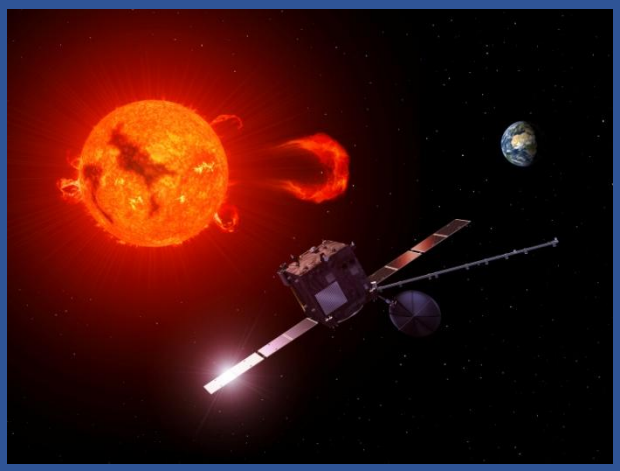


IAASARS

2024 ANNUAL REPORT

INSTITUTE FOR ASTRONOMY, ASTROPHYSICS, SPACE APPLICATIONS AND REMOTE SENSING

NATIONAL OBSERVATORY OF ATHENS

MISSION

The mission of IAASARS is to carry out state-of-the-art basic and applied research in ground-based and space-borne astrophysics, from distant galaxies to the solar neighborhood, as well as near-Earth space physics, remote sensing, earth observation and signal processing. In particular, the three main scientific disciplines represented by the Institute are: (i) Observational Astrophysics using both space and ground-based facilities, (ii) Solar-Terrestrial Environment - Space Physics, encompassing Solar and Heliospheric, Space and Ionospheric Physics, and (iii) Remote Sensing and Machine Learning for Signal/Image Processing.

Preface from IAASARS Director

The Institute for Astronomy, Astrophysics, Space Applications and Remote Sensing (IAASARS) is one of the three Institutes of the National Observatory of Athens (NOA) and the largest Institute in its field in Greece. The Institute operates a wide range of national facilities aiming to support research and services in the respective disciplines, including: (a) the Aristarchos 2.3m and Kryoneri 1.2m telescopes and corresponding instrumentation; (b) the European Digital Upper Atmosphere Server System - DIAS and the Athens Digisonde DPS4D station for monitoring the ionosphere; (c) the BEYOND operational unit maintaining satellite acquisition antennas and computational infrastructure; (d) The HESPERIA operational unit for forecasting space weather, (d) the remote Isensing part of the PANGEA climate observatory of Antikythera; (e) the HellENIc GeoMagnetic Array – ENIGMA.

Clearly the annual report shows the impressive scientific achievements of IAASARS teams, all enjoyed international recognition and have established international relationships and collaborations. In 2024, IAASARS researchers published 119 articles in high-impact journals, receiving more than 11,700 citations, and attracted a total funding of ~9.9 M€ from competitive European and national research grants (HORIZON2020, ESA, Marie Curie, ELIDEK etc). The excellence of the Institute is further demonstrated by the large amount (32) of new scientific programs running. On top of that, three IAASARS researchers appeared in Stanford's list of world' s top 2% scientists, while several research teams advise national and international organizations.

The coordination role for IAASARS on space science activities is also critical as it concerns its role as a national hub for the Space Agencies (ESA, EUMETSAT) and other relevant organizations and bodies within the European Union (GEO, WMO). Some highlights include the activity of IAASARS in the European Space Agency (ESA) Space Situational Awareness (SSA) program to improve the monitoring and understanding of potential Earth hazards by developing experimental methods and analysis techniques to study the impact of asteroids on the Moon. ESA has also singled out IAASARS to produce time-domain value-added products for the Hubble Space Telescope Archive, while the cosmology team participates in the LISA experiment.

Within this framework, the strategic partnership with ESA is currently running and thus the participation of IAASARS in the iconic ARTES/ScyLight and EuroQCI projects brought the Institute to the forefront of optical/quantum communications research by developing new synergies with Space Agencies and worldwide space companies. Specifically, as part of NASA's Psyche mission, IAASARS telescopes are the only ones chosen by ESA to participate in the flagship mission aiming to create a 300-million-kilometer-long communication "bridge" in space. Moreover, IAASARS is participating as a key partner in the Greek-French synergy (Hellas Sat/IAASARS and CNES/Thales Alenia) on the development of an optical communication payload for the upcoming new mission to be embarked on the future Hellas Sat 5 satellite. This innovative payload aims to connect with Optical Ground Station of the National Athens Observatory in Greece, Optical Ground Stations in France,

Optical Ground Stations of ESA and Thales Alenia Space's LEO HydRON telecommunication satellite. Concerning Kryoneri Observatory the plan of NOA administration is to transform it into a major Space Hub for Space Security and Earth Observation in Southern Europe. Space security refers to the development of a European Space Situational Awareness (SSA) capability that will underpin the exploitation of European space assets, contributing to autonomous access to space for Europe. The SSA program will cover two major scientific segments: (a) Space Surveillance & Tracking (SST) and (b) Near Earth Objects (NEOs). Regarding the national GR-SST program, with the Operational Unit BEYOND being assigned the role of the National Operation Center for Greece, EU-SST partnership funding for the next programmatic period (up to 2027) will be used. This has been secured in the implementation of Space Regulation and HE TOPs Actions for SST (contracts signed in and also through additional competitive funds from the delivery of third-party SST services (e.g. satellite operators, ESA, etc.).

IAASARS offers critical information to the Greek State Authorities and the public, through the operation of its operational units for providing dedicated services on Natural Disasters, Climate Change and Space Weather. In particular, IAASARS is a key service provider to the Copernicus flagship Earth Observation program, by delivering a portfolio of standardized products tailored to disaster risk reduction and mitigation, land use/ land cover and marine applications.

Another flagship initiative of NOA is the establishment of the "PANhellenic GEophysical observatory of Antikythera (PANGEA)". Starting from 2018, IAASARS via the ReACT team put a tremendous effort to establish, operate and maintain the Remote Sensing Facility of NOA's PANGEA Climate Observatory at the island of Antikythera. Finally, the Institute is providing continuously and in real-time, innovative standardized and validated services to the ESA SSA Program for the Space Weather System of Federated Services, through the European Ionosonde Service that is supported from the DIAS system

Last but not least, in 2024 IAASARS operated two visitor centers. The first in Penteli and the second at the heart of Athens, in Thiseion. All visitor centers are open on a daily basis, in order to, facilitate educational visits from school, while each center opens about three times per week accommodating visits of the public combined with observations of the night sky with our historical telescopes. Indicative numbers that highlight the Educational & Public Outreach service provided by IAASARS this year, are the ~37.000 visitors among which ~16.000 students from 322 schools that visited our telescopes at both Penteli and Thiseio.

Finally, I'd like to thank the Scientific Council and the entire personnel of IAASARS for their intense efforts in order to grow all aspects of the Institute. I'd also like to express my appreciation to the editorial board of this annual report (Drs. Saridakis Manos, Sykioti Olga, Tziotziou Kostas, and Xilouris Manolis) for their careful editing and proofreading as well as Dr Papaioannou Thanasis for collecting all the relevant metrices presented here.

Dr. Spyros Basilakos
IAASARS Director
Acting Director & Vice President of the NOA Board

ABOUT US

The Institute for Astronomy, Astrophysics, Space Applications and Remote Sensing (IAASARS) is one of the three institutes of the National Observatory of Athens (NOA). It obtained its current structure in 2012, after the merging of two Institutes: the Institute of Astronomy and Astrophysics, which carried on the tradition of optical astronomy in Greece since the establishment of the Observatory of Athens in 1842, and the Institute for Space Applications and Remote Sensing, which evolved from the old Ionospheric Institute, founded in 1955. A short description of the three active groups of the Institute follows:

☐ ASTRONOMY – ASTROPHYSICS Group

The Astronomy-Astrophysics group focuses on four general thematic areas. The Ground-based Astrophysics team has expertise in ground-based observations with optical telescopes in both photometry and spectroscopy. They mainly address problems related to stars, their evolution, the complex interplay with the Interstellar Medium (ISM) as well as binary stars and the study of the morphology and evolution of nearby galaxies. The X-ray Astrophysics team has extensive experience in X-ray data analysis mainly from the XMM-Newton space observatory and from the Chandra X-ray observatory, focusing on problems related to AGN formation. The Infrared Astrophysics team has strong expertise in infrared data analysis and extragalactic astrophysics obtained with the Spitzer Space Telescope of NASA, and ESA's Herschel Space Observatory and Infrared Space Observatory. Finally, the Cosmology team's research activities focus on the fields of theoretical and observational cosmology and specifically in the study of the Universe as a whole, from its primordial to its late-time era.

☐ SOLAR-TERRESTRIAL ENVIRONMENT – SPACE PHYSICS Group

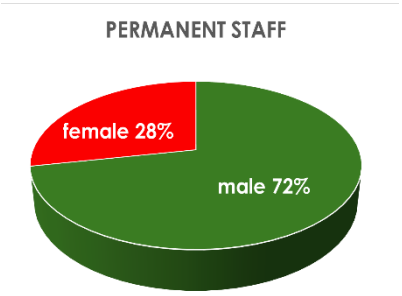
The Solar-Terrestrial Environment – Space Physics Group is composed of three thematic teams. The Solar and Heliospheric Physics team studies the Sun using observational data from satellites and/or ground-based observatories combined with theory and modeling and analyses Solar Energetic Particle (SEP) data and complementary plasma and magnetic field data collected by ESA and NASA spacecrafts to study the effects of eruptive solar events in the interplanetary space and the Earth's environment. The Space Research and Technology group specializes in studies of planetary and interplanetary plasmas, geomagnetism and space magnetism, and space weather prediction techniques for flaring and SEP activity. The main activities of the Ionospheric Group focus on the performance of systematic ionospheric monitoring and the development of ionospheric and trans-ionospheric nowcasting and prediction systems through the online implementation of advanced modeling techniques ingesting ground and space data from all regions of geospace.

☐ REMOTE SENSING – MACHINE LEARNING/SIGNAL PROCESSING Group

The research focus of the Remote Sensing and Machine Learning/Signal Processing group is Remote Sensing for physical parameter estimation including optical, atmospheric and thermal remote sensing, GNSS and InSAR, modeling based on EO products, Radiative Transfer Models, Signal and Image processing (e.g. Machine Learning, big data-information extraction) and Cal/Val research campaigns for validation and certification of new mission data and value-added products. Furthermore, a substantial effort is invested in applied research and production of new complex value-added products, concerning temporal mapping of the Earth, monitoring and changes in sensitive ecosystems and human environment as a result of climate change and economic activity, natural disaster management (forest fires, floods, earthquakes, volcanic activity, air pollution), monitoring the Urban Heat Island phenomena, geological mapping and mineral exploration.

PERSONNEL AND ETHICS

Each discipline is supported by the scientific and technical staff that is responsible for boosting cutting-edge research as well as scientific and technological excellence. At the end of 2024, the permanent staff of the institute consisted of the Director, 26 researchers, 1 secretary and 5 research support specialists. Moreover, 31 postdoctoral researchers, 26 PhD students, and 60 research and technical associates and 1 secretary were on contract, making IAASARS the largest institute in its field in Greece. IAASARS, and NOA as a whole, is a research, working and educational environment that respects the constitutionally enshrined principle of gender equality and non-discrimination. It seeks to promote and ensure substantive equality between women and men at all levels of operation and areas of activity, as well as to ensure that no discrimination appears in terms of race, religion, political views, or class origin. In line with EU objectives, directives, the broader EU strategy and the corresponding initiatives at national level, IAASARS and NOA, through a special Committee, are devoted to implementing targeted actions, tailored to its structures and needs, in order to address any disparities and inequalities, so that the gender and non-discrimination dimension shall become a key pillar within NOA in human resources management, as well as in the access and participation of the personnel in management and decision-making bodies.



IAASARS ORGANISATION STRUCTURE

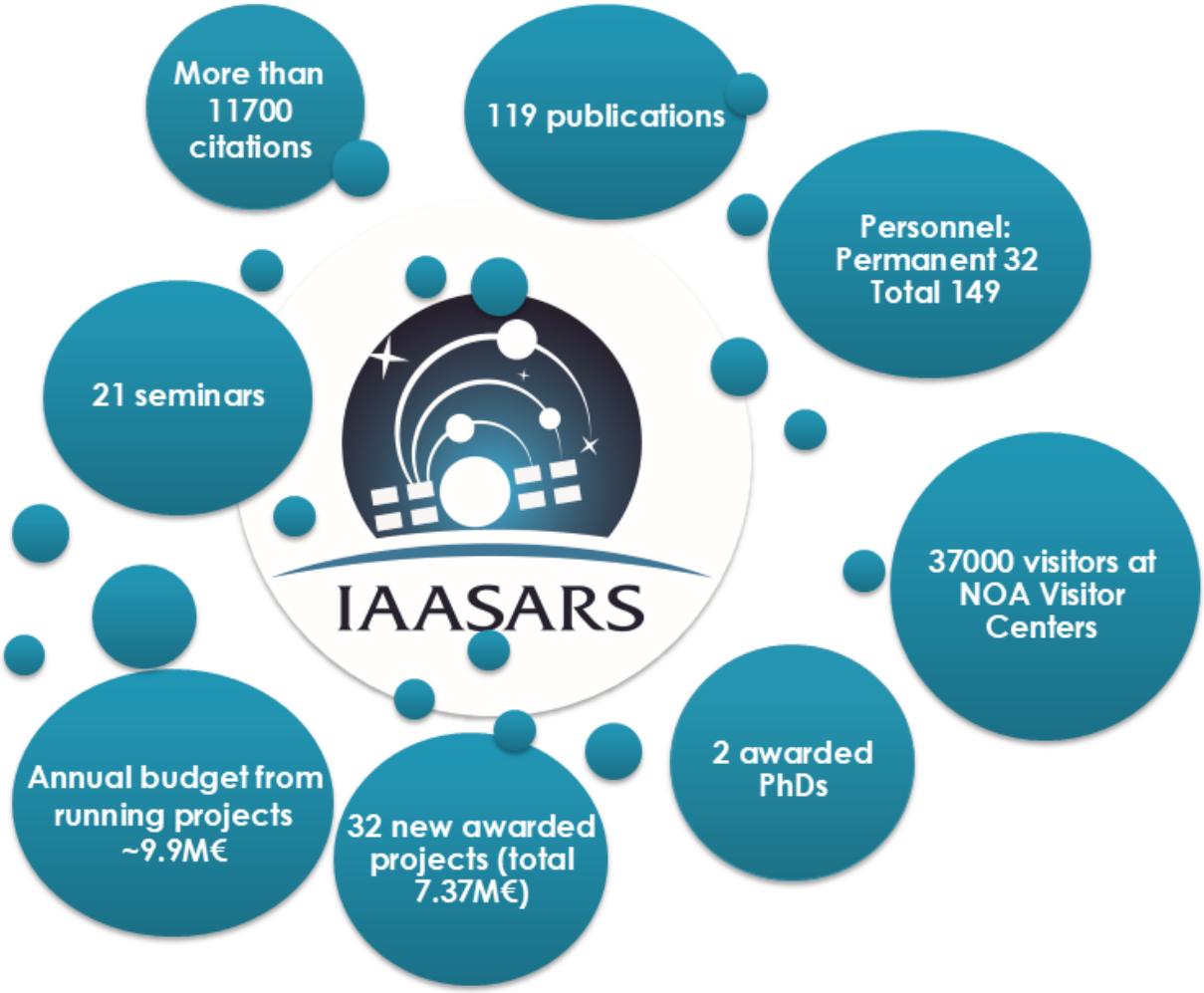
The institutional structure of IAASARS is based on well-defined roles and responsibilities ensuring organizational effectiveness and efficiency. The Director of IAASARS serves as the head of the Institute. He coordinates and oversees all the activities fulfilling the mission, strategic goals and commitments to the State and the scientific community. The Deputy

Director is proposed by the Scientific Council (SC) and approved by the Board of Directors. He replaces the Director when not present at the Institute. The IAASARS secretariat is the contact point with internal (NOA's) and external institutions as well as with other bodies. An important component of IAASARS is the SC, which plays an auxiliary role concerning the scientific policy of the Institute. As of November 2024, the SC, consisting of Drs K. Tziotziou (president), O. Sykioti (vice-president), G. Balasis, E. Saridakis, and P. Boumis (members), serves as an advisory entity for decision-making and planning, having also the role of monitoring the overall progress toward achieving the Institute's vision and strategic goals. The members of the SC are elected by the researchers of the Institute every two years and consist of five (5) researchers of A' and B' Grade. The Chair is designated by the SC. The SC, in collaboration with the Director, addresses the present needs and defines the Institute's priorities from a short- and long-term perspective. The SC has regular meetings with the Director in order to fulfill its mission, while the SC Chair communicates the minutes of the meetings to the Institute. In order to ensure full transparency, awareness and communication of decision rationale at the Institute's level, regular plenary meetings are organized where all the members of IAASARS have the opportunity to be informed directly from the higher-level governance units as well as to express their opinion, concerns and potential solutions aiming at improving the overall performance of the Institute.

The names/photos of the IAASARS permanent staff (including emeritus and adjunct researchers) are presented here below:


Director
Basilakos Spyros
Sciientific Council
Deputy Director
Xilouris Manolis
Secretariat
Vassilaki Maria
Astronomy-Astrophysics
Solar-Terrestrial Environment - Space Physics
Remote Sensing - Machine Learning
Adjunct Researchers
Permanent Support Personnel
Akras Stavros
Akylas Athanassios
Basilakos Spyros
Bonanos Alceste
Boumis Panayotis
Georgakakis Antonis
Georganto-poulos Ioannis
Hantzios Panagyiotis
Koulouridis Elias
Liakos Alexios
Saridakis Emmanuel
Xilouris Manolis
Anastasiadis Anastasios
Balasis Georgios
Belehaki Anna
Giannakis Omiros
Malandraki Olga
Papaio-annou Athanasios
Tsagouri Ioanna
Tsiropoula Georgia (Emeritus)
Tziotziou Konstantinos
Amiridis Vassilis
Elias Panagiotis
Keramitso-glou Iphigenia
Kontoes Chara-lampos
Koutroumbas Konstantinos
Marinou Eleni
Sifakis Nicolas
Sykioti Olga
Vourlidas Angelos
Kiranoudis Christos
Papa-dopoulos Padelis
Mavromatos Nikolaos
Papoutsis Ioannis
Potirakis Stelios
Rontogiannis Athanasios
Sergis Nick
Kolokotronis Evangelos
Koutoulidis Lazaros
Metallinou Fiori-Anastasia
Papadimi-triou Christos
Paronis Dimitrios

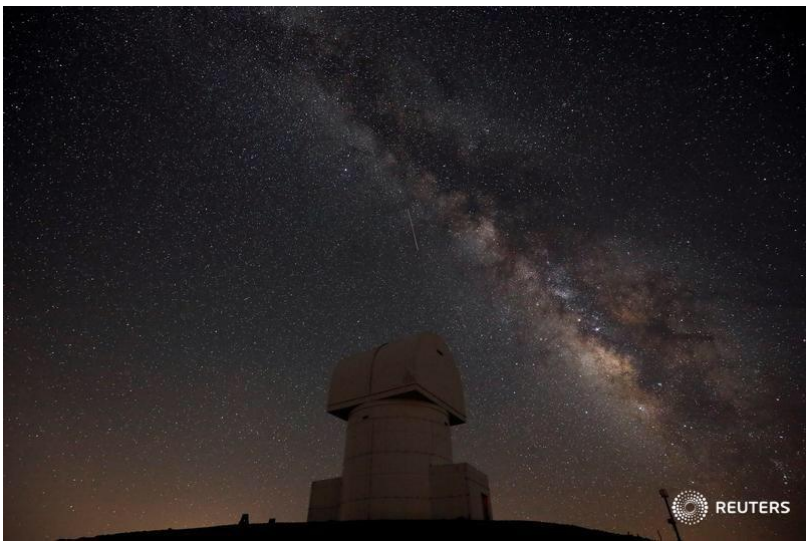
2024 IN NUMBERS



INFRASTRUCTURE

The Institute operates a wide range of national facilities aiming to support research and services in the respective disciplines.

The HELMOS Observatory



The 2.3 m "Aristarchos" telescope, the largest research infrastructure of NOA, is installed at Helmos Observatory (https://helmos.astro.noa.gr/en/). Helmos Observatory is located at an altitude of 2340 m, approximately 220 km southwest of Athens, near the city of Kalavryta, in one of the darkest locations in Europe. The Aristarchos telescope (Ritchey-Chretien design) was manufactured by the Carl Zeiss GmbH and was inaugurated in summer 2007. It has a 2.3 m diameter aperture and a focal length of 17.8 m. The telescope's positional accuracy is better than 4 arcseconds, while it can follow targets with a positional offset better than a fraction of an arcseconds within an hour. The facilities of Helmos Observatory include the dome building, which encloses the telescope, the telescope control and the guest house building as well as the building that contains the electrical power equipment that connects the observatory with the public electricity network and the supporting power generators. A small optical/electronics laboratory, supporting activities for the maintenance of the telescope, is also available. In November 2009, the Helmos Observatory was connected to the National telecommunication network through fiber optics allowing for speeds up to 1 Gb/s for internet connection and data transfer.

Since 2016, the 2.3m Aristarchos telescope participates in the OPTICON (https://www.astro-opticon.org/) Trans-National Access program, making its instrumentation available to the international community. In March 2021, the optical and radio communities decided to come together in the Opticon Radionet Pilot (ORP) (http://www.orp-h2020.eu/) providing for the first time a coordinated and coherent plan for access to a set of optical/infrared and radio facilities, support and

training for multi-wavelength astronomers, and specific developments to improve the capabilities of facilities. In total, 23 nights have been awarded to observers, through OPTICON and ORP, for performing observations with the Aristarchos telescope.

Helmos Observatory (Aristarchos telescope) was selected in August 2020 to become the first ground station of the ScyLight (Secure and Laser communication technology https://www.esa.int/Applications/Connectivity_and_Secure_Communications/ScyLight) program of the European Space Agency (ESA). Since 2021, it has been equipped with a bistatic transmit/receive system conducting optical links with Alphasat. The large aperture of the telescope, combined with excellent atmospheric seeing conditions of the site, makes Aristarchos a valuable asset for optical communications and quantum key distribution (QKD) and especially suited for lunar, Lagrange orbit and deep space communications (DSOC). In 2025 DSOC links will be demonstrated with NASA's Psyche probe, while optical links with the ERMIS Hellenic Cubesat Demonstration Mission are expected to take place in early 2026. Furthermore, the telescope is being prepared for future space-based QKD experiments. An ESA contract (~1.8 M€) is already in place to support the upgrade of the control system of the Aristarchos telescope as well as the development of specialized instrumentation in order to perform optical communication and Quantum Key Distribution operations (compatible with ESA's EAGLE-1 mission).

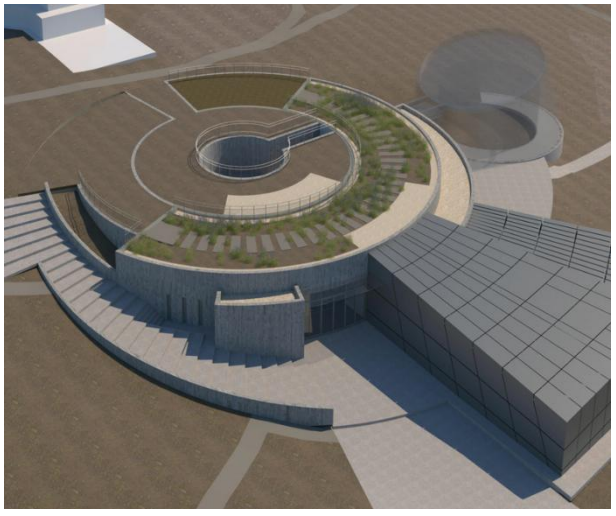
The Kryoneri Observatory

The Kryoneri Observatory (https://kryoneri.astro.noa.gr/en/) is situated 100 km west of Athens at an altitude of 930 m. The observatory hosts the 1.23 m telescope, built in 1975 by Grubb-Parsons Co. in Newcastle. In 2015, the 1.2 m Kryoneri telescope was selected (after a trade-off analysis) as the optimal facility of NOA for the ESA-funded NELIOTA project (https://neliota.astro.noa.gr/). The NELIOTA science objectives imposed strict requirements on the optical design and therefore, in 2016, the telescope underwent an extensive upgrade by DFM Engineering Inc., within the NELIOTA project. Furthermore, and according to the requirement for lunar observations, the optics of the telescope were modified to operate with instruments at the prime focus, bringing the telescope back to its primary mirror f/3 focal ratio and providing an unvignetted field-of-view (FOV) of ~1.4 degrees. A twin imaging system, the Kryoneri Prime Focus Instrument (KPFI), designed and developed by DFM Engineering Inc., is now in use, sampling 17.0'x 14.4' of the total corrected FOV at the prime focus of the telescope, providing simultaneous high-cadence observations in two bands.

In 2024, the 1.2m Kryoneri telescope is a sensor in the EU-SST network contributing to the Cataloguing and

the Collision Avoidance activities of the European Space Surveillance & Tracking program with a dedication of 25% of its time. In parallel to the EU-SST, two Very Wide Field of View (VWFOV) for LEO Optical Triangulation Network sensors are also hosted at Kryoneri Observatory. In the framework of an MoU between POLSA (Polish Space Agency) and NOA, the IAASARS team operating Kryoneri Observatory provides services and assists the operations of these specialized detector systems. This sensors have been developed by CILIUM Engineering for observations of Low Earth Orbit objects using triangulation techniques. A network of five such stations (three in Poland and two in Greece) is currently in operation.

The Manchester-Athens Wide Field Camera (MAWFC; a joint project between the National Observatory of Athens and Jodrell Bank Centre for Astrophysics, UK) hosted at Kryoneri Observatory is a state-of-the-art, wide-field (~30-degree diameter), narrow-band, optical filter camera, which was the first scientific instrument for astronomy that was constructed and tested completely in Greece. The camera will conduct a large-area sky survey that will provide maps at less than 1 arcmin resolution, in order to investigate the very extensive, but faint, line emission regions over the whole northern sky in the optical emission lines of Ha, [O III], Hβ, and [S II], from Kryoneri Observatory site. The successful outcome will have a significant impact on topical astronomical areas of research e.g. subtracting the foreground for the cosmic microwave background; estimating the electron temperature of the warm ionized gas by comparison with radio data; investigating the giant, high latitude, radio filaments from the Galactic center or very close objects in the Galactic plane of extreme angular extent; detecting the northern end of the LMC/SMC H I stream.



The current administration has developed a strategic collaboration with the local government of Peloponnese regarding the Kryoneri Observatory. Specifically, in May 2021 IAASARS was awarded a two-year funding of 362 k€ from the Operational Program for the Region of Peloponnese (under the NSRF/ESPA 2014-2020) in order to upgrade and use the infrastructures at Kryoneri Observatory for public outreach purposes. Overall the aim of the above activities is to transform Kryoneri Observatory into a public outreach center and to attract people interested in learning about the recent developments in science. Under this framework, people are able to visit the facilities at Kryoneri Observatory, familiarize with the operations of the 1.2-m telescope and its instrumentation, but, most importantly, interact with expert scientists and listen to dedicated public talks on various topics related to modern science.

On top of that in December 2021 a master plan was completed which will set the baseline for IAASARS to fulfill its strategic goal for the reconstruction of the Kryoneri astronomical station. This master plan is based on the transformation of the Kryoneri Observatory into a major Space Hub for Space Security and Earth Observation in Southern Europe. Space Security refers to development of a European Space Situational Awareness (SSA) capability that will underpin the exploitation of European space assets, contributing to autonomous access to space for Europe. The SSA programmes will cover two major scientific segments: (a) Space Surveillance & Tracking (SST) and (b) Near Earth Objects (NEOs). Our proposal has already been funded by the European Recovery fund (~10.8 M€) and by the local government of Peloponnese (~4.3 M€). Recently, Greece became a full partner in the EU-SST network with NOA coordinating the activities. Currently, IAASARS is upgrading its capabilities by building a small 0.7 m telescope with a large field-of-view. Its fast-tracking capability (more than 10 degrees per second) will make it a unique tool for the tracking of low-Earth orbit (LEO) missions. The tracking of these missions (mainly small telecom missions) presents great commercial potential.

The PANGEA Observatory

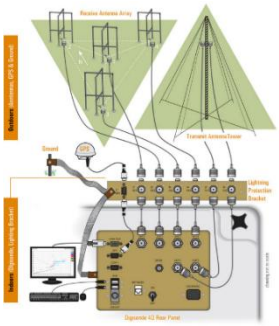
PANGEA (PANhellenic GEophysical observatory of Antikythera) is an ambitious strategic goal of NOA to establish a sustainable climate observatory at the island of Antikythera (35.861N, 23.310E, 110m a.s.l). The site has been selected by NOA and PANACEA due to its representativeness of the broader region of Eastern Mediterranean. The region is a crossroad of air masses transporting different aerosol types, significantly impacted by mineral dust from Africa, smoke from frequent regional forest fires, anthropogenic pollution from megacities and background sea-salt particles. NOA is currently implementing the PANGEA-ReACT facility at Antikythera, an instrumental suite that fulfills the optimum requirements of the ACTRIS RI, including POllyXT-NOA 24/7 multi-wavelength lidar (fully operational at Antikythera), a NASA-AERONET sunphotometer and a DAVIS Weather Station. Since 2023 the PANGEA-ReACT facility is included in the GAW stations network, while the measurements were used for the validation of the ESA Aeolus mission products (Gkikas et al. 2023).

Penteli Atmospheric Remote Sensing Station

PARSS (Penteli Atmospheric Remote Sensing Station) is a state-of-the-art mobile research facility operated by NOA to support atmospheric studies in Athens and the broader Eastern Mediterranean region. Strategically located in Penteli, the station is equipped with advanced instrumentation designed to investigate aerosol and cloud properties along with radiation measurements and is actively deployed in experimental campaigns. Key components of PARSS include: 1) the WALL-E lidar, a polarization lidar system developed by NOA/ReACT group, in collaboration with LMU and Raymetrics S.A., capable of monitoring dust orientation and microphysical properties; 2) the EVE lidar, a mobile polarization lidar system developed by NOA/ReACT group in collaboration with ESA, LMU and Raymetrics S.A.,

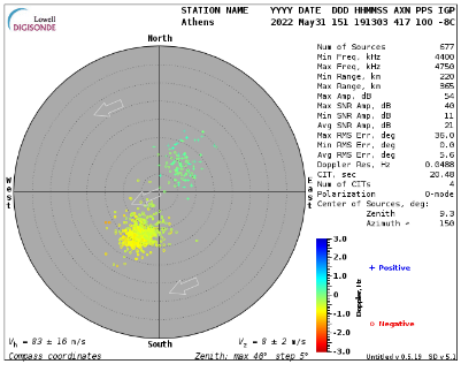
serving as a reference ground-based system for spaceborne lidar measurements of aerosols and thin clouds from satellite missions such as Aeolus and EarthCARE; and 3) an actinometric platform consisting of a Kipp & Zonen SOLYS2 sun tracker and a number of shortwave broadband Kipp & Zonen instruments (two pyranometers to measure the total global (GHI) and total diffuse (DFI) solar irradiance and a pyrheliometer that measures the direct normal irradiance (DNI)), as well as a shortwave and longwave net radiometer. These instruments ensure PARSS meets the requirements of the ACTRIS Research Infrastructure and contribute significantly to satellite Cal/Val activities.

Athens Digisonde (AT138)



The Ionospheric Group operates the Athens Digisonde (URSI Code: AT138), a Digital Portable Sounder 4D (DPS4D) since 2000, with continuous upgrades regarding its hardware and software components. This scientific instrument operates in real-time and provides observed characteristics for research investigations and for the derivation of ionospheric specification data-products.

The Athens Digisonde operates in monostatic and bistatic mode and derives vertical ionograms, oblique ionograms, synchronized vertical sounding ionograms with other Digisonde stations, sky maps and oblique Digisonde-to-Digisonde skymaps (http://www.iono.noa.gr/athens-digisonde).



The Athens Digisonde is the main contributing sounder to the European Ionosonde Service (EIS) and to the Travelling Ionospheric Disturbances Warning and Mitigation Service (TechTIDE) which are part of the Space Weather Network of the European Space Agency (ESA). Athens Digisonde data are exploited for the derivation of data products able to support High Frequency (HF) direction finding and communication systems, HF over the horizon radars, satellites orbiting at LEO and MEO heights, radio astronomy telescopes, and support the development of mitigation technologies and strategies against ionospheric disturbances and irregularities triggered by space weather events and lower atmosphere forcing.

Fireball monitoring cameras

In 2023, IAASARS joined the allsky7.net (https://allsky7.net/) network and obtained two camera systems for recording meteor, bolide, and fireball events. This network collects data from over 200 similar systems in Europe and aims to determine the appearance frequency of such events in the Earth's atmosphere. Simultaneous recording from two or more systems allows for an accurate determination of their velocity as well as their entry angle in Earth's

atmosphere, hence their trajectory. In cases of fireball events, that a small fraction of the projectiles potentially reaches the surface, the simultaneous recording allows for the determination of the impact location, hence, the discovery of new meteorites. Each system consists of eight cameras in total. Seven with a field-of-view of 45x80 degrees that cover the whole sky and one camera with a fisheye lens that covers all the sky at lower resolution. Each individual camera has a recording rate of 25 fps and can detect events with a brightness up to 4th magnitude. Each system has a pre-installed automated software for data reduction and analysis. The two camera systems were installed at NOA in Penteli (Attica) and at Kryoneri Observatory (Corinthia). These stations are the first of this network to be installed in South-East Europe and the systematic very good weather conditions at both sites allow the acquisition of large amounts of high-quality data.

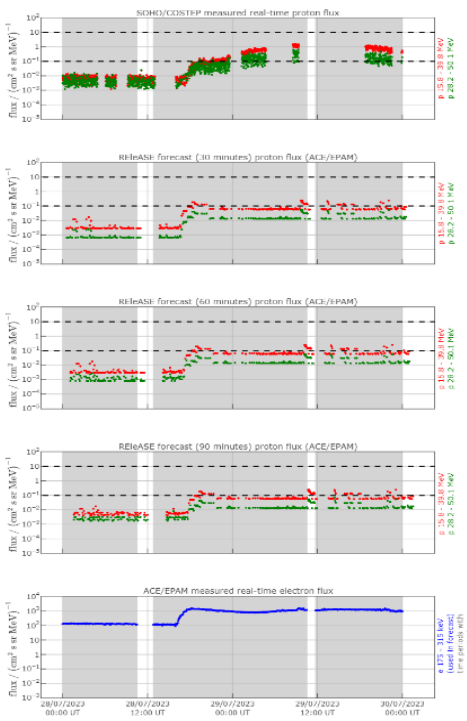
Global Positioning System (GNSS) geodetic stations

The two Global Navigation Satellite System (GNSS) geodetic receivers of NOA, installed in Penteli and Florina, support the observation of space weather by recording ionosphere fluctuations due to terrestrial natural disasters. They are also used to study the primary effects of natural and geological hazards on the Earth's crust, environment and troposphere, contributing to the characterization and modeling of their source. Finally, they are used collaboratively with remote sensing satellite data for calibration and validation of added-value products.

Solar Telescope

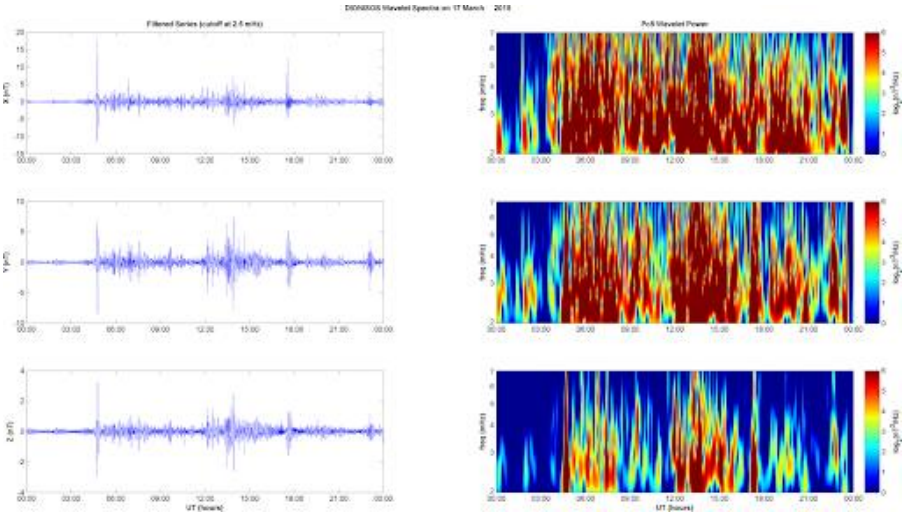
The solar telescope, which is placed in a permanent dome at the premises of the National Observatory of Athens in Penteli, was constructed by Lunt Solar Systems and has an objective lens diameter of 100 mm, a focal length of 800 mm, It is equipped with a cut-off filter of 1800 mm and a built-in Ha filter with a spectral range less than 0.75 Å that becomes 0.5 Å with the use of an external double stack filter. Two different cameras are available for acquiring solar images, a CCD camera with a resolution of 1200x1600 pixels and a field of view (FOV) on the Sun of 30'x23' to capture partial images of the solar disc and a CMOS camera with a resolution of 2048x2048 pixels and a FOV of 57'x57', allowing to observe the entire solar disk with a resolution of approximately 1.6 arcsec. In addition, focal ratio reducers and Barlow lenses permit us to visualize parts of the solar disk and record specific active regions (ARs) of interest. Real-time processing of registered solar images results in high-quality images of the solar disk and ARs that are archived and presented through the website of the Center for Space Weather Monitoring and Forecasting (http://spaceweather.space.noa.gr).

The Space Weather Operational Unit



The forecasting of Solar Energetic Particles (SEPs) generated by solar eruptive events is crucial for spacecraft and launch processes, as well as for estimating the conditions of radio wave propagation in the Earth's ionosphere. It is mandatory for interplanetary travel beyond Low Earth Orbit (LEO), especially outside the Earth's magnetosphere. In addition to the general prediction of SEP events, the forecasting of high-energy SEPs is of potential interest, as these particles can penetrate deeper into the Earth's atmosphere and contribute to the radiation dose received by aircraft crews and passengers. As part of the Space Weather Operational Unit of NOA, the HESPERIA REleASE tool has been developed, providing real-time forecasts of solar energetic protons with energies of 30-50 MeV in Geospace. It is based on observations of electrons traveling at the speed of light and crossing the distance between the Sun and Earth in tens of minutes, collected by the spacecrafts SOHO and ACE near Earth, as precursors of protons arriving 30-90 minutes later. This tool provides more comprehensive forecasts compared to others based solely on observations of solar flares in the solar hemisphere. The other operation tool of the unit is the HESPERIA UMASEP-500 which provides real-time forecasts of events detected on the ground by very high-energy protons (> 500 MeV). The tool provides more timely forecasts compared to ground-based neutron detectors and relies solely on space data. The forecasts are available through the website of the National Observatory of Athens (NOA) at http://www.hesperia.astro.noa.gr. The HESPERIA tools were selected by NASA as a top priority internationally to be included in the simulation of the manned mission to Mars. Currently, the HESPERIA tools provide real-time forecasts for NASA's CCMC, as part of the Moon to Mars (M2M) initiative. The space weather unit has maintained close cooperation since 2020 with the above NASA departments as a consultant on space weather issues. Finally, the HESPERIA tools have been integrated, operated, and provide forecasts for space weather at the European Space Agency (ESA), and are used in collaboration with a foreign company partnering with ESA for predicting events affecting international civil aviation.

ENIGMA - the HellENIc GeoMagnetic Array



IAASARS operates ENIGMA (HellENIc GeoMagnetic Array), an array of 4 ground-based magnetometer stations in the areas of Trikala (Klokotos), Attiki (Dionysos), Lakonia (Velies) and Lasithi (Finokalia) that provides measurements for the study of geomagnetic pulsations, resulting from the solar wind – magnetosphere – ionosphere coupling. ENIGMA is the first magnetometer station array to operate in Greece, and within a few years of operation has achieved the status of a SuperMAG contributor. SuperMAG is a worldwide collaboration of organizations and national agencies that currently o perate more than 300 ground-based magnetometers. ENIGMA monitors the variations of the geomagnetic field associated with the occurrence of geospace magnetic storms and magnetospheric ultra-low frequency (ULF) electromagnetic waves. One of the ENIGMA main research objectives is the study of space weather effects on the ground, i.e., Geomagnetically Induced Currents (GIC). GIC flow along electric power-transmission systems and other electrically conducting infrastructure during increased geomagnetic activity and can cause wide-spread blackouts and power failures.

BEYOND Center for Earth Observation and Satellite Remote Sensing

BEYOND Centre of Excellence for Earth Observation Research and Satellite Remote Sensing is an Operational Unit of the Institute for Astronomy, Astrophysics, Space Applications and Remote Sensing (IAASARS) of the National Observatory of Athens (NOA). BEYOND plays a pivotal role in developing cutting-edge research and providing innovative services in crucial thematic areas of security and crisis management and social growth relating to national and EU independence such as: Space Safety and Security, Disasters and Crisis Management, Citizen Safety, Humanitarian Aid, Food and Energy Security and Societal Wellbeing and Health. BEYOND Centre addresses stakeholders needs across Europe, and the neighboring Regions including Balkans, Middle East, and Africa.

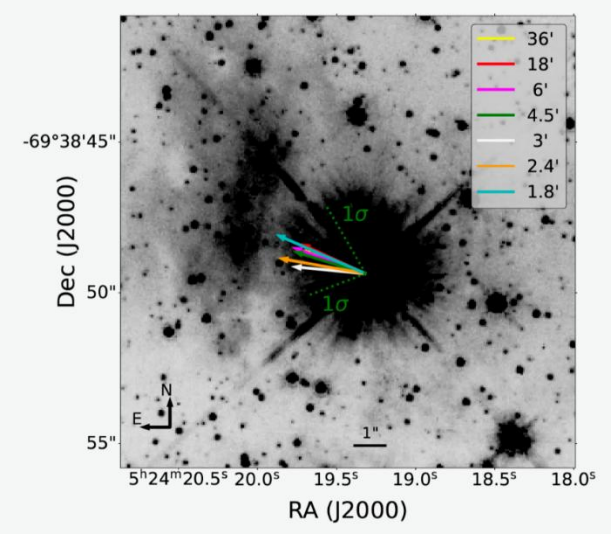
BEYOND, in the delivery of its tasks, collaborates with leading organizations, including, but not limited to, the World Meteorological Organization (WMO), the European Centre for Medium-Range Weather

Forecasts (ECMWF), the Barcelona Supercomputing Center (BSC) and the European Organization for the Exploitation of Meteorological Satellites (EUMETSAT). Furthermore, BEYOND Centre has the role of **UN-SPIDER Regional Support Office** to advance Capacity Building and services for DRR worldwide and is an active member of the CEOS Working Group on Disasters, GEO/LEO/SAR Flood Pilot "Understanding Flood Risk from Space" for the Balkan flood pilot (Evros river basin), and the **GEO Disaster Risk Reduction Working Group**. The Centre coordinates the GEO-CRADLE enabling a mechanism that is leveraging the GEO and EuroGEO innovation in Balkans, Black Sea, Middle East, Africa and Pacific Asia areas for addressing security and DRR priorities of national civil protection and civil safety authorities. Since 2023, leads the Space Surveillance and Tracking (SST) operations in Greece in the support of the European SST Partnership.

EXCELLENCE

In 2024, IAASARS researchers have published 119 articles in high-impact ISI journals, receiving ~11722 citations, and attracted a total funding for IAASARS of ~9.9 M€ from competitive European and national research grants (¬1.2 M€ were retained by the Special Account Unit (ELKE) for NOA) and additional 6.4 M€, input for funding NOA project partners. Furthermore, three IAASARS researchers, namely, Spyros Basilakos, Kostas Koutroumbas, and Emmanuel Saridakis, appeared in the Stanford' s list of world' s top 2% scientists. The list is conducted based on a large number of indicators of excellence, influence and impact of their published works during the year 2023. Some indicative science highlights produced by researchers of IAASARS as well as funded research grants initiated within 2024 are presented below.

ERC-funded ASSESS project: Episodic mass loss in red supergiant stars

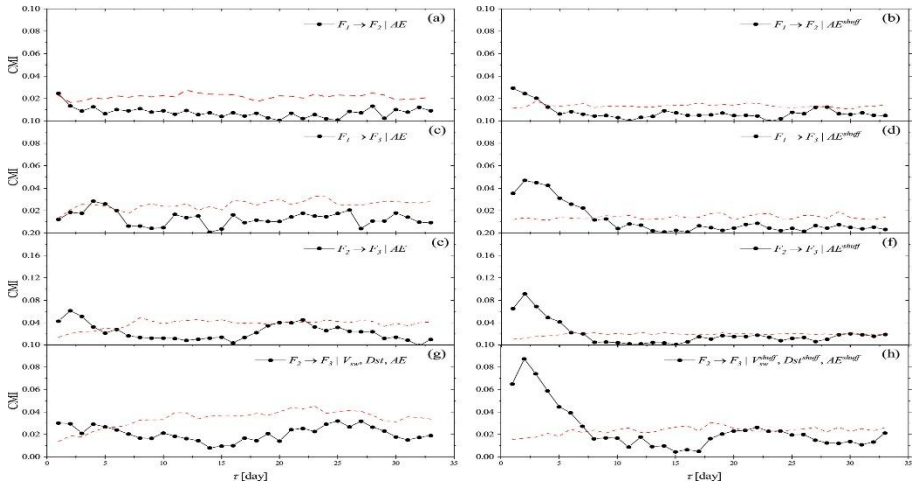


Multiple lines of evidence from both the massive star and supernova communities are pointing to violent, episodic mass-loss events being responsible for removing a large part of the envelope of massive stars, especially in low-metallicity galaxies. Episodic mass loss, however, is not understood theoretically, neither accounted for in state-of-the-art models of stellar evolution, which has far-reaching consequences for many areas of astronomy. The ERC-funded ASSESS project (9/2018-8/2024) aimed to determine the role of episodic mass loss in the evolution of the most massive stars. ASSESS developed a photometric classifier, i.e. a machine-learning algorithm, based on existing multi-band photometry and applied it to luminous sources in ~26 nearby galaxies, yielding reliable classifications of over 275,000 dusty sources in 21 nearby galaxies. ASSESS also conducted a large spectroscopic survey of dusty, evolved stars in nearby galaxies spanning a range of metallicity, resulting in the largest catalog of evolved massive stars (185 stars) beyond the Local Group, including 129 low-metallicity red supergiants, 3 new luminous blue variables and 6 new supergiant B[e] stars. We investigated the different temperature scales of RSG, i.e. those based on TiO lines measured in the optical vs. atomic lines measured in the near-IR and derived a scaling relation that translates one to the other. We also found substantial changes in the spectral types (i.e. effective temperatures) of >10% of our RSGs, providing evidence for episodic mass loss and an estimate on the occurrence rate.

ASSESS for the first time measured precise and accurate mass-loss rates using the largest-ever sample of red supergiants in the Magellanic Clouds, finding enhanced mass loss at luminosities above log(L/Lo)~4.5, and lower rates by 2-3 orders of magnitude, compared to the mass-loss relations applied in evolutionary models. We highlight the extreme (in luminosity

and radius) red supergiant [W60] B90 in the Large Magellanic Cloud (LMC; see Figure), which is a massive analog of Betelgeuse, exhibiting 3 dimming events, as well as evidence for a bow shock. Finally, we discovered that WOH G64, a red supergiant in the LMC boasting the highest luminosity and mass-loss rate, underwent a never-seen before transition to the blue in 2013-2014, which has implications for the 'red supergiant problem' and the Humphreys-Davidson limit..

Causal Inference in the Outer Radiation Belt: Evidence for Local Acceleration



Despite the fact that the discovery of the radiation belts occurred more than 60 years ago, a comprehensive understanding of the physical processes that are involved in the dynamics of the fluxes of relativistic electrons in the outer radiation belt is still lacking. Development of a thorough physical model accounting for the radiation belt dynamics has the potential to assist mitigation of spacecraft hazards caused by energetic particles. In a new study in *American Geophysical Union (AGU)* journal *Geophysical Research Letters*, an information-theoretical approach, based on the methodology of causal inference, is applied for identification of factors that control fluxes of relativistic electrons in the outer belt. The patterns of interactions between the solar wind, geomagnetic activity and belt electrons have been investigated. The study has provided evidence that inward radial transport from an external source is a less favorable mechanism than local acceleration for the energization of outer radiation belt electrons from relativistic to ultra-relativistic energies. For further details see: Manshour, P., Papadimitriou, C., Balasis, G., & Paluš, M. (2024). Causal inference in the outer radiation belt: Evidence for local acceleration. *Geophysical Research Letters*, 51, e2023GL107166. https://doi.org/10.1029/2023GL107166.

NOA/ReACT's participation to the Aerosol-Cloud-Radiation-Interaction (ACI/ARI) European cluster initiative

NOA/ReACT participates in the European cluster initiative for ACI/ARI, aiming to shed light on the most uncertain elements on weather and climate model simulations. EC Horizon Europe project **CERTAINTY**, under the flagship ACI European action and the related impacts in the Earth System, aims to deliver the knowledge and models that provide improved confidence and representation of the role of ACI in climate and weather (Fig. 1).

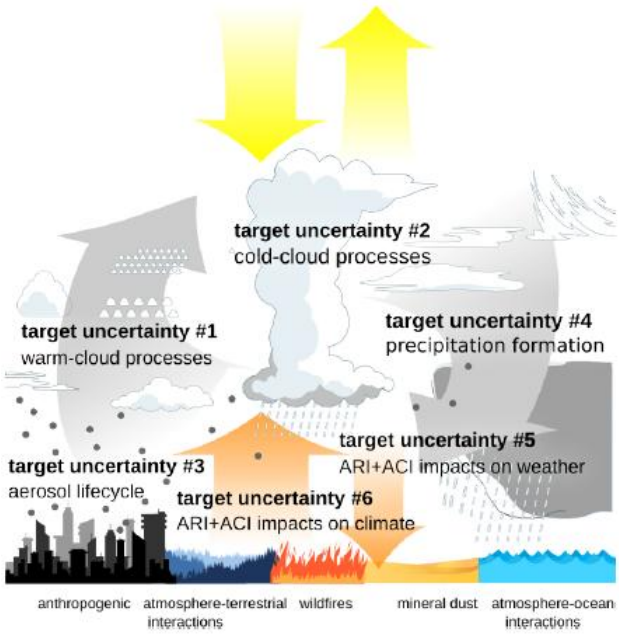


Figure: Key target ACI uncertainties/processes that are the focus of CERTAINTY including focused work based observations, data assimilation, advanced algorithms and models

AIRSENSE activity

AIRSENSE activity is part of Atmosphere Science Cluster of ESA's EO Science for Society programme, an element of the ESA FutureEO programme. NOA/ReACT ensures the coordination of the scientific activities related to ACI performed in CERTAINTY and AIRSENSE, and further contributes to (a) climate studies related to the aerosols and clouds in the atmosphere, (b) Cal/Val of the new ESA EarthCARE mission and satellite products developed within AIRSENSE, and (c) improvement of aerosol, cloud and ACI representations in atmospheric models.

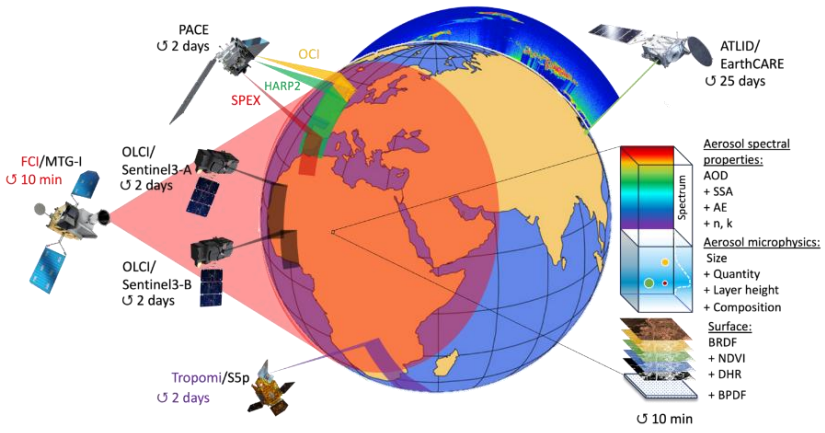


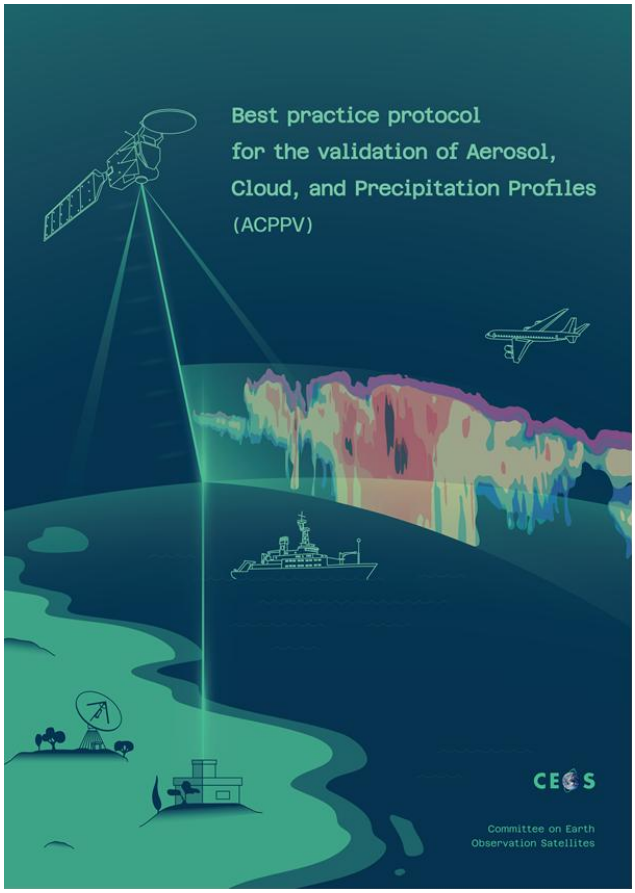
Figure: AIRSENSE satellite products, utilising unique synergies of observations from different satellite platforms

NOA/ReACT's Contribution to the ESA EarthCARE Mission

In the framework of the ESA-JAXA EarthCARE mission, dedicated to advancing our understanding of cloud, aerosol, and radiation interactions in Earth's climate system, NOA/ReACT plays a pivotal role in ensuring the accuracy and scientific value of EarthCARE's data. NOA/ReACT leads the development of calibration and validation (Cal/Val) tools and co-leads the coordination of Cal/Val activities within the **EarthCARE Data Innovation and Science Cluster (DISC)** project, guaranteeing the high quality of EarthCARE's products. Leveraging its expertise in measurement intercomparisons, collocated observations, and atmospheric modelling, NOA/ReACT integrates EarthCARE data to enhance the representation of aerosol-cloud interactions. Additionally, NOA/ReACT is responsible for the Greek Cal/Val component of the EarthCARE mission through the **ESA-ACROSS** project, organizing validation campaigns over Greece and the Mediterranean utilising ground-based and airborne measurements. The first intensive observational period took place in November 2024, featuring DLR-HALO overflights above PANGEA as part of the DLR-PERCUSION campaign).

Best Practice Protocol for the Validation of Aerosol, Cloud, and Precipitation Profiles (ACPPV)

NOA/ReACT coordinated the international ACPPV (Aerosol, Cloud, and Precipitation Profiling Validation Best Practices) consortium, consisting of 80 research organizations and space agencies, including ESA, NASA, and JAXA, to establish standardized best practices for the calibration and validation (Cal/Val) of space-based aerosol, cloud and precipitation products from active remote sensing profilers. By leveraging lessons learned from past missions such as CALIPSO and CloudSat, ACPPV optimized Cal/Val methodologies, improved intercomparison techniques, and enhanced data quality control for current and future missions like EarthCARE and NASA's Atmosphere Observing System (AOS). The initiative developed a unified protocol, accepted as a Committee on Earth Observation Satellites (CEOS) best practice protocol, ensuring consistency between global suborbital and satellite observations while addressing gaps in Cal/Val knowledge. Through these efforts, NOA/ReACT strengthens the reliability of spaceborne atmospheric profiling, advancing our understanding of aerosol, cloud, and precipitation processes in Earth's climate system.



BEYOND Centre in support of the Global Copernicus Emergency Management Service for Risk and Recovery

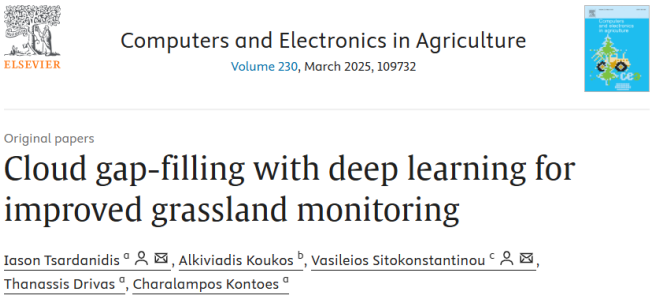
At the end of 2023, the Operational Unit BEYOND/IAASARS/NOA was selected between the contractors for realizing the Copernicus Emergency Management Service (CEMS) Risk and Recovery Mapping (RRM) for the benefit of societies on a global scale. The consortium is led by the Centre BEYOND of Earth Observation Research and Satellite Remote Sensing of IAASARS/NOA, with the participation of the School of Mining and Metallurgical Engineering/ Engineering Geology & Hydrogeology Lab/NTUA and the IT company IDCOM. Copernicus Emergency Management Service (CEMS) Risk and Recovery Mapping RRM is the European contribution to assist global efforts of the authorized service users in Disaster Risk Reduction, communities and businesses to natural disasters, and minimization of losses in human lives and economic assets. The project aims at promoting knowledge-based decision making with the use of products generated through applying adequate processing of Earth Observation data, specifically using the Copernicus knowledge base.
During 2024, JRC released 25 activations and Operational Unit BEYOND/IAASARS/NOA was awarded 8 of the 14 proposals submitted. The activations included risk and recovery mapping across Europe but also in Africa.

EMSN196 - Drought and surface water monitoring in Zambia's Central and Southern Provinces

The aim of this activation was to provide scientific evidence of successful integrated

watershed management (IWsM)/groundwater harvesting measures in Zambia, using remote sensing data and GIS analysis. These insights aim to enhance planning and facilitate joint decision-making by relevant ministries, substantiating the importance of scaling up the AWARE 2.0 project's approaches through government extension services. Initially, change detection mapping was performed. In specific, spatiotemporal changes in land cover/use were investigated by applying advanced supervised and unsupervised classification techniques and algorithms, along with Very High Resolution (VHR) satellite imagery (e.g. Pleiades Neo, GeoEye-1, Worldview 3). Moreover, in order to evaluate and monitor spatiotemporal pressures and changes, related to drought, in the soil – water – vegetation nexus, a comprehensive time series/change detection analysis took place by producing and analyzing a series of spectral indices (indicatively: EVI, LAI, FAPAR, NMDI, NLSWI, etc.) using High-Resolution (HR) satellite imagery (Copernicus Sentinel-2 Mission data). Furthermore, in order to investigate the surface water - groundwater trade-offs and dynamics in the studied AOIs, surface water flow, groundwater flow and hydrological flow modelling took place, using state-of-the-art physical models like HEC-RAS, MODFLOW algorithms and HEC-HMS correspondingly. To conclude the analysis, soil erosion modelling was also employed, using the RUSLE (Revised Universal Soil Loss Equation) spatial model. Thematic maps were produced, for four of the AOIs with the highest importance-score, in relation to drought-pressure significance, as defined through the Analytical Hierarchical Process (AHP) model, based on meticulously selected criteria derived from the outputs of the aforementioned analyses.
Last but not least, the WorldDEM Neo DTM Level 1 dataset was processed and refined, using contemporary geospatial tools and techniques, to produce a DTM suitable for accurate hydrological and geomorphological applications. 6 products were produced for this activation including: Change detection mapping; Surface water flow modelling; P03-Groundwater flow and hydrological flow modelling;P04- Soil erosion modelling; P05-Thematic maps at 1:5,000; P06- DTM post-processing methodology.

Cloud Gap-Filling with Deep Learning for Improved Grassland Monitoring



The Agrihub team of the BEYOND Centre of Excellence of IAASARS/NOA, published a study, "Cloud Gap-Filling with Deep Learning for Improved Grassland Monitoring," in the high-impact journal Computers and Electronics in Agriculture. This research introduces a deep learning approach to generating continuous NDVI time series by integrating Sentinel-1 SAR and Sentinel-2 optical imagery. By producing uninterrupted and reliable time series, it enhanced the accuracy and efficiency of grassland mowing event detection, offering a more robust solution for monitoring vegetation dynamics under difficult cloud coverage scenarios.

Greek National Operations Center (GR-SST NOC) in the EU-SSTb

The BEYOND operational unit of IAASARS/NOA leads the Space Surveillance and Tracking (SST) operations in Greece in the support of the European SST Partnership. As the Greek National Operations Center (GR-SST NOC) for SST enables real-time monitoring of the orbital environment, supporting informed decision-making for satellite operators, policymakers, and defense entities. BEYOND as GR-NOC SST, supports the operations of the Greek observing telescopes offered by NOA, AUTH, FORTH, and NTUA. The Centre is responsible for the relevant activities at the national level, and at the EUSST level, and represents the Greek SST program in broader international collaborations, including with the United States Space Command.

GR-NOC SST oversees activities that involve, but are not limited to:

- **Coordinating Greek sensors** for conducting space surveillance observations,
- **Processing observational data** in accordance with EUSST specifications,
- **Correlating observations** with known objects in space catalogs,
- **Contributing correlated results** (in the form of Tracking Data Messages - TDM) to the EUSST database.

As part of the Greek participation in the EUSST Partnership, GR-NOC actively supports the main EUSST services in collaboration with the operational centers of other EU member states. The main EUSST services are:

- **Collision Avoidance (CA)** – Assessment of the collision risk between space objects and evaluation around the need for collision avoidance maneuvers
- **Re-entry analysis (RE)** – Forecasting the trajectory of space objects re-entering Earth's atmosphere in an uncontrolled manner and estimating the potential risk to infrastructure and human life.
- **Fragmentation Analysis (FG)** – Detection and characterization of in-orbit fragmentations originating from collisions and other break-up events.

Impact of the SST services

GR-NOC SST lays the foundation for supporting space operations and working toward greater autonomy in both National and EU-level. Through Greece's participation in EUSST, significant benefits arise for the involved entities, Greek citizens, and the country as a whole, including:

- Enhancing the security of Greek satellite missions and, consequently, national security, by protecting from threats originating from or passing through space.
- Monitoring and predicting the re-entry of space debris and other objects (e.g., spent rocket stages, ballistic missiles) of known or unknown origin.
- Advancing space surveillance technologies (detection and tracking) by leveraging Greece's existing scientific expertise and infrastructure.
- Integrating into emerging space markets that invest in space-related services.
- Developing technological capabilities, specialized training, and expertise, fostering a skilled workforce and advancing research in space surveillance.
- Establishing collaborations between the Greek space industry and European and international organizations, contributing to economic growth.
- Supporting European policies on space traffic management, security, and defense,

while safeguarding the interests of the EU and its Member States.

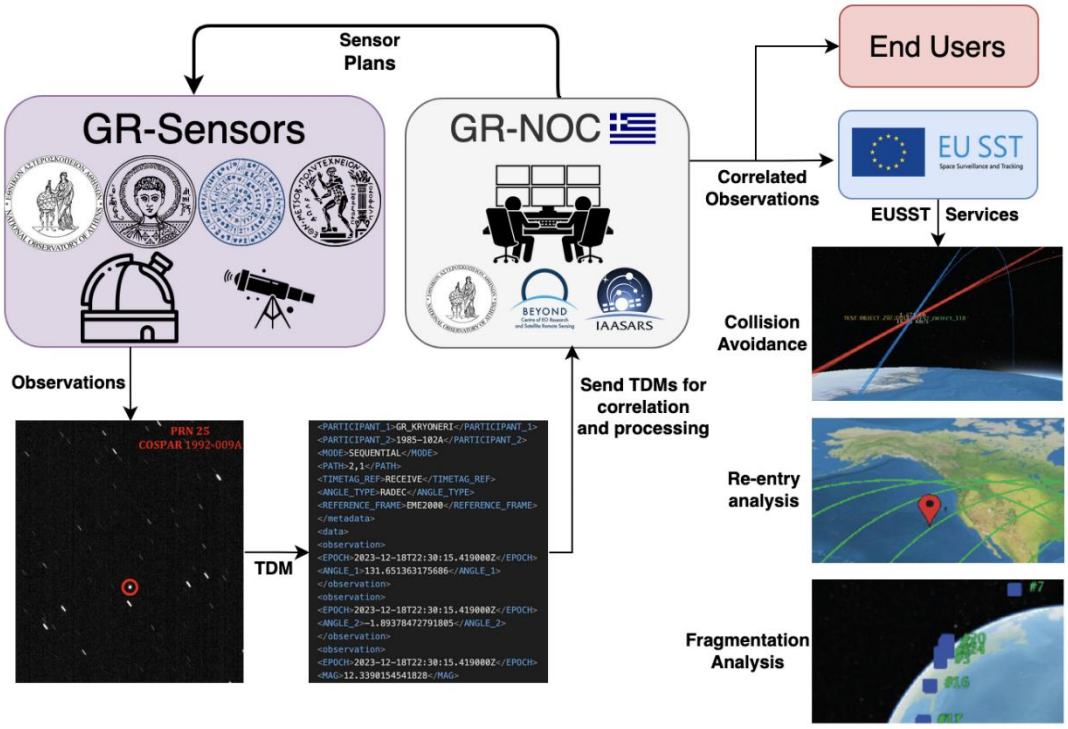


Figure: High-level overview of the Greek SST activities. The Greek National Operations Center for SST (GR-NOC SST), hosted by the BEYOND Center of Excellence, is responsible for the coordination of the SST activities. These include, but are not limited to, the generation of sensor plans for the Greek telescopes, the correlation of observations against space object catalogs, and the contributions to EUSST and its services.

The Strategic Partners & End users of BEYOND consist of entities such as NOA, AUTH, NTUA, FORTH, HELLENIC SPACE CENTER, Hellenic Ministry of Defense, Hellenic Ministry of Digital Governance, Hellenic Ministry of Development, EUSPA, GMV, HELLAS SAT, Libre Space Foundation, USSPACECOM, NKUA, etc.

Milestones of the Greek contributions to the EUSST

The 2024 performance analysis of the Greek sensors participating in EUSST highlights their exceptional contribution to space surveillance and tracking. The survey telescopes GR_HOLOMON1 and GR_THESSALONIKI1 ranked first by a significant margin, providing 496,000 and 341,000 measurements, surpassing the next best-performing sensor by a factor of 3x and 2x respectively.

The tracking telescope GR_KRYONERI also demonstrated strong results despite operating with a low dedication (25%). It achieved the highest total number of measurements (~372,000), ranked third in the number of tracks (competing against telescopes with 70% and 50% dedication), and recorded the second-highest measurement rate with 100% timeliness. Additionally, it made a significant impact in autonomous product generation, securing the second position, just behind a sensor that operates at a much higher 70% dedication.

These achievements underscore the efficiency and competitiveness of the Greek SST sensors within the European framework.

OUTREACH AND EDUCATION

IAASARS has always placed great emphasis on science dissemination and outreach. Afterall, IAASARS research is funded by public (national or European) grants, and thus the research results should return in a suitable way to the public itself. The institute's main components to this aim are the Penteli Visitor Center (since 1995) and quite recently the Thiseio Visitor Center (since 2014). Both visitor centers are now unified on a single structure within IAASARS, namely the Visitor Centers of National Observatory of Athens, and are very active, engaging in a huge variety of outreach indoors and outdoors activities covering a large age-range, which was non-existent in previous years.

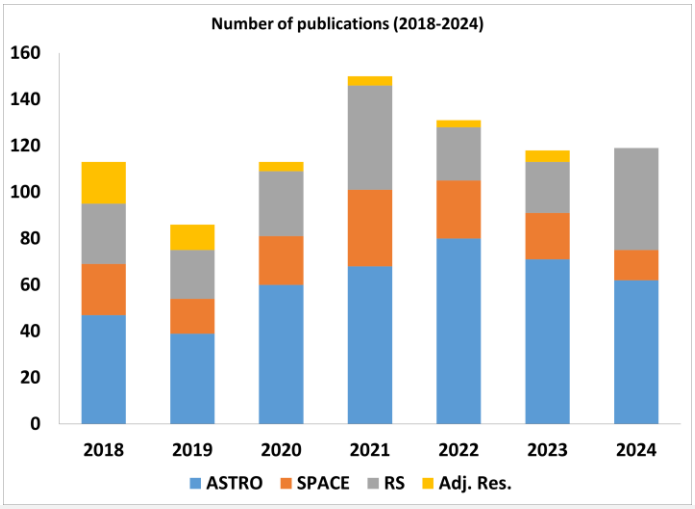
The purpose is to mediate between science and the public using diverse activities paved by modern educational means which is always based on the interaction between the specialized staff and the audience. This has been made possible through customized schemes that serve the needs of a particular age group. The Visitor Centers have also welcomed to their educational programs unemployed people, refugees, guests of Mental Health Centers, disabled persons, and students from Special Schools. Special presentations are chosen from a plethora of topics in coordination with the main research areas of the IAASARS. Other educational activities of the Institute include the annual astrophysics summer school for high-school seniors, regular organization of international conferences and a vigorous seminar program.

During 2024, the Visitor Centers were visited by 297 schools, with 16382 pupils in total (49% increase compared with 2023), plus 25 schools with free entrance due to social requirements (school increase 9% compared with 2023). Additionally, 16140 visitors (60% increase compared with 2023) participated in 227 events, while the Visitor Centers organized 54 special events. Moreover, Visitor Centers stuff visited 14 schools in remote areas of Greece, in person or online, for special events. Finally, the Visitor centers organized 34 actions for kids, and 35 theater/music performances. More than ~3000 citizens had free entrance due to social requirements, while 1100 were citizens with special needs.

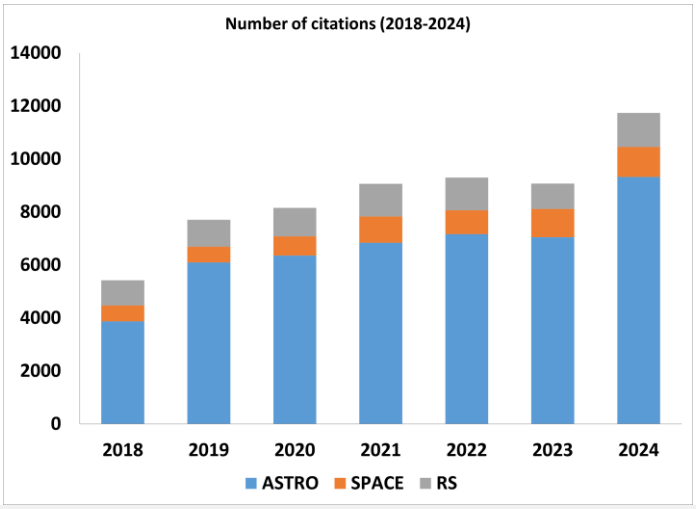
Additionally, within the framework of implementing the strategic objective of IAASARS to reconstruct the Kryoneri Observatory with the aim of transforming it into (i) a Space Hub and (ii) a Science Public Outreach Center — an investment directly funded by the Prefecture of Peloponnese — and although the renovation works are still in progress, the site has already been visited by approximately 500 visitors. Furthermore, the activities of the Visitor Centers in Kalavryta attracted more than ~400 visitors. During 2024, IAASARS researchers, including the Director of the institute, wrote tenths of articles in newspapers and sites and appeared frequently in TV and radio interviews and broadcasts. Additionally, they had a significant contribution in KOSMOS, NOA's on-line scientific journal, with many articles on the IAASARS research fields.

PERFORMANCE METRICS

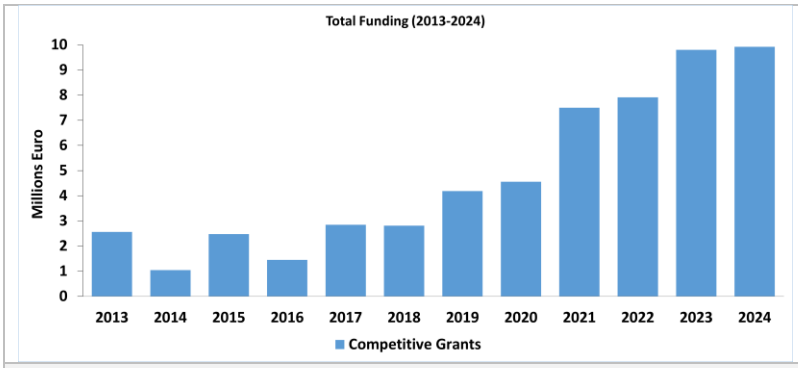
The scientific activity within 2024 resulted in 119 papers in refereed scientific journals with more than 11700 citations. Moreover, the scientists of the Institute have been successful in attracting 7.3 M€ in 2024 from new national and European competitive research grants while the total annual running project budget is ~9.9 M€. IAASARS, provided novel applied and basic research results, services and public outreach activities, supporting at the same time 118 on contract positions including 31 postdocs, 26 PhD students and 60 research and technical associates, funded by external competitive frameworks.



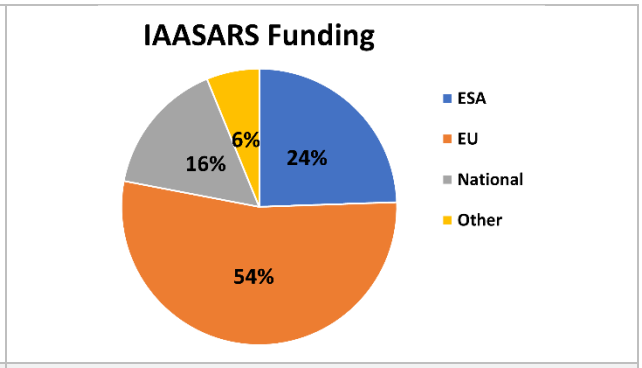
Refereed papers per discipline 2018-2024 (source ISI-Web of Science)



Citations per discipline 2018-2024 (source ISI-Web of Science)



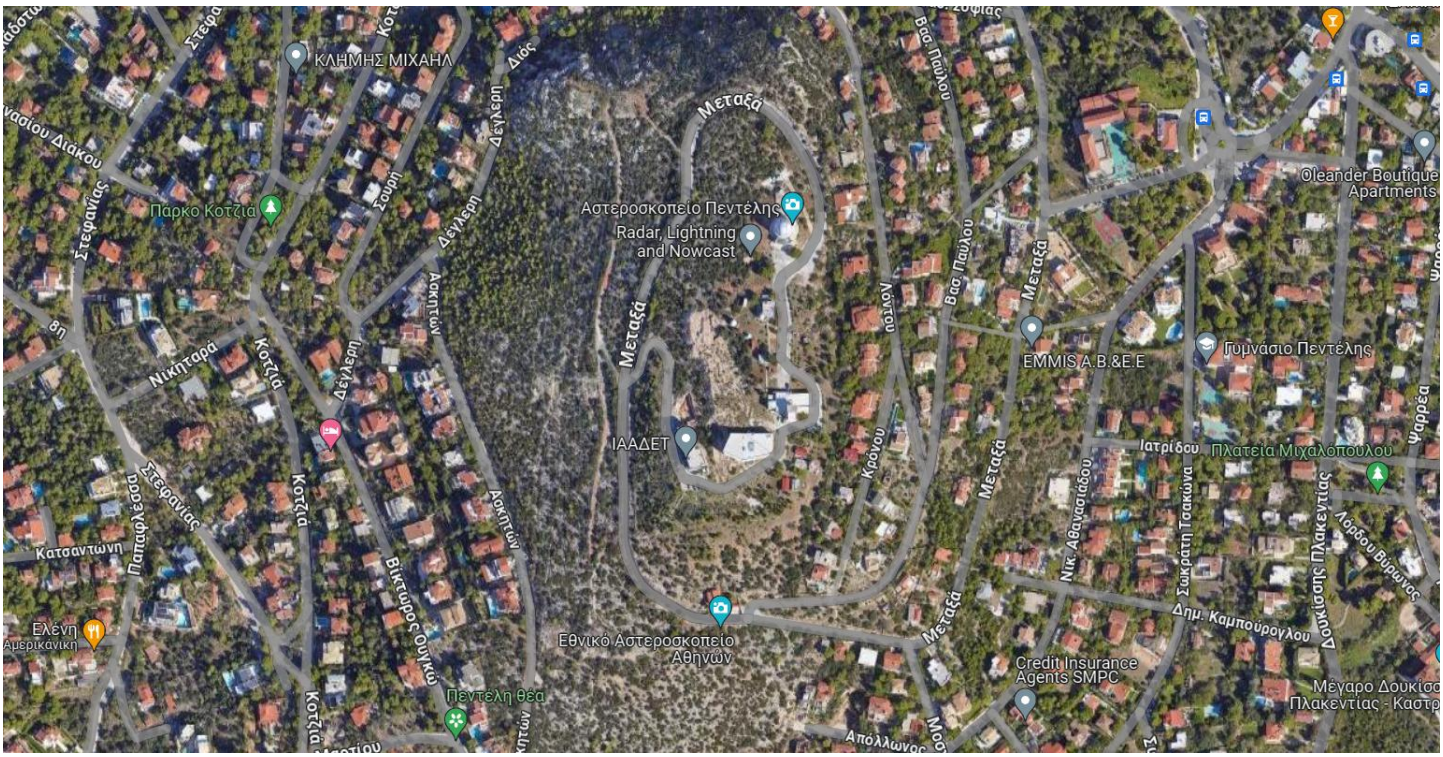
External funding from competitive grants awarded to IAASARS researchers (2013-2024). Each bar indicates the running funding for each year.



Distribution of external funding in 2024 from various funding schemes.

CONTACT

IAASARS is located on the grounds of the National Observatory of Athens in Penteli, about 19 km northeast of the historical building of the Observatory at the center of Athens. The following map indicates the Institute's building location as well as the location of the Visitor Center.



Vas. Pavlou & I. Metaxa, GR-15 236 Penteli, Greece

+30 2103490150

as_sec@noa.gr

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