural health assessment and risk mitigation. This study investigates machine learning approaches for predicting piezometric water levels, a critical indicator in dam seepage analysis. We evaluate and compare the performance of three advanced AI models - Least Squares Support Vector Machine (LSSVM), Group Method of Data Handling (GMDH), and M5 Prime - against conventional neural network approaches (Backpropagation Neural Network (BPNN) and Radial Basis Function Neural Network (RBFNN)). The analysis utilizes 22 years of monitoring data from multiple piezometers installed at different locations within Bouhanifia's Concrete Face Rockfill Dam (CFRD). Results demonstrated high prediction accuracy across all piezometers, as evidenced by strong performance metrics: low root mean square error (RMSE) and mean absolute error (MAE), minimal maximum absolute relative error (errMax), excellent scatter index (SI), high correlation coefficient (R), and near-perfect variance accounted for (VAF).

Wednesday, October 15, 2025

Session Poster-Solar Physics , Space Weather and Space Geophysics

VLF Signal Propagation During X-Class Solar Flares: Observations and Simulations

KERRACHE FETHIA | Benmorsli Djihane | Nait Amor Samir | Ikhlef Rabah
Center for Research in Astronomy, Astrophysics and Geophysics | University of Science and Technology Houari Boumediene, Faculty of Physics | Center for Research in Astronomy, Astrophysics and Geophysics | Center for Research in Astronomy, Astrophysics and Geophysics

X-class solar flares cause intense ionization in the D-region, altering Very Low Frequency (VLF) wave propagation in the Earth-Ionosphere waveguide. This study analyzes VLF signals from two Mediterranean transmitters and investigates their perturbations during X-class flare events. Using the Long Wave Propagation Capability (LWPC) code, we simulate amplitude and phase variations induced by increased ionization. Results confirm a strong correlation between flare intensity and VLF signal response. These findings improve our understanding of VLF wave propagation under extreme solar conditions, with applications for communication, navigation, and space weather forecasting.

Direct Observational Evidence on a CME Deflection by a Complex Interaction between Magnetic Cloud (MC) and Corotating Interaction Region (CIR) occurred on 16 November 2007

Amaal Mohamed
NRIAG

We report on an observational evidence on a CME deflected due to a complex interaction occurred on 16 November, 2007 between a magnetic cloud (MC) and a corotating interaction region (CIR). The CME occurred on 16 November 2007 at 11:45 20 UT using observations from STEREO-A/ COR1. The deflection angle is 20Â°. The complex interaction was reported by Farrugia et al. [2011] who performed comprehensive analysis of in-situ observations. Their study concerned a MC that is most likely of a double-rope structure observed by STEREO-B, Wind/ACE , and STEREO-A. Images of STEREO-A/ COR2 have shown clearly the double-rope structure of the associated CME. Surprisingly, a clear diffusion of the front part of the flux rope material is observed at 16:23:20 UT. We conclude that the inherited flux rope structure kept by the CME through its propagation can reach Earth as MC while the lost flux rope structure through the propagation process result in either non-MC ICME or a streamer interface as in the present case.

Fathy Bahloul

aimouche nihad kheira
The University of Science and Technology Houari Boumediene

The ionosphere exerts a disruptive influence on GNSS signals, often amplified by plasma instabilities linked to solar events. In this work, we studied the response to solar events of the ionospheric vertical total electron content (vTEC) and scintillation activity (measured by the scintillation index, ROTI) occurring at high latitudes, using GNSS data from the IGS network.Our results highlight the spatiotemporal variation of the ionospheric environment. As we observed a hemispheric asymmetry in vTEC amplitude, significantly correlated with polar cap magnetic indices (PCS/PCN). In addition, the vTEC value shows a decrease at higher latitudes, illustrating the latitudinal dependence of the ionospheric response. Concerning scintillation activity, high-latitude stations show rapid fluctuations in vTEC, in contrast to the almost Gaussian curve observed at a mid-latitude station. As a result, scintillation measured by the ROTI index is much more frequent at high latitudes, we also noted a maximum ROTI value for stations located in or near the auroral zone, while the mid-latitude station shows low scintillation.The ultimate aim is to improve our ability to anticipate and forecast ionospheric disturbances caused by solar events in the high latitude regions where these disturbances are amplified, to improve our understanding of the fundamental mechanisms of the ionosphere and to perfect ionospheric models.

Wednesday, October 15, 2025

Dynamic Calibration of NeQuick 2 Using Real-Time EUV Flux Proxies for TEC Modeling During Solar Variability

Manar M. Abady | H. M. El-Zafarani
Solar and Space Science Department in National Research Institute of Astronomy and Geophysics | Solar and Space Science Department in National Research Institute of Astronomy and Geophysics

Accurate modeling of the ionosphere is essential for space weather forecasting and communication system performance. This study investigates the dynamic calibration of the NeQuick 2 ionospheric model by utilizing real-time extreme ultraviolet (EUV) flux measurements as proxies for solar activity, replacing the commonly used F10.7 solar radio flux. EUV fluxes, which directly influence ionospheric electron density, are used to refine the effective ionization parameter Azâ€‹, with a comparison to results obtained from F10.7-based estimates. In addition, solar wind speed and density are incorporated into the analysis to assess their effects on ionospheric variability and discrepancies in Azâ€‹. This work explores the potential of real-time EUV flux data in total electron content (TEC) modeling under varying space weather conditions, with further investigation required to assess its full impact.

Ultra Low Altitude Frozen Orbits around the Moon

osama ramla | Fawzy Ahmed Abd Elsalam
Astronomy, Space Science, and Meteorology Department, Faculty of Science, Cairo University | Astronomy, Space Science, and Meteorology Department, Faculty of Science, Cairo University

In this study, families of frozen orbits for a satellite revolving around the triaxial Moon are investigated. The Hamiltonian for this scenario is formulated, considering the lunar gravitational zonal harmonic coefficients up to J6 and its most effective triaxiality factors, namely J22, J31, J32, and J33. Using canonical Lie transforms, the Hamiltonian undergoes an average process where short-term periodic elements are eliminated while retaining secular components up to the second order. New families of critical inclination roots are obtained, one of which lies near polar orbits, and the other is close to typical critical inclinations. This research paper investigates how variations in eccentricity, semi-major axis, and argument of periapsis affect these critical inclinations. A family of frozen orbits around the apsidal line, along with their graphical representation, is revealed. To ensure such orbits, we solve for the periapsis argument. This establishes certain constraints when selecting the inclination that meets the criteria for the frozen argument of periapsis orbits. Significant perturbations in the critical inclination occur in high lunar orbits.

The Influence of Magnetic Clouds (MCs) and Non-Magnetic Clouds (non-MCs) on Space Weather During Solar Cycles 23 and 24: An Analysis of Geoeffectiveness

Eid Amin | Amaal Mohamed | Abdelrazek M. K. Shaltout | Ali G. A. Abdelkawy | Mohamed. M. Beheary | Rabab. Abdelhamid
NRIAG | NRIAG | Al-Azhar University | Al-Azhar University | Al-Azhar University | NRIAG

We report on the properties of the Magnetic Clouds (MCs) and Non-Magnetic Clouds (non-MCs) correlated with Disturbance Storm Time Index (Dst).Â We investigate their impact upon Space Weather environment during the Solar Cycles: SC23 and SC24 revealing the reason behind the SC24 weakness.Â Given that a white-light CME observed near the Sun can generate a shock, sheath, and a driving ICME at 1AU, it is anticipated that the CME's geoeffectiveness is contingent upon the presence of a southward magnetic field component in either the sheath, the magnetic cloud (MC) portion, or both. We explore the correlation between the Dst index and CME speed, sheath speed, and ICME speed for 50 MCs and 35 non- MCs. The findings reveal a strong correlation between Dst and ICME speed, CME speed (V CME) the shock speed (V Shock), and mean sheath speed (VmeanSh) for the MCs during the solar cycle 23 than their values at solar cycle 24. We also, find that the correlation between Dst and ICME speed, CME speed (V CME), and mean sheath speed (VmeanSh) for the non-MCs are larger than the corresponding values for the SC24 except for the Vshock which surprisingly found to be larger than that for SC23. Interestingly, the correlation for the Vshock and Dst for non-MCs at SC24 was higher than that for both MCs and non-MCs in the two solar cycles 23 and 24. This result needs further investigation towards the reasons behind the weakness of the solar cycle 24.

Wednesday, October 15, 2025

Thermoelectric properties and piezoelectric voltage coefficient of Bi2Mn4O10 prepared by mechanochemical method

Shereef A. Fareed | Makram Ibrahim | Ahmed E. Hannora | M. M. El-Desoky
National Research Institute of Astronomy and Geophysics (NRIAG), Helwan 11421, Cairo, Egypt | National Research Institute of Astronomy and Geophysics (NRIAG), Helwan 11421, Cairo, Egypt | Faculty of Petroleum and Mining Engineering, Suez University, Suez 4351, Egypt.| Faculty of Science, Suez University, Suez 43518, Egypt

The thermoelectric and piezoelectric properties of bismuth and manganese oxide Bi2Mn4O10 were studied, the sample was prepared using the mechanochemical technique followed by heat treatment. The X-Ray Diffraction (XRD) analysis was carried out to obtain the formed phases during the mechanochemical process. The thermoelectric measurements of the prepared samples showed negative-type conductivity with high Seebeck coefficient of 277 μV/K at 480K for the sample milled at 5h and very high value of 2260 μV/K at 316 K for the sample milled at 50h.. we calculated the piezoelectric voltage coefficients (g33) for three samples. The sample which milled at 50h owned the maximum voltage coefficient of piezoelectricity (257 x 10-3 V.m/N) while it was 29 x 10-3 V.m/N for the nanostructured two-composite Bi0.5Sr0.5MnO3- Bi2Mn4O10 and its related multi-phases. According to the variation of the thermoelectric power factor with temperature and the variation of the piezoelectric voltage coefficient with applied stress, the sample which milled at 50h can be used in space applications as an energy transducer.

Correlation Study Between Solar Radio Flux (F10.7) and Total Solar Irradiance (TSI)

Nouhaila Bouhadi
University Chouaib Doukkali

The Sun's activity is vital for understanding its impact on Earth's climate and space weather. In this study, we analyse the relationship between the solar radio flux at wavelength 10.7 cm (F10.7) and Total Solar Irradiance (TSI) using data spanning multiple years. F10.7 serves as a key proxy for solar activity, while TSI measures the Sun's energy output at 1 AU. Our results reveal a moderate positive correlation ($r \approx 0.71$), suggesting a link between solar activity and irradiance variations. These findings provide insights into solar processes and their implications for Earth’s energy balance.

VLF Signal Analysis of Ionospheric Disturbances Triggered by the Tonga Eruption

Djhane Benmorsli | Hanane arif | Samir Nait Amor | Fethia Kerrache | RabAh Ikhlef
Theoretical Physics Laboratory, Faculty of Physics, University of Science and Technology Houari Boumediene | Theoretical Physics Laboratory, Faculty of Physics, University of Science and Technology Houari Boumediene | Center for Research in Astronomy, Astrophysics and Geophysics, | Center for Research in Astronomy, Astrophysics and Geophysics, | Center for Research in Astronomy, Astrophysics and Geophysics,

The eruption of the Hunga Tonga-Hunga Ha'apai volcano on 15 January 2022 generated major ionospheric disturbances in the form of Travelling Ionospheric Disturbances (TIDs), which spread across the globe and circled the Earth several times. Algeria, and more specifically its deep south, is located at the antipode of the eruption, making it a key region for the observation of these disturbances. This study is based on the analysis of VLF (Very Low Frequency) signals recorded in Algiers to track the impact of the eruption on the ionosphere. The results show clear wave fluctuations in the VLF signals, with periods of between 30 seconds and 2 minutes, coinciding with the passage of the TID over the VLF wave path. These variations are also accompanied by similar perturbations in the atmospheric pressure measurements. Comparison with TID propagation simulations confirms these observations, highlighting the direct influence of the eruption on the ionosphere over Algeria.

Wednesday, October 15, 2025

Photospheric Motions and Flux Rope Reformation: A Pathway to Homologous Confined Eruptions

Ahmed Abulwfa | Alaa Fouad | Alshaimaa Hassanin | Khaled Mohamed

National Research Institute of Astronomy and Geophysics | Astronomy, Space Science and Meteorology Dep., Faculty of Science, Cairo University | Astronomy, Space Science and Meteorology Dep., Faculty of Science, Cairo University | Astronomy, Space Science and Meteorology Dep., Faculty of Science, Cairo University

Solar eruptions, including coronal mass ejections (CMEs) and flares, are textbook cases of magnetic energy release in the solar corona. Magnetic flux ropes—helically twisted bundles of magnetic field lines—cause these events. Whether or not such structures exist prior to or develop during the eruption process is an open question. In this paper, we investigate magnetic flux rope reformation as a driver of homologous, but confined, solar eruptions. With the help of three-dimensional magnetohydrodynamic (MHD) simulations of a Titov–Démoulin equilibrium altered, we model a first confined eruption as a result of helical kink instability on a torus-stable background. After this eruption, localized vortex motions in the footpoints are used to model the magnetic twist accumulation. This results in the re-formation of the flux rope, which then experiences a second confined eruption. Our findings imply that in spite of enhanced energy input and reconfiguration, the overlying magnetic field structure is still resilient enough to inhibit complete ejection into interplanetary space. Our results imply that homologous confined eruptions can be the result of repetitive flux rope reformation mechanisms, fueled by local photospheric movements, independent of large-scale flux emergence or shearing. This work provides a window into the magnetic requirements for containment of eruptions and is relevant to solar prediction.

Exploring Pre-Dynastic Era Archaeology in Aswan Using Ground-Penetrating Radar and Vertical Magnetic Gradient Techniques

Mahmoud Mekkawi | Ashraf khuzium | Ahmed Kubbia
NRIAG| NRIAG | NRIAG

The Pre-Dynastic Period (5000â€“7000 BC) marks a crucial phase in ancient Egyptian history, characterized by early societal developments, emerging settlements, and advancements in craftsmanship and trade. Aswan, strategically located along the Nile, played a vital role in prehistoric trade routes and early cultural interactions between Upper Egypt and Nubia. This region holds significant archaeological potential, offering insights into settlement patterns, burial practices, and technological advancements of the time. With the advancement of modern geophysical techniques, non-invasive subsurface exploration has become an essential tool in archaeological investigations. This research aims to identify and map potential archaeological features from the Pre-Dynastic Period in a selected areas of Aswan using Ground-Penetrating Radar GPRÂ and Vertical Magnetic Gradient VMGÂ techniques. These methods provide valuable subsurface data, allowing for the detection of buried structures, ancient artifacts, and changes in soil composition associated with human activity. There are many objectives of this study: utilizing GPR to examine subsurface layers, detect buried architectural remains, and identify anomalies that indicate archaeological significance; analysing VMG Measurements to detect magnetic variations caused by ancient human activities, such as tools and burial sites; and integrating Findings with Archaeological Studies: To create an interpretive map that highlights potential excavation zones and enhances our understanding of Aswanâ€™s prehistoric occupation. By employing these geophysical techniques, this study seeks to deepen our knowledge of settlement dynamics in Aswan during the Pre-Dynastic Period. Additionally, it emphasizes the role of geophysical surveys in modern archaeology, contributing to the preservation and documentation of Egyptâ€™s rich cultural heritage.

TDEM-DC Resistivity Joint Inversion and Land Magnetic Survey for Groundwater Exploration in Ecoreviera City, Future of Egypt Project, New Delta, Giza, Egypt

Mohamed Ibrahim Mohamed Ahmed | Sultan Awad Sultan Araffa | Tarek Arafa-Hamed | Taha Tawfik Taha Rabeh | Ahmad Muhammad Sobhy Ahmad Helaly | Karam Samir Ibrahim Farag | Esraa Mahmoud Azmy
National Research Institute of Astronomy and Geophysics, Helwan, Cairo, Egypt | National Research Institute of Astronomy and Geophysics, Helwan, Cairo, Egypt | National Research Institute of Astronomy and Geophysics, Helwan, Cairo, Egypt | National Research Institute of Astronomy and Geophysics, Helwan, Cairo, Egypt | Department of Geophysics, Faculty of Science, Ain Shams University, Cairo, Egypt. | Department of Geophysics, Faculty of Science, Ain Shams University, Cairo, Egypt. | Department of Geophysics, Faculty of Science, Ain Shams University, Cairo, Egypt.

Water scarcity and land degradation are critical global challenges driving population stress and food insecurity. In response, Egyptâ€™s Vision 2030 promotes sustainable development through new urban communities like Ecoreviera and major land reclamation initiatives. A key project under this vision is the "Future of Egypt" development within the New Delta region of the Northwestern Desert. To support this effort, a comprehensive geophysical survey was conducted, including a land magnetic survey with an average station spacing of 0.5 km. Additionally, joint inversion of 25 Vertical Electrical Sounding (VES) and 25 Time Domain Electromagnetic (TDEM) soundingsâ€”collected during 2021â€“2022â€”was performed at corresponding locations. Results identified three main groundwater aquifers: the Miocene, Oligocene, and Upper Cretaceous. The Miocene aquifer is unconfined, with a thickness ranging up to 320 meters, but completely eroded in basaltic exposure zones. The Oligocene and Upper Cretaceous aquifers are confined, separated by basaltic sheets and the Dabaa Shale. The Oligocene aquifer, composed of claystone, shale, limestone, and sandstone, ranges from 262 to 340 meters thick. The Dabaa Shale, acting as a confining layer, varies from 70 to 136 meters in thickness. The Upper Cretaceous aquifer extends beyond the 500-meter investigation limit. The groundwater table lies between 130 and 160 meters below ground surface, influenced by regional topography and structural controls. These findings enhance understanding of the area's hydrogeological framework and provide essential input for sustainable groundwater management and urban expansion planning in arid regions.

Reinventing Grounding Systems: Experimental and Simulation for Optimizing Soil Composition, Thickness, and Replacement under Fault Performance

Mahmoud Ramadan Hefny Ali
NRIAG

It is important to study some natural properties around the ground grid to create an appropriate environment for the grounding process. This paper investigates the impact of soil replacement around a ground grid on its performance, with a focus on replacing the base soil with a lower-resistivity material and analyzing the influence of the replaced layer's area and thickness. The study explores the effects of soil replacement on critical parameters such as total ground resistance, earth surface potential (ESP), current density, and electric field distribution under line-to-ground fault conditions. Key soil properties, including water content, thermal and electrical conductivity, heat capacity, density, and relative permittivity coefficient, are also considered to assess their role in optimizing the grounding environment. The results demonstrate that replacing high-resistivity sand (431.88 Ω·m) with low-resistivity clay (44.57 Ω·m) significantly reduces total ground resistance. For a 1-meter-thick replaced layer, resistance decreased from 8.4 Ω to 3.17 Ω (a 62.3% reduction) when sand was replaced with clay, whereas replacing clay with sand increased resistance to 11.5 Ω (a 37% increase) at 1.5 meters of thickness. Similarly, ESP values dropped substantially when clay was introduced as a replacement layer, enhancing current dissipation and reducing surface potential risks.

Assessing Drought Conditions in Algeria via GRACE-DSI and Their Influence on Dam Reservoir Levels

BENYAHIA SLIMANE | ROUISSAT BOUCHRIT | SMAIL NADIA | TOUATI FATAH | BENARABA NAWAL

Space Geodesy Department, Center of Space Techniques , Algerian Space Agency , Oran | RISAM Lab, Faculty of Technology, University of Tlemcen | RISAM Lab, Faculty of Technology, University of Tlemcen | Space Geodesy Department, Center of Space Techniques , Algerian Space Agency , Oran | LGTE Lab, Faculty of Architecture and Civil Engineering, University of Science and Technology of Oran

Recurrent droughts in Algeria have intensified in recent decades, causing significant socio-economic and environmental impacts. This study develops a monthly Drought Severity Index (DSI) for Algeria derived from terrestrial water storage (TWS) anomalies measured by the Gravity Recovery and Climate Experiment (GRACE) mission. The GRACE-DSI quantifies hydrological drought severity using time-variable gravity data, providing a spatially continuous assessment of water storage deficits.To evaluate drought impacts on surface water resources, we analyze in situ reservoir-level measurements from three embankment dams in northwestern Algeria: Sidi Mhamed Benaouda, Bouhanifia, and Sidi Abdeli. These datasets enable a rigorous comparison between GRACE-derived drought indices and observed water storage declines. Preliminary results demonstrate a good correlation between GRACE-DSI and reservoir levels during extreme drought periods.Our integrated approach highlights the utility of GRACE-DSI for monitoring drought impacts on critical water infrastructure, with implications for water resource management.

Thursday, October 16, 2025

Environmental implications of magnetic heavy metal pollution in the industrial area of 6th of October city

Reem Mostafa | Alshymaa Guda | Ahmed Awad | Nouran Salama
NRIAG | NRIAG | NRIAG | Geology Department, Faculty of Science، Helwan University

The rapid growth of urbanization, poor planning, and industrial development have caused severe biosphere pollution, affecting human health. Among major pollutants are heavy metals (HMs), which require periodic assessment due to their health risks. Since many HMs are linked to magnetic particles, magnetic properties can serve as proxies for heavy metal pollution in topsoil and street dust.This study applies magnetic parameters to trace heavy metal contamination. We performed environmental magnetic and geochemical analyses on 28 street dust samples from the 6th of October industrial area, a site hosting diverse industries. Parameters measured included volume and mass-specific magnetic susceptibility (K and χlf), frequency-dependent susceptibility (χfd%), and isothermal remanent magnetization (IRM). The magnetic assessment was followed by chemical analysis of toxic HMs and the calculation of pollution indices (EF, CF, and PLI). K values ranged from 5.42×10^{-5} to 2.80×10^{-3} SI. The χlf distribution strongly agreed with in-situ measurements. Higher susceptibility values were found in the southeastern area, where steel and concrete industries dominate. Lower values appeared near food industries in the north and west. The lowest χfd% value (1.37%) was recorded near Egyptian and Elseweedy steel factories, indicating dominance of multidomain magnetic particles. The mean S-ratio of 0.90 ± 0.09 (median 0.94) suggests a dominance of magnetite over hematite and goethite. Overall, high pollution levels are mainly linked to steel and concrete factories in the southeastern to central parts of the study area.

Assessment of Global Solar Radiation over Egypt Using Measured and Reanalysis Data (1980–2020)

Ashraf Shaban Khamees | usama ali Rahoma | Amir hussen Hassan
National Research Institute of Astronomy and Geophysics | National Research Institute of Astronomy and Geophysics | National Research Institute of Astronomy and Geophysics

Overview; This study investigates the long-term variability and spatial distribution of global solar radiation (GSR) over Egypt using both ground-based measured data and reanalysis datasets spanning the period from 1980 to 2020. Database; Statistical analysis including mean bias error (MBE), root mean square error (RMSE), and correlation coefficients was conducted to assess the agreement between datasets. Seasonal and annual variability patterns were also analyzed to understand the temporal trends in solar radiation. Reanalysis data; Analyzing seasonal and interannual variability patterns of solar radiation is crucial for understanding long-term trends and predicting future solar energy availability. This analysis helps identify how solar radiation changes over different timescales, influenced by factors like Earth's tilt, atmospheric conditions, and climate patterns Results; The results showed a pretty strong link between the measured data and the reanalysis data, although there were some differences depending on the region and the season. In the end, this study supports the idea that reanalysis datasets can reliably reflect solar radiation trends in Egypt, but it also emphasizes the need for ongoing ground measurements to keep everything accurate for assessing solar energy resources.

Utilizing precise GPR scanning to drive archaeological tombs of ancient necropolis remains at Gebel El-Siwa in Kharga Oasis, Egypt

Khamis Mansour | Ali M. Radwan | Abdelhamid Elbsebeshi | Dalia Gamal Ahmed Wahba | Gebely Abu El-Kheir | Mohamed Rashwan

Geomagnetic Department, National Research Institute of Astronomy and Geophysics | Geodynamics Department, National Research Institute of Astronomy and Geophysics | Geodynamics Department, National Research Institute of Astronomy and Geophysics | New valley university | New valley university | Geodynamics Department, National Research Institute of Astronomy and Geophysics

This study presents results of GPR surveys conducted for exploration of unexcavated tombs at the Kharga Oasis. These surveys were carried out in two ancient tombs. The first site is located in Labakha while the second one is located in Gebel El-Siwa which is still unexcavated. The goal of this study was to investigate the existence of unexcavated tombs in Labakha, as well as the depth, extension and constituents of an unexcavated tomb in Gebel El-Siwa. Ground penetrating radar measurements were carried out using a single channel system with 200 MHz and 400 MHz antennas synchronized with accurate GNSS system for positioning of each high reflectivity responses. 2D ground penetrating radar profiles were acquired and subsequently processed and interpreted, and isolated reflections could be identified. Lateral continuity of the reflections could be observed through comparative analyses of the adjacent scans. By doing so, the remnants of the two tombs became easier to correlate. Two ground penetrating radar anomalies could be detected in the archaeological site of Gebel El-Siwa; these anomalies are probably caused by a nearby tomb. By correlating the obtained data with the archaeological knowledge of the discoveries made in the surrounding areas, it was possible to interpret the linear reflectors as to be caused by the tomb. This study is useful in providing archaeologists with information on the expression of this type of ancient Egyptian necropolis tombs at Kharga.

Geophysical exploration for mineralization using Remote sensing and magnetic analysis in Wadi Queih area, Eastern Desert, Egypt.

Arwa Sameer Ibrahim Alkholy | Ahmed Saleh | Sultan Awad Sultan Araffa | Sami Hamed Abdel Nabi | Karam S. I. Farag | Mohamed Aldeep

NRIAG | NRIAG | NRIAG | Ain Shams University | Ain Shams University | NRIAG

Aeromagnetic and Remote sensing datasets were used to provide essential information on structural configurations and to infer potential sites of mineralization in the Wadi Queih area of the central Eastern Desert, Egypt. The analysis of both data sets aimed to identify structural lineaments and their trends, along with hydrothermal alteration zones, to determine the most favorable areas for mineralization in the region. To effectively manage aeromagnetic data, it is essential to first process the observed magnetic data so that it corresponds with the reduced magnetic pole (RTP). Mathematical filters for detecting and enhancing boundaries between rock units, based on their magnetization affinity, were applied. These included the first vertical derivative, the analytic signal, and 3D Euler deconvolution. Following a structural analysis of the data, we obtained the subsequent findings: The primary structural trends identified from both surface and subsurface estimations include a northwest–southeast orientation and a northeast–southwest orientation. In our remote sensing analysis, we used Landsat-8 to define lithological units and create a structural map. Principal component analysis (PCA), band ratios (BR), and minimum noise fraction (MNF) transformation were used to analyze the responses from the alteration zones. Consequently, the correlation between regions of significant structural complexity and hydrothermal alterations is a compelling indicator of the prospective for substantial ore deposits.

Thursday, October 16, 2025

A modified predictive exploration model for Au mineralization

Maha Abdelazeem | Mohamed Gobashy
NRIAG, Department of Geomagnetism and Geoelectricity. | Cairo University, Faculty of science, Geophysics Department.

The integration and correlation of diverse prospecting methodologies are crucial in yielding meaningful and substantial results in the exploration of mineral resources. These techniques are extensively applied within exploration frameworks across a wide array of geological environments. This study aimed to establish a predictive exploration model for Au (Gold Element) within the mafic-ultramafic Intrusion situated in selected localities, Eastern desert, Egypt. To construct this model, the research utilized a combination of accessible datasets—including airborne magnetic and detailed geological mapping. The synthesis of these datasets led to the identification of new prospective targets characterized by coincident geophysical and geological anomalies. Magnetic and radiometric data demonstrated a strong correlation between magnetic intensity and anomalous concentrations of different elements. Furthermore, enrichments in both potassium and uranium anomalies were found to be closely associated with the occurrence of ultramafic lithologies. Geological mapping corroborated these findings, confirming that mineralization is spatially and genetically linked to ultramafic rock units.

Geophysical Investigation of Subsurface Archaeological Extensions at Karkour Area, Helwan, Egypt

Marwa Shaheen | Tareq Abdallatif | Abbas Mohamed | Hesham Zahra | Ahmed Kotb | Mohamed salem | Wael R. Gaweish | Ahmed Awad
researcher assisstant at National Research Institute of Astronomy and Geophysics-NRIAG, 11421-Helwan, Cairo, Egypt. | professor at National Research Institute of Astronomy and Geophysics-NRIAG, 11421-Helwan, Cairo, Egypt. | professor at National Research Institute of Astronomy and Geophysics-NRIAG, 11421-Helwan, Cairo, Egypt. | professor at faculty of science, Benha university | professor at National Research Institute of Astronomy and Geophysics-NRIAG, 11421-Helwan, Cairo, Egypt. | professor at faculty of science, Benha university | Assciate Professor at National Research Institute of Astronomy and Geophysics-NRIAG, 11421-Helwan, Cairo, Egypt. | Assciate Professor at National Research Institute of Astronomy and Geophysics-NRIAG, 11421-Helwan, Cairo, Egypt.

Karkour is a relatively small and understudied archaeological site located in Helwan, south of Cairo on the eastern bank of the Nile. the site holds historical importance due to continuous human activity spanning from the Paleolithic period to the end of the ancient era. The rich cultural heritage of Helwan enhances the significance of Karkour, particularly given its proximity to one of Egypt's most important Early Dynastic cemeteries.Recent archaeological evidence suggests that the Karkour site may contain subsurface remains such as tombs, craft installations, or processional pathways potentially associated with ancient Helwan. To investigate these possibilities, a non-invasive integrated geophysical survey was conducted using Magnetic Gradiometry and Ground Penetrating Radar . Vertical magnetic gradient data were acquired using a Fluxgate Gradiometer (FM256), followed by high-frequency GPR data collection using a SIR-2000 system (GSSI) across three selected zones, labeled Areas A, B, and C. In addition, X-ray diffraction (XRD) analyses were performed on soil samples randomly collected from these areas to support material characterization.The results reveal subsurface anomalies of varying scales, predominantly aligned in a north–south orientation. Magnetic data highlight distinct features, most likely composed of mudbrick or fired brick, suggesting architectural or funerary elements. Correlations between magnetic anomalies and GPR reflections provided further insights into the geometry and composition of these buried structures. These preliminary findings contribute valuable information toward understanding the spatial organization and subsurface archaeology of Karkour, shedding light on aspects of daily life and ritual practices in ancient Helwan.

Microscopic and mineralogical study of gold and associated elements in the Al-Urf-Umm Balad area, Egypt, using geophysical studies

Mohamed Hussein
NRIAG

The Um Balad area has significant promise for future gold exploitation due to the presence of broad and powerful alteration zones. In these altered locations, these altered minerals may be linked to precious minerals like sulphides and gold precipitations. The Um Balad gold-copper deposits were limited to veinlets and well-developed quartz veins sliding across the host country rocks. Studies of around thirty representative hand specimens were gathered from the ore body and the alteration zones and subjected to spectral analysis (ASD) and scanning electron microscope (SEM) examinations to ascertain the compositional characteristics of the gold-copper deposits in the Um Balad area and for an understanding of the mode of occurrence and extent of gold mineralization. The thirty rock samples were extracted from different lithological units in the study area. By gravity measurements and aeromagnetic imagery inspection and, the structural complexity and porphyry intrusions density maps have been effectively constructed by applying Enhanced Center for Exploration Targeting (CET) techniques. Â A combination of CET structural complexity, circular features, and alteration zones produced a potential mineralization map pointing out numerous prospective zones for mineralizing gold. The results show that these major components and alteration mineral assemblages are mainly related to gold mineralization and widely occur in gold deposits.

Mapping and evaluation of Shallow Groundwater Resources in Al-Hofuf, Eastern Saudi Arabia, Using Vertical Electrical Sounding for Sustainable Water Management

Saad S. Alarifi | Kamal Abdelrahman | Khaled Al-Kahtany | Alfahad A. Almakrami
King Saud University

This study identifies the optimal locations for groundwater wells in the Al-Hufof region of eastern Saudi Arabia, where hydrogeological control is limited and water quality is variable. We combined vertical electrical soundings (VES) with basic hydrochemistry to convert geoelectrical responses into decision-ready indicators of aquifer productivity and salinity risk. After quality control, VES curves were inverted to 1-D layer resistivity–thickness models; Dar–Zarrouk parameters (longitudinal conductance, S, and transverse resistance, TR) were computed over the target aquifer; and water resistivity (ρw) was estimated from EC (25 °C) to derive formation factor (F) and Archie-based hydraulics porosity (φ), hydraulic conductivity (K), and transmissivity (T = K·b). Across 20 VES stations, transmissivity spans 2.0–1099.5 m²/day (median 262.2 m²/day), while hydraulic conductivity ranges 0.02–9.35 m/day (median 2.03 m/day) with a median φ ≈ 0.50. A simple T-screen classifies 6 sites as High (T ≥ 700 m²/day; e.g., VES 5, 6, 9, 10, 14, 16), 8 as Moderate (100–699.9 m²/day), and 6 as Low (< 100 m²/day). High-class sites delineate corridors suitable for production subject to verification, whereas low-class areas merit avoidance or monitoring. Zones where low resistivity coincides with elevated EC are flagged for selective well screening and salinity surveillance. We recommend confirming priority targets via step-drawdown or pumping tests and establishing two to three monitoring transects that cross high/low-T boundaries. Overall, the study provides a reproducible VES-to-hydraulics pathway that turns geophysics into actionable guidance for sustainable abstraction in arid settings.

Thursday, October 16, 2025

Session **Poster-Astronomy 2**

Axisymmetric Equilibria of Differentially Rotating n=1.5 Polytropes Under Arbitrary Angular Velocity Distributions

H. M. El-Zafarani
Solar and Space Science Department in National Research Institute of Astronomy and Geophysics

A semi-analytical approach is developed to determine the internal structure of axisymmetric stellar configurations with either uniform or differential rotation, based on polytropic models with index n=1.5. The R. A. James (1964) formalism is systematically generalized to incorporate differential rotation by imposing angular velocity distributions as general functions of radial distance and the cosine of co-latitude. The method accommodates a wide class of rotation laws, including both analytical prescriptions and observationally motivated profiles, such as an approximation of the solar surface rotation derived from helioseismic data. The effects of viscosity and meridional circulation are neglected to isolate the impact of rotational stratification. The resulting equilibria exhibits strong agreement with expected global properties of rotating stars, capturing essential features of structural deformation and angular momentum distribution. A flexible computational scheme is introduced to efficiently resolve arbitrary angular velocity inputs within the polytropic framework.

Direct imaging of exoplanets with Coronography

salma Makhtich
Faculty of Science Semlalia Marrakech

The direct imaging of exoplanets represents a pivotal method for exploring planetary systems beyond our solar system. This technique faces significant challenges, primarily due to the extreme brightness contrast and small angular separation between exoplanets and their host stars. Coronagraphy has emerged as a powerful optical approach to suppress starlight and enhance the detection of faint planetary signals. This work provides an in-depth review of coronagraphic techniques, including phase masks, Lyot coronagraphs, vortex coronagraphs, and their integration with adaptive optics systems. Recent advancements in these methods are analyzed, alongside their application in state-of-the-art instruments such as the James Webb Space Telescope (JWST) and future observatories like the Extremely Large Telescope (ELT). The study also highlights the current limitations and technical challenges in advancing the field of exoplanet imaging.

A deep investigation of the poorly studeid open clster Barkhatova 2 using VRI CCD and Gaia DR3

Reda Elbendary | E.G. Elhossieny
Astronomy dept. NRIAG | NRIAG

In this study, we determined for the first time the astrophysical parameters of the poorly studied cluster Barkhatova 2. We used observations of VRI CCD with a limiting magnitude of V = 20 mag. The stars of the cluster was observed utilizing the Newtonian focus of a 74-inch telescope at the Kottamia Astronomical Observatory in Egypt. Cross-matched data from the new global database Gaia DR3 were used in the present study. The radial density distributions, core and tidal radii, color-magnitude diagrams, geometrical distances, age, and color excess were presented for Barkhatova 2. The luminosity and mass functions, the total mass and the relaxation time of the cluster was estimated as well.

Thursday, October 16, 2025

A Detailed Investigation of the Star Clusters in IRAS 00117+6412 Based on Astrometric Data from Gaia DR3

Wageeh Ahmed Badawy
NRIAG

Open clusters consist of stars that form at the same time, making them valuable tools for testing theories of star formation, stellar evolution, and dynamics within the Milky Way disk. In this study, we utilize the Hierarchical Density-Based Spatial Clustering of Applications with Noise (HDBSCAN) algorithm on astrometric data obtained from Gaia Data Release 3 (DR3). We applied the HDBSCAN algorithm to determine cluster membership, identifying 95 members within a 15-arcminute search radius using Gaia DR3 astrometric data. The cluster radii for these clusters are determined to be 15.842 arcminutes based on the radial density profiles of their members. The calculated log age of 7.713±0.147 years suggests that the open cluster is young. The findings of this study indicate that the cluster is not a relaxed open cluster. The mass function slope for main-sequence stars is determined to be 115.302±0.723 within the mass range 0−0.50, showing reasonable agreement with Salpeter's IMF value (IMF=−2.35) within the uncertainty.

Fusion Cross Sections and Astrophysical S-Factors of Carbon and Oxygen Reactions at Sub-Barrier Energies.

Abdelrahman Hussam | Khaled Muhammed | AlShaimaa Saad Hassanien
Kazan Fedral University in Egypt | saint petersburg university in egypt | Cairo university

We investigate the astrophysical S-factor and fusion cross sections for carbon and oxygen-induced reactions at sub-barrier and astrophysical energies. These reactions, such as 13C+12C, 13C+13C, 12C+16O, and 16O+16O, play a critical role in stellar evolution and explosive astrophysical phenomena. We employ both relativistic and non-relativistic theoretical frameworks, using the double-folding model to obtain the nuclear potential with density-dependent nucleon-nucleon interactions obtained using Relativistic Mean Field (RMF) theory, alongside non-relativistic potentials based on Skyrme parameterizations. The theoretical fusion cross sections and corresponding S-factors are systematically compared with available experimental data. Particular attention is given to the hindrance phenomenon observed at deep sub-barrier energies, and the ability of each model to reproduce this suppression behavior is analyzed.

Exploring the Connection Between Soft Excess Temperature and Black Hole Mass in quasars

Amr.I.Basuny | Ashraf A. Shaker | N. Z. Darwish | Y. Abdou | SH. M. Shehata
National Research Institute of Astronomy and Geophysics (NRIAG) | National Research Institute of Astronomy and Geophysics (NRIAG) | physics department-Tanta University | physics department-Tanta University | National Research Institute of Astronomy and Geophysics (NRIAG)

The soft X-ray excess is a prominent feature in the spectra of many active galactic nuclei (AGN), yet its physical origin remains debated. In this study, we investigate the relationship between the temperature of the soft excess component and the black hole mass in a sample of quasars, with a particular focus on distinguishing between radio-loud and radio-quiet populations. Using high-quality X-ray spectral data from XMM-Newton and Chandra, we model the soft excess using thermal and phenomenological approaches to derive characteristic temperatures. Our results suggest that the soft excess may be influenced by factors related to jet activity or accretion mode, and they provide new role into the interplay between X-ray emission processes and central engine properties in quasars.

Thursday, October 16, 2025

A Multi-Mission Study of Spectral Variability in Eight Anomalous AGN Sources

Shahd Y. Farahat | Baraa Hany | SH. M. Shehata | R. Misra

Physics Department, Faculty of Science, Helwan University, Cairo, Egypt | Physics Department, Faculty of Science, Helwan University, Cairo, Egypt | National Research Institute of Astronomy and Geophysics, Cairo, Helwan, 11421, Egypt | Inter-University Center for Astronomy and Astrophysics, Ganeshkind, Pune, 411007, India

Active galactic nuclei (AGN) are known for their strong X-ray spectral variability, which is often linked to changes in the structure and energy balance between the accretion disk and corona. While many sources exhibit a â€œsofter when brighterâ€ behavior, a subset shows hints of the opposite trend. Motivated by this, we focused on eight peculiar sources that suggest a potential â€œharder when brighterâ€ signature. We performed a systematic reduction and spectral analysis using data from multiple X-ray missions, including XMM-Newton, Chandra, Swift, and NuSTAR. Our results were consistent across missions and observations, offering high-confidence measurements that reveal detailed spectral trends. This allowed us to study the physical characteristics of these sources with greater clarity and depth.

Subsurface velocity structures at the Egyptian seismological network stations retrieved by diffuse field assumption for Earthquakes

Khaled Omar
National Research Institute Of Astronomy And Geophysics (NRIAG) Helwan, Cairo, Egypt

Retrieving detailed subsurface velocity structures down to the seismic bedrock at any given site is a crucial step to delineate the site amplification factors accurately and precisely. The present research work contributes first new estimations for detailed velocity structures down to the seismic bedrock beneath the Egyptian National Seismological Network (ENSN) stations, which are distributed in Egypt nationwide. We used the diffuse field assumption for earthquakes to reproduce the horizontal to vertical spectral ratios (EHVSR) at these stations. We accepted waveform database of 424 earthquakes recorded at 75 ENSN stations. After achieving the inverted subsurface velocity structures, we establish site-specific frequency-depth regression and map the V S30 and seismic bedrock depth beneath Egypt. Because of comparability regarding the seismic site class of B and C, the regression coefficients of the newly established frequency-depth regression exhibit similarity with those achieved from previous regressions in Japan. Furthermore, we observe modest consistency between the seismic bedrock depths and the various geologic features, particularly agreement between basin-shape seismic bedrock depths and the existence of Cretaceous and Jurassic extensional basins. Our findings suggest that the Precambrian basement rocks can be interpreted as the seismic bedrock in Egypt. One of the most significant obstacles in the present work is the low-dense distribution of ENSN stations nationwide. However, the achieved results raise new questions and challenges regarding precise and accurate future estimations for site amplification calculations at different localities in Egypt, particularly for urban planning by engineers.

Machine Learning and Remote Sensing based Neotectonic Signals from Hindukush: Insights from 3-Fractals and Surface Dynamics

Anam Munawwar
Institute of Space science, University of the Punjab, Lahore

Fractal dimensions correspond to non-linear drainage system analysis and related neotectonic deformation. This research utilizes 3-fractal analysis of DEM based channels in Hindukush region (HKR). The aim is to delineate and identify the areas robustly affected by neotectonics. Hence, the objective is to find out a fractal based potential association among the gap-filling capability, differential relative uplifts through stream geometries. HKR is being influenced by frequent earthquakes in the context of Indo-Eurasian collision and resulting neotectonic surface deformation (NSD). Stream network is very sensitive landform and shows linearized pattern with low values of fractal dimension under the influence of NSD. The rivers in this region preserve sensitive NSD records and related vertical differential movements. A detailed textural assessment is accomplished to investigate the linearization, connectivity and heterogeneity of the fractal behaviour of the stream network. The fractal attributes for stream textures are determined by 3-fractals approach; fractal dimension values (FdVs), lacunarity values (LaVs) and succolarity values (SaVs). 3-fractals technique is mutually related and objects having identical FdVs may be distinguished further with LaVs and SaVs examination. The spatial maps of FdVs, LaVs and SaVs have provided very interesting and valuable information regarding robust neotectonic signals in HKR. The low FdVs of the Chitral, Turkho, Tirchmir, Arkari, Kocha, Garm Chashma, Kamdesh, Laghman, Andarab, Kabul, Teera, Alingar, Dir, Swat, Panjsher Rivers are credited to modern NSD. As a foremost conclusion, spatially differential uplifts, influencing the Hindukush morphology, show primary control for the 3-fractals obtained, while surface lithologies have a minor role.

Thursday, October 16, 2025

Seismic site characteristics and soil classification for the proposed area of New Akhmem City, Sohag - Egypt.

Asmaa Nasser Mahmoud Edrees | Raafat El SHafie Fat-Helbary |Mohsen Mohamed Attia |Ahmed Hamed

Department of Geology, Faculty of Sciences, Sohag University, Egypt. | National Research Institute of Astronomy and Geophysics |Department of Geology, Faculty of Sciences, Sohag University, Egypt. | National Research Institute of Astronomy and Geophysics

The main objective of the current study is to determine the dynamic properties of the foundation rocks based on different shallow geophysical techniques. The vulnerability index (Kg) and Ground Shear Strain (GSS) have been estimated to evaluate the effect of local geology on seismic motion. in addition, Vs30 and soil classification maps have been constructed. The estimated (Kg) is high due to the presence of weak zones that are marked by alluvium and loose sediments, as well as the presence of underground water close to the earth's surface due to the proxy to the River Nile. Such areas are thought to be susceptible to little rock deformation such as cracks and fractures. Moreover, there are two points have GSS values 10-5, characterized by highly stiffer sites without any proposal of landslide. The calculated sediments thickness at the middle of the study area is larger than the whole area. The estimated thickness matched well with the topography of the study area. The Vs30 map is transformed into site classification based upon the NEHRP guidelines. The site classification scheme, which has been developed for the study area includes two generalized site classes, class (D) and class (C). Â Class (D) soft soil sites are found at two restricted zones south of the study area with velocity ranges from 258 to 327 m/s. While, Class (C) which comprises the majority of the region and characterized by highly thick soil and soft rock.

A study of seismic hazard and energy released from earthquakes along the eastern and western coasts of the Red Sea in Egypt and Saudi Arabia

Sayed Abdallah Dahy

national research institute of astronomy and geohysics

In this study, the eastern and western coasts of the Red Sea in Egypt and Saudi Arabia are considered one of the few regions of the world whereas evidence of historical activities has been documented during several centuries. A general correlation between these earthquakes and the tectonic setting is observed clearly in these regions and its surroundings. The interaction of the African, Arabian, Eurasian plates and Sinai sub-plate is the main factor behind the seismicity of northern part of the Red Sea. The seismic hazard in the investigated areas is evaluated from historical earthquake data and it is given in terms of the expected peak ground acceleration and the expected acceleration response spectrum. Typically, a high seismic hazard zone is nearest a seismic zone where there are more earthquakes, and a lower seismic hazard zone is farther away from a seismic zone. A significant seismic hazard exists in the eastern and western coasts of the Red Sea in Egypt and Saudi Arabia from large tectonic earthquakes that can reach magnitude 6.5 with intensity ranges âˆ¼VIâ€“VIII. On the other hand, the seismic hazard in the investigated areas increased with the increasing of earthquake energy release values, and the relation between them is observed clearly at the eastern and western coasts of the Red Sea in Egypt and Saudi Arabia.

Egyptian National Strong Motion Network (ENSM) In Southern Sinai, Egypt

Shaimaa Maamoun Khair
NRIAG

It is well known that structures can be damaged by earthquake shaking that is caused by the rapid rupture of the fault, which releases the stored energy that can result in significant loss of life and property, particularly in heavily populated metropolitan areas (Po-Shen & Chyi-Tyi 2008). The vulnerability of structures against earthquake motion can be estimated using the input earthquake acceleration. For economical and hazard aspects, the general seismological laboratory, seismology department, NRIAG, made the first step of hazard mitigation and vulnerability of buildings and structures by constructing the strong motion network (ENSM), trying to get a better understanding of structural vulnerability in urban areas in Egypt. The primary goal of this study is to define the highest peak ground acceleration (PGA) values in the southern area of the Sinai Peninsula during the period from October 2024 to February 2025. (ENSM), or Egyptian National Strong Motion Network, was established and operated by the Seismology Department in the National Institute of Astronomy and Geophysics (NRIAG). It started in 2008 in the main centre of the National Research Institute of Astronomy and Geophysics (NRIAG), Helwan, Cairo. ENSM had succeeded in establishing four permanent strong motion stations in southern Sinai (Taba, Nuiba, Sharm El-Sheikh and Shedawan). The primary results showed that the maximum PGA value had been defined at the SHR station (47.8 gal) and that values of PGA were not just affected and decreased by epicentral distances, but were mainly dependent on site effects and local amplification.

Aswan seismic network, the challenges and there impacts on the seismic activity monitoring in Aswan area, Egypt

Abdelnasser Mohamed | Hamada Saadalla
National Research Institute of Astronomy and Geophysics (NRIAG) | National Research Institute of Astronomy and Geophysics (NRIAG)

Before 1975, seismic activity in Aswan was only inferred from limited historical and archaeological records, with no confirmed local earthquakes before the 20th century. Seismic monitoring in the Aswan region started in October 1975 with the installation of short-period seismic stations at Aswan and Abu Simbel. After the 1981, when a 5.6 magnitude Kalabsha earthquake revealed previously undetected seismic activity, including foreshocks and smaller tremors., a temporary network of portable stations was set up, which was later replaced by the Aswan Telemetric Seismic Network (ATSN) in 1982. Following the 1992 Cairo earthquake, the Egyptian National Seismological Network (ENSN) was created to improve seismic analysis, increase the accuracy of earthquake location, and assess seismic risks across Egypt. As part of this initiative, Aswanâ€™s Seismic Network (ASN) was upgraded in 2009 with advanced broadband sensors that transmitted data via satellite. Recently, ASN is facing one of the most worried problems, the security matter where many stations were destroyed and stole, so the decrease number of the seismic stations has a direct effect on the seismic monitoring, where there is a gap for locating the small and background events. The seismicty distribution in the last five years indicated that there is a decrease in the number of small earthquakes in Aswan area comparing to the previous time. Different efforts were performed to come over this problem such as reducing the number of the stations by merging two or three stations in one safe site trying to keep the good distribution.

Thursday, October 16, 2025

Session **Oral-Space Weather and Space Geophysics 2**

Comparative analysis of the regional effects of three major geomagnetic storms on Earth's magnetic field response during solar cycle 25

WALID BADENJKI | Essam Ghamry
Department of Astronomy, Space and Meteorology, Cairo universit, Egypt | National Research Institute of Astronomy and Geophysics,Cairo, Egypt

In this study, we present a comparative analysis of the regional effects of three intense geomagnetic storms observed during Solar Cycle 25. Utilizing data from a global network of geomagnetic observatories positioned across diverse latitudes, we map the geomagnetic field response to these storms. By assessing the spatial distribution of magnetic field variations, we identify the regions most impacted by geomagnetic disturbances. The comparison of these major storms offers critical insights into the influence of geomagnetic storms on Earth's magnetic field, emphasizing the areas with the most significant disturbances. This research is vital for assessing future risks and developing strategies to mitigate the effects of geomagnetic storms on satellite systems, power grids, and other critical infrastructure, enhancing preparedness in vulnerable regions.

The influence of solar and terrestrial natural hazards on the Earth's magnetic field

Fatma kotb | Essam Ghamry | Magdy Youssef
Astronomy department, Cairo University | National Research Institute of Astronomy and Geophysics, Cairo, Egypt | Astronomy department, Cairo University

Understanding how solar and terrestrial natural hazards affect the magnetic field is very important. Changes in the magnetic field can influence satellite operations, communication systems, and power grids. By studying these changes, we can better predict and prepare for possible disruptions. This study aims to explore how electromagnetic waves associated with earth’s magnetic field could be detected before, during and after earthquakes. By collecting Earth’s magnetic data from ground-based station over the period from 2014 to 2025, we will analyze/process the electromagnetic wave in the range of 22-100 mHz. Furthermore, few case studies would be studied individually.

Predicting the Number of Sunspots for Solar Cycle 25 through the Facebook Prophet Model

Helal I. Abdel Rahman | W. A. Badawy
National Research Institute of Astronomy and Geophysics | National Research Institute of Astronomy and Geophysics

The solar cycle, commonly referred to as the solar magnetic activity cycle, signifies a roughly periodic variation in solar activity that takes place approximately every 11 years, as demonstrated by the observation of sunspot numbers. In this study, we utilize the FB Prophet forecasting model, employing sunspot data gathered from January 1749 to March 2025 (spanning a duration of 276.25 years), to forecast sunspot numbers for the latter half of Solar Cycle 25 (69 months). The correlation coefficient between our forecast outcomes and the published forecast data from the National Oceanic and Atmospheric Administration (NOAA) reveals a remarkably strong correlation of 98%. This finding indicates a significant level of concordance in the results and further validates the effectiveness and appropriateness of the FB Prophet Prediction model for forecasting sunspot activity during Cycle 25. The model yielded highly precise predictions, as evidenced by the robust correlation in the comparative analysis. Consequently, we have introduced an additional reliable model that can be employed to predict sunspot numbers. Keywords: Solar cycle; Time series analysis; Sunspots; Statistical model; FB Prophet Prediction Model. Write You Abstract here with out any formatting.

Stream Interaction Region and Interplanetary Coronal Mass Ejections: two case studies

SOLAIMAN ELSAFTY | essam elghamry | Shaimaa Saad | mohamed saleh elnawawy
Cairo university | National Research Institute of Astronomy and Geophysics, Cairo, Egypt. | Cairo University, Astronomy department, Cairo, Egypt | Cairo University, Astronomy department, Cairo, Egypt

Geomagnetic storms are among the most significant manifestations of space weather, capable of disrupting satellite operations, radio communications, navigation systems, and power infrastructure. These storms are primarily driven by interplanetary structures such as Interplanetary Coronal Mass Ejections (ICMEs) and Stream Interaction Regions (SIRs). While ICMEs are widely known for their geoeffectiveness, recent studies (e.g., Chi et al., 2018) have emphasized that compound events involving both ICMEs and SIRs can produce particularly intense geomagnetic disturbances. In this study, we present a comparative analysis of two geomagnetic storm events, both driven by SIRs but with different solar wind configurations. The first event involves an SIR interacting with a preceding ICME, forming a compound stream. The second event is an isolated SIR with no ICME involvement. Both events are associated with notable geomagnetic activity, characterized by significant depressions in the Dst index. To investigate the solar wind and magnetospheric conditions during these events, we utilize high-resolution in-situ data from NASA's ACE and WIND satellites, including solar wind velocity, proton density, temperature, dynamic pressure, and interplanetary magnetic field components. These space-based observations are complemented by ground-based magnetic field measurements from several INTERMAGNET stations. The results reveal clear differences in solar wind properties and geomagnetic responses between the compound and isolated SIR events. Our findings suggest that SIR–ICME interactions can significantly enhance storm intensity and duration. This emphasizes the importance of identifying compound structures in real-time monitoring to improve the accuracy of space weather forecasting and risk mitigation strategies.

Interplanetary origin of Geomagnetic storms during solar cycle 25

Susan W. Samwel | Rositsa Miteva
National Research Institute of Astronomy and Geophysics (NRIAG), 11421, Helwan, Cairo, Egypt | Institute of Astronomy and National Astronomical Observatory - Bulgarian Academy of Sciences, 1784 Sofia, Bulgaria

A preliminary investigation was carried out to identify the potential interplanetary drivers—namely, interplanetary coronal mass ejections (ICMEs) and corotating interaction regions (CIRs)—associated with 103 geomagnetic storms (Dst ≤ -50 nT) that occurred during the ascending phase of Solar Cycle 25 (2020–2025). A statistical analysis of these storms was conducted. Additionally, a comparative study was performed to evaluate the variations in the interplanetary origins of geomagnetic storms between Solar Cycles 24 and 25

Ionospheric response during the commencement and recovery stages of the May and October 2024 storms

Chukwuma Anoruo | Paulo Roberto Fagundes | Valdir Pillat
Universidade do Vale do Paraiba | Universidade do Vale do Paraiba

Pole-to-pole VTEC data from the Madrigal GNSS network on May 10â€“12 and October 10â€“12, 2024, were analyzed to diagnose the ionospheric response during the May superstorm and the October severe storm. VTEC, superimposed with S4 and Sigma-phi scintillation, was used to study the spatiotemporal evolution of small-scale irregularities, while ROTI data from the ISEE GNSS network complemented the analysis by examining large-scale irregularities during both events. The meridional average of zonal drift and ROTI keograms at 90Â°â€“60Â° W and 60Â°â€“90Â°E longitudes revealed an eastward PPEF response, which favored the development of both small- and large-scale irregularities, while suppression was observed in the westward PPEF. The ROTI keogram indicated a strong hemispheric connection of plasma depletions during the October storm, supported by variations in the thermospheric O/Nâ„ ratio during the storm's onset and recovery phases. The results concluded that the October storm had a greater impact on Earth's ionosphere compared to the May storm, leading to extreme scintillations that are highly detrimental to systems that rely on radio signals.