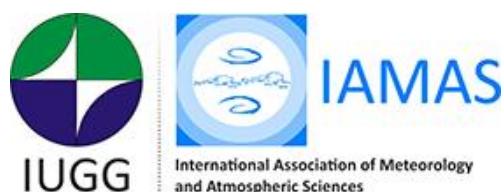


IAMAS REPORT



International Association of Meteorology and Atmospheric
Sciences (IAMAS)

ACTIVITIES IN GREECE FOR THE PERIOD 2019-2023

Edited by

Christos S. Zerefos
IAMAS National Correspondent

Contributions from:

- *Research Centre for Atmospheric Physics and Climatology, Academy of Athens*
- *Center for Environmental Effects on Health (CEEH) of the Biomedical Research Foundation of the Academy of Athens (BRFAA)*
- *Laboratory of Atmospheric Physics, Department of Physics, Aristotle University of Thessaloniki*
- *Department of Meteorology and Climatology, School of Geology, Aristotle University of Thessaloniki*
- *Dept. of Environmental Engineering, Demokritus University of Thrace*
- *Laboratory of Laser Remote Sensing of the Atmosphere, Dept. of Physics, National Technical University of Athens*
- *Laboratory of Atmospheric Physics – Department of Physics – University of Patras*
- *Environmental Chemical Processes Laboratory (ECPL), University of Crete*
- *Institute for Environmental Research & Sustainable Development, National Observatory of Athens (IERSD-NOA)*
- *Laboratory of Climatology and Atmospheric Environment (LACAE) of the National and Kapodistrian University of Athens (NKUA)*

Athens, July 2023

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FOREWORD

This report was prepared as part of the national report of the Committee of Geodesy and Geophysics of Greece, on the occasion of the 28th General Assembly of the International Union of Geodesy and Geophysics (IUGG) which will be held in Berlin, Germany, July 11-20, 2023.

The content of the report is divided in eleven sections with each section being entitled with the name of the corresponding university institute or agency. The contribution of each institute is reported based on the material they provided along with the respective list of literature. An attempt was made to slightly homogenize the material provided by the respective contributors. Therefore, the text and, in general, the style of each sub-report, have been maintained in the subsequent sections.

I take the opportunity to express my sincere thanks to all colleagues working at University Departments, Research Institutions and National Agencies in Greece for their contributions, extensive lists of publications and for providing their activities for the compilation of this report.

Athens, July 2023

Prof. Christos S. Zerefos
Academy of Athens

Research Centre for Atmospheric Physics and Climatology, Academy of Athens

Participation in national networks

“Panhellenic infrastructure for atmospheric composition and climate change (PANACEA)”, Ministry of Economy and Development (Operational Programme Competitiveness, Entrepreneurship and Innovation – EPAnEK 2014-2020), Coordinator N. Michalopoulos, University of Crete, 2018-2021 (<http://panacea-ri.gr/>).

Participation in International networks

“A European Brewer Network (EUBREWNET)”, Cost Action ES1207, Coordinator J. Rimmer, Univ. of Manchester, UK, 2013–2017 (<http://www.eubrewnet.org/cost1207/>).

Coordination Unit on the Follow-up of the Greek Initiative on Climate Change impacts on Cultural & Natural Heritage

The Center has undertaken the scientific support of the Coordinating Working Group of Greece's international initiative for the protection of cultural heritage and natural monuments from the effects of climate change following a relevant proposal by the Supervisor of the Center Prof. C. Zerefos to the Greek Government (2019) for the creation of a flexible international mechanism for the protection of natural and cultural heritage monuments from climate change, which has been included in the flagship activities of the UN by the UN Secretary General, Antonio Guterres. This initiative has been supported by more than 100 countries, UNESCO, the World Meteorological Organization and NGOs such as ICOMOS and Europa Nostra as well as the Hellenic Geo-observation Office. This initiative has attracted international attention and several workshops and conferences have been organized on this topic (<https://ccich.gr/>).

UN SDSN Global Climate Hub

Following a joint proposal by professors Jeff Sachs (President of the UN Sustainable Development Solutions Network-SDSN), Phoebe Kountouri (Athens University of Economics & Research Center), Yannis Ioannidis (Athens Research Center) and the Supervisor of the Center Christos Zerefos, as co-directors, the establishment of the UN SDSN Global Climate Hub was launched in May 2022. This initiative was based on the need for governments around the world to take immediate decisive action to reduce the effects of climate change. The aim is to provide scientific advice to combat the worsening climate crisis and prevent further deterioration. The Climate Hub will use all the data, knowledge and technologies provided by experts in various fields to implement country action plans that will be endorsed and strengthened by society (<https://unsdsn.globalclimatehub.org/>).

Field measurements

Ozone and ultraviolet radiation measurements at the Biomedical Research Foundation of the Academy of Athens (continuously operational since 06.2003), listed at <http://www.uvnet.gr/> and <http://www.bioacademy.gr/lab/zerefos>.

Indicative funding

- “EuroGEOSS Showcases: Applications Powered by Europe-EuroGEOSS” Horizon 2020 Project, Coordinator Mathieu Reboul, 2019-2023
- “Boosting the implementation of adaptation policy across Greece: LIFE-IP Adapt-InGR”, LIFE project, 2018-2025.
- “Strengthening Education, Research and Innovation For Climate Smart Crops In India-AdaptNET”, ERASMUS+, Coordinator A. Voloudakis, 2019-2022
- “International network for harmonization of atmospheric aerosol retrievals from ground-based photometers – HARMONIA”, COST, 2022-2024
- “Determination of Agrometeorological Parameters in Messinia – AGROME”, Department of Physical Geography, University of Stockholm, 2021-2023
- “Sustainable Approaches to LAnd and water Management in Mediterranean Drylands – SALAM-MED”, EU PRIMA, 2022-2025
- “Copernicus Atmosphere Monitoring Service CAMS2_82: Evaluation and quality control (EQA) of Global products”, EU, ECMWF, Coordinator Henk Eskes, 2022-2025

Indicative publications

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Center for Environmental Effects on Health (CEEH) of the Biomedical Research Foundation of the Academy of Athens (BRFAA)

Purpose and activities

The Center for Environmental Effects on Health (CEEH) of the Biomedical Research Foundation of the Academy of Athens (BRFAA) focuses on the continuous monitoring of the dangerous solar ultraviolet (UV) radiation, the total column of ozone and sulfur dioxide, as well as the measurements of gaseous components and meteorological parameters related to the environment and health. CEEH has a Brewer type spectrophotometer, pyranometers of total and ultraviolet solar radiation and a mobile Health-Environment unit with modern laser radar technology as well as instruments for the measurement of air pollution. All these instruments are used to monitor the structure and composition of the atmosphere, in collaboration with the National Technical University of Athens and the Navarino Environmental Observatory at Costa Navarino in collaboration with the University of Stockholm. CEEH has participated in a number of national and international activities, including the free offer of the erythemal doses of solar UV radiation to the Olympic athletes of ATHENS 2004, through the website www.uvnet.gr. The ozone and ultraviolet spectrophotometric station is part of the World Ozone and Ultraviolet Radiation Data Center of WMO.

Since the Center began its operation, its researchers have participated in a series of international competitive European research projects, including CANDIDOZ, QUOBI, SCOUT-O3, QUANTIFY, GEMS, CIRCE, GEOMON, AMFIC, MACC, DARECLIMED, MACC II and III, CAMS, GEO-CRADLE, SMURBS ERA-PLANET etc., as well as in national competitive research projects such as UVNET, ΠΕΝΕΔ 2003 (Research Capacity Building Program), ΕΔΗΕ (National Network for Solar Energy), PANACEA and CLIMPACT. CEEH has participated in the organization of important international conferences, including the Scientific Symposium marking the 20th anniversary of the Montreal Protocol for the protection of the ozone layer (co-organised with international organisations and the International Ozone Commission), featuring the participation of three Nobel laureates: P. Crutzen, S. Rowland, and M. Molina.

In December 2009, a trilateral Agreement was signed between BRFAA, the Bert Bolin Center of Stockholm University and the development company of Costa Navarino, TEMES S.A., in order to create an Observatory of climatic and environmental changes in the area of Costa Navarino of Messinia, under the name Navarino Environmental Observatory (N.E.O.). The activities of the Observatory focus on research on Climate Change and its impact on the natural environment and human activities in the Mediterranean area.

Participation in experimental field campaigns (2019-2022)

- a. Participation in the PANACEA experiment (July 2019) – Volos – Prefecture of Magnesia
- b. Participation in the PANACEA experiment (January-February 2020) – Ioannina – Prefecture of Ioannina (period of COVID-19)
- c. Participation in the PANACEA experiment (October-November 2021) – Mount Helmos – Prefecture of Achaia
- d. Participation in the ASPIRE experimental campaign (December 2020 – November 2021) – Athens – Prefecture of Attica

3. Measurements of the quality of the atmospheric environment (2019-2022)

- a. Long-term measurements of the ozone layer in Athens, Greece
- b. Measurements of sulfur dioxide and aerosol optical depth in Athens during the wildfires of August 2021
- c. Measurements of ozone and carbon monoxide at the N.E.O.

The researchers of CEEH of BRFAA analysed the atmospheric concentrations of ozone (O₃) and carbon monoxide (CO) in Messinia, from the measurements of the N.E.O. station which has been operating in Methoni since 2016. The station is part of the PANACEA national research infrastructure, and its aim is to monitor on a long-term basis the concentrations of basic suspended particles and air pollutants, in order to understand the factors determining the levels and variability of pollution in remote areas. The measurements of air pollutants were compared to the corresponding measurements of Finokalia station in Crete. The correlation coefficient between the daily values of O₃ in Methoni and Finokalia is approximately +0.6. A similar correlation was also found for CO. The scientific results were presented at the 2nd scientific conference of PANACEA, which was held online between September 29 and October 1, 2020.

- d. Educational activities at the N.E.O.

The 3rd educational Workshop of the AdaptNET project on the impact of climate change on agriculture was held at the Costa Navarino, Messinia, from February 3 to February 8, 2020. The AdaptNET project (Strengthening education, research and innovation for climate smart crops in India) is an ERASMUS+ CAPACITY BUILDING project funded by the European Commission. The Workshop was attended by 29 Indian teachers/scientists as well as 15 postgraduate students from Greece. The training was organized by Dr. Ioannis Kapsomenakis and Dr. Dimitris Voloudakis.

Indicative publications (2019-2022)

1. Dimitriadou, L., Nastos, P., Eleftheratos, K., Kapsomenakis, J., and Zerefos, C.: Mortality related to air temperature in European cities, based on threshold regression models, *International Journal of Environmental Research and Public Health*, 19, 4017, <https://doi.org/10.3390/ijerph19074017>, 2022.
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6. Eleftheratos, K., Kapsomenakis, J., Zerefos, C. S., Bais, A. F., Fountoulakis, I., Dameris, M., Jöckel, P., Haslerud, A. S., Godin-Beekmann, S., Steinbrecht, W., Petropavlovskikh, I., Brogniez, C., Leblanc, T., Liley, J. B., Querel R., and Swart, D. P. J.: Possible Effects of Greenhouse Gases to Ozone Profiles and DNA Active UV-B Irradiance at Ground Level, *Atmosphere*, 11, 228, [doi:10.3390/atmos11030228](https://doi.org/10.3390/atmos11030228), 2020.
7. Eleftheratos, K., Zerefos, C. S., Balis, D. S., Koukouli, M.-E., Kapsomenakis, J., Loyola, D. G., Valks, P., Coldewey-Egbers, M., Lerot, C., Frith, S. M., Haslerud, A. S., Isaksen, I. S. A., and Hassinen, S.: The use of QBO, ENSO and NAO perturbations in the evaluation of GOME-2 MetOp A total ozone measurements, *Atmospheric Measurement Techniques*, 12, 987–1011, <https://doi.org/10.5194/amt-12-987-2019>, 2019

Laboratory of Atmospheric Physics, Department of Physics Aristotle University of Thessaloniki

Participation in national networks

Panhellenic infrastructure for atmospheric composition and climate change (PANACEA), Ministry of Economy and Development (Operational Programme Competitiveness, Entrepreneurship and Innovation - EPAnEK), 10.2018-9.2021.
<http://panacea-ri.gr/>

National Network for Climate Change and its impact (CLIMPACT),
<https://climpact.gr/main/>

Participation in International networks

UV-visible (DOAS, max-DOAS) measurements at Thessaloniki, Greece accepted as affiliated contributor to the Network for the Detection of Atmospheric Composition Change (NDACC), December 2021, <https://ndacc.larc.nasa.gov/stations/thessaloniki-auth-greece>

European Aerosol Research Lidar Network, European Research Infrastructure for the observation of Aerosol, Clouds and Trace Gases
https://www.earlinet.org/index.php?id=earlinet_homepage

Aerosol Robotic Network (AERONET), <https://aeronet.gsfc.nasa.gov/>

United Nations Environment Programme (UNEP), Environmental Effects Assessment Panel (EEAP) of Ozone Depletion, UV Radiation, and Interactions with Climate Change, <https://ozone.unep.org/science/assessment/eeap>

Field measurements

14th RBCCE Intercomparison Campaign “El Arenosillo” Atmospheric Sounding Station, INTA, 17-28 June 2019

16th RBCCE Intercomparison Campaign “El Arenosillo” Atmospheric Sounding Station, INTA, 6 – 16 September 2021

TROLIX'19 (TROPOMI Validation Experiment), Cabauw, The Netherlands, 26 August – 30 September 2019.

Table 1. Current National and International Funded Research Projects

Project title	Funding agency	Start date	End date	Budget
NATIONAL NETWORK ON CLIMATE CHANGE AND ITS IMPACTS	GSRI, National Funding, 2014-2020	17/10/2019	28/2/2023	248.520,00
A STUDY OF ALERGENIC POLLEN IN THE ATMOSPHERE	ΕΣΠΑ 2014-2020	30/12/2019	22/08/2022	37.037,00
A SYSTEM FOR INTEGRATED ENVIRONMENTAL INFORMATION IN URBAN AREAS	EU PROGRAMMES 2021-2027, PROGRAMME FOR ENVIRONMENT AND CLIMATE ACTION (LIFE)	1/8/2022	31/7/2025	246.528,00
SUPPORT OF THE UPGRADE OF THE NATIONAL NETWORK ON CLIMATE CHANGE AND ITS IMPACTS (CLIMPACT)	National Funding, 2021-2027	16/03/2023	31/12/2025	225.500,00
EUMETSAT Satellite Application Facility on Atmospheric Composition (Third Continuous Development and Operations Phase).	EUMETSAT	01/03/2017	28/02/2022	308.583,00
EUMETSAT Satellite Application Facility on Atmospheric Composition (Fourth Continuous Development and Operations Phase).	EUMETSAT	01/03/2012	28/02/2027	354.163,00
Mission Performance Centre of S5P/TROPOMI	ESA	1/12/2018	31/12/2021	113.055,00
Panhellenic infrastructure for atmospheric composition and	ΕΣΠΑ 2014-2020	1/11/2018	31/10/2021	700.000,00

climate change.				
Mission Performance Cluster (Mpc) Service For The Copernicus Sentinel-5p Atmospheric Mission (Atm-Mpc Service)	ESA	1//4/2022	31/3/2027	111.056,00
Quality assurance for earth observation - phase 2	ESA	1/5/2022	31/12/2025	50.000,00
Fiducial Reference Measurements for Ground-Based DOAS Air-Quality Observations 2.0	EUROPEAN SPACE AGENCY (ESA) INITIATIVES	15/9/2021	15/9/2025	27.340,00

Table 2. Selected publications by members of the Laboratory of Atmospheric Physics, Aristotle University of Thessaloniki, Greece, for the previous five years [2019-2022] sorted by first author.

First Author	Title	Year	Journal	DOI
Barnes	Environmental effects of stratospheric ozone depletion, UV radiation, and interactions with climate change: UNEP Environmental Effects Assessment Panel, Update 2021	2022	Photochemical and Photobiological Sciences	10.1007/s43630-022-00176-5
Eleftheratos	Ozone, DNA-active UV radiation, and cloud changes for the near-global mean and at high latitudes due to enhanced greenhouse gas concentrations	2022	Atmospheric Chemistry and Physics	10.5194/acp-22-12827-2022
Georgoulas	Climate change projections for Greece in the 21st century from high-resolution EURO-CORDEX RCM simulations	2022	Atmospheric Research	10.1016/j.atmosres.2022.106049
Giechaskiel	Revisiting Total Particle Number Measurements for Vehicle Exhaust Regulations	2022	Atmosphere-Basel	10.3390/Atmos13020155
Godin-Beekmann	Updated trends of the stratospheric ozone vertical distribution in the 60 degrees S-60 degrees N latitude range based on the LOTUS regression model	2022	Atmospheric Chemistry and Physics	10.5194/acp-22-11657-2022
Inness	Evaluating the assimilation of S5P/TROPOMI near real-time SO ₂ columns and layer height data into the CAMS integrated forecasting system (CY47R1), based on a case study of the 2019 Raikoke eruption	2022	Geoscientific Model Development	10.5194/gmd-15-971-2022
Karagkiozidis	Retrieval of tropospheric aerosol, NO ₂ , and HCHO	2022	Atmospheric Measurement	10.5194/amt-15-1269-2022

	vertical profiles from MAX-DOAS observations over Thessaloniki, Greece: intercomparison and validation of two inversion algorithms		Techniques	
Kontos	High resolution modeling of Quercus pollen with an Eulerian modeling system: A case study in Greece	2022	Atmospheric Environment	10.1016/j.atmosenv.2021.118816
Koukouli	Volcanic SO ₂ layer height by TROPOMI/SSP: evaluation against IASI/MetOp and CALIOP/CALIPSO observations	2022	Atmospheric Chemistry and Physics	10.5194/acp-22-5665-2022
Koukouli	Air Quality in Two Northern Greek Cities Revealed by Their Tropospheric NO ₂ Levels	2022	Atmosphere-Basel	10.3390/Atmos13050840
Liora	"On-Line" Heating Emissions Based on WRF Meteorology-Application and Evaluation of a Modeling System over Greece	2022	Atmosphere-Basel	10.3390/Atmos13040568
Logothetis	The Southeast Asian monsoon and El Nino-Southern Oscillation impact on the summer atmospheric circulation of East Mediterranean during 20th century based on ERA-20C and CMIP5 simulations	2022	International Journal of Climatology	10.1002/joc.7510
Mavromatis	Spatiotemporal Evolution of Seasonal Crop-Specific Climatic Indices under Climate Change in Greece Based on EURO-CORDEX RCM Simulations	2022	Sustainability	10.3390/Su142417048
Parliari	Short-Term Effects of Apparent Temperature on Cause-Specific Mortality in the Urban Area of Thessaloniki, Greece	2022	Atmosphere-Basel	10.3390/Atmos13060852
Paschou	The eVe reference polarisation lidar system	2022	Atmospheric Measurement	10.5194/amt-15-2299-2022

	for the calibration and validation of the Aeolus L2A product		Techniques	
Pseftogkas	Comparison of S5P/TROPOMI Inferred NO ₂ Surface Concentrations with In Situ Measurements over Central Europe	2022	Remote Sensing	10.3390/Rs14194886
Rizos	The influence of the summer tropospheric circulation on the observed ozone mixing ratios at a coastal site in the Eastern Mediterranean	2022	Atmospheric Pollution Research	10.1016/J.Apr.2022.101381
Rizos	Determination of the background pollution in the Eastern Mediterranean applying a statistical clustering technique	2022	Atmospheric Environment	10.1016/j.atmosenv.2022.119067
Samaras	Perspectives for regulating 10 nm particle number emissions based on novel measurement methodologies	2022	Journal of Aerosol Science	10.1016/j.jaerosci.2022.105957
Voudouri	Evaluation of Aerosol Typing with Combination of Remote Sensing Techniques with In Situ Data during the PANACEA Campaigns in Thessaloniki Station, Greece	2022	Remote Sensing	10.3390/Rs14205076
Weber	Global total ozone recovery trends attributed to ozone-depleting substance (ODS) changes derived from five merged ozone datasets	2022	Atmospheric Chemistry and Physics	10.5194/acp-22-6843-2022
Alexandri	Effect of Aerosols, Tropospheric NO ₂ and Clouds on Surface Solar Radiation over the Eastern Mediterranean (Greece)	2021	Remote Sensing	10.3390/Rs13132587
Barnes	The success of the Montreal Protocol in	2021	Global Change	10.1111/gcb.15841

	mitigating interactive effects of stratospheric ozone depletion and climate change on the environment		Biology	
Chalvatzaki	Personal deposited dose and its influencing factors at several Greek sites: an analysis in respect to seasonal and diurnal variations	2021	Environmental Science and Pollution Research	10.1007/s11356-021-12815-y
Chatzimpaloglou	Photolytic and photocatalytic degradation of antineoplastic drug irinotecan. Kinetic study, identification of transformation products and toxicity evaluation.	2021	Chemical Engineering Journal	10.1016/j.cej.2020.126866
De Smedt	Comparative assessment of TROPOMI and OMI formaldehyde observations and validation against MAX-DOAS network column measurements	2021	Atmospheric Chemistry and Physics	10.5194/acp-21-12561-2021
Giechaskiel	Particle Number Emissions of a Euro 6d-Temp Gasoline Vehicle under Extreme Temperatures and Driving Conditions	2021	Catalysts	10.3390/Catal11050607
Giechaskiel	Effect of Extreme Temperatures and Driving Conditions on Gaseous Pollutants of a Euro 6d-Temp Gasoline Vehicle	2021	Atmosphere-Basel	10.3390/Atmos12081011
Karras	Investigating the Role of Functional Polymorphism of Maternal and Neonatal Vitamin D Binding Protein in the Context of 25-Hydroxyvitamin D Cutoffs as Determinants of Maternal-Neonatal Vitamin D Status Profiles in a Sunny Mediterranean Region	2021	Nutrients	10.3390/Nu13093082

Karras	Vitamin D equilibrium affects sex-specific changes in lipid concentrations during Christian Orthodox fasting	2021	The Journal of Steroid Biochemistry and Molecular Biology	10.1016/j.jsbmb.2021.105903
Keppas	Future Climate Change Impact on Urban Heat Island in Two Mediterranean Cities Based on High-Resolution Regional Climate Simulations	2021	Atmosphere-Basel	10.3390/Atmos12070884
Kontos	Towards a regional dust modeling system in the central Middle East: Evaluation, uncertainties and recommendations (vol 246, 118160, 2021)	2021	Atmospheric Environment	10.1016/j.atmosenv.2021.118368
Kosmopoulos	Real-time UV index retrieval in Europe using Earth observation-based techniques: system description and quality assessment	2021	Atmospheric Measurement Techniques	10.5194/amt-14-5657-2021
Koukouli	Sudden changes in nitrogen dioxide emissions over Greece due to lockdown after the outbreak of COVID-19	2021	Atmospheric Chemistry and Physics	10.5194/acp-21-1759-2021
Liora	Estimating Road Transport Pollutant Emissions Under Traffic-Congested Conditions with an Integrated Modelling Tool-Emissions Reduction Scenarios Analysis	2021	Emission Control Science and Technology	10.1007/s40825-021-00191-5
Liu	An improved TROPOMI tropospheric NO ₂ research product over Europe	2021	Atmospheric Measurement Techniques	10.5194/amt-14-7297-2021
Mermigkas	FTIR Measurements of Greenhouse Gases over Thessaloniki, Greece in the Framework of COCCON and Comparison with S5P/TROPOMI Observations	2021	Remote Sensing	10.3390/Rs13173395

Michailidis	First validation of GOME-2/MetOp absorbing aerosol height using EARLINET lidar observations	2021	Atmospheric Chemistry and Physics	10.5194/acp-21-3193-2021
Neale	Environmental effects of stratospheric ozone depletion, UV radiation, and interactions with climate change: UNEP Environmental Effects Assessment Panel, Update 2020	2021	Photochemical and Photobiological Sciences	10.1007/s43630-020-00001-x
Pseftogkas	Pseftogkas, A. A New Separation Methodology for the Maritime Sector Emissions over the Mediterranean and Black Sea Regions	2021	Atmosphere-Basel	10.3390/Atmos12111478
Robson	Robson, T. M. Floral bullseyes and stratospheric ozone	2021	Current Biology	10.1016/j.cub.2021.06.019
Skoulidou	Evaluation of the LOTOS-EUROS NO ₂ simulations using ground-based measurements and S5P/TROPOMI observations over Greece	2021	Atmospheric Chemistry and Physics	10.5194/acp-21-5269-2021
Skoulidou	Changes in Power Plant NO _x Emissions over Northwest Greece Using a Data Assimilation Technique	2021	Atmosphere-Basel	10.3390/Atmos12070900
Solomou	Analog ensemble technique to post-process WRF-CAMx ozone and particulate matter forecasts	2021	Atmospheric Environment	10.1016/j.atmosenv.2021.118439
Tigkiropoulos	Thirty-Day Results of the Novel CGuard-Covered Stent in Patients Undergoing Carotid Artery Stenting	2021	Journal of Endovascular Therapy	10.1177/15266028211007466
Tirpitz	Intercomparison of MAX-DOAS vertical profile retrieval algorithms: studies on field data from	2021	Atmospheric Measurement Techniques	10.5194/amt-14-1-2021

	the CINDI-2 campaign			
Verhoelst	Ground-based validation of the Copernicus Sentinel-5P TROPOMI NO ₂ measurements with the NDACC ZSL-DOAS, MAX-DOAS and Pandonia global networks	2021	Atmospheric Measurement Techniques	10.5194/amt-14-481-2021
Adam	Biomass burning events measured by lidars in EARLINET - Part 1: Data analysis methodology	2020	Atmospheric Chemistry and Physics	10.5194/acp-20-13905-2020
Ades	Global Climate	2020	Bulletin of the American Meteorological Society	
Bernhard	Environmental effects of stratospheric ozone depletion, UV radiation and interactions with climate change: UNEP Environmental Effects Assessment Panel, update 2019	2020	Photochemical and Photobiological Sciences	10.1039/D0PP90011G
Chervenkov	Degree-Day Climatology over Central and Southeast Europe for the Period 1961-2018 - Evaluation in High Resolution	2020	Cybernetics and Information Technologies	10.2478/cait-2020-0070
Compernelle	Validation of Aura-OMI QA4ECV NO ₂ climate data records with ground-based DOAS networks: the role of measurement and comparison uncertainties	2020	Atmospheric Chemistry and Physics	10.5194/acp-20-8017-2020
Donner	Evaluating different methods for elevation calibration of MAX-DOAS (Multi AXis Differential Optical Absorption Spectroscopy) instruments during the CINDI-2 campaign	2020	Atmospheric Measurement Techniques	10.5194/amt-13-685-2020
Eleftheratos	Possible Effects of Greenhouse Gases to Ozone Profiles and DNA	2020	Atmosphere-Basel	10.3390/Atmos11030228

	Active UV-B Irradiance at Ground Level			
Fountoulakis	Fountoulakis, I. Solar UV Irradiance in a Changing Climate: Trends in Europe and the Significance of Spectral Monitoring in Italy	2020	Environments	10.3390/environments7010001
Georgoulas	A First Case Study of CCN Concentrations from Spaceborne Lidar Observations	2020	Remote Sensing	10.3390/Rs12101557
Gialitaki	Is the near-spherical shape the "new black" for smoke?	2020	Atmospheric Chemistry and Physics	10.5194/acp-20-14005-2020
Hülßen	Second solar ultraviolet radiometer comparison campaign UVC-II	2020	Metrologia	10.1088/1681-7575/ab74e5
Karras	Characterizing neonatal vitamin D deficiency in the modern era: A maternal-neonatal birth cohort from Southern Europe	2020	The Journal of Steroid Biochemistry and Molecular Biology	10.1016/j.jsbmb.2019.105555
Kreher	Intercomparison of NO ₂ , O ₄ , O ₃ and HCHO slant column measurements by MAX-DOAS and zenith-sky UV-visible spectrometers during CINDI-2	2020	Atmospheric Measurement Techniques	10.5194/amt-13-2169-2020
Lakkala	Validation of the TROPOspheric Monitoring Instrument (TROPOMI) surface UV radiation product	2020	Atmospheric Measurement Techniques	10.5194/amt-13-6999-2020
Logothetis	Etesians and the summer circulation over East Mediterranean in Coupled Model Intercomparison Project Phase 5 simulations: Connections to the Indian summer monsoon	2020	International Journal of Climatology	10.1002/joc.6259
Melas	Development and evaluation of a catalytic stripper for the measurement of solid	2020	Aerosol Science and Technology	10.1080/02786826.2020.1718061

	ultrafine particle emissions from internal combustion engines			
Papagiannopoulos	An EARLINET early warning system for atmospheric aerosol aviation hazards	2020	Atmospheric Chemistry and Physics	10.5194/acp-20-10775-2020
Paschou	The effect of considering polar vortex dynamics in the validation of satellite total ozone observations	2020	Atmospheric Research	10.1016/j.atmosres.2020.104870
Pinardi	Validation of tropospheric NO ₂ column measurements of GOME-2A and OMI using MAX-DOAS and direct sun network observations	2020	Atmospheric Measurement Techniques	10.5194/amt-13-6141-2020
Siomos	Automated Aerosol Classification from Spectral UV Measurements Using Machine Learning Clustering	2020	Remote Sensing	10.3390/rs12060965
Vitt	UV-index climatology for Europe based on satellite data	2020	Atmosphere-Basel	10.3390/atmos11070727
Voudouri	Variability in cirrus cloud properties using a Polly(XT) Raman lidar over high and tropical latitudes	2020	Atmospheric Chemistry and Physics	10.5194/acp-20-4427-2020
Voudouri	Consistency of the Single Calculus Chain Optical Products with Archived Measurements from an EARLINET Lidar Station	2020	Remote Sensing	10.3390/Rs12233969
Wang	Inter-comparison of MAX-DOAS measurements of tropospheric HONO slant column densities and vertical profiles during the CINDI-2 campaign	2020	Atmospheric Measurement Techniques	10.5194/amt-13-5087-2020
Zerefos	The Role of Weather during the Greek-Persian "Naval Battle of Salamis" in 480 BC	2020	Atmosphere-Basel	10.3390/Atmos11080838
Bais	Ozone–climate	2019	Photochemical and	10.1039/C8PP90059K

	interactions and effects on solar ultraviolet radiation		Photobiological Sciences	
Barnes	Ozone depletion, ultraviolet radiation, climate change and prospects for a sustainable future	2019	Nature Sustainability	10.1038/s41893-019-0314-2
Ciardini	Interconnections of the urban heat island with the spatial and temporal micrometeorological variability in Rome	2019	Urban Climate	10.1016/J.Uclim.2019.100493
Drossinos	Morphology-dependent random binary fragmentation of in silico fractal-like agglomerates	2019	EPL	10.1209/0295-5075/127/46002
Eleftheratos	The use of QBO, ENSO, and NAO perturbations in the evaluation of GOME-2 MetOp A total ozone measurements	2019	Atmospheric Measurement Techniques	10.5194/amt-12-987-2019
Filioglou	Aerosol Effect on the Cloud Phase of Low-Level Clouds Over the Arctic	2019	Journal of Geophysical Research- Atmospheres	10.1029/2018JD030088
Fountoulakis	Deriving Aerosol Absorption Properties from Solar Ultraviolet Radiation Spectral Measurements at Thessaloniki	2019	Remote Sensing	10.3390/rs11182179
Garane	TROPOMI/S5P total ozone column data: global ground-based validation and consistency with other satellite missions	2019	Atmospheric Measurement Techniques	10.5194/amt-12-5263-2019
Giannaros	On the short-term simulation of heat waves in the Southeast Mediterranean: Sensitivity of the WRF model to various physics schemes	2019	Atmospheric Research	10.1016/j.atmosres.2018.11.015
McKenzie	Success of Montreal Protocol Demonstrated by Comparing High-	2019	Scientific Reports	10.1038/s41598-019-48625-z

	Quality UV Measurements with “World Avoided” Calculations from Two Chemistry-Climate Models			
Proestakis	EARLINET evaluation of the CATS Level 2 aerosol backscatter coefficient product	2019	Atmospheric Chemistry and Physics	10.5194/acp-19-11743-2019
Voudouri	Comparison of two automated aerosol typing methods and their application to an EARLINET station	2019	Atmospheric Chemistry and Physics	10.5194/acp-19-10961-2019
Zyrichidou	Adverse results of the economic crisis: A study on the emergence of enhanced formaldehyde (HCHO) levels seen from satellites over Greek urban sites	2019	Atmospheric Research	10.1016/j.atmosres.2019.03.017

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Participation in national networks

CLIMPACT - National Research Network on Climate Change and its Impacts., General Secretariat of Research and Technology, Public Investment Program of the Ministry of Development and Investments of Greece (<https://climpact.gr/>), 2019-2022.

«Panhellenic infrastructure for atmospheric composition and climate change (PANACEA)», Ministry of Economy and Development (Operational Programme Competitiveness, Entrepreneurship and Innovation - EPAnEK), 10.2018-9.2021 (<http://panacea-ri.gr/>).

Participation in International networks

WCRP ([World Climate Research Programme](#))

EURO-CORDEX (Coordinated Downscaling Experiment - European Domain) <https://www.euro-cordex.net/>

IPCC (Intergovernmental Panel on Climate Change) Working Group I (WGI), Sixth Assessment Report (AR6) - Lead Authors Panel, in Chapter 6 <https://archive.ipcc.ch/report/authors>, and Contributing Authors in Chapter Atlas

https://www.ipcc.ch/report/ar6/wg1/downloads/report/IPCC_AR6_WGI_Atlas.pdf

Tropospheric Ozone Assessment Report (TOAR) <http://www.igacproject.org/activities/TOAR>

MEDcyclones (European network for Mediterranean cyclones in weather and climate), COST Action CA19109, 2020-2024

Field measurements

Network of meteorological stations. It operates the Aristotle University Meteorological Station since 1930. Additionally, in operation are the Olympus centre (E.K.O.) placed on San Antonios summit (2817 m) in Mount Olympus, and various other weather stations located in the greater Thessaloniki area, listed at <https://meteo.geo.auth.gr/en/meteo-obs>.

Numerical atmospheric models:

- a) WRF (Weather Research and Forecasting Model)
<https://meteo3.geo.auth.gr/WRF/home.html>
[WRF-SFIRE](#)
- b) RegCM4 (Regional Climate Model version 4)
<https://www.ictp.it/research/esp/models/regcm4.aspx>
- c) Flexpart (FLEXible PARTicle dispersion model) and FLEXTRA (FLEXible TRAjectory model)
<https://www.flexpart.eu/>
- d) CAMx (Comprehensive air quality model with extensions)
<http://www.camx.com/>

Climate Services:

The DEAR-Clima application tool at <http://meteo3.geo.auth.gr:3838/> or <http://datahub.geocradle.eu/dataset/dear-clima> .

[Mosquito Vision](#), Digital application for the prediction of mosquito nuisance “Mosquito vision (collaborative project)

[EYWA](#) Early WARNING System for Mosquito borne diseases (collaborative project, 1st prize European Innovation Council- Early Warning for Epidemics)

Africultures – Monitoring and Early Warning System for Drought (now only available for Commercial Use upon request)

Participation in projects with funding

- TRIQUETRA - Toolbox for assessing and mitigating Climate Change risks and natural hazards threatening cultural heritage, <https://triquetra-project.eu/>, HORIZON-CL2-2022-HERITAGE-01-08, 2023-2025
- Support for upgrading the operation of the National Network for Climate Change (CLIMPACT)], General Secretariat of Research and Technology, 2023-2025.
- Sub-seasonal prediction of intense weather events, Hellenic Foundation for Research and Innovation, 2022-2024
- Comparison and validation of forecast products of numerical weather prediction models for the Region of Central Macedonia, Subcontracting by OMIKRON S.A., 2022-2023

- CLIMPACT - National Research Network on Climate Change and its Impacts., General Secretariat of Research and Technology, Public Investment Program of the Ministry of Development and Investments of Greece (<https://climpact.gr/>), 2019-2022.
- SOILGUARD, Horizon 2020, 2021-2025.
- MICROSERVICES, Horizon 2020 ERA-NET COFUND scheme BiodivERsA, 2021-2023.
- AGRORAY (Development of a forecasting system and geographical indicators for the agriculture), European Regional Development Fund and Greece, 2021-2023
- HFRI, Scholarships for PhD Candidates, Assessment of precipitation errors and uncertainty in climate simulations over Africa: investigation of physical processes (2019-2022)
- HFRI, Scholarships for PhD Candidates, Investigating the impact of land cover changes on European climate with regional climate model simulations (2019-2022)
- Operational Program «Central Macedonia 2014-2020», Innovation Investment Plans, Digital application for the prediction of mosquito nuisance “Mosquito vision”, (2021-2023)
- EC, H2020, LC-SFS-19-2018-2, Resilient farming by adaptive microclimate managements – Stargate 2019-2023
- «Panhellenic infrastructure for atmospheric composition and climate change (PANACEA)», Ministry of Economy and Development (Operational Programme Competitiveness, Entrepreneurship and Innovation - EΠΑnEK), 10.2018-9.2021.
- ECMWF, Copernicus Atmospheric Monitoring Services, CAMS84, Global and regional a posteriori evaluation and quality assurance 2019-2021
- NSRF 2014-2020, GSRT, Establishment and Early Warning System for Mosquito-borne diseases and implementation of new vector control tools in the urban environment, EWSMD (2018-2021)
- EU, H2020-SFS-2016-2017, SFS-43-2017, RIA, Pr. Nr. 774652 Enhancing Food Security in AFRIcan AgriCULTUral Systems with the Support of REmote Sensing (Africultures). Duration: 2017- 2021.
- State Scholarship Foundation & German Academic Exchange Service (IKYDA 2018) Impact of Land Use Changes on regional and local climate in Europe: present and future climate projections (LUCE), 2018-2020
- DAAD bilateral cooperation, Justus-Liebig University Giessen and Aristotle University of Thessaloniki, The Mediterranean Hot-Spot: Challenges and Responses in a Changing Environment, 2017-2019.

List of selected publications over the period 2019-2022

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Participation in National and International networks

Atmospheric Electricity Network (ELECTRONET)

PANhellenic infrastructure for Atmospheric Composition and climate change
(<https://panacea-ri.gr/?lang=en>)

Global Coordination of Atmospheric Electricity Measurements (GLOCAEM)
(<https://glocaem.wordpress.com/data-access/>)

Field measurements

1. Continuous measurements are carried out since 2011 until today at the Kimmeria Xanthi Campus for the following:

Atmospheric Electric Field

Meteorological parameters

Total radiation

(<http://ik-meteostation-kimmeria.link/>)

2. Since 2019, continuous measurements of suspended particles (PM_{2.5}) have been carried out in 3 cities of Thrace (Xanthi, Komotini, Alexandroupoli) and in a non-urban area (Kimmeria University).

(<http://clean-air.gr/thraki>)

Indicative funding

- Program "Atmospheric Electricity Network: coupling with the Earth System, climate and biological systems (ELECTRONET)" (Coordinator), EU, COST, 11.2016-4.2021.
- Program "PANhellenic infrastructure for Atmospheric Composition and climate change" (MIS) (MIS 5021516) of the action "Reinforcement of the Research and Innovation Infrastructure", financed by top Operational Program "Competitiveness, Entrepreneurship and Innovation" (NSRF 2014-2020) with co-financing from Greece and the EU. (European Regional Development Fund)."
- Program "COSMIC AND ELECTRICAL EFFECTS ON AEROSOLS AND CLOUDS" (E.Y.) (MIS 5049552), ESPA 2014-2020, 11.2019-11.2021.

Indicative publications

1. Riancho J., J. Sanchez de la Torre, L. Paz-Fajardo, C. Limia, A. Santurtun, M. Cifra, K. Kourtidis and P. Fdez-Arroyabe, The role of magnetic fields in neurodegenerative diseases, *Int. J. Biometeorol.*, 65, 107–117, <https://doi.org/10.1007/s00484-020-01896-y>, 2021.
2. Kourtidis K., K. Szabóné André, A. Karagioras, I.-A. Nita, G. Sători, J. Bór, N. Kastelis, The influence of circulation weather types on the exposure of the biosphere to atmospheric electric fields, *International Journal of Biometeorology*, 65, 93–105, <https://doi.org/10.1007/s00484-020-01923-y>, 2021.
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9. I.A. Mironova, M. Fullekrug, K. Kourtidis, E.A. Mareev, Editorial: Atmospheric Electricity, *Frontiers in Earth Science* 10, <https://doi.org/10.3389/feart.2022.853584>, 2022.

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Laboratory of Laser Remote Sensing of the Atmosphere, Department of Physics, National Technical University of Athens

Research activities

Vertical profiling of aerosol optical and microphysical properties using the lidar technique
Radiative Transfer calculations based on aerosol optical properties.

Relative publications regarding field measurements and radiation calculations

1. Pantazis, A., and A. Papayannis, Lidar algorithms and technique for 3D scanning for Planetary Boundary Layer height and single-beam-single-pointing wind speed retrieval, *Applied Optics*, 58, 2284-2293, 2019.
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Participation in International networks

European Aerosol Research Lidar Network (EARLINET) (2000-today)

National funding

- 1) National Infrastructures - E.P. "Competitiveness, Entrepreneurship and Innovation 2014-2020", entitled: "Hellenic Infrastructure for Atmospheric Recommendation and Climate Change: PANACEA' and MIS 5021516 (2018-2022) (€350,000)

- 2) ELIDEK "Research-Innovate" Research Program. Project Title: "Development of an innovative three-dimensional (3D) LIDAR operational system recording meteorological and atmospheric parameters in real time time, with the aim of increasing the safety and efficiency of of air transport-SAFE TRANS" with code T1EDK -03147 (2018-2021) (155.988€).

Institute of Oceanography Hellenic Centre for Marine Research (IO/HCMR)

This is the first time that IO/HCMR has the opportunity to contribute to the National Report of Greece to the IUGG.

Therefore, the following report aims to provide a short summary of the IO/HCMR activities that are relevant to the objectives of the IUGG.

1 Seafloor Bathymetry and Morphology

Department of Marine Geology-Geophysics, IO/HCMR: Dr D. Sakellariou, Dr G. Rousakis, Dr V. Kapsimalis, V. Drakopoulou, I. Morfis, I. Livanos, Dr K. Tsampouraki-Kraounaki, Ch. Kyriakidou, Dr M. Iatrou, Dr A. Varesis, V. Saltagiannis.

1.1 Infrastructure

HCMR operates three research vessels: 1) the 62 m long open-sea R/V AEGAE0, 2) the 30 m long R/V PHILIA and 3) the 13.5 m long coastal R/V ALKYON. R/Vs AEGAE0 and ALKYON are built for oceanographic research while PHILIA is used for fisheries and coastal research.

R/Vs AEGAE0 and ALKYON are equipped with hull-mounted multibeam echosounders and capable of performing seafloor bathymetric surveys.

R/V AEGAE0 performs swath bathymetry research since 2000, when the first multibeam system was installed on her hull. A new, state-of-the-art, full ocean depth swath bathymetry system has been installed on R/V AEGAE0 in 2021.

R/V ALKYON was built in 2009 and was equipped with a multibeam system from the beginning of her life.



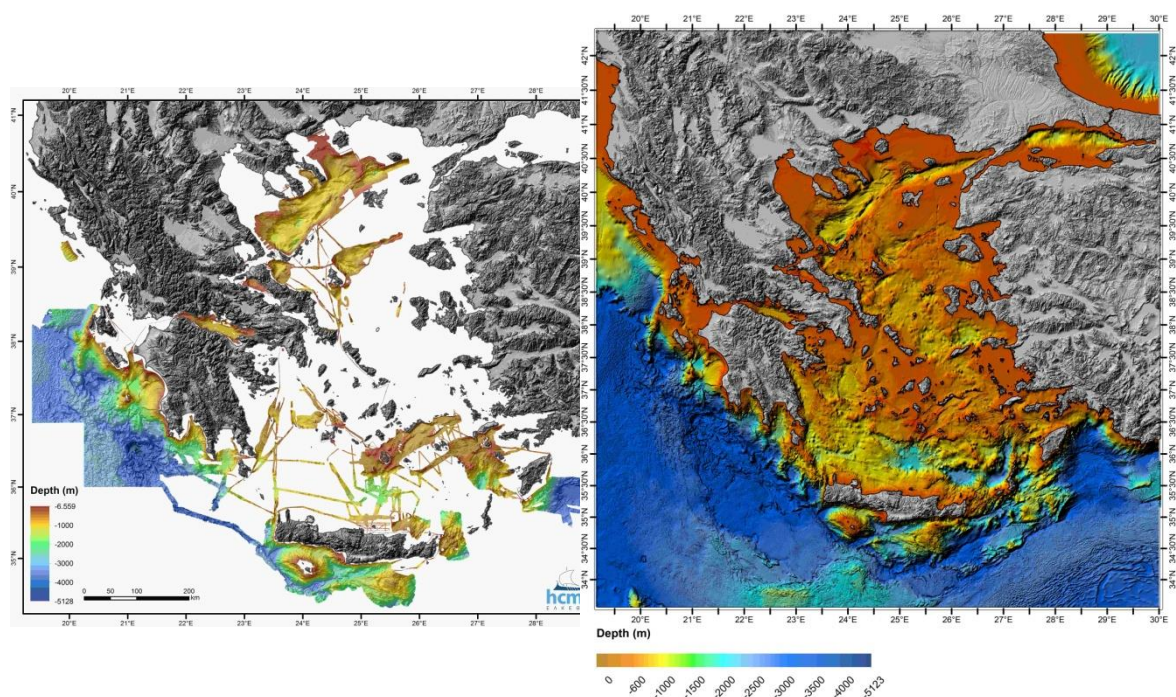
Left: the 62 m long open-sea R/V AEGAE0. Right: the 13.5 m long coastal R/V ALKYON

1.2 Research Projects

IO/HCMR has implemented a very large number of national, European and international research projects and cruises on board the R/Vs AEGAEO and ALKYON and has acquired swath bathymetry data from various areas in the Aegean and Ionian Seas, the Eastern Mediterranean as well as the Black and Red Seas.

The left map below shows the total coverage of the Greek Seas by means of swath bathymetry surveys. The right map below presents the most up-to-date bathymetric-morphological map of the Greek Seas, compiled with the use of swath bathymetry data, where available, and single-beam and GEBCO bathymetric data.

IO/HCMR participates, since 2009, in the EMODnet Bathymetry project as regional coordinator for the harmonization of bathymetric data and compilation of the seafloor Digital Terrain Model of the Eastern Mediterranean.



Left: total coverage of the Greek Seas by means of swath bathymetry surveys.

Right: the most up-to-date bathymetric-morphological map of the Greek Seas.

2 Seafloor Faults and Landslides

Department of Marine Geology-Geophysics, IO/HCMR: Dr D. Sakellariou, Dr G. Rousakis, Dr K. Tsampouraki-Kraounaki, V. Drakopoulou, Dr M. Iatrou, I. Morfis, I. Livanos, K. Manta, Ch. Kyriakidou, Dr A. Varesis, V. Saltagiannis.

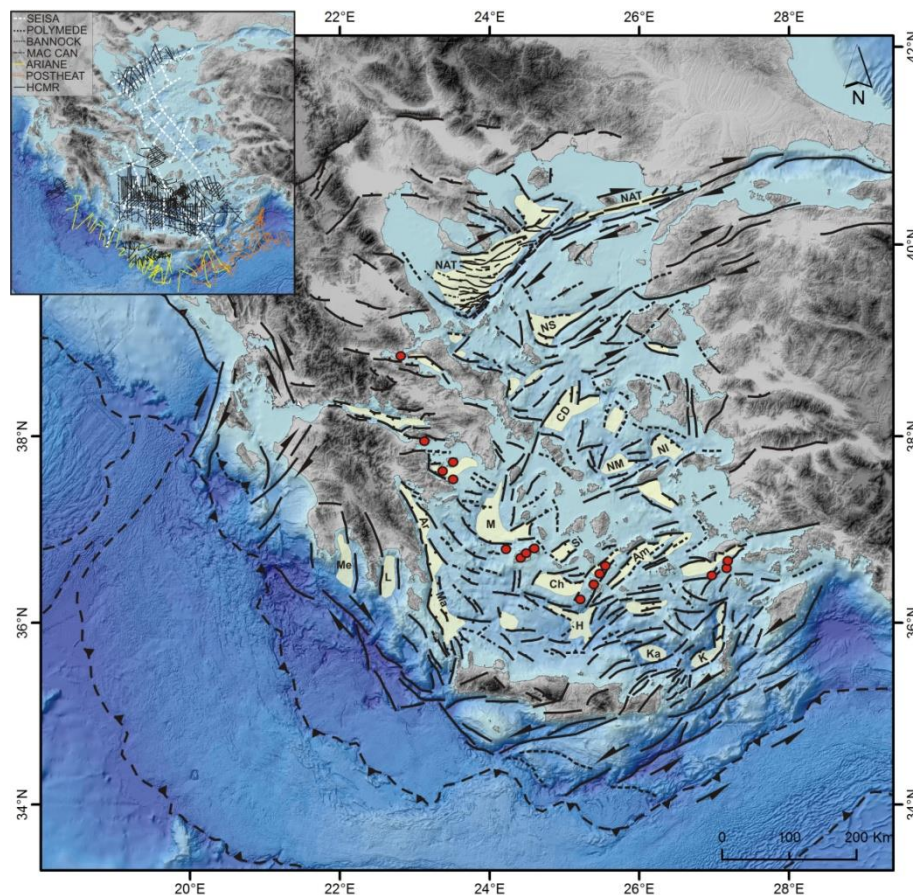
Research initiatives include:

- Mapping of active offshore faults and estimation of their kinematic characteristics and seismic potential.
- Understanding the spatial and genetic relationship between active faulting and volcanic / non-volcanic fluid flow (volcanoes and hydrothermal fields, mud-volcanoes, shallow gas emissions, extreme environments).
- Detailed mapping of slope failures and mass transport deposits, identification of areas prone to submarine landslides.
- Assessment of landslide-triggered tsunami hazard.

Three decades after the first map of offshore faults in the Aegean published by Mascle & Martin (1990) and after several years of systematic marine research campaigns on board R/V AEGAE0 and interpretation of old and recent geological and geophysical data, the Department of Marine Geology-Geophysics has published a new comprehensive map that visualizes the most up-to-date information and the current state of knowledge on the offshore faults, the sedimentary basins and the evolution of the deformation of the Aegean Sea during the Plio-Quaternary (Sakellariou & Tsampouraki-Kraounaki, 2019).

An additional result of the above research work is the establishment of a GIS-based Data Base of Active Offshore Faults of the Greek Seas. The data base contains more than 250 faults that have been mapped, along with their geometrical and kinematic characteristics as well as with relevant literature sources. This effort contributes to the larger initiative supervised by the Permanent Commission of Seismotectonics of the Greek Earthquake Planning & Protection Organization (EPPO), that aims to establish a National Data Base of Active Faults in Greece.

In addition to the Active Faults Data Base, a new GIS-based Data Base of Submarine Landslides in the Greek Seafloor is under construction. More than 60 known submarine landslides, with their characteristics, have been included in the data base so far.



Map of offshore faults, sedimentary basins and volcanic centers in the Greek Seas (Sakellariou & Tsampouraki-Kraounaki, 2019)

The proposal with the title *'ATHENA vs. EGELADUS: Interaction between the Hellenic Subduction and the North Anatolian Fault: Implications for the intra-plate deformation and seismic hazard in the Aegean'* submitted in the context of the "Hellenic Foundation for Research & Innovation (HFRI) 1st Call for proposals for research projects and the procurement of strategic research equipment" has been evaluated with 97.75/100 and funded with 1,248,188 €. The project started in April 2021 and its main objectives include (i) the purchase of a multi-channel reflection seismic system and (ii) a 12-day research cruise in the Aegean and the Hellenic Arc to acquire multi-channel seismic profiles and interpret the tectonic structure and style of deformation.

Two researchers of DMGG, Dr D. Sakellariou and Dr G. Rousakis (as substitute), are members of the following three Permanent Scientific Commissions of the Greek Earthquake Planning & Protection Organization (EPPO):

- a) Commission of Seismotectonics (since 2014)
- b) Commission for the Monitoring of the Hellenic Volcanic Arc (since 2020)
- c) Commission for the Seismic Hazard and Seismic Risk (since 2022)

3 Satellite Bathymetry and Habitat Mapping

Department of Marine Geology-Geophysics, IO/HCMR: V. Drakopoulou, Dr V. Kapsimalis, I. Morfis

Determination of nearshore bathymetry is essential for multiple applications, i.e., submarine morphodynamics, coastal erosion, tsunami propagation towards the coast, climate change initiatives, operational activities by local authorities and decision makers. This kind of knowledge is crucial for planning sustainable coastal development, coastal risk assessment (including tsunami hazard) and sustainability of submarine ecosystems. Moreover, coastal bathymetry represents a critical contribution to nearshore navigation and investigation of submarine resources.

10.3.1 Research Projects

In the framework of European (BathySent, 4S Horizon 2020-SPACE), national projects (Chania gulf coastal zone and marine space study) and research studies, various methods of satellite image analysis have been developed and implemented providing reliable and cost-efficient mapping of the shallow coastal zone regarding the extend and quality of habitats and shallow bathymetry.

The proposed novel approach "BathySent" for coastal bathymetric mapping, using the Copernicus Sentinel-2 mission, as well as the assessment and specification of the uncertainties of the derived depth results are the objectives of an ongoing research effort. For this reason, Sentinel-2 bathymetry retrieval results for three different pilot sites in Greece (Kos, Kasos and Crete islands) were compared with ground-truth data.

4S stands for "Satellite Seafloor Software Suite", a project co-funded by EU Horizon Europe. Under the lead of EOMAP, eight partners - QPS (NL), Fugro (DE/NL), Smith Warner (JM), Consiglio Nazionale delle Ricerche ISMAR (IT), Institute of Oceanography-Hellenic Centre for Marine Research HCMR (GR), and Instituto Hidrográfico (PT), Länsstyrelsen Västerbotten (SE) – have been cooperating from 2019 to 2023. 4S harnesses Copernicus satellite data and other Earth Observation information together with users' own data to analyze them jointly in a state-of-the-art workflow for aquatic remote sensing and service components – processed and stored in a cloud environment. The project 4S is designed to develop a cloud-based software solution empowering its users to map and monitor seafloor habitats, morphology and water depth from the comfort of their desks (<https://www.sdb-online.eoapp.de/>). Throughout this project, the partners are optimizing usability and validity of the software suite in 16 [use cases](#), three of which are in Greek coastal and transitional waters (Kos, Paros-Naxos strait and Lesser Cyclades, and the Logarou Lagoon).

The most popular and successful approaches for bathymetry retrieval, the Lyzenga (1985) linear bathymetry model and the Stumpf et al. (2003) ratio method, are applied to very high-resolution satellite imagery (Worldview-2,3), in order to investigate the conditions of achieving the highest possible accuracy derived bathymetric models for the shallow-waters in various coastal areas of Greece (Chania, Varkiza, Komi etc).

4 Satellite Oceanography and Marine Optics

Satellite Oceanography and Marine Optics Group, IO/HCMR: Dr A. C. Banks, Dr A. Karageorgis.

4.1 Satellite Vicarious Calibration

ROADMAP

Phase	Status
Requirements	Completed
Preliminary Design, Project Plan and Costing	Completed
Infrastructure Location	Completed
Engineering Design, Technical Definition, Specifications	Proposed
Development, Testing and Demonstration in the Field	Proposed
Operations	Proposed



PROGRAMME OF THE EUROPEAN UNION  **IMPLEMENTED BY** 

- Ongoing HCMR bid for Crete to be the field location for the Copernicus Ocean Colour System Vicarious Calibration (OC-SVC) infrastructure (PI: A. C. Banks). Involvement has been since Phases 1 & 2 (work at JRC and NPL: Zibordi et al., 2017; FRM4SOC, 2017; Banks et al., 2020) and in Phases 2 & 3 (work at HCMR: Antoine et al., 2020; Banks et al., 2022) where in the last phase Crete was selected from many European sites to support Phase 4 (Engineering Design, Technical Definition and Specification, starting 2023-24) as a potential site for implementation and operations (Phases 5 & 6).
- The main objective of Copernicus OC-SVC is to provide top-of-atmosphere ocean colour vicarious adjustment gains for satellite ocean colour radiometry, with a priority for Copernicus and the Ocean and Land Colour Instrument (OLCI) on the Sentinel-3 satellite present and next generation missions but also applicable to all

global ocean colour satellite missions, including the NASA Plankton, Aerosol, Cloud ocean Ecosystem (PACE) satellite mission to be launched in 2024.

- OC-SVC is based on extremely accurate fiducial reference water leaving radiance measurements from a fixed buoy deep-sea platform specifically designed for this purpose. Until now there have only been two other sites in the world: MOBY in Hawaii and BOUSSOLE in the West Mediterranean. This has been shown to be insufficient to fully support European and global ocean colour satellite missions and has led to the Copernicus initiative for new OC-SVC infrastructure.
- HCMR is also running the field operations in Crete for the NASA HyperNAV project (PI: A. C. Banks) which is a new paradigm for ocean color satellite calibration and validation: highly accurate, low uncertainty, hyperspectral radiometric measurements from autonomous platforms technology. This is being deployed in the prime locations for OC-SVC around the world, including Crete, in support of the NASA PACE mission.

4.2 Satellite validation and product improvement activities

- Member of the ESA-EUMETSAT Sentinel 3 Validation Team for Ocean Colour (S3VT-OC, A. C. Banks), which works for the duration of the mission in support of the ocean colour measurements from the Ocean and Land Colour Instrument (OLCI) on S3 (A, B, C, D). Ocean Colour is an essential climate variable as defined by the Global Climate Observing System (GCOS).
- Member of the ESA-EUMETSAT Sentinel 3 Validation Team for Sea Surface Temperature (S3VT-SST, A. C. Banks), which works in support of the SST measurements from the Sea and Land Surface Temperature Radiometer (SLSTR) on S3 (A, B, C, D). SST is an essential climate variable as defined by GCOS.
- Partner in EUMETSAT project (2023-2024, PI: A. C. Banks) - Provision of S3 OLCI Ocean Colour product improvements (Flags, High Chlorophyll-a concentration, IOP). This project aims to address three tasks in support of the Copernicus Level 2 (L2) Ocean Colour processor evolution led and procured by EUMETSAT:
 - Improvement of Level2 (L2) pixel flagging, more specifically in this study, a new flag for pixels contaminated by cloud shadow.
 - Improvement of the retrieval of high Chlorophyll-a concentrations, > 10 mg/m³.
 - Support to the implementation of new ocean colour products, more specifically in this study, an extended validation of the aspirational Inherent Optical Properties (IOP) products.
- The HCMR-UNIWA Marine Optics and Earth Observation group was formed from a group of scientists from diverse backgrounds to meet and discuss ongoing research needs and opportunities in the field of marine optics of the Eastern Mediterranean. This has led to involvement in a number of projects, cruises and papers in recent years (e.g. NABUCCO, MARRE, BICEP, PERLE-2 and a joint HCMR-JRC 2022 dedicated marine optics – satellite ocean colour validation cruise

around Crete, with another planned for 2024 also involving NASA to support the launch of PACE).

- The New chlorophyll-*a* concentration retrieving Algorithm Based on fiducial reference measurements of ocean COLOUR (NABUCCO, 2022-2025, PI: A. Karageorgis) HFRI project is of particular importance because it is coordinated by HCMR with the main aim to study the optical properties of seawater in the oligotrophic Cretan and NW Levantine Seas, improve their SI-traceability and uncertainty evaluation (Banks et al., 2020) and thereby derive an appropriately accurate regional Chl-*a* satellite retrieval algorithm. It is also helping to establish new optics calibration facilities that may go on to be used and expanded by Copernicus OC-SVC.
- Coastal satellite SST validation has been undertaken using existing HCMR in situ temperature sensor arrays off the North coast of Crete (Androulakis, Banks et al., 2020) and work is underway to upgrade this further offshore through the deployment of accurate fiducial reference measurement (FRM) sensors both on the HCMR / GOOS E1-M3A fixed oceanographic buoy and by deploying FRM SST drifting buoys from the EUMETSAT TRUSTED project (PI: A. C. Banks).
- CLIMPACT project: tying together the satellite SST time series with the HCMR POSEIDON buoys temperature time series for the Hellenic Seas.

4.3 ESA / Copernicus next generation activities

- Membership of the European Space Agency (ESA) Copernicus Sentinel 3 Next Generation satellite mission ad-hoc expert group (2021-2023, A. C. Banks).
- Membership of the European Space Agency (ESA) Copernicus Sentinel 3 Next Generation satellite Mission Advisory Group (2023-launch c. 2034, A. C. Banks).
- Partner in the NGS-ASLSTR Sentinel 3 - Next Generation Optical Phase 0/A Scientific Support Study for the Advanced Sea and Land Surface Temperature Radiometer (ASLSTR, 2023-2024, PI: A. C. Banks). This study is in support of the next generation of Copernicus Sentinel satellite missions and has the following high-level objectives:
 - Definition of the uncertainty budget for SST, including its sensitivity to calibration, path length ratio and correlated and uncorrelated errors.
 - Consolidation: to consolidate the specifications of the spectral channels of ASLSTR in order to fulfil the relevant user requirements, services and applications defined for the S3NGO mission.
 - Traceability: to ensure, and explain in detail, full traceability of the channel specifications to the mission scientific objectives, and establish priority amongst the goal channels.
 - Fostering synergy of ASLSTR with AOLCI by ensuring that the requirements for synergistic applications are captured and the joint exploitation of the two instruments is maximised. A synergy workshop, organised by the Agency, will

be attended jointly with NGS-AOLCI to prepare a joint white paper on synergy.

HCMR is involved in all aspects of the study and is leading the Synergy work package.

- Partner in the NGS-AOLCI – Sentinel-3 Next Generation Optical Phase 0/A Scientific Support Study for the Advanced Ocean and Land Colour Instrument (AOLCI, 2023-2024, PI: A. C. Banks). This study is in support of the next generation of Copernicus Sentinel satellite missions and has the following high-level objectives:
 - Consolidation: to consolidate the specifications of the spectral bands of AOLCI in order to fulfil the relevant user requirements, services and applications defined for the S3NGO mission;
 - Traceability: to ensure, and explain in detail, full traceability of the band specifications to the mission objectives and underlying needs of applications;
 - Prioritisation: to establish a priority in the selection of bands (and/or entire spectral windows) for different targets (open ocean, coastal waters, land, ice), to allow optimal exploitation of AOLCI in dependence of any constraints on power, mass, data rate, data storage, downlink rate that may arise during the Phase 0/A system studies;
 - Fostering synergy of AOLCI with ASLSTR by ensuring that the requirements for synergistic applications are captured and the joint exploitation of the two instruments is maximized. A synergy workshop, organised by the Agency, will be attended jointly with NGS-SLSTR to prepare a joint white paper on synergy.

HCMR is involved in all aspects of the study and is leading the Synergy work package.

Laboratory of Atmospheric Physics, Department of Physics, University of Patras

International Networks

- Copernicus Academy – Affiliated Member
(https://www.copernicus.eu/sites/default/files/Network_of_Copernicus_Academies-List_of_Members_03Sept2018.pdf)
- NEREUS network – Associate Member (<https://www.nereus-regions.eu/who-we-are/our-members/>)
- EO4GEO Alliance – Member (<http://www.eo4geo.eu/eo4geo-alliance-members/>)

National Networks

- CLIMPACT (<https://climpact.gr/main/>)
- PANACEA (<https://panacea-ri.gr/>)

Field Measurements

The LAPUP has set up maintains

- Two meteorological and one radiometric stations, in Patras, Greece:
 - Meteorological station at the campus at Rion:
<http://mymeasurements.eu/u/lapup/meteo.php?lang=en>
 - Meteorological station at the campus at Koukouli:
<https://mymeasurements.eu/u/Up/Koukouli.php?lang=en>
 - Radiometric station: <http://mymeasurements.eu/u/lapup/solar.php?lang=en>
- Air quality monitoring networks in Greece (<http://www.clean-air.gr/>)

Atmospheric Models

The LAPUP uses the following third-party models:

- Weather Research and Forecasting (WRF) mesoscale numerical weather prediction model
- FLEXible PARTicle dispersion model (FLEXPART)
- The Library for Radiative Transfer (libRadtran) model
- Several weather data homogenisation packages (CLIMATOL, HOMER, MASH)

It also develops its own mechanistic models, in the frame of its research activities:

- spatial dynamical Model for wEst nile virus (MIMESIS)
- Soiling Forecasting model (SF)

Research projects

- Solar Collectors with Static Concentrators, for solar thermal applications at intermediate to medium temperatures - SCoSCo (Bilateral cooperation between Greece and Germany). Period 05/2018 – 04/2022. Financed by Hellenic Secretariat for Research and Development.
- Global Monitoring of Nitrogen Isotopes in Atmospheric Waters (International Atomic Energy Agency Coordinated Research Project F32008 – Contract #22879/R0). Period 06/2018 – 05/2021. Financed by the International Atomic Energy Agency.
- Comparative study of changing climate indexes between China and Greece based on daily homogenized daily observations – CLIMEX (Bilateral Research & Technology Cooperation Program between Greece and China – Hellenic General Secretariat for Research and Development). Period 01/2019 – 07/2022. Financed by Hellenic Secretariat for Research and Development.
- IREEDER: Introducing electrical recent engineering developments into undergraduate curriculum. Period: 2019-2022, co-funded by the Erasmus+ program of the European Union.
- SMARTAQM: Smart system for air quality monitoring
- EO4GEO: Towards an innovative strategy for skills development and capacity building in the space geo-information sector supporting Copernicus user uptake, H2020 Erasmus + (2018-2022).
- PANACEA: Panhellenic infrastructure for atmospheric composition and climate change, Hellenic General Secretariat for Research and Technology (2018 – 2022).
- Winner of the €5 million EIC Horizon Prize on Early Warning for Epidemics Early Warning System for Mosquito-borne Diseases (EYWA).
- DeepSky: Development of an innovative flexible system of ground meteorological atmospheric and solar measurements combining physical models with computer vision and deep learning methods Hellenic General Secretariat for Research and Technology (2019 – 2023).
- D3D: Deep 3D scattering of solar radiation in the atmosphere due to clouds Hellenic General Secretariat for Research and Technology (2022 – 2025).
- CLIMPACT: Support of the operational upgrade of the National Network for Climate Change (2023-2025)
- TwinAIR: technological solutions system to improve air quality in a wide spectrum of indoor living activities Horizon Europe (2022-2025).
- Advanced Earth Observation and Information Technology Techniques for Early Investigation/ Analysis and Warning of Mosquito-Borne Diseases Hellenic General Secretariat for Research and Technology (2020-2023)
- Smart Solar System SolarERAnet (2021-2023)
- EuroGEO Showcases – Applications Powered by Europe Horizon 2021-2022

Publications

1. Argiriou, A.A., Li, Z., Armaos, V., Mamara, A., Shi, Y., Yan, Z. Homogenised Monthly and Daily Temperature and Precipitation Time Series in China and Greece since 1960 (2023) *Advances in Atmospheric Sciences*, 40 (7), pp. 1326-1336.
2. Kolokythas, K.V., Argiriou, A.A., Kotroni, V. Analyzing and forecasting lightning flashes and the related wind gusts at a wind energy power plant in a hilly region of western Greece (2023) *Atmosfera*, 36 (2), pp. 279-298.
3. Li, Z., Shi, Y., Argiriou, A.A., Ioannidis, P., Mamara, A., Yan, Z. A Comparative Analysis of Changes in Temperature and Precipitation Extremes since 1960 between China and Greece (2022) *Atmosphere*, 13 (11), art. no. 1824.
4. Panagopoulos, O., Argiriou, A.A., Dokouzis, A., Alexopoulos, S.O., Göttsche, J. Optical and thermal performance simulation of a micro-mirror solar collector (2022) *Energy Reports*, 8, pp. 6624-6632.
5. Salamalikis, V., Tzoumanikas, P., Argiriou, A.A., Kazantzidis, A. Site adaptation of global horizontal irradiance from the Copernicus Atmospheric Monitoring Service for radiation using supervised machine learning techniques (2022) *Renewable Energy*, 195, pp. 92-106.
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7. Petrakis, T., Kavga, A., Thomopoulos, V., Argiriou, A.A. Neural Network Model for Greenhouse Microclimate Predictions (2022) *Agriculture (Switzerland)*, 12 (6)
8. Kolokythas, K.V., Argiriou, A.A. Optimizing the input vectors of applied artificial neural network models for wind power production forecasting (2022) *Wind Engineering*, 46 (3), pp. 712-723.
9. Panagopoulos, O., Argiriou, A.A. Low-Cost Data Acquisition System for Solar Thermal Collectors (2022) *Electronics (Switzerland)*, 11 (6).
10. Droutsas, K.G., Kontoyiannidis, S., Balaras, C.A., Dascalaki, E.G., Argiriou, A.A. Representative typology of buildings: case study of hellenic non residential buildings (2022) *Energy Sources, Part A: Recovery, Utilization and Environmental Effects*
11. Kolokythas, K.V., Argiriou, A.A. An application of a feed-forward neural network model for wind speed predictions (2022) *International Journal of Sustainable Energy*, 41 (4), pp. 323-340.
12. Wang, S., Song, Y., Zhang, M., Argiriou, A.A., Shi, Y. Satellite-measured water vapor isotopologues across the Tianshan Mountains, central Asia (2021) *Sciences in Cold and Arid Regions*, 13 (6), pp. 488-495.
13. Droutsas, K.G., Kontoyiannidis, S., Balaras, C.A., Argiriou, A.A., Dascalaki, E.G., Vartotsos, K.V., Giannakopoulos, C. Climate change scenarios and their implications on the energy performance of Hellenic non-residential buildings (2021) *Sustainability (Switzerland)*, 13 (23).

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PROJECTS 2019- today

Ongoing:

1. Kanakidou M - Principal investigator of CLIMPACT II- National flagship project on Climate Change and its impacts in Greece, General Secretariat of Research and Innovation-Greece, 24/05/2023- 31/12/2025, (137.5 Keuro)
2. Kanakidou M - Principal Investigator of EYECLIMA- Verifying Emissions of Climate Forcers, HORIZON no 101081395), 1/1/2023-31/12/2026 (190 Keuro)
3. Kanakidou M - Principal Investigator of Edu4ClimAte European Higher Education Institutions Network for Climate and Atmospheric Sciences, HORIZON-WIDERA no101071247, 1/10/2022-30/9/2026 (470 Keuro).
4. Kanakidou M - Coordinator of CLIMADEMY - CLIMAtE change Teacher's acaDEMY, ERASMUS + Teachers Academy, 07/06/2022 - 31/05/2025, (323.4 Keuro).
5. Kanakidou M - Coordinator of Edu4clima - Learning and Teaching about Climate Change EDU4Clima, Hellenic Foundation for Research and Innovation, ΕΛΙΔΕΚ no 1686, 19/10/2021 - 18/04/2024 (94.4 Keuro)
6. Kanakidou M - Coordinator of BIOCAN- Bioaerosol Contribution to Atmospheric Nutrient deposition, Hellenic Foundation for Research and Innovation, ΕΛΙΔΕΚ no 4050, 1/5/2022-31/4/2025 (192 Keuro)
7. Kanakidou M - Excellence Chair – Impacts of emissions and feedbacks to the Earth system, University of Bremen Insitute of Environmental Physics, University of Bremen & DFG (Jan 2020- Dec 2025) (1080 Keuro)
8. Kanakidou M - Co-PI AIR-CHANGES (Air pollution in China and the undesired effects of mitigation strategies) Deutsche Forschungsgemeinschaft (DFG, Oct 2021-2024; University of Bremen, Insitute of Environmental Physics)
9. Kanakidou M - Participant to the Horizon2020 project FORCES (Constrained aerosol forcing for improved climate projections- air pollution and climate) (Sept. 2019-2023) (FORTH, ICE-HT, participant).
10. Kanakidou M - Participant to the Research Infrastructures Services Reinforcing Air Quality Monitoring Capacities in European Urban & Industrial AreaS (RI-URBANS) (H2020, 1 Oct 2021-30 Sept 2025) (FORTH ICE-HT, WP leader)

Ended

1. Kanakidou M - Principal investigator of CLIMPACT- National flagship project on Climate Change and its impacts in Greece (Oct. 2020- Feb 2023) (180 Keuro)

2. Kanakidou M - Work Package leader and vice-co-ordinator of the PANhellenic infrastructure for Atmospheric Composition and climate change (PANACEA – 2018-2022) (co-PI, WP leader; 1400 Keuro for UoC)
3. Kanakidou M - Coordinator of DRASIS Investigates the contribution of amines and ammonia to new particle formation. Financed by the Operational Programme “Human resources Development, Education and Lifelong Learning 2014-2020”, co-financed by Greece and the European Social Fund -ESF), (Jan 2020- Oct 2021 - 56 Keuro)

Peer reviewed publications in international journals since 2019

1. Kalivitis, N., Kerminen, V.-M., Kouvarakis, G., Stavroulas, I., Tzitzikalaki, E., Kalkavouras, P., Daskalakis, N., Myriokefalitakis, S., Bougiatioti, A., Manninen, H. E., Roldin, P., Petäjä, T., Boy, M., Kulmala, M., Kanakidou, M., and Mihalopoulos, N.: Formation and growth of atmospheric nanoparticles in the eastern Mediterranean: Results from long-term measurements and process simulations, *Atmos. Chem. Phys.*, 19, 2671–2686, 2019.
2. Wong, J. P. S., Tsagkaraki, M., Tsiodra, I., Mihalopoulos, N., Violaki, K., Kanakidou, M., Sciare, J., Nenes, A., and Weber, R. J.: Atmospheric Evolution of Molecular Weight Separated Brown Carbon from Biomass Burning, *Atmos. Chem. Phys.*, 19, 7319–7334, 2019.
3. Fanourgakis, G. S., Kanakidou, M.*, Nenes, A., Bauer, S. E., Bergman, T., Carslaw, K. S., Grini, A., Hamilton, D. S., Johnson, J. S., Karydis, V. A., Kirkevåg, A., Kodros, J. K., Lohmann, U., Luo, G., Makkonen, R., Matsui, H., Neubauer, D., Pierce, J. R., Schmale, J., Stier, P., Tsigaridis, K., van Noije, T., Wang, H., Watson-Parris, D., Westervelt, D. M., Yang, Y., Yoshioka, M., Daskalakis, N., Decesari, S., Gysel Beer, M., Kalivitis, N., Liu, X., Mahowald, N. M., Myriokefalitakis, S., Schrödner, R., Sfakianaki, M., Tsimpidi, A. P., Wu, M., and Yu, F.: Evaluation of global simulations of aerosol particle and cloud condensation nuclei number, with implications for cloud droplet formation, *Atmos. Chem. Phys.*, 19, 8591–8617, 2019
4. Ito A., Myriokefalitakis S., Kanakidou M., Mahowald N.M., R. A. Scanza, D. S. Hamilton, A. R. Baker, T. Jickells, M. Sarin, S. Bikkina, Y. Gao, R. U. Shelley, C. S. Buck, W. M. Landing, A. R. Bowie, M. M. G. Perron, C. Guieu, N. Meskhidze, M. S. Johnson, Y. Feng, Jasper F. Kok, A. Nenes, R. A. Duce, Pyrogenic iron: The missing link to high iron solubility in aerosols, *Science Advances*, 01 May 2019, 5(5), eaau7671 DOI: 10.1126/sciadv.aau7671
5. Kanakidou M.*, China’s Nitrogen management, *Nature Geoscience*, 2019. DOI: 10.1038/s41561-019-0358-y
6. P. Suntharalingam, L. Resplandy, S. Setzinger, E. Buitenhuis, M. Kanakidou, A. Landolfi, S. Bikkina, L. Zamora, J.-F. Lamarque, H. Bange, M. Sarin, A. Singh, Anthropogenic nitrogen inputs and impacts on oceanic N₂O fluxes in the northern Indian Ocean: the need for an integrated observation and modelling approach, *Deep Sea Research II*, <https://doi.org/10.1016/j.dsr2.2019.03.007>, 2019.

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Institute for Environmental Research & Sustainable Development, National Observatory of Athens (IERSD-NOA)

Participation in national networks

PANACEA Network, key partner in «Panhellenic infrastructure for atmospheric composition and climate change (PANACEA)» (<http://panacea-ri.gr/>) national Research Infrastructure.

Participation in International networks

ERA-PLANET Network, coordinator of the «SMartURBan Solutions for air quality, disasters and city growth (SMURBS/ERAPLANET), ERA-NET Cofund (H2020-SC5-15-2015) (smurbs.eu/), within which innovative solutions for AQ monitoring have been, among others, introduced into smart-city approaches.

ACTRIS Network, key partner in «Aerosols, Clouds, and Trace gases Research InfraStructure (ACTRIS)» (<https://www.actris.eu/>) relevant projects and operation of the Thissio Air Monitoring Station of the National Observatory of Athens, according to the guidelines of the RI.

ICOS (Integrated Carbon Observation System) (<https://www.icos-cp.eu/>) Network, partner of the RI and operation of the Thissio Air Monitoring Station of the National Observatory of Athens according to the guidelines of the RI.

Field measurements

The Thissio Air Monitoring Station of the National Observatory of Athens has been operating since December 2013 at the premises of the National Observatory of Athens historical site located downtown Athens, characteristic for urban background conditions, implementing aerosol filter sampling and measuring major inorganic and greenhouse gases, on-line aerosol mass and chemical composition of main fine non-refractory components, number size distribution and aerosol optical properties among its overall activities.

Furthermore, the Atmospheric Chemistry Laboratory of the National Observatory of Athens disposes of a mobile unit monitoring station in a specified VAN vehicle for the monitoring of the main atmospheric pollutants (PM₁₀, CO, NO, NO₂, SO₂, O₃, BC).

Additionally, the National Observatory of Athens, in collaboration with other partners of the PANACEA National RI, has installed and operates a network of innovative air quality monitoring low-cost PM_{2.5} optical monitors (PurpleAir PA-II) that use sensors and IoT technologies aiming to provide reliable real-time information to citizens, to support air quality management authorities in decision making, and improve characterization of personal exposure to ambient pollution and its determining factors.

Indicative funding

«Aerosols, Clouds, and Trace gases Research InfraStructure (ACTRIS-2)», European Commission Horizon 2020 Research and Innovation Framework Programme, 05.2015-05.2019, 550.000€.

«Aerosols, Clouds, and Trace gases Research InfraStructure, Project Preparation Phase (ACTRIS-PPP)», European Commission Horizon 2020 Research and Innovation Framework Programme, 05.2015-05.2019, 160.000€.

SMartURBan Solutions for air quality, disasters and city growth (SMURBS/ERAPLANET), ERA-NET-Cofund under (H2020-SC5-15-2015 – Strengthening the European Research Area in the domain of Earth Observation, 09.2017-08.2020, 2.000.000€ (33% EU funding).

«Panhellenic infrastructure for atmospheric composition and climate change (PANACEA)», Ministry of Economy and Development (Operational Programme Competitiveness, Entrepreneurship and Innovation - EPAnEK), 11.2018-10.2021, 580.000€.

«Specialized air quality measurements in the Port of Piraeus - Source identification (PiraeusAQ)», Region of Attica, 09.2017-09.2020, 85.000€

«Environmental monitoring integrated system using an IoT network (EMISSION)», European Regional Development Fund of the EU and Greek national funds through the Operational Program Competitiveness, Entrepreneurship and Innovation, under the call RESEARCH CREATE INNOVATE, 08.2018-07.2021, 240.000€

«EuroGEO Showcases: Applications Powered by Europe (e-shape)», European Commission Horizon 2020 Research and Innovation Framework Programme, 05.2019-04.2023, 292.000€

«Solutions for Sustainable Access to Atmospheric Research Facilities (ATMO-ACCESS)», European Commission Horizon 2020 Research and Innovation Framework Programme, 04.2021-03.2025, 395.500€

«Research Infrastructures Services Reinforcing Air Quality Monitoring Capacities in European Urban & Industrial Areas (RI - URBANS)», European Commission Horizon 2020 Research and Innovation Framework Programme, 10.2021-09.2025, 355.000€

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Laboratory of Climatology and Atmospheric Environment (LACAE) of the National and Kapodistrian University of Athens (NKUA)

Main activities

The Laboratory of Climatology and Atmospheric Environment (LACAE) of the National and Kapodistrian University of Athens (NKUA) specialises in atmospheric environmental research, climate variability on various time and space scales, atmospheric circulation teleconnections, measurements of ultraviolet radiation and meteorological parameters, air quality impacts of weather and climate on public health, quality of the atmospheric environment, and investigates the causes and processes associated with weather and climate extremes (heat waves, droughts, floods, tornadoes, etc.).

LACAE has undertaken a systematic effort in recording tornadoes, waterspouts, and funnel cloud in Greece since 2007 and in 2009 the first innovative Greek online Tornado Report System (GTRS; <http://tornado.geol.uoa.gr>), has been launched, contributing to the compilation of climatology of these extreme weather events. Since then, LACAE has been actively collecting information on tornadic events (tornadoes, waterspouts, and funnel cloud) in Greece. The current tornado reporting system is designed based on Greek language, but an updated version is under progress, and it will support multilingual users (e.g., English, French, Italian and German). The main goal of the GTRS is to collect, verify and provide detailed and quality-controlled information regarding tornado activity in Greece, and in the near future GTRS will be able to incorporate all the extreme weather phenomena. Further LACAE maintain a Research Unit of recording and forecasting extreme weather with emphasis on early warning for tornadoes and storms in Greece, by applying high spatial resolution modeling (non-hydrostatic Weather Research and Forecasting model; WRF).

Scientists working at LACAE collaborate with scientists from the Academy of Athens, the Aristotle University of Thessaloniki, the National Technical University of Athens, the University of Freiburg, the DLR-Institute of Atmospheric Physics, ETH Zurich, the University of Helsinki, the University of Albany of New York, and with many other high-level Institutions. The members of LACAE have long experience in teaching in undergraduate and postgraduate courses and have supervised many undergraduate and postgraduate theses in the fields of climatology and atmospheric physics (climate change, regional climate models, extreme weather phenomena, human biometeorology, outdoor thermal comfort, tropospheric ozone, atmospheric pollution on urban and regional scale).

Research topics

- Regional climate variability and trends
- Extreme weather phenomena (heat waves, flash floods, droughts, tornadoes, waterspouts): observations and modelling
- Impact of bioclimatic conditions on human health
- Impact of air pollution on human health
- Analysis of miscellaneous weather phenomena (Foehn winds, Saharan dust episodes)
- Analysis of climatic parameters using satellite and reanalysis datasets, on regional and local scale
- Estimation of hydrological balance on local and regional scale
- Extreme climatic indices on local and regional scale
- Tropospheric ozone variability
- Ozone layer, ultraviolet (UV) radiation, greenhouse gases, clouds variability

Competitive research projects (2019-2022)

1. **BIOASTY** “Bioclimatic urban design services for the sustainability and resilience of the urban environment in the context of climate change”, Action: Research and Innovation Synergies in the Region of Attica, Operational Program "Attica 2014 - 2020" Invitation Code ATT123, Coordination P. Nastos, NKUA, Greece, 2022-2024.
2. **MED-GOLD** Turning climate-related information into added value for traditional MEDiterranean Grape, OLive and Durum wheat food systems. Funded by H2020-EU.3.5.1. Fighting and adapting to climate change, 2017–2021.
3. **SOCLIMPACT** DownScaling CLimate imPACTs and decarbonisation pathways in EU islands and enhancing socioeconomic and non-market evaluation of Climate Change for Europe, for 2050 and beyond. Funded by H2020-EU.3.5.1. Fighting and adapting to climate change, 2017–2021.
4. **PANACEA** “Panhellenic infrastructure for atmospheric composition and climate change”, Ministry of Economy and Development (Operational Programme Competitiveness, Entrepreneurship and Innovation – EPAnEK 2014-2020), Coordination N. Mihalopoulos, University of Crete, Greece, 2018–2022.
5. **CLIMPACT** “National Research Network for Climate Change and its Impacts”, Flagship Initiative, General Secretariat for Research and Innovation (G.S.R.I.), Coordination N. Mihalopoulos, National Observatory of Athens, Greece 2020–2022.

6. **ASPIRE** “Atmospheric parameters affecting spectral solar irradiance and solar energy”, Category I proposal (project number 300), Scientific Area: Environment & Energy, Hellenic Foundation for Research and Innovation (H.F.R.I.) under the “First Call for H.F.R.I. Research Projects to support Faculty members and Researchers and the procurement of high-cost research equipment grant”, Coordination K. Eleftheratos, NKUA, Greece, 2020–2023.
7. **DI-STEM** “Diffusion of STEM”, Hellenic Foundation for Research and Innovation (H.F.R.I.), 2021–2023.

Educational activities (2019-2022)

- Undergraduate programme, Department of Geology and Geoenvironment, NKUA
- MSc in Earth Sciences and the Environment, Department of Geology and Geoenvironment, NKUA
- MSc in Environmental, Disaster and Crises Management Strategies, Department of Geology and Geoenvironment, NKUA
- MSc in Ecology and Biodiversity Conservation, Department of Biology, NKUA
- MSc in Crisis & Disaster Management and Public Health Nursing, Department of Nursing, NKUA
- Interinstitutional Postgraduate Program “Oceanography and Management of the Marine Environment”, NKUA and HCMR.
- Interinstitutional Postgraduate Program “Water, Biosphere and Climate Change”, NKUA, IHU and UNESCO Chair Con-E-Ect.
- Interinstitutional Postgraduate Program “Applications of Biology in Medicine”, Department of Biology and School of Medicine, NKUA
- ERASMUS MUNDUS PANGEA, MSc in Paleontology, Track 2: Applied Palaeontology
- e-Learning NKUA “Meteorological Phenomena: Understanding and Interpretation”.
- 1st Nisyros Summer School, Nisyros Aspiring UNESCO Global Geopark, Department of Geology and Geoenvironment, NKUA, May 29 – June 5, 2022.

Peer-reviewed journal publications (2019-2022)

1. Politi, N., Vlachogiannis, D., Sfetsos, A., Nastos, P. T., and Dalezios, N. R.: High Resolution Future Projections of Drought Characteristics in Greece Based on SPI and SPEI Indices, *Atmosphere*, 13(9), 1468; <https://doi.org/10.3390/atmos13091468>, 2022.

2. Proustos, N., Alexandris, S., Liakatas, A., Nastos, P., and Tsiros, I. X.: PAR and UVA composition of global solar radiation at a high altitude Mediterranean forest site, *Atmospheric Research*, 269, 106039, <https://doi.org/10.1016/j.atmosres.2022.106039>, 2022.
3. Georganta, C., Feloni, E., Nastos, P. T., and Baltas, E.: Critical Rainfall Thresholds as a Tool for Urban Flood Identification in Attica Region, Greece, *Atmosphere*, 13(5), 698; <https://doi.org/10.3390/atmos13050698>, 2022.
4. Papachristopoulou, K., Fountoulakis, I., Gkikas, A., Kosmopoulos, A., Nastos, P. T., Hatzaki, M., and Kazadzis, S.: 15-Year Analysis of Direct Effects of Total and Dust Aerosols in Solar Radiation/Energy over the Mediterranean Basin, *Remote Sens.*, 14(7), 1535; <https://doi.org/10.3390/rs14071535>, 2022.
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6. Tounta, D. D., Nastos, P. T., Tesseromatis, C.: Human activities and zoonotic epidemics: a two-way relationship. The case of the COVID-19 pandemic, *Global Sustainability*, 5, e19, 1–21. <https://doi.org/10.1017/sus.2022.18>, 2022.
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8. Dimitriadou, L., Nastos, P., Eleftheratos, K., Kapsomenakis, J., and Zerefos, C.: Mortality related to air temperature in European cities, based on threshold regression models, *International Journal of Environmental Research and Public Health*, 19, 4017, <https://doi.org/10.3390/ijerph19074017>, 2022.
9. Toumpos, M., Flocas, H. A., Kouroutzoglou, J., and Hatzaki, M.: An updated climatology of atmospheric blocking in the eastern Atlantic-European region, *International Journal of Climatology*, 42(16), 10153–10172, <https://doi.org/10.1002/joc.7889>, 2022.
10. Poulos, S., Karditsa, A., Hatzaki, M., Tsapanou, A., Papapostolou, C., and Chouvardas, K.: An Insight into the Factors Controlling Delta Flood Events: The Case of the Evros River Deltaic Plain (NE Aegean Sea), *Water*, 14(3), 497; <https://doi.org/10.3390/w14030497>, 2022.
11. Flaounas, E., Davolio, S., Raveh-Rubin, S., Pantillon, F., Miglietta, M. M., Gaertner, M. A., Hatzaki, M., Homar, V., Khodayar, S., Korres, G., Kotroni, V., Kushta, J., Reale, M., and Ricard, D.: Mediterranean cyclones: current knowledge

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12. Spyropoulos, G. C., Nastos, P. T., and Moustris, K. P.: Performance of Aether Low-Cost Sensor Device for Air Pollution Measurements in Urban Environments. Accuracy Evaluation Applying the Air Quality Index (AQI), *Atmosphere*, 12(10), 1246, <https://doi.org/10.3390/atmos12101246>, 2021.
13. Dimitriadou, L., Nastos, P., and Zerefos, C.: Defining Heatwaves with Respect to Human Biometeorology. The Case of Attica Region, Greece, *Atmosphere*, 12(9), 1100, <https://doi.org/10.3390/atmos12091100>, 2021.
14. Solomos, S., Nastos, P. T., Emmanouloudis, D., Koutsouraki, A., and Zerefos, C.: A Modeling Study on the Downslope Wind of “Katevatos” in Greece and Implications for the Battle of Arachova in 1826, *Atmosphere*, 12(8), 993, <https://doi.org/10.3390/atmos12080993>, 2021.
15. Nastos, P. T., Dalezios, N. R., Faraslis, I. N., Mitrakopoulos, K., Blanta, A., Spiliotopoulos, M., Sakellariou, S., Sidiropoulos, P., and Tarquis, A. M.: Review article: Risk management framework of environmental hazards and extremes in Mediterranean ecosystems, *Nat. Hazards Earth Syst. Sci.*, 21, 1935–1954, <https://doi.org/10.5194/nhess-21-1935-2021>, 2021.
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