ANNUAL REPORT

INSTITUTE FOR ASTRONOMY
ASTROPHYSICS SPACE APPLICATIONS
& REMOTE SENSING

2022

IAASARS Evaluation Report 2022

Executive Summary

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.

Scientific mission and disciplines

IAASARS mission 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 (3) 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 Physics and Ionospheric Physics, and (iii) Remote Sensing and Machine Learning for Signal/Image Processing.

Staff

Each discipline is supported by the scientific and technical staff who are responsible for boosting cutting-edge research as well as scientific and technological excellence. At the end of 2022 the permanent staff of the institute consisted of the Director, 28 researchers, 1 secretary and 4 research support specialists. Moreover, 33 postdoctoral researchers, 30 PhD students, and 48 research associates were on contract, making IAASARS the largest institute in its field in Greece.

Infrastructure

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 remote

sensing part of the PANGEA climate observatory of Antikythera; (e) the HellENIc GeoMagnetic Array – ENIGMA.

Excellence

In 2022, IAASARS researchers have published 132 articles in high-impact ISI journals, receiving ~8,500 citations, and attracted a total funding of ~7.6M€ from competitive European and national research grants. The excellence of the Institute is further demonstrated by the three European Research Council (ERC) Grants that are currently running, the ASSESS project for the Astronomy & Astrophysics Group and the other two, the ERC Consolidator Grant D-TECT and the ERC Proof of Concept project PM-Scanner, to the ReaCT team of the Remote Sensing Group. On top of that, IAASARS BEYOND Unit of Earth Observation Research and Satellite Remote Sensing - as the leader organization of a European consortium - received an exceptional honor: the First European Innovation Council (EIC) Horizon PRIZE for EPIDEMICS - EarlY WArning System for Mosquito borne diseases (EYWA). In the context of PANGEA, IAASARS has received competitive funding from the HORIZON-WIDERA-2021-ACCESS-03 program for the implementation of the PANGEA4CalVal project. In this ambitious project, IAASARS aims to enhance PANGEA with new knowledge, research, and tools, to create a center for satellite Calibration and Validation (Cal/Val) in the Mediterranean Region.
Additionally, IAASARS hosted 2 Marie Curie and 5 HFRI (ELIDEK) fellowships.

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. IAASARS well established experience in areas of SSA is confirmed by a recently awarded grant (~11M€) from the European Recovery Fund. This grant, which is a fraction of the total grand of NOA-AEGIS project (47M€), will be used to build new modern facilities in Kryoneri Observatory devoted to satellite and space debris tracking as well as Near Earth Objects (NEO) detection and tracking.

Helmos Observatory (Aristarchos telescope) of the National Observatory of Athens was selected in August 2020 to become the first ground station of the ScyLight program of ESA. With the completion of the relevant works, Helmos Observatory will be a key element in the new generation of networks in Europe. Specifically, the ARTES ScyLight program envisages the upgrade of satellite systems and the construction of ground stations in selected locations, in order to create a “fiber optic network in the sky”. In November 2021 the first successful optical communication link between

Aristarchos telescope and Alphasat took place paving the way for regular optical down link activities as well as deep space and quantum communication services. In 2022 the HOTSPOT Project, funded by ESA, started aiming to identify all possible activities that can be carried out at Helmos observatory concerning optical, quantum, and deep space communications. Finally, Helmos Observatory is an Optical Ground Station (OGS) to be used in the Hellas Quantum Communication Infrastructure network (HellasQCI), part of the EuroQCI initiative. The aforementioned activities are expected to promote Greece to a major player in Optical and Quantum Communications, Space Security and Awareness in Europe.

Technology and innovation

IAASARS is active in converting basic and applied research into services and technological developments, connecting the research outcomes with entrepreneurship and the Greek industry. Within the evaluation period, IAASARS has provided know-how to the Greek industry for developing sophisticated surface-based and airborne remote sensors, including prototypes such as advanced ground-based polarization lidar systems for atmospheric research (WALL-E, EVE, EMORAL systems). Moreover, IAASARS has been designing and developing instrumentation for astronomical observations, such as wide-field imaging cameras (e.g. MAWFC, AWFC) and spectrographs (ATS). Researchers of the Institute are members of the consortium that develops and tests the Wide-Field Imager detector for the ATHENA mission. ATHENA is an ESA L-class X-ray Astronomy mission that will be launched in 2028.

Services to the State and the public

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. This mission of IAASARS is fulfilled by the BEYOND operational unit and several research teams that introduced new perspectives on space-based information and provided authoritative services by mapping needs of users, making the most of the data, support decision-making and addressing priorities of stakeholders in the following domains: Agriculture, Disasters, Climate, Energy, Epidemics. As in its vision IAASARS has established and maintained a European Excellence Centre for cutting edge remote sensing science and for developing operational applications based on mature research outputs. Another flagship initiative of NOA is the establishment of the “PANhellenic GEophysical observatory of Antikythera (PANGEA)”. Starting from 2018, IAASARS put a tremendous effort to establish, operate and maintain the Remote Sensing Facility of NOA's PANGEA Climate Observatory at the island of Antikythera. The station has already collected a 3-year dataset of atmospheric variables representative of the wider Mediterranean area, providing vital information for climate research. The first IAASARS facility of PANGEA (a sophisticated aerosol lidar and a NASA-AERONET), is systematically calibrated and qualified according to the standards of the ACTRIS Pan-European Research Infrastructure, providing real-time in-situ data streams to the CAMS

service of Copernicus and Cal/Val datasets to ESA and EUMETSAT for several EO missions. IAASARS has the major contribution to PANGEA through the operation of the remote sensing facilities. Furthermore, IAASARS is providing continuously and in real-time, innovative standardized and validated services to the ESA SSA Programme for the Space Weather System of Federated Services, through the European Ionosonde Service that is supported from the DIAS system. Finally, 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, climate change, land use/ land cover and marine applications.

Outreach and Education

The Institute has a solid record of nearly 20 years of a public outreach and science education program. This includes special seminars, talks, and observations with the historic telescopes of the Institute. In 2022, the Visitor Centers of IAASARS in Penteli and Thissio attracted more than 18.000 people and about 210 schools. In May 2021 IAASARS was awarded a two-year funding of 362K€ from the Operational Program for the Region of Peloponnese (NSRF/ESPA:2014-2020) in order to upgrade and use the infrastructures at Kryoneri Observatory for public outreach purposes. Furthermore in 2022 the master plan which will set the baseline for IAASARS to fulfill its strategic goal for the reconstruction of the Kryoneri astronomical station aiming to transform it into a public outreach center, was completed. This investment will be funded directly by the Perfecture of Peloponnese, where the total budget is estimated to ~4.3M€. 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.

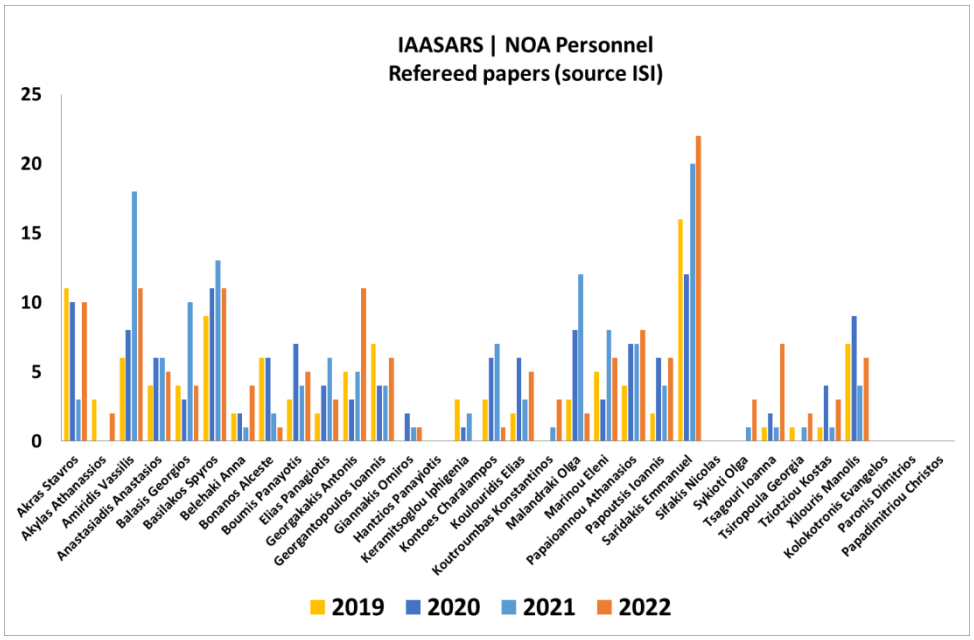
Performance metrics

(please also refer to the diagrams included in the Appendix)

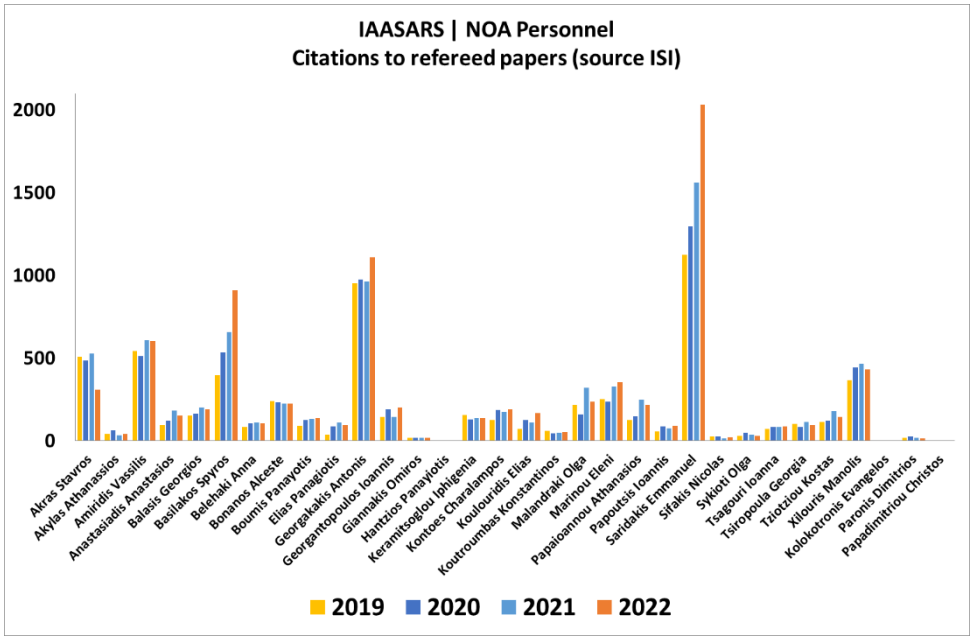
The scientific activity within 2022, resulted in more than 132 papers in refereed scientific journals with more than 8,500 citations. Moreover, the scientists of the Institute have been successful in attracting on average ~ 7.6 M€ from national and European competitive research grants. IAASARS, provided novel applied and basic research results, services and public outreach activities, supporting at the same time nearly 111 on contract positions (33 postdocs, 30 PhD students and 48 research associates) funded by external competitive frameworks.

APPENDIX

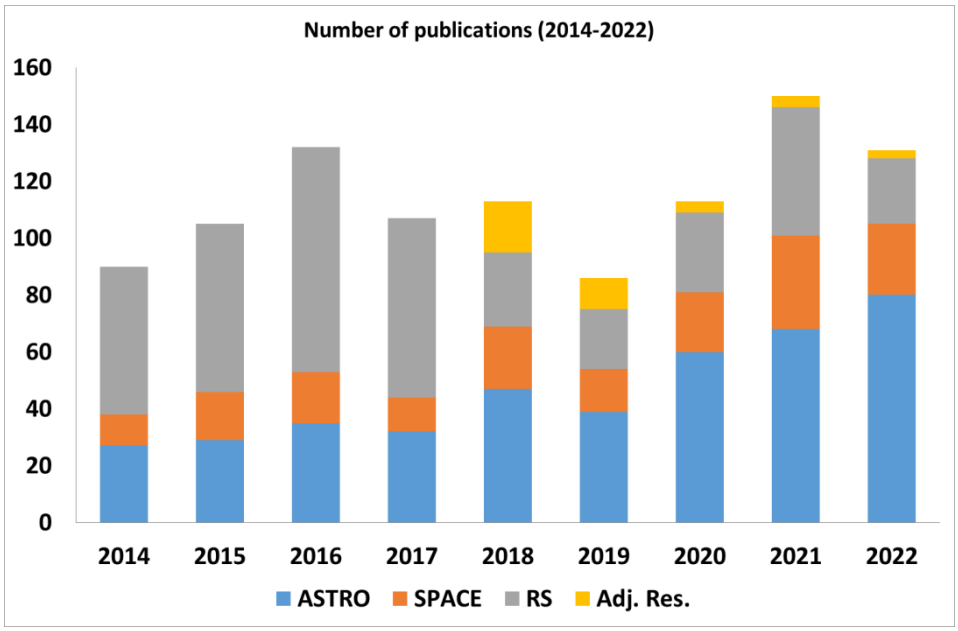
Diagrams of the IAASARS performance metrics



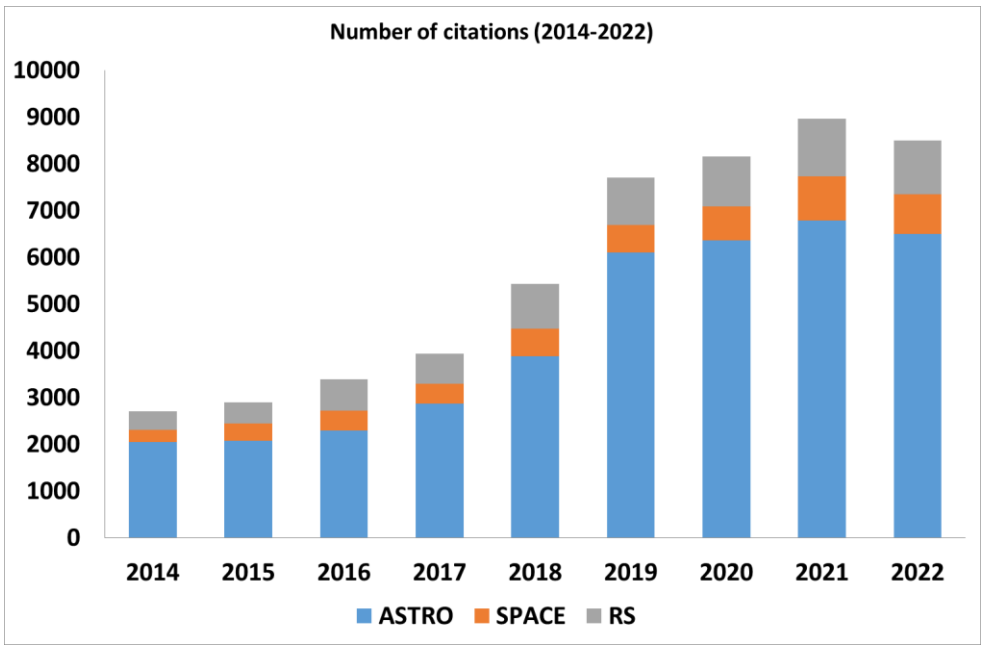
A histogram of the refereed papers published by the research personnel *(source ISI-Web of Science)*



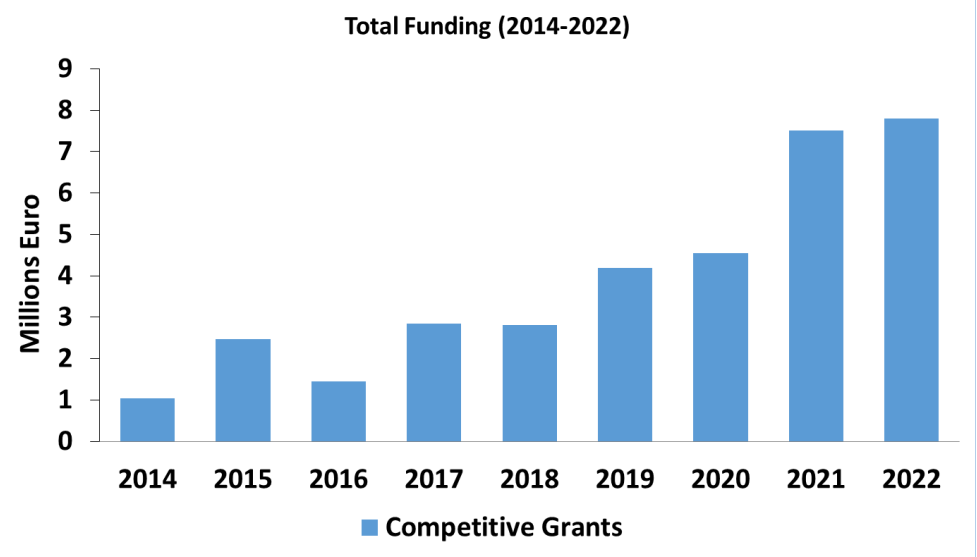
A histogram of the citations to refereed papers published by the research personnel *(source ISI-Web of Science)*



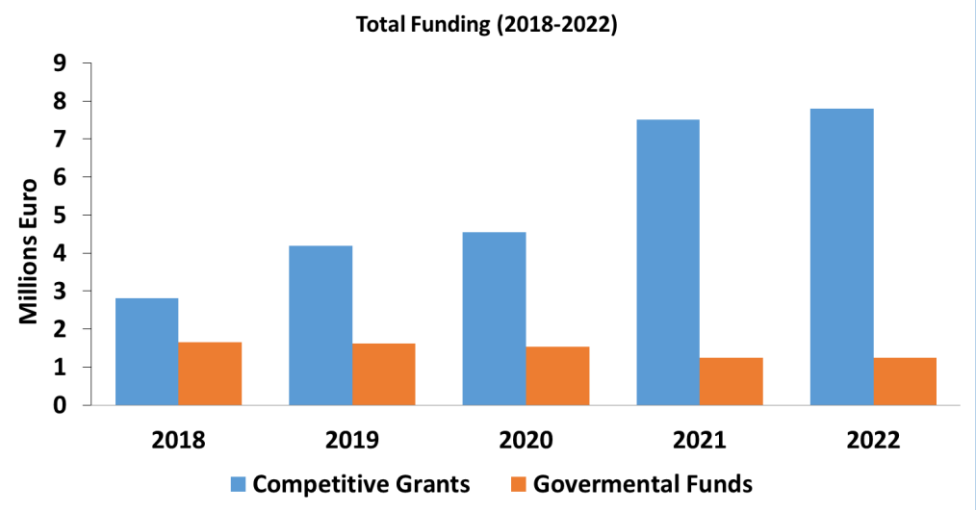
A histogram of the refereed papers per IAASARS discipline *(source ISI-Web of Science)*



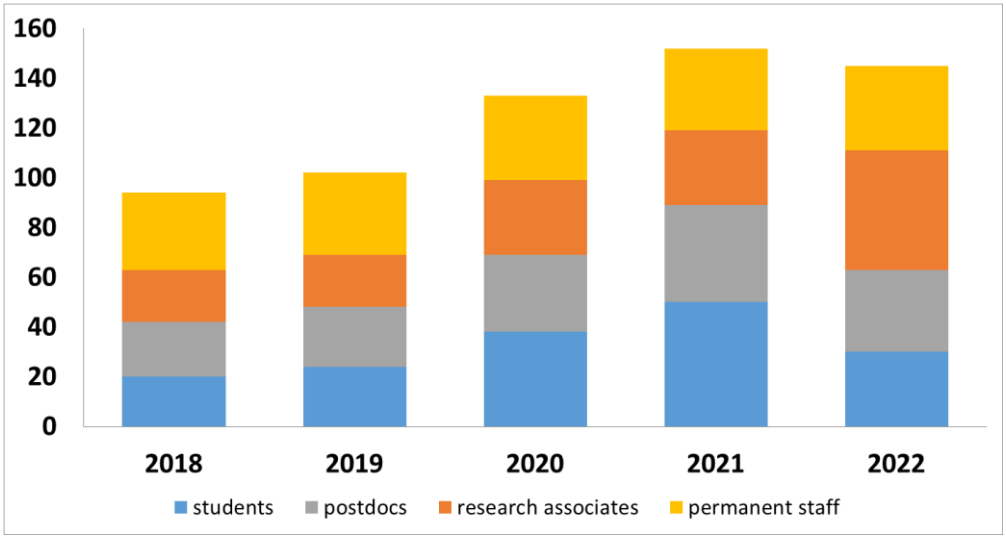
A histogram of the citations per IAASARS discipline *(source ISI-Web of Science)*



A histogram of the external funding from competitive grants awarded to researchers *(blue bars)* from 2014-2022



A histogram of the external funding from competitive grants awarded to researchers *(blue bars)* versus the incoming governmental funds (*orange bars*) from 2018-2022



A histogram of (on contract) PhD students, postdoctoral researchers and research associates of IAASARS per year together with the permanent staff.