CRL School 2024

Corinth Rift Observatory

Patras-Nafpaktos, Greece

06-10 September 2024

Welcome!!!

Dear teachers and students, welcome to the 2024 edition of the CRL-School!

As you know, the general objective of the School is to unite Master and PhD students from various Greek and foreign universities collaborating in the Corinth Rift Observatory (http://crlab.eu), together with high school European teachers to introduce them to different geophysical and geological methods and observations and first-hand scientific knowledge.

At the School, methods such as seismology, GPS, SAR interferometry, the methods underlying the ESA-SENTINEL mission, the Geohazards Exploitation Platform (GEP) and paleomagnetism, will be examined from a theoretical point of view as well as from the point of view of their applications and results in the specific areas of the Corinth Rift. This rift is one of the most seismically active regions of Europe, where movements are so rapid that it has been defined as “a natural geodynamical laboratory”. The knowledge acquired there is applicable to other seismically active regions worldwide and, thus, has a general signification.

As every year, this school will comprise a mixture of topical presentations, excursions in the field and hand-on activities. It will take place partly in Nafpaktos, partly in Patras. We foresee that the participants will gain understanding of all these methods and their results and be engaged in discussions about the interpretation of the results and how they can be used in teaching and learning in general Earth Sciences, Chemistry, Physics, Biology and Geology.

In Nafpaktos, the presentations will be done in the Municipality Building, which has been generously proposed to us by the Mayor and the Council of the city of Nafpaktos. In Patras we will be hosts of several departments of the University.

Highlights will be, among others, the educational activities for High School, the dissemination to the general public, the presentation of the seismobox, the hand-on ESA software, the field training sessions and the presentation of cores from the sea bottom. There will be also a presentation of the structural monitoring and geometric control of the Rio-Antirrio bridge.

The Organising/Scientific Committee has been one of the key elements in preparing this School, but other people and/or Institutions have contributed to it. We would like to continue to offer students and teachers the opportunity to the CRL School in future years. Of course, this depends upon us being able to show our sponsors that the School has been useful to students and teachers in their studies and in their daily teaching, or as inspiration for teaching geoscience in new ways in their schools.

Therefore, after the School we will ask you:

- To complete the evaluation forms (for students and for teachers) as soon as possible and email it back to us,

- To make a presentation of your experiences at the CRL School to a group of your colleagues after your return from Nafpaktos, and

- Teachers, we invite you to send us reports and photographs about how you have used the CRL School information in your classrooms. We also encourage you to write reports on the School in publications specifically intended for geosciences, science and geography teachers.

Important Note!!!

The interaction between the lecturers and the students of the School is considered crucial. It is being performed throughout the full duration of the School and will be depended not only from the type of the presentation/hand on but also from the students' availability, their preparedness and their proactiveness with the corresponding lecturer/chairperson and the Organizing/Scientific Committee. We encourage the students, and it is foreseen as their duty to initiate communication.

For now, please enjoy your CRL School 2024 in Nafpaktos-Patras! And please tell your colleagues at school, fellow students and friends about it and encourage them to come to future editions of the School!

The CRL School Organizing/Scientific Committee

Acknowledgments

- We thank the **European Geosciences Union (EGU)** for sponsoring CRL School 2024. EGU is a leading organization in Europe focused on advancing Earth, planetary, and space sciences. Founded in 2002, EGU conducts research, organizes conferences, and engages in outreach efforts to support scientific understanding and environmental sustainability globally.
- We thank the **Pleiades IoT Innovation Cluster** for sponsoring CRL School 2024. Pleiades IoT Innovation Cluster is a non-profit company that founded in 2022, contributing to the creation of a dynamic Greek contributing to the creation of a dynamic Internet of Things ecosystem and accelerating its adoption in Greece. The Collaborative Cluster consists of individuals and organizations such as research centers, universities, large and small companies, and small and medium-sized enterprises with specific expertise, as well as start-ups, with the main objective of producing innovation and development of new business models, the provision of optimal services, and increased efficiency of operating models.
- We thank the **European Space Agency (ESA)** for sponsoring CRL School 2024. ESA is an intergovernmental organization dedicated to exploring space, advancing scientific research, and supporting space technology development. ESA conducts satellite missions, space exploration, and Earth observation projects, working closely with international partners to promote space science and innovation. It aims to understand our universe, monitor environmental changes, and foster space-related industry within Europe.
- The Centre National de la Recherche Scientifique (CNRS)
- The municipality of Nafpaktos for logistical support for the lectures given in Nafpaktos,
- A special thanks is given to Uni Systems for taking the time and energy to invest in our vision and in our event.
- And we thank all the speakers who have contributed to the school and their institutions.

CRL School 2024 Organising/Scientific Committee

CHAIR

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George Goutsos

Corinth Rift Laboratory School–2024

(Patras-Nafpaktos September 6-10, 2024)

Programme

Friday September 6, 2024

Department of Physics, University of Patras

13:00 – 13:30 **Welcome to the CRL School 2024**

13:30 – 14:00 **Why CRL?**
Pierre Briole, École normale supérieure / CNRS, Paris, France

14:00 – 14:30 **Geodynamic setting, large earthquakes and the growth of faults in the western Corinth rift**
Athanassios Ganas, National Observatory of Athens, Greece

14:30 – 15:00 **The geodetic monitoring of the Corinth Rift Observatory with GPS and SAR interferometry**
Pierre Briole, École normale supérieure / CNRS, Paris, France

15:00 – 15:30 Break

15:30 – 16:00 **Use of CRL Data for Detailed Seismological Studies** Efthimios Sokos, Universioty of Patras, Greece

16:00 – 16:30 **Large Earthquakes and Focal Mechanisms in the Gulf of Corinth**
George Kaviris, National and Kapodistrian University of Athens, Greece

16:30 – 17:00 **Off-shore faults imaging and monitoring in the Corinth Rift**
Maria Geraga, University of Patras, Greece

17:00 – 17:30 **EGU, educational committee, activities supported by EGU**
Fotios Danaskos, EGU GEFO (Geoscience Education Field Officer) for Greece

17:30 Departure to Nafpaktos (Akti Hotel)

Saturday September 7, 2024

08:30 Departure from Akti Hotel

Nafpaktia Conference room, Nafpaktos (for the location, click here)

08:45 – 09:00 **Welcome messages**

09:00 – 09:30 **Tectonics, structural setting and tectono-sedimentary processes in the Corinth Rift**
Haralambos Kranis, National and Kapodistrian University of Athens, Greece

09:30- 10:00 **Use of CRL Data for Detailed Seismological Studies**
Anna Serpetsidaki, University of Patras, Greece

10:00 – 10:30 **Historical elements for sciences and observatories**
Fiori-Anastasia Metallinou, National Observatory of Athens, Greece

10:30 – 10:40 **Introduction to geological (outcrop) field trip of Sunday**
Athanassios Ganas, National Observatory of Athens, Greece

10:40 – 11:10 Break

11:10 – 13:00 **Hands on GNSS measuring**
Panagiotis Elias, National Observatory of Athens, Greece
George Polykretis, TREE Company, Athens, Greece
Pierre Briole, École normale supérieure / CNRS, Paris, France

13:00 – 15:00 Lunch Break

15:10 – 15:30 Transport to hands-on lab

15:30 – 16:30 **Hands on simple seismic software package provided in the CRL portal**
George Kaviris, National and Kapodistrian University of Athens, Greece Ioannis Spingos, National and Kapodistrian University of Athens, Greece

16:30 – 17:30 **Presentations by the students**
3mn per student + questions

17:30 – 21:30 Free time

21:30 – 23:00 **Sky gazing (in an area close the hotel Akti that will be announced shortly before)**
Fiori-Anastasia Metallinou, National Observatory of Athens, Greece
Drivas Argyris, 3rd Junior High School of Nafpaktos, Astronomy Group of Nafpaktos, Greece

Sunday September 8, 2024

08:30 Departure from Akti Hotel

08:30 – 13:30 **Field trip at Psaromita (GNSS and seismic station), geologic stops along the journey**
Athanassios Ganas, National Observatory of Athens, Greece

Arrival at Akti hotel

13:30 – 15:00 Lunch Break

15:00 – 15:40 **A concise overview of the lithostratigraphy architecture and its implications to the Quaternary evolution of the Gulf of Corinth (Greece)**
Koutsovitis Petros, University of Patra

15:40 – 16:10 **The earthquake suitcase**
Vasiliki Kouskouna, National and Kapodistrian University of Athens, Greece

16:10 – 16:40 Break

16:40 – 17:10 **Data mining at school: some examples to address geosciences cases studies at school with online data**
Patrick Strozza, Lycée international Georges Duby, Luynes, France

17:10 – 17:40 **Best practices for Geosciences teaching in Mediterranean area**
Eleni Koutsopoulou, PhD Geologist, Teacher at Secondary Education/ Patras

17:40 – 18:30 **Laboratory: Training teachers & pupils on geosciences through Virtual Field Trips. Pilot application from AR activities**
TripGift Erasmus+ Team partners (Makri Kiki)

Monday September 9, 2024

10:00 Departure from Akti Hotel to 3rd Junior High School in Nafpaktos

10:30 – 11:30 **Teaching Earthquakes in classroom using stem tools**
Fotios Danaskos, EGU GEFO, Greece/8th Junior High School in Chalandri, Greece

11:30 – 12:10 **Teaching Earthquakes in classroom using open data, case study: active fault bases**
Kiki Makri, 26th Experimental Junior High Schools of Athens/National Observatory of Athens

12:10 – 12:40 **CRL School's educational team**
Experimental activities, Pedagogical activities, Online activities

University Students

Nafpaktia Conference room, Nafpaktos (for the location, click here)

09:00 – 09:30 **GNSS: from the planning of a continuous network to the analysis and interpretation of the relative data**
Pierre Briole, École normale supérieure / CNRS, Paris, France

09:30 – 10:00 **Introduction to satellite SAR interferometry**
Panagiotis Elias, National Observatory of Athens, Greece

10:00 – 10:30 **Ground Deformation Studies in Seismic Active Areas combining Local GPS/GNSS and permanent GNSS networks. The Case of Central Ionian Islands and Patras Gulf**
Vasilios Sakkas, National and Kapodistrian University of Athens, Greece

10:30 – 11:00 **Multitemporal monitoring of active faults with close-range (t-LiDAR, UAS) remote sensing equipment**
Emmanouel Vassilakis, National and Kapodistrian University of Athens, Greece

11:00 – 11:30 Break

11:30 – 12:00 **Static and dynamic gravity investigations within Corinth Rift Laboratory project**
Jan Mrlina, Institute of Geophysics, Czech Academy of Science, (IGCAS) Prague

12:00 – 12:30 **Open Seismic Data Retrieval through EIDA Nodes and Automated Moment Tensor Analysis**
Christos Evangelidis, National Observatory of Athens, Greece

12:30 – 13:00 **Seismic hazard in Greece with a focus in the Western Gulf of Corinth**
Angelos Zymvragakis, National and Kapodistrian University of Athens, Greece

13:00 – 13:30 **Physical mechanisms behind seismic site response - Some examples from Aegion**
Olga Ktenidou, National Observatory of Athens, Greece

13:30 – 14:30 Lunch Break

14:30 – 16:00 **Free time!**

16:00 – 16:20 Transport to hands-on lab

16:20 – 18:00 **Follow-up Hands on GNSS measuring**
Pierre Briole, École normale supérieure / CNRS, Paris, France
Panagiotis Elias, National Observatory of Athens, Greece

Tuesday September 10, 2024

08:30 Departure from Akti Hotel

Laboratory of Seismology, University of Patras

09:30 – 10:00 **Climate and Earthquakes: Recent Research and Potential Contribution of Near Fault Observatories**
Zafeiria Roumelioti, University of Patras, Greece

10:00 – 10:30 **Relative Sea level changes in the Corinth Gulf during the late Holocene** Niki Evelpidou, National and Kapodistrian University of Athens, Greece Anna Karkani, National and Kapodistrian University of Athens, Greece

10:30 – 11:00 **Earthquake structural response of Rion Antirrion Bridge: 15yrs of continuous structural surveillance through permanent instrumentation system**
Akis Panagis, GEFYRA S.A., Greece

11:00 – 11:30 ***Move from Seismology Laboratory to Department of Geology***

11:30 – 12:00 **Recent sedimentary processes in the Gulf of Corinth. Seismic and aseismic turbidites**
Spyros Sergiou, University of Patras, Greece

12:00 – 12:50 **(parallel groups of ~10) Laboratory class for coring study**
Spyros Sergiou, University of Patras, Greece

(parallel groups of ~10) Laboratory class: Study of archaeomaterials in "KERAMos Lab"
Ioannis Iliopoulos, University of Patras, Greece
Vaia Xanthopoulou, University of Patras, Greece

12:50 – 14:00 Lunch at the cafeteria near the department of Physics

14:00 – 15:00 ***Drive to the Helike Fault***

15:00 – 16:30 **Educational field activities at the Helike fault**
CRL School's educational team: Kiki Makri & Fotis Danaskos

16:30 – 17:30 **Field trip to the Helike fault**
Emmanouel Vassilakis, National and Kapodistrian University of Athens, Greece

End of the CRL School 2024 - School Bus to the city of Aigion and to Nafpaktos

See the timetable for buses from Aigio to Athens

Participants

Students

a/a	First Name	Last Name	e-mail address	Affiliation
1	Alexandros	Papadopoulos	alpa@geol.uoa.gr	National and Kapodistrian University of Athens
2	Anastasios	Slavis	tasossl@gmail.com	National and Kapodistrian University of Athens
3	Angelos	Zymvragakis	azymvragakis@geol.uoa.gr	National and Kapodistrian University of Athens
4	Christoforos	Giannadakis	christophgia@gmail.com	Harokopio University of Athens
5	Dejan	Bajić	bajicdejan998@gmail.com	University of Novi Sad
6	Dimitrios	Potamousis	dimitrispot25@gmail.com	National and Kapodistrian University of Athens
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10	Tryfon	Boutas	mpoutastryphonas@gmail.com	Harokopio University of Athens
11	Tunahan	Aykut	tunahanaykutt@gmail.com	Istanbul Technical University
12	Vera Christanti	Agusta	vera-christanti.agusta@etu.univ-nantes.fr	Nantes University

Teachers

a/a	Last Name	First Name	e-mail address	Affiliation
1	Agnes	Pointu	agnes.pointu@gmail.com	Lycée Louis de Broglie
2	Apostolou	Myrto	myrto2005@yahoo.gr	26th Experimental Secondary School of Athens
3	Freitas	Carla	freitas.carla76@gmail.com	Escola Básica e Secundária de Macedo de Cavaleiros
4	Koniari	Aikaterini	koniari.kat@gmail.com	Kranea & Elassona Secondary School
5	Molinos Solsona	Marta	m.molinossolsona@edu.gva.es	Institut de La Vall d'Alba
6	Spanias	Athanasios	thanassis.spanias@gmail.com	7th Experimental Secondary School of Trikala
7	Thabet	Soumaya	thabetsoumaya@gmail.com	Lycée Gustave Flaubert La Marsa
8	Toumanidis	Nikolaos	niktouman@gmail.com	General High School of Mochos
9	Tsetsou	Eyaggelitsa	ltsetsou@yahoo.gr	6th Secondary School of Nea Ionia
10	Uz	Gülsüm Yasemin	gyaseminuz@gmail.com	İstanbul Fuat sezgin BİLSEM

Curricula Vitae

Pierre Briole

Research Director
Ecole Normale Supérieure,
Paris Sciences et Lettres Research University,
Département des Géosciences

briole@ens.fr

Education

1990 Ecole Normale Supérieure de Cachan in applied physics. Agrégation 1983.PhD, University Paris VI, Paris

Career

2007-today	Research Director CNRS Ecole Normale Supérieure/Paris Sciences et Lettres Research University - Département des Géosciences - Laboratoire de Géologie
2008-2009	09/2008-2009: Directeur des études,
2010-2013	2010-2013: Head of the Department
2004-2007	Research Director CNRS Institut de Physique du Globe de Paris
2005-2006	Director of the laboratory of Geodesy
1990-2004	Chargé de Recherche CNRS Institut de Physique du Globe de Paris - Département de Sismologie
1989-1990	Researcher Institut Géographique National – Laboratoired'Opto-Electronique et de Micro-informatique

Research interests

Study of the deformation or volcanoes (Etna, Campi Flegrei, Vulcano (Italy), Piton de la Fournaise (France), Nisyros (Greece), Sakurajima (Japan) and seismic zones (Asal Rift (Djibouti), Gulf of Corinth (Greece), Northern Chile, Umbria (Italy), Algeria, Bulgaria) using various methods, including GPS, radar interferometry, high resolution imaging and local methods (tiltmeter, micro-gravity, ...).
Modelling of ground deformations and interpretation combining tectonic, geodetic, and seismological data.
Development of new technologies (Projects of satellites, ground based radars, robots).

Publications and services

73 articles in journals with peer review, 2951 citations
194 communications in international meetings
3 articles in outreach journals, participation to 4 educational &/or educative movies, several interviews in French radios, several lectures in schools

Coordinator of the "Insegnaci Etna" project http://ietna.eu

Athanassios Ganas

Research Director

Institute of Geodynamics, National Observatory of Athens

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Education

Bachelor of Science, Geology, University of Athens; Master of Science in Structural Geology, Carleton University, Canada; PhD in Geological Remote Sensing and Earth Sciences University of Reading, UK.

Career

2012-2023 Research Director NOA

2000-2011 Researcher NOA

Research interests

Active Tectonics-Seismotectonics and Remote Sensing / Geophysical Earth Observation including Fault Interaction, Tectonic Geomorphology and GNSS networks.

Publications and services

Evelpidou N, Ganas A, Karkani A, Spyrou E, Saitis G. 2023. Late Quaternary Relative Sea-Level Changes and Vertical GNSS Motions in the Gulf of Corinth: The Asymmetric Localization of Deformation Inside an Active Half-Graben. Geosciences, 13(11):329. https://doi.org/10.3390/geosciences13110329

Mesimeri, M., Ganas, A., Pankow, K.L., 2022. Multisegment ruptures and Vp/Vs variations during the 2020-2021 seismic crisis in western Corinth Gulf, Greece, Geophysical Journal International, Volume 230, Issue 1, Pages 334–348, ggac081, https://doi.org/10.1093/gji/ggac081

In October 2021 he was elected President of the Geological Society of Greece. He is the Editor-in-Chief of BGSG https://ejournals.epublishing.ekt.gr/index.php/geosociety.Since 2017 he serves as Member of the Greek National Committee for Seismotectonics. During 2010-2017 he served as regular member at the Board of Directors of the EPPO (Earthquake Planning and Protection Organisation, Greece). Since 2021 he has been an elected member of the EPOS TCS-GNSS Consortium Board. Since 2013 he has initiated and leads the NOAFAULTs project (Database of Active Faults of Greece; https://zenodo.org/record/8075517).

Awards and honors

In 2016 he received the best Geodesy paper of the Academy of Athens (with Kostas Chousianitis). In 2007 he won the Fulbright prize “Project Title: *Earthquake recurrence and seismic hazard forecast along the Cascadian and Hellenic subduction zones*”. In 2010 he was awarded the distinction «AGU Editors’ Citations for Excellence in Refereeing». In 2017 he was announced as “Outstanding Reviewer” for Tectonophysics.ed faults. Geophys. J. Int., 215, 659-676. doi: 10.1093/gji/ggx301, 2018.

Efthimios Sokos

Professor of Seismology and Engineering Seismology
University of Patras, Geology Department

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Education

BSc in Geology (1992, Univ. of Patras), PhD in Seismology (1998, Univ. of Patras).

Career

2002-2005	Researcher at the Geodynamical Institute of the National Observatory of Athens
2005-today	Faculty member, Geology Department, Univ. of Patras

Research interests

Seismic source studies, seismotectonics and seismic hazard

Publications and services

Prof. E. Sokos has more than 80 publications in international peer reviewed journals, and more than 2000 citations for his work (h-index:25). He is responsible for the seismic network operation at the University of Patras, for the last fifteen years. He is co-author of ISOLA moment tensor inversion software, which is used in many research institutes.

George Kaviris

Associate Professor
National and Kapodistrian University of Athens
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Education

1994: Graduated from the Faculty of Physics, National and Kapodistrian University of Athens (NKUA)
2003: PhD of Seismology, Department of Geophysics and Geothermics, Faculty of Geology and Geoenvironment, NKUA. Thesis subject: "Study of Seismic Source Properties of the Eastern Gulf of Corinth".

Career

2021 – today: Associate Professor of "Seismology–Seismic Anisotropy", Sect. Geophysics and Geothermics, Department of Geology and Geoenvironment, NKUA.
2016 – 2021: Assistant Professor of "Seismology – Seismic Anisotropy", Sect. Geophysics and Geothermics, Department of Geology and Geoenvironment, NKUA.
2013 – 2016: Lecturer of "Seismology", Sect. Geophysics and Geothermics, Department of Geology and Geoenvironment, NKUA.
2006 – 2013: Research Associate, Laboratory of Seismology, Sect. Geophysics and Geothermics, Department of Geology and Geoenvironment, NKUA.
2004 – 2007: Post-Doc Researcher, Research Project "Pythagoras" entitled: «Identification of Anisotropic Media in Greece using body and surface waves».

Research interests

My primary research interest is Seismic Anisotropy and Shear-wave Splitting of the upper crust and mantle. In addition, Seismotectonics, Seismic Hazard and Risk, Receiver Functions, Ambient Noise, Slip Distribution, Seismic Swarms and Earthquake Early Warning.

Publications and services

Supervisor of 20 MSc and 24 BSc students. I am currently supervising 2 PhD Theses.
I have 191 publications in international scientific journals and congress proceedings. Among my publications for the Gulf of Corinth:

G. KAVIRIS, A. Zymvragakis, P. Bonatis, V. Kapetanidis, N. Voulgaris, 2022. Probabilistic and Scenario – based Seismic Hazard Assessment on the Western Gulf of Corinth (Central Greece). Appl. Sci., 12 (21), 11152. doi: 10.3390/app122111152.

G. KAVIRIS, P. Elias, V. Kapetanidis, A. Serpetsidaki, A. Karakonstantis, V. Plicka, L. De Barros, E. Sokos, I. Kassaras, V. Sakkas, I. Spingos, S. Lambotte, C. Duverger, O. Lengliné, Ch. Evangelidis, I. Fountoulakis, O.-J. Ktenidou, F. Gallovič, S. Bufféral, E. Klein, El M. Aissaoui, O. Scotti, H. Lyon-Caen, A. Rigo, P. Papadimitriou, N. Voulgaris, J. Zahradnik, A. Deschamps, P. Briole, P. Bernard, 2021. *The Seismic Record*,1, doi.org/10.1785/0320210021.

G. KAVIRIS, I. Spingos, V. Kapetanidis, P. Papadimitriou, N. Voulgaris and K. Makropoulos, 2017. Upper crust seismic anisotropy study and temporal variations of shear-wave splitting parameters in the Western Gulf of Corinth (Greece) during 2013. Phys. Earth Plan. Int., 269, 148-164, doi.org/10.1016/j.pepi.2017.06.006.

G. KAVIRIS, Ch. Millas, I. Spingos, V. Kapetanidis, I. Fountoulakis, P. Papadimitriou, N. Voulgaris and K. Makropoulos, 2018. Observations of shear-wave splitting parameters in the Western Gulf of Corinth focusing on the 2014 Mw=5.0 earthquake. Phys. Earth Plan. Int., 282, 60-76. doi.org/10.1016/j.pepi.2018.07.005.

Awards and honors

January 2017: Highly cited Research Award for "Karst collapse susceptibility mapping considering peak ground acceleration in a rapidly growing urban area" (co-author). This publication was awarded as being among the five (5) most cited works of the "Engineering Geology" for the period January 2014 - June 2016.

Maria Geraga

Professor,

Laboratory of Marine Geology and Physical Oceanography, Department of Geology, University of Patras, 26504 Rio Achaia

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Education

2000:	Phd in Oceanography, Department of Geology, University of Patras, Greece. Title of thesis: 'Evaluation of palaeoceanographic and palaeoclimatic changes during Holocene in SW Aegean Sea (Greece) and the formation of the sapropels''
1993:	B. Sc. in Geology, University of Patras, Greece

Career

2020-today	Professor, Dept. of Geology, University of Patras, Greece
2016-2020	Assistant Professor (permanent), Dept. of Geology, University of Patras, Greece
2012-2015	Assistant Professor (adjustment), Dept. of Geology, University of Patras, Greece.
2006-2012	Lecturer in "Archaeological Oceanography", Dept. of Geology, University of Patras, Greece
2000-2006	Under Appointed Ass. Professor in Polytechnics, in Chemical Oceanography. Higher Educational Technological Institute of Messolonghi, Greece.
1993-2006	Research Associate in the Laboratory of Marine Geology and Physical Oceanography, Dept. of Geology, University of Patras.

Research Interests

Palaeoclimatology-Palaeoceanography, Marine sedimentology, Marine Geoarchaeology, Marine hazards, Marine natural and cultural heritage sites and Marine Pollution

Publications And Services

She has more than 85 articles in journals of Science Citation Index, peer reviewed scientific journals and chapters in scientific books and 65 publications (full length papers) and more than 55 publications (abstracts) in International Conferences in the field of Marine Science. Scientist in charge for several national and EU projects. Reviewer in journals of Science Citation Index and peer reviewed journals. Evaluator in national and international Science Foundations. Supervisor of undergraduate and postgraduate dissertations and Phd dissertations. Member of the Science Party of IODP Expedition 381 Corinth Rift.

Haralambos Kranis

Assistant Professor
National and Kapodistrian University of Athens
Department of Geology and Geoenvironment

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Education

Degree in Geology National and Kapodistrian University of Athens, Post-graduate Diploma, in Seismology, (International Institute for Seismology and Earthquake Engineering), Ph.D. in Geological Sciences, National and Kapodistrian University of Athens

Career

My scientific career mainly involves working for the Department of Geology and Geoenvironment, at the Sector of Dynamic, Tectonic and Applied Geology, while I have also served as Tectonics and Structural Geology expert for the General Secretariat for Civil Protection, collaborated with the Earthquake Research and Planning Organization (EPPO), and the Hellenic Centre for Marine Research (HCMR); and as a consultant for major infrastructure projects, such as gas and oil pipelines, and management of natural hazards.

Research Interests

My main research interests include, but are not limited to, Tectonics and Structural Geology (especially brittle deformation), Neotectonics, Active Tectonics and Earthquake Geology, Tectonic Geomorphology and Palaeoseismology. In the last decade, I am involved in research on the tectonic control on sedimentation and basin formation in actively evolving continental rifts and their inactive analogues. Extending my scope in field geology and geological mapping, I have adopted methods and techniques that involve spatial analysis of geological structures through Structure from Motion (SfM), 3D outcrop modelling of outcrops, digital field mapping and modelling of tectonically-controlled landscapes.

Publications and Services

I have published over 40 articles in peer-reviewed scientific journals, several field guides and special reports, as well as geological and neotectonic maps at various scales.

Awards and Honors

Scholarship from the Government of Japan (Japan International Cooperation Agency)
Goldschmidt Lecturer, Geological Survey of Norway.

Anna Serpetsidaki

Researcher

Seismological Laboratory, Geological Department,
University of Patras, Patras, Greece

annaserp@upatras.gr

Education

BSc Geology (1999), Geological Department, University of Patras, Greece
PhD Seismology (2004), Applied Geology and Geophysics, Geological Department, University of Patras, Greece
Postdoctoral Research (2005), Faculty of Mathematics and Physics, Department of Geophysics, Charles University of Prague, Czech Republic.

Career

2013 – today: Faculty Member of Geology Department, Patras University
2000 – 2013: Researcher, Seismological Laboratory of Patras University

Research Interests

Ground Response Analysis, Seismic Hazard, Seismic Source Properties, Moment Tensor,Microsesmic networks, Seismotectonics.

Publications And Services

Nikolakopoulos, K.G., Kyriou, A., Sokos, E., Bousias, S., Strepelias, E., Groumpos, P., Mpelogianni, V., Roumelioti, Z., **Serpetsidaki, A.,**Paliatsas, D., Stephanopoulos, P., Ganas, A., Charalampoulou, V.B., Athanasopoulos, T..(2023). Outcomes of continuous monitoring of crucial infrastructure in the framework of "IIROION" project. Conference Paper. Proceedings of SPIE - The International Society for Optical Engineering.

Serpetsidaki, A.,Kapetanidis, V., Elias, P., Rigo, A., Spingos, I., De Barros, L., Lengliné, O., Bufféral, S., Karakonstantis, A., Bernard, P., Briole, P., Zahradník, J., Kaviris, G., Plicka, V., Sokos, E., Voulgaris, N.. (2023). The 2020–2021 seismic sequence in the Western Gulf of Corinth: Insights on the triggering mechanisms through high resolution seismological and geodetic data analysis. Journal Article. Tectonophysics.

Zahradnik J., Aissaoui E.M., Bernard P., Briole P., Bufferal S., De Barros L., Deschamps A., Elias P., Evangelidis C.P., Fountoulakis I., Gallovic F., Kapetanidis V., Kaviris G., Ktenidou O.-J., Lambotte S., Lengline O., Lyon-Caen H., Noble M., Plicka V., Rigo A., Roumelioti Z., **Serpetsidaki A**., Sokos E., Voulgaris N. (2022). An Atypical Shallow Mw 5.3, 2021 Earthquake in the Western Corinth Rift (Greece). Journal of Geophysical Research: Solid Earth, 127 (9), art. no. e2022JB024221 DOI: 10.1029/2022JB024221.

Ganas, A.; Hamiel, Y.; **Serpetsidaki, A**.; Briole, P.; Valkaniotis, S.; Fassoulas, C.; Piatibratova, O.; Kranis, H.; Tsironi, V.; Karamitros, I.; Elias, P.; Vassilakis, E. The Arkalochori Mw = 5.9 Earthquake of 27 September 2021 Inside the Heraklion Basin: A Shallow, Blind Rupture Event Highlighting the Orthogonal Extension of Central Crete. Geosciences 2022, 12, 220. https://doi.org/10.3390/geosciences12060220

V. Plicka, F. Gallovic, J. Zahradnik, **A. Serpetsidaki**, E. Sokos, N. Vavlas, A. Kiratzi, The 2020 Samos Mw7 earthquake: Source model depicting complexity and rupture directivity, Tectonophysics, Volume 843, 2022, 229591, ISSN 0040-1951, https://doi.org/10.1016/j.tecto.2022.229591.

Serpetsidaki, A., Sokos, E., Tselentis, G.-A. A ten year Moment Tensor database for Western Greece (2016) Physics and Chemistry of the Earth, 95, pp.2-9.

Serpetsidaki , A., Elias, P., Ilieva, M., Bernard, P., Briole, P., Deschamps, A., Lambotte, S., Lyon-Caen, H., Tselentis, G-A. &Sokos, E. (2014), New Constraints from Seismology and Geodesy on the Mw=6.4 2008 Movri (Greece) Earthquake. Evidence for a Growing Strike Slip Fault System. Geophysical Journal Intenational, , 198 (3), pp. 1373-1386.

Serpetsidaki, A., Verma, N. K., Tselentis, G. A., Martakis, N., Polychronopoulou, K., & Petrou, P. (2013). Seismotectonics of Lower Assam, Northeast India, Using the Data of a Dense Microseismic Network. Bulletin of the Seismological Society of America, 103(5), 2875-2883.

Fiori - Anastasia Metallinou

Public Outreach Officer
National Observatory of Athens
Institute for Astronomy, Astrophysics, Space Applications and Remote Sensing (IAASARS)

ametal@noa.gr

Education

2009 Ph.D. in Space Physics, Aristotle University of Thessaloniki, National Observatory of Athens. Title of Thesis: "Development and Recovery of Magnetic Storms in Geospace".
2001 M.Sc. Degree in Atmospheric and Environmental Physics, Aristotle University of Thessaloniki, Greece.
1998 Diploma in Physics, Physics Department, Aristotle University of Thessaloniki, Greece.
2008 Diploma in Classical Singing from the Athens Conservatory "Musical Horizons".
2004-2006 Studies in the Faculty of Melodramatic State Conservatory, Thessaloniki, Greece.

Career

2014-today Lead Public Outreach Officer at the Thissio Visitor Center of the National Observatory of Athens (located at the historic site in the center of Athens).
2010-2013 Research Associate at the Institute for Astronomy, Astrophysics, Space Applications and Remote Sensing of the National Observatory of Athens.

Research interests

Simulation of ion acceleration in the Earth's magnetosphere during magnetic storms and magnetospheric substorms.
Sonification of scientific data describing magnetospheric disturbances.
The use of the "sounds of space" in education, dissemination of Astronomy and the arts.

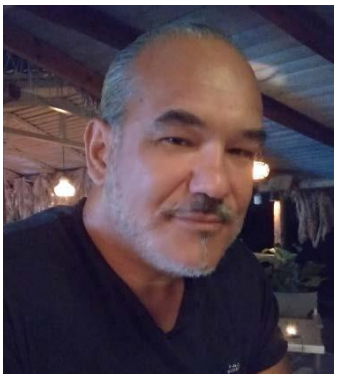
Publications and services

F.-A Metallinou, "Pythagoras Redivivus: The Music of the Spheres and it' s Reification in Modern Astronomy" 10th Congress of the International Society for the Interdisciplinary Study of Symmetry, Adelaide, Australia, 1-6 December 2016.
E. Rovithis, F.-A Metallinou, A. Floros, "Hearing a magnetic storm: an Educational Interactive Audio Environment", 8th Pan Hellenic Conference of Acoustics 2016, 3-4 October 2016, Athens.

2019: Scientific research, scenario and presentation of the documentary "*The Experiment of Eratosthenes*", production: Cosmote TV.
2018: Scientific research, scenario and voice over of the documentary "*Time of Greece*", production: Cosmote TV.

Awards and honors

She has received the Research Grant "HRAKLEITOS" with priority in Basic Research of the Ministry of Education of Greece (2002 - 2005) and the award of the "Barbanis Price of Astronomy" from the Aristotle University of Thessaloniki (1995).
She has been a TEDx speaker in 2014, 2018 and 2022. She contributes to the dissemination of Astronomy and Space Physics concepts with public lectures and articles in the media, newspapers, public journals, TV shows, documentaries and activities combining science and art. She has been an invited speaker by educational organizations, private and public schools, laboratory science centers of the Hellenic Department of Education, associations of amateur astronomers,



Panagiotis Elias

Associate Researcher

National Observatory of Athens
Institute for Astronomy, Astrophysics, Space
Applications and Remote Sensing (IAASARS)

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Education

2013 PhD in the framework of co-tutelle agreement between the École Normale Supérieure (Département des Géosciences, France) and the University of Patras (Department of Physics, Greece), with title "Ground deformation observed in the western Corinth rift (Greece) by means of SAR interferometry".

2007 MSc in Signal Processing for Telecommunications and Multimedia of the department of Informatics and Telecommunications of the University of Athens, Greece.

2003 Degree of Electronics Engineering of the Technological Educational Institute of Piraeus.

Career

2021- Associate Researcher of IAASARS/NOA.

2005-2021 Scientific staff of IAASARS/NOA.

1998-2005 Research assistant of Institute for Space Applications and Remote Sensing (later IAASARS) of NOA.

Research interests

I have participated in more than 40 research projects in the field of satellite geodesy and image/signal processing exploiting the synergy of active and passive earth observations satellites as well as GNSS and other in-situ measurements such as inclinometers, levelling and seismological data. My research interest is focused in the detection and measurement of ground deformation and infrastructure instability due to geophysical processes of manmade activities. Moreover, I am contributing to the development of methodologies and to the modelling of the deformation sources considering the particular underlying geodynamic and geophysical background. I am author of 45 peer refereed publications in international journals, and more than 75 presentations in international conferences.

Selected publications and services

1. Serpetsidaki, A., Kapetanidis, V., Elias, P., Rigo, A., Spingos, I., De Barros, L., ... & Voulgaris, N. (2023). The 2020–2021 seismic sequence in the Western Gulf of Corinth: Insights on the triggering mechanisms through high resolution seismological and geodetic data analysis. Tectonophysics, 863, 230011.
2. P. Elias, I Spingos, G Kaviris, A Karavias, T Gatsios, V Sakkas and I . Parcharidis (2021). Combined Geodetic and Seismological Study of the December 2020 Mw= 4.6 Thiva (Central Greece) Shallow Earthquake. Applied Sciences 11 (13), 5947
3. Briole P., Ganas A., Elias P., Dimitrov D. (2021). The GPS velocity field of the Aegean. New observations, contribution of the earthquakes, crustal blocks model, Geophysical Journal International, 2021, ggab089, https://doi.org/10.1093/gji/ggab089
4. Roukounakis N., Elias P., Briole P., Katsanos D., Kioutsioukis I., Argiriou A., Retalis A. (2021). Tropospheric Correction of Sentinel-1 Synthetic Aperture Radar Interferograms Using a High-Resolution Weather Model Validated by GNSS Measurements.Remote Sensing 13 (12), 2258
5. Briole P., Ganas A., Elias P., Dimitrov D. (2021). The GPS velocity field of the Aegean. New observations, contribution of the earthquakes, crustal blocks model, Geophysical Journal International, 2021, ggab089, https://doi.org/10.1093/gji/ggab089

Co-responsible for the operation of 16 GNSS stations of the CRL observatory

Awards and honors

Member of the ESA Living Planet Symposium Scientific Committee for the years 2010 and 2013.

Ioannis Spingos

PhD Candidate in Seismology
National and Kapodistrian University of Athens
Department of Geology and Geoenvironment
Section of Geophysics and Geothermics

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Education

I completed the undergraduate programme of the Department of Geology &Geoenvironment at the National and Kapodistrian University of Athens to obtain my BSc and then continued in the postgraduate courses at the same department, to obtain my MSc in Seismology. Today, I am a PhD candidate in Seismology.

Career

August 2018-today	Researcher in various nationally and EU- funded research projects at the National and Kapodistrian University of Athens, the Geodynamic Institute of the National Observatory of Athens, and the Hellenic Mediterranean University.

Research interests

My research focuses on shear-wave splitting in the upper crust and its properties as earthquake precursors. I have also worked on seismic hazard and earthquake early warning topics. I extensively code in Python, maintaining my own GitHub repositories.

Publications and services

My published work includes 16 articles in international peer-reviewed journals and 29 publications in conferences, with over 100 citations, which focus on shear-wave splitting, seismotectonics and earthquake early warning. Selected publications:

Kaviris, G., Spingos, I., Kapetanidis, V., Papadimitriou, P., Voulgaris, N., Makropoulos, K., 2017. Upper crust seismic anisotropy study and temporal variations of shear-wave splitting parameters in the Western Gulf of Corinth (Greece) during 2013. Phys. Earth Planet. Inter. 269, 148–164. doi: 10.1016/j.pepi.2017.06.006

Kaviris, G., Millas, C., Spingos, I., Kapetanidis, V., Fountoulakis, I., Papadimitriou, P., Voulgaris, N., Makropoulos, K., 2018. Observations of shear-wave splitting parameters in the Western Gulf of Corinth focusing on the 2014 Mw = 5.0 earthquake. Phys. Earth Planet. Inter. 282, 60–76. doi: 10.1016/j.pepi.2018.07.005

Spingos, I., Kaviris, G., Millas, C., Papadimitriou, P., Voulgaris, N., 2020. Pytheas: An open-source software solution for local shear-wave splitting studies. Comput. Geosci. 134, 104346. doi: 10.1016/j.cageo.2019.104346

Fotios Danaskos

Geologist, School Teacher
8th Junior High School in Chalandri, HELLAS

fdanas@yahoo.gr

Education

2008: National and Kapodistrian University of Athens Hellas, School of Education/University College London Institute of Education, M.A. Education and Human Rights direction Special Education, MSc.
2004: National and Kapodistrian University of Athens Hellas, Department of Communication & Media Studies, Annual Teacher Training Seminar, "Professional Identity and Communication Counseling".
1994: Technological Educational Institute of Athens Hellas, Faculty of Health and Caring Professions, Physiotherapy Department, BSc.
1986: National and Kapodistrian University of Athens Hellas, Department of Geology, Athens, BSc.

Career

1997-2007	Freelance Physiotherapist
1994-2013	Physiotherapist School Teacher
2013-today	Geologist School Teacher

Research interests

Researcher «Recording the symptoms of pain in the joints of the spine and upper and lower limbs of students in Vocational Secondary School, 2005.
Member of the research group "Pattern of Child Status in Primary and Vocational Secondary School, 2005

Publications and services

E.G.U. Geoscience Education Field Officer for Greece
Member of the Scientific Committee of C.R.L. School, Corinth Rift Observatory
G. Secretary of the Committee of GEO sciences Didactis of Geological Society of Greece
Participation in CRL 2018 – 2021 and Insegnaci Etna School 2019, Assistant presenter in CRL 2019 on the SEISMOBOX
Member of the B' Training Team in the New Curricula for Geology/Geography in High School 2022-2023
Erasmus+ , eTwinning School Coordinator
Organization of programs on Environmental Education and Geosciences through partnerships with schools of Europe.
Member of the Writing Team for the course "Introduction to Physiotherapy", of the of the Assistant Physiotherapists 2nd class of the TVES of Health and Welfare Sector, Pedagogical Institute 2001.
Member of the Jury Team for the Workshop on "Supervised Practice in Welfare Services" Round 1, Class 2 TVES, of Health and Welfare Sector**,** Pedagogical Institute 2001.
Member of the Curriculum Development Team of the Assistant Physiotherapists of the TVES. 2000.

Kiki Makri

Teacher of Geosciences - Postdoctoral Researcher - Institute of Environmental Research and Sustainable Development of National Observatory of Athens

kikimakri@noa.gr

Education

2015: PhD, Department of Geology, Aristotle University of Thessaloniki. Prof. Spyridon Pavlides. Study of historical development of geological education in Greece, (Greece). ND36236
2007: M.Sc., Teaching of Chemistry and New Educational Technologies, Department of Chemistry, Aristotle University of Thessaloniki
2005: B.Sc., Department of Geology, Aristotle University of Thessaloniki (Greece).

Career

2020 - today: Teacher of Geosciences at Secondary Education Ministry of Education and Religious Affairs.
2020 - today: Postdoctoral Researcher: Institute of Environmental Research and Sustainable Development of National Observatory of Athens.
2021 - 2021: Curriculum Designer of course Geology and Geography for Junior High School. Institute of Education Policy/Ministry of Education and Religious Affairs.
2021: Curriculum Designer of Skill Labs "Climate change - Natural disasters - Civil protection" for High School. Institute of Education Policy/Ministry of Education and Religious Affairs.
2019 - 2020: Educator at the school program "Sustainable Planet", Stavros Niarchos Foundation Cultural Center, Athens.
2017 – 2020: Assistant Coordinator MSc in Space Sciences Technologies and Applications at National Observatory of Athens.
2016 – 2018: Contract Lecturer: Teaching for the course "Teaching of Geology". Department of Geology, Aristotle University of Thessaloniki, Greece.

Research interests

History of Geosciences, History of Education, Epistemology, Teaching Methodology, Curriculum Design, Curriculum Studies.

Publication and services

Kyriaki Makri, The Content of Meteorology in Greek Geosciences' Textbooks. World Journal of Educational Research ISSN 2375-9771 (Print) ISSN 2333-5998 (Online) Vol. 9, No. 5, 2022, http://dx.doi.org/10.22158/wjer.v9n5p43

Makri, K. and Danaskos, F., The history of Geosciences, as teaching scenario, EGU General Assembly 2023, Vienna, Austria, 24–28 Apr 2023, EGU23-9044, https://doi.org/10.5194/egusphere-egu23-9044, 2023.

Danaskos, F., Makri, K., Kaviris, G., and Elias, P. The CRL School in the European Education community and the modern classroom, EGU General Assembly 2023, Vienna, Austria, 24–28 Apr 2023, EGU23-4424, https://doi.org/10.5194/egusphere-egu23-4424, 2023.

Awards and Honors

Operational Programme «Human Resources Development, Education and Lifelong Learning» in the context of the project "Reinforcement of Postdoctoral Researchers - 2nd Cycle" (MIS-5033021), implemented by the State Scholarships Foundation (IKY). Co-financed by Greece and the European Union (European Social Fund- ESF). Research title: "Approaches of Meteorology and Climate Change in school textbooks of sciences: the case of at Junior High School and High School in Greece".
EC2E2N Award for excellence present: 2012 Makri K., Antoniadis A., Koliarmou E. National Greek Team. The Magic of Chemistry - European Competition of educational chemical experiments. Annual Plenary meeting Milan

Vassilis Sakkas

Laboratory Teaching Personnel
National and Kapodistrian University of Athens
Department of Geology and Geoenvironment
Section of Geophysics and Geothermics

vsakkas@geol.uoa.gr

Education

1999 Ph.D. in Geophysics - University of Leicester, UK.
Research project: "Combined Transient Electromagnetic and Magnetotelluric study across southern Kenya Rift Valley"

1994 BSc in Physics - National and Kapodistrian University of Athens

Career

2000-2015 Research Associate in Space Application Research Unit in Geosciences, Department of Geophysics &Geothermics,

2015-today Laboratory Teaching Personnel, Department of Geophysics and Geothermics, NKUA

Research interests

Exploration geophysicist with twenty fiveyears experience in field operations and R&D with emphasis on processing and interpretation of multiple geophysical (Electromagnetic, magnetic, gravity, seismic) data to investigate earth's interior.

Great experience in collecting, processing and interpretation of geodetic data (GNSS) and joint interpretation and modelling of GNSS and interferometric data for ground deformation monitoring due to tectonic, seismic, volcanic or manmade (water/oil extraction) reasons. Person in charge of the permanent GNSS stations of NKUA. Expert in processing of GNSS data using Bernese v5.2 software.

Publications and services

Tzanis, A., Chailas, S., Sakkas, V., Lagios, E., 2020. "Tectonic deformation in the Santorini volcanic complex (Greece) as inferred by joint analysis of gravity, magnetotelluric and DGPS observations" *Geophys. J. Int.* 220, 461–489. doi: 10.1093/gji/ggz461

Sakkas, V., Lagios, E. 2017 "Ground deformation effects from the ~M6 earthquakes (2014–2015) on Cephalonia– Ithaca Islands (Western Greece) deduced by GPS observations" Acta Geophysica,65,1,207-222, Springer International Publishing, DOI: 10.1007/s11600-017-0017-x).

Sakkas, V., Lagios, E., 2015 "Fault modelling of the early-2014 ~M6 Earthquakes in Cephalonia Island (W. Greece) based on GPS measurements" Tectonophysics,644,184-196, Elsevier. DOI 10.1016/j.tecto.2015.01.010.

Awards and honors

2017 "Academy of Athens" Reward "Dimitrios Lampadarios" for research publication on geodesy for the paper: *«Fault modelling of the early-2014 ~M6 Earthquakes in Cephalonia Island (W. Greece) based on GPS measurements»* [Tectonophysics, Vol. 644-645 (2015) pp. 184-196].

Emmanuel Vassilakis

Associate Professor in Remote Sensing & Tectonic Geomorphology

Director of Remote Sensing Laboratory
NKUA, Dpt of Geology & Geoenvironment,

evasilak@geol.uoa.gr

Education

My education at NKUA includes BSc in Geology, MSc in Applied Geology and PhD in Remote Sensing & GIS Techniques. I'm still collaborating with Earth, Atmospheric & Planetary Sciences Dpt at MIT (USA) after appointed for a Post-Doctoral Associate Position during 2006.

Career

2021	Associate Professor National and Kapodistrian University of Athens
2016	Assistant Professor National and Kapodistrian University of Athens
2012	Lecturer National and Kapodistrian University of Athens
2003	Researcher National and Kapodistrian University of Athens
2000	Sergeant (Hellenic Air Force, National Centre of Space Applications)

Research interests

My scientific interests include optical Remote Sensing data processing, Airborne and Terrestrial LiDAR data interpretation, UAS data acquisition and processing, active tectonics, coastline displacement and high precision geodetic techniques, mainly used for surface deformation measurements.

Publications and services

My research work (more than 220 papers) has been published in international scientific journals or conference proceedings and have been cited more than 1240 times. In the most recent publications, my colleagues and I describe techniques for combining UAS and LiDAR data for measuring several geomorphological landforms and processes.

Awards and honors

I have been offered scholarships from GSF for my PhD studies (1996), from MIT for a Post-Doctoral Associate position (2006), as well as for a Visiting Scientist (2018).

Jan Mrlina

Senior geophysicist

Institute of Geophysics, Czech Academy of Sciences,

Dept. of Applied Geophysics jan@ig.cas.cz

jan@ig.cas.cz

Education

MSc. obtained from Charles University in Prague, Faculty of Natural Sciences, Ph.D. received from the same university

Career

1993-recent	Institute of Geophysics: Senior researcher, Head of Gravity group, research projects leader, occasional lecturer abroad
1980-1992	Geofyzika Brno Co.: Exploration geophysicist, later Head of Gravity Dept.

Research interests

Application of gravimetry and gravity surveys to oil&gas exploration, other minerals exploration, volcanology, tectonics, geodynamics, geoengineering and archaeology

Publications and services

Long-term contract with coal mining company for landslide hazard monitoring in open-pit mine. 3 selected papers:

Mrlina, J. (2004): Structures and tectonics derived from gravity survey around Aigion, Gulf of Corinth, Greece. Proceed. 5th Int. Symp. on Eastern Mediterranean Geology, 14-20 April, 2004, Thessaloniki, Greece, Vol.1, p. 138-140.

Mrlina, J., Kämpf, H., Kroner, C., Mingram, J., Stebich, M., Brauer, A., Geissler, W.H., Kallmeyer, J., Matthes, H. and Seidl, M. (2009): Discovery of the first Quaternary maar in the Bohemian Massif, Central Europe, based on combined geophysical and geological surveys. – J. Volc. Geoth. Res. , 182, 97-112.

Klanica R., Kadlec J., Tábořík P., Mrlina J., Valenta J. & Kováčiková S., et al. (2020). Hypogenic versus epigenic origin of deep underwater caves illustrated by the Hranice Abyss (Czech Republic) - The world's deepest freshwater cave. Journal of Geophysical Research: Earth Surface, 125, e2020JF005663

Awards and honors

Honorary Member of Myanmar Association of Petroleum Geologists (2017) Platinum Member of EAGE.
Award of Arabian Association of Geophysics and Astronomy for life-long contribution to the development of gravimetry in Egypt (2021).

Christos P. Evangelidis

Senior Researcher
Institute of Geodynamics
National Observatory of Athens

cevan@noa.gr

Education

He obtained a Bachelor's degree in Geology from the University of Patras between 1994 and 1999. Additionally, he holds a Ph.D. in Geophysics/Seismology, earned from the National Oceanography Center at the University of Southampton from 2001 to 2004. Prior to that, he completed a Master's degree in Advanced Geophysics at the University of Durham from 1999 to 2000.

Career

2020–today	Senior Researcher, National Observatory of Athens, Athens (Greece)
2016–2019	Associate Researcher, National Observatory of Athens, Athens (Greece)
2011-2015	Assistant Researcher, National Observatory of Athens, Athens (Greece)
2007-2011	Research Assistant, National Observatory of Athens, Athens (Greece)
2004-2004	Postdoctoral Researcher, National Oceanography Center, Southampton (United Kingdom)

Research interests

His main research interests include studying the crust and upper mantle seismic anisotropy using earthquake recordings from seismic station deployments. He is focused on large and moderate earthquake source studies by back-projecting waveforms at local and regional stations. He is involved on ambient seismic noise studies aiming to image temporal changes in volcanoes, active faults and man-made structures. He is the manager of NOA broadband seismic network (HL network) and the European Intergrated Data Archive (EIDA) National Node at NOA. He has served and coordinates as PI in many European and National research projects, infrastructural national development funds on seismology, EU Civil Protection programmes and exercises and major Seismic Monitoring Assessment commercial projects in the energy sector in Greece. He has an extensive fieldwork experience in broadband and strong motion seismic station installations and has participated in seismic exploration research cruises.

Publications and services

He has 29 publications in international peer reviewed journals. His publications include the current state-of-the-art reference articles on earthquake backprojection. He has reviewed many third party manuscripts, served as a guest editor in well respected SCI journals and convened special sessions in international conferences and meetings. He is supervising PhD candidates in Geophysics and Applied Mathematics and acts as a mentor on undergraduate and postgraduate students in Physics and Geology.

Awards and honors

He serves as the elected Chair of the EIDA Management Board (EMB) of ORFEUS and Member of the Executive Committee (ExeCom) of the ORFEUS. He is the appointed delegate for Greece on EPOS-European Research Infrastructure Consortium (ERIC). He is the Representative of NOA as Foreign Affiliate to IRIS (Incorporated Research Institutions for Seismology) and in Comprehensive Test Ban Treaty Organization (CTBTO) of United Nations. He is an assistant Mountaineering and Rock Climbing Instructor of the Hellenic Federation of Mountaineering & Climbing (since 2013)

Angelos Zymvragakis

MSc Geologist
National and Kapodistrian University of Athens
Faculty of Geology and Geoenvironment
Department of Geophysics and Geothermics

azymvragakis@geol.uoa.gr

Education

2021 BSc degree in Geology and Geoenvironment, National and Kapodistrian University of Athens (NKUA).
2023 MSc degree in Applied Geology and Geophysics, Earth Science and Environment, National and Kapodistrian University of Athens (NKUA).
2023-today PhD candidate in seismic hazard, National and Kapodistrian University of Athens (NKUA).

Career

2021-2022 Participated in research project titled “Evaluation of Seismic, Conflagration & Flood In Attica Region”, in the Deliverable titled “Seismicity, seismic hazard and strong motion distribution maps of Attica region (Argosaronikos’ islands, Kithira and Antikithira)”.

Research interests

My primary research interest is Probabilistic Seismic Hazard Assessment (PSHA) and Physics-based seismic hazard assessment.

Publications and services

Pavlou, K., Kaviris, G., Kouskouna, V., Sakkas, G., Zymvragakis, A., Sakkas, V., Drakatos, G., 2021. Minor seismic hazard changes in the broader area of Pournari artificial lake after the first filling (W. Greece). Results in Geophysical Sciences 100025. https://doi.org/10.1016/j.ringps.2021.100025

Kaviris, G., Zymvragakis, A., Bonatis, P., Sakkas, G., Kouskouna, V., Voulgaris, N., 2022. Probabilistic Seismic Hazard Assessment for the Broader Messinia (SW Greece) Region. Pure and Applied Geophysics. https://doi.org/10.1007/s00024-022-02950-z

Kaviris, G., Zymvragakis, A., Bonatis, P., Kapetanidis, V., Voulgaris, N., 2022. Probabilistic and Scenario-Based Seismic Hazard Assessment on the Western Gulf of Corinth (Central Greece). Applied Sciences 12. https://doi.org/10.3390/app122111152

Kaviris, G., Zymvragakis, A., Bonatis, P., Kapetanidis, V., Spingos, I., Mavroulis, S., Kotsi, E., Lekkas, E., Voulgaris, N., 2023. A Logic-Tree Approach for Probabilistic Seismic Hazard Assessment in the Administrative Region of Attica (Greece). Applied Sciences 13. https://doi.org/10.3390/app13137553B

Awards and honors

2021: First degree grade in the undergraduate programm of the Department of Geology and Geoenvironment of the National and Kapodistrian University of Athens.

2022: Award for the third best oral presentation by a young scientist at the 3rd European Conference on Earthquake Engineering and Seismology (3ECEES) held in Bucharest, Romania from September 4-9, 2022. The publication was entitled "A Preliminary Probabilistic Seismic Hazard Assessment for Boeotia, Central Greece".

2022: Scholarship under the programme "Awards of Excellence to Higher Education Graduates" for the academic year 2020-2021.

2022: Reciprocal scholarship with the obligation to provide auxiliary teaching work in the respective first cycle curricula. The title of the scholarship is "Support of the educational activities of the National and Kapodistrian University of Athens (NKUA) during the academic year 2021-2022 with the integration of supplementary teaching in addition to the main lectures".

Olga-Joan Ktenidou

Associate researcher
Institute and department: National Observatory of Athens (NOA), Institute of Geodynamics, Athens, Greece

olga.ktenidou@noa.gr

Education

2023	Aristotle University Thessaloniki, BA in English Language & Literature
2018	University of Greenwich, Postgraduate Certificate in Higher Education
2010	Aristotle University Thessaloniki, Greece, PhD in Civil Engineering National Autonomous University of Mexico, Visiting researcher (2008)
2004	Imperial College London, MSc in Soil Mechanics and Engineering Seismology
2003	Aristotle University Thessaloniki, Greece, Diploma in Civil Engineering

Career

2018–today	NOA, Associate researcher
2016–2018	University of Greenwich, Department of Engineering Science, Senior Lecturer
2015–2016	GFZ German Research Centre for Geosciences, Senior researcher
2011–2014	Université Grenoble-Alpes - ISTerre (France), Postdoctoral researcher PEER - University of California at Berkeley, Visiting scholar (2013)
2010–2011	Institute for Radiological Protection and Nuclear Safety (France), Postdoc.

Research interests

Expertise in engineering seismology and strong ground motion: site characterisation and reference station definition, site effects and soil amplification (experimental and numerical study), seismic hazard and ground motion prediction, uncertainty and variability. Interested in geotechnical/earthquake engineering, earthquake reconnaissance, structural response under low gravity and other stuff.

Publications and services

Publication summary: 31 articles in int'l journals, 29 in peer-reviewed conferences, 28 invited talks, 52 intl conf. abstracts, 11 technical reports, 3 book sections.
Pub metrics (GoogleScholar): 1200 citations • h-index=18 • i10-index=34
2020 - today: Head of NOA seismic monitoring and analysis group
2022 - today: Assistant secretary of ESC (European Seismological Commission)
2019 - today: Executive Committee of EFEHR (European Facilities for Earthquake Hazard & Risk)
2018-2022: UAG of ORFEUS (Observatories & Research Facilities fr European Seismology)
2022 - today: Associate Editor for SRL (Seismological Research Letters)
Convener or co-organiser for 15 international conference special sessions
Consulting services for ground motion characterisation for critical facilities & energy sector

Awards and milestones

2020: Top-2 finalist for the British Council's 'Study UK' Professional Development awards in Greece (top 2 out of over 1000 UK graduates since 2004)
2020: Featured alumna, Imperial College London, School of Engineering (https://www.imperial.ac.uk/alumni/alumni-stories/olga-joan-ktenidou/)
Fellow of the UK Higher Education Academy since 2018

Zafeiria Roumelioti

Assoc. Prof. of Seismology and Geophysics

University of Patras, Department of Geology

zroumelioti@upatras.gr

Education

1997 Diploma in Geology, Aristotle University of Thessaloniki
1999 MSc in Geophysics, Department of Geology, Aristotle University of Thessaloniki
2003 PhD in Seismology, Department of Geology, Aristotle University of Thessaloniki

Career

2024 Asoc. Prof. of Seismology and Geophysics, Department of Geology, University of Patras

2019 Assist. Prof. of Seismology and Geophysics, Department of Geology, University of Patras

2007 Research/Teaching Staff, Dept of Geology/Dept. Civil Engineering, Aristotle University of Thessaloniki

2006 Researcher in Seismology, Institute of Geodynamics, National Observatory of Athens

2005 Geologist, Prefecture of Chalkidiki, Northern Greece

Research interests

- Kinematic modeling of earthquake sources
- Variability of strong ground motion due to source and site effects
- Near-fault effects on strong ground motion
- Simulation of strong ground motion using both deterministic (Empirical Green's Functions) and stochastic approaches with emphasis on the incorporation of the finite-source and directivity effects
- Near real-time applications for the computation of earthquake source parameters (fast moment tensors) and shake maps for earthquakes in areas covered by sparse networks
- Study of non-linear site response during earthquakes
- Seismicity studies (relocation, determination of source parameters, seismotectonic implications)
- Seismic Hazard
- Earthquake Early Warning
- Shallow geophysics exploration

Publications and services

- Articles published in peer reviewed, SCI journals: **47**; Full articles in conference proceedings: **38**; Abstracts: **57**
- Greece's National Representative/Review Panel Member for the COST Association Open Calls since 2017-2022 (OC-2017-1, OC_2018-2, OC-2019-1, OC-2021-1, Cost Association, Belgium)
- BoD nominated member of the ORFEUS Executive Committee since July 2022
- Reviewer for 13 international scientific journals and several national and international conferences since 2003

Niki Evelpidou

Professor
National and Kapodistrian University of Athens
Department of Geology and Geoenvironment

evelpidou@geol.uoa.gr

Education

Dr. Niki Evelpidou holds a BSc degree in Geology from the National and Kapodistrian University of Athens, an MSc in "Geography and Environment" from the National and Kapodistrian University of Athens, a PhD on Geomorphology and GIS from the Faculty of Geology and Geoenvironment, National and Kapodistrian University of Athens, and a second PhD on Geoarchaeology from the University of Franche Comte.

Career

2019-today	Professor, Faculty of Geology and Geoenvironment, National and Kapodistrian University of Athens
2014-2018	Associate Professor
2009-2014	Assistant Professor
2003-2009	Lecturer

Research interests

geomorphology
sea level changes
palaeogeography
geoarchaeology
spatial technologies
study and modeling of natural hazards

Publications and services

Her research numbers more than 300 publications in scientific conferences and journals and 28 books and educational textbooks.

She is actively involved in academic, research and educational activities, as she has organized more than 30 educational seminars and training schools while she has participated in the organization of 37 national conferences and workshops, of national and international interest.

Evelpidou N., Karkani A., Kampolis I., 2021. Relative sea level changes and morphotectonic implications triggered by the Samos earthquake of 30th October 2020. Journal of Marine Science and Engineering, 9(1), 40. https://doi.org/10.3390/jmse9010040

Evelpidou, N., Zerefos, C., Synolakis, C., Repapis, C., Karkani, A., Polidorou, M., Saitis, G., 2020. Coastal Boulders on the SE Coasts of Cyprus as Evidence of Palaeo-Tsunami Events. Journal of Marine Science and Engineering 8, 812. doi:10.3390/jmse8100812

Awards and honors

Dr. Evelpidou has received a number of awards and recognitions. Amongst the most significant are two awards from the Academy of Athens: in 2013 for work promoting the geological knowledge of the Greek region for the paper entitled "Evidence of a recent rapid subsidence in the S-E Cyclades (Greece): an effect of the 1956 Amorgos earthquake?" and in 2019 for her monography "Sea level changes".

Anna Karkani

Postdoctoral researcher
National and Kapodistrian University of Athens
Department of Geology and Geoenvironment

ekarkani@geol.uoa.gr

Education

2009 BSc in Geology and Geoenvironment, National and Kapodistrian University of Athens
2012 MSc in Oceanography and Management of Marine Environment
2017 PhD "Study of the geomorphological and environmental evolution of the coastal zone of Central Cyclades"

Career

2020-today Postdoctoral researcher
2012-2016 Research associate, Faculty of Geology and Geoenvironment, National and Kapodistrian University of Athens

Research interests

Geomorphology, palaeogeography, sea level changes, geoarchaeology, natural hazards

Publications and services

Karkani A., Evelpidou N., 2021. Multiple submerged tidal notches: A witness of sequences of coseismic subsidence in the Aegean Sea, Greece. Journal of Marine Science and Engineering 9(4), 426, https://doi.org/10.3390/jmse9040426.

Evelpidou, N. Karkani, A., Kampolis, I. 2021. Relative sea level changes and morphotectonic implications triggered by the Samos earthquake of 30th October 2020. Journal of Marine Science and Engineering, 9(1), 40. https://doi.org/10.3390/jmse9010040.

Evelpidou N., Zerefos C., Synolakis C., Repapis C., Karkani A., Polidorou M., Saitis I., 2020. Coastal boulders on the SE coasts of Cyprus as evidence of palaeo-tsunami events. Journal of Marine Science and Engineering 8(10), 812. https://www.mdpi.com/2077-1312/8/10/812

Karkani, A., Evelpidou, N., Morhange, C., Giaime, M., Marriner, N., Spada, G., Late Holocene sea level evolution of Paros Island (Cyclades, Greece), Quaternary International 500, 139-146. https://doi.org/10.1016/j.quaint.2019.02.027

Awards and honors

2020-2021 Scholarship for postdoctoral research by State Scholarships Foundation
2012-2016 Scholarship from National &Kapodistrian University of Athens for PhD studies
2014 DAAD scholarship for training on OSL–Optically Stimulated Luminescence on beachrocks

Akis Panagis

Civil Engineer MSc University of Patras

Monitoring engineer GEFYRA SA

akis.panagis@gefyra.gr

Education

2004: Diploma in Civil Engineering Department University of Patras
2006: Master in Seismic design of structures in Civil Engineering Department University of Patras

Career

2005-2006: Structural modelling and analysis of the lattice roof structure of the archaeological excavation in Akrotiri Santorini (In cooperation with the scientific committee appointed to investigate collapse mechanism) and evaluation of partial collapse mechanism upon dead loading.

2006-today: Structural Designer for various Industrial and residential Buildings composing of different structural system (Steel/Concrete/Timber).

2008-today: Monitoring engineer for Structural Dpt of Rion Antirrion Bridge, involved in the maintenance of Structural Health Monitoring system instrumentation, as well as with the data analysis and engineering interpretation of the records. Engaged with the structural design of Building and maintenance equipment for Rion Antirion Bridge.

Research Interests

Structural modelling, analysis and design of structures, Earthquake structural design, Modal Identification, Ambient structural vibration. Modal Operational Analysis. Sensor technology. Data acquisition. Data analysis Technics.

Publications And Services

Olivier Flamand, Fabrice De Oliveira, Aris Stathopoulos-Vlamis, Panagiotis Papanikolas, Akis Panagis, Using non continuous records from full scale monitoring system for fatigue assessment, EWSHM2014, July 08-11, 2014, Nantes, France

Panayotis Papanikolas, Aris Stathopoulos-Vlamis, Akis Panagis, Alain Pecker, Samuele Infanti, The behavior of Rion-Antirion Bridge during the Earthquake of “ACHAIA-ILIA” on June 8, 2008, 3rd fib International Congress – 2010

Spyros Sergiou

PhD Marine Geologist

University of Patras

sergiou@upatras.gr

Education

2022 PhD in Marine Geology &Paleoceanoraphy. PhD thesis: *''Paleoceanographic and stratigraphic investigation in two semi-closed basins during Late Quaternary: The southern Red Sea and the Gulf of Corinth. Effects of sea-levelchanges and regionalclimatedynamics''*

2015 MSc in Environmental Oceanography, Dep. of Geology, Univ. Patras. Title of MSc thesis: ''Recent sedimentary processes in the Western gulf of Corinth, Greece''. In co-operation with: University of Savoy (ISTerre - Insitut des Sciences de la Terre), France and University of Liege, Belgium.

2012 B. Sc. in Geology, University of Patras, Greece

Career

2014-today Research Associate in the Laboratory of Marine Geology and Physical Oceanography, Dept. of Geology, University of Patras

Research Interests

Marine geology, sedimentology, paleoceanography

Selected Publications

Sergiou, S., Geraga, M., Rohling, E.J., Rodríguez-Sanz, L., Prandekou, A., Noti, A., Paraschos, F., Sakellariou, D., Bailey, G. (2022) The evolution of seafloor environmental conditions in the southern Red Sea continental shelf during the last 30 ka. Marine Micropaleontology, 177, 102181https://doi.org/10.1016/j.marmicro.2022.102181

Sergiou S, Geraga M, Rohling EJ, Rodríguez-Sanz L, Hadjisolomou E,Paraschos F, Sakellariou D, Bailey G (2022). Influences of sea level changes and the South Asian Monsoon on southern Red Sea oceanography over the last 30 ka. Quaternary Research 1–19. https://doi.org/10.1017/qua.2022.16

Pechlivanidou S, **Sergiou S**, Geraga M, Gawthorpe R, Antoniou D, Angelopoulou D, Ford M, Fabregas N, (2020). Controls on stratigraphic variability in a semi-closed rift basin overthe Late Quaternary, Gulf of Corinth, Greece. EGU General Assembly 2020. https://doi.org/10.5194/egusphere-egu2020-11898

McNeill, L.C., Shillington, D.J., Carter, G., Everest, J., …**Sergiou, S.,** et al, (2019). High-resolution record reveals climate-driven environmental and sedimentary changes in an active rift, Scientific Reports, 9 https://doi.org/10.1038/s41598-019-40022-w

Sergiou S, Beckers A, Geraga M, Papatheodorou G, Iliopoulos I, Papaefthymiou H, 2017. ''Recent sedimentary processes in the western gulf of Corinth, Greece. Seismic and aseismic turbidites'' Bulletin of the Geological Society of Greece, 50, 383-391

Services

He is Assistant tutor for undergraduate and graduate courses, and BSc and MSc theses. He has participated in research & industrial projects. He is member in both offshore and onshore science parties of 'IODP Expedition 381-Corinth Active Rift Development'' serving as a sedimentologist.

Awards And Honors

VISTA Visiting Scholar 2018, 2019. Department of Earth Science, University of Bergen, Norway.

PhD scholarship of General Secretariat for Research and Technology (GSRT) – Hellenic Foundation for Research and Innovation (HFRI).

Ioannis Iliopoulos

Professor
Department of Geology,
University of Patras (UP), Greece

ilios@upatras.gr

Education

Dr Ioannis Iliopoulos is a Professor at the Department of Geology, University of Patras, Greece. He conducted his PhD Thesis in the field of Metamorphic Petrology.

Career

2019 – today	Director of the Science & Technology Museum, School of Natural Sciences, UP
2022 – today	Professor, Department of Geology, UP
2008 – 2022	Associate Professor / Assistant Professor / Lecturer, Department of Geology, UP
2003 – 2008	Laboratory Assistant (ETEP), Department of Geology, UP
1998 – 2001	Researcher, Dipartimento di Chimica e Fisicadella Terra, University of Palermo, Palermo, Italy

Research interests

His research focuses on the systematic application of analytical techniques for the study of archaeomaterias and earth raw materials from the wider Mediterranean area (Italy, Spain, Greece) and Latin America (Ecuador, Peru) and he leads the KERAMos Research Group. He has published in peer reviewed international journals and edited volumes (h-index: 14).

Publications and services

He is an external collaborator of the Institutd'Arqueologia de la Universitat de Barcelona (IAUB) Spain and a scientific consultant of the Academy of Institutions and Cultures, Greece. Since 2019 he has been elected as the Director of the Science and Technology Museum at the University of Patras and has supervised several thematic exhibitions and educational programs for students of primary, secondary and higher education under a participatory framework.

Awards and honors

He was awarded the Picker Interdisciplinary Science Institute research award (Colgate University, USA) and was appointed as Researcher at the Dipartimento di Chimica e Fisicadella Terra (CFTA), University of Palermo, Italy, under the auspices of the interdisciplinary European Geo-archaeological Research Project "GEOPRO".

Vayia Xanthopoulou

Research Associate/ XRF, SEM and Raman technician
University of Patras, Department of Geology and Laboratory of Electron Microscopy and Microanalysis (L.E.M.M.)

vxanthopoulou@upatras.gr

Education

Dr. Vayia Xanthopoulou is a research associate at the Department of Geology, University of Patras, Greece. She conducted her MSc. and PhD theses in Archaeometric studies and issues that deal with the ceramic analysis and the raw material prospection for the ceramic manufacture.

Career

2015-today	WDXRF, SEM and micro-RAMAN technician, Laboratory of Electron Microscopy and Microanalysis, School of Natural Sciences, UP
2020-today	Research Associate, Department of Geology, UP
2020-2023	Post-doctoral research, IKY, UP
2011-2013	Principal investigator at in C. Caratheodory Funding Programme. Project, UP

Research interests

Her research interests are focused on the characterization of clayey raw materials in terms of their suitability for ceramic production, using various analytical techniques. The raw materials come mainly from Greece (northern Peloponnese, western Greece, western Crete, and Ionian Islands). As a technician in L.E.M.M is responsible for the daily maintenance, calibration and running of samples using the Scanning Electron Microscope (SEM), the elemental spectrometer (WD-XRF) and the spectrometer micro-RAMAN.

Publications and services

She has published ten articles in International Peer-reviewed Journals (some recent are given below) and has participated in more than twenty International Conferences.

I Liritzis, I Iliopoulos, M Kokkaliari, V Xanthopoulou. Novel archaeometrical and historical transdisciplinary investigation of early 19TH century hellenic manuscript regarding initiation to secret" Philike Hetaireia. Mediterranean Archaeology & Archaeometry, 2023

Xanthopoulou, V.; Iliopoulos, I. An Insight into the Suitability of Clayey Raw Materials: The Ceramic Provinces of the Northern Peloponnese and South Epirus, Greece. Buildings 2023, 13, 473. https://doi.org/10.3390/buildings13020473

Xanthopoulou, V., Iliopoulos, I., Katsonopoulou, D. and Katsarou St. (2022). Standardized patterns in the ceramic craft at Early Bronze Age Helike, Achaea, Greece. ArchaeolAnthropol Sci 14, 154 (2022). https://doi.org/10.1007/s12520-022-01621-3

ABSTRACTS

Why CRL?

Pierre Briole

Ecole Normale Supérieure, Paris Sciences et Lettres Research University, Département des Géosciences

The Western part of the Gulf of Corinth (WGoC) presents a high level of seismic activity known since the ancient times. The geology, sedimentology and tectonics of the Corinth Gulf is studied since the 1970's. After several seismological and geodetic campaigns carried out in the 1990's, the Corinth Rift Laboratory network (CRLnet) was established in the early 2000's, covering first a 30 km × 30 km area with the installation of local networks around Aigio. Due to the important seismicity and aiming to a better understanding of the fault system, the networks increased progressively towards the west, with the participation of many institutions. The present state of the network was reached in 2013 and allows to address scientific questions on the deformation of the crust and the potential for large earthquakes as, for example:

- Migration of the deformation towards onshore and offshore faults.
- Clustering of microearthquakes: dimensions and relationships with the related fault segments and with the occurrence of the main events?
- How can the observed deformation be explained? What is the part controlled by the seismicity?
- What is the role of fluids in the seismicity triggering?
- Can we observe creeping on low dipping normal faults?

To address these questions, CRLnet comprises 80+ permanent stations, equipped with seismometers, accelerometers, Global Navigation Satellite Systems (GNSS), tide gauges and strainmeters. It enables detailed monitoring of the fluctuations of the intense microseismicity and deformation. The seismicity in the WGoC is clustered in time and space, with episodic seismic sequences, for example, the 2003–2004 offshore, the 2013 Helike and the 2015 Malamata swarms, and the most recent 2020-2021 crisis. GNSS recordings and Interferometric Synthetic Aperture Radar (InSAR) revealed the deformation sources of moderate earthquakes and the likely existence of aseismic slip at shallow depth in some places. In addition, significant research has been performed on fault mapping, geomorphology, sedimentology. It is also proposed to specific very detailed studies and methodological experiments. The large number of observations accumulated over the last 10 years has also made it possible to address questions on a wider scale, such as the connection between the WGoC and the Ionian subduction/collision to the west.

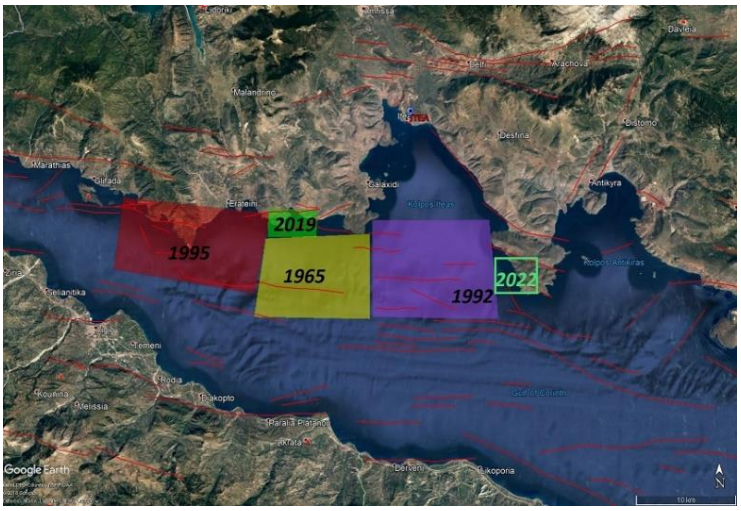
CRL is one of the Near- Fault Observatories (NFO) of the European Plate Observing System (EPOS), and the only with an international status. It is administered and maintained by the Centre National de la Recherche Scientifique (CNRS-France), the National and Kapodistrian University of Athens (NKUA-Greece), the University of Patras (UPAT-Greece), and the National Observatory of Athens (NOA-Greece), with the participation of Charles University Prague (CUP-Czech Republic).

Geodynamic setting, large earthquakes and the growth of faults in the western Corinth rift

Athanassios Ganas

NOA, Institute of Geodynamics, Athens, 11810 Athens, Greece

The Gulf of Corinth is a back-arc extensional basin of the Hellenic Arc which cuts through the Alpine fold-and-thrust belt of the Hellenides and started to develop since Upper Miocene. The western – central Gulf of Corinth (see Figure below) has not experienced a strong earthquake since 1995 (the M_w=6.5 event of Aigion on 15 June 1995), although the Gulf is extending fast (over 12 mm/yr of N-S extension from continuous GPS data spanning a period of 20 years) and its seismic history since 1769 exhibits twelve (12) shallow events with M>6.0. The lecture will present the latest results across several disciplines in solid Earth Science indicating a) the Holocene sea-level and decadal GNSS datasets fit the tectonic model of an active half-graben where the hanging wall (northern coast) subsides and the footwall (southern coast) is uplifted b) the highest uplift rates (3.5 mm/year) are found on the western part of the Gulf, which indicates an asymmetric localization of deformation inside this active rift c) the existence of active high-angle normal fault zones oriented parallel to the rift axis, d) the continuation of the 1995 low-angle fault towards the west (Psathopyrgos area) and east (Galaxidi), e) the occurrence of earthquake swarms in the hanging wall of the north-dipping, low-angle fault d) new geological and InSAR results mapping ground motions and patterns of crustal extension. The uniqueness of the Corinth rift is revealed by the multi-disciplinarity in geological & geophysical datasets (active fault maps, fault geometry, fault slip rates, trenching data on past earthquakes, historical and instrumental seismicity, InSAR data) and competing models for earthquake generation processes suggested from observed seismicity patterns, geodetic data, magnitude-frequency distributions and fluid migration.



Use of CRL Data for Detailed Seismological Studies

Efthimios Sokos

University of Patras

Department of Geology

The Corinth Rift Laboratory Near Fault Observatory (NFO) is located within one of the most seismically active zones in Europe. Thus, it provides the perfect setup for detailed studies of seismic events, even for small ones, that would be almost impossible to study with regional networks. All the modern seismological instruments exist in this NFO, starting of course from a dense seismological network, including weak and strong motion sensors, and continuing with geodetic networks, either real time or campaign based. This infrastructure allows us to accurately locate the seismic events and invert for their source details. Although in regional networks this kind of scientific work is possible for events roughly larger than 6M, in the CRL even events one order of magnitude smaller, can be studied in detail. Furthermore, networks of strainmeters, tide gauges, InSARetc, can provide further data when additional constraints are needed.

In this talk a detailed analysis of the last seismic crisis in the CRL area is presented. The crisis occurred between December 2020 and February 2021, with thousands of small earthquakes and two Mw > 5 events. The crisis was studied in detail by the CRL research team, using all the available data in the area. The space – time evolution of the crisis will be presented; moreover, details will be given about the source process of the mainshock (February 17, 2021). Using all the available CRL data it was possible to reveal interesting details about the source process of this moderate size event. Indeed the Mw 5.3 mainshock was peculiar, while it nucleated at a depth of ~8 km, most of the slip occurred at unusually shallow depths of ~0–5 km. This major rupture segment, well constrained by seismic, geodetic, and tide gauge data, was interpreted as a rare shallow activation of a south-dipping offshore fault. This continuation is most likely the Mornos fault, lying opposite (antithetic) to the major north-dipping Psathopyrgos fault which outcrops on the southern coast. The gained knowledge, supplemented by new offshore measurement techniques, will improve seismic and tsunami hazard assessment in the CRL area.

Large Earthquakes and Focal Mechanisms in the Gulf of Corinth

George Kaviris

Associate Professor of Seismology-Seismic Anisotropy,

Section of Geophysics and Geothermics, Department of Geology and Geoenvironment, National and Kapodistrian University of Athens

The Gulf of Corinth is a “natural laboratory” for seismology and geosciences, as it is characterized by high tectonic activity, with the bulk of earthquakes occurring close to its western border. Active normal faults, oriented in an approximately E-W direction, dominate in the Gulf of Corinth. Regarding the morphology of the gulf, it is an E-W trending asymmetric graben, with the major active faults outcropping at the southern coast and dipping north, resulting in a long record of rifting in the center of the gulf and an upward displacement of the main footwalls at both the northern and southern sides. GNSS measurements at the Gulf of Corinth have revealed a high extension rate in a NNE-SSW direction, which increases from the east to the west, i.e. from 11 mm/yr to 16 mm/yr.

Since the historical era, moderate to strong earthquakes have occurred in the western part of the Gulf, including destructive ones, as the 373 BC Helike earthquake that was accompanied by a tsunami wave. Large events have also occurred during the instrumental period, causing severe damage to urban areas in the broader region, e.g. Eratini, M=6.3, 1965; Antikyra, M=6.2, 1970; Galaxidi, M=5.8, 1992; Aigion, Ms=6.2, 1995. Regarding the eastern part of the gulf, large earthquakes are also present, however more rare. In 1981, on February 24, 25 and March 4, a seismic sequence with three major earthquakes of surface magnitudes Ms = 6.7, 6.4 and 6.4 occurred in the Alkyonides Gulf, causing significant damage to Athens. It is worth noting that the seismicity in the WGoC is mostly expressed through the occurrence of seismic swarms, as the one close to Helike in 2013. A seismic crisis occurred at the western part of the Gulf during 2020–2021, which evolved in three stages. It started with an Mw 4.6 event near the northern shore of the Gulf, opposite of Aigion, then migrated eastward toward Trizonia Island after an Mw 5.0 event, and eventually culminated with an Mw 5.3 event, ∼3 km northeast of the Psathopyrgos fault.

The intense seismicity in the Gulf of Corinth has resulted in the installation of a permanent network in the area, with stations belonging to the Hellenic Unified Seismological Network (HUSN). Furthermore, the international initiative of the Corinth Rift Laboratory (CRLN) has greatly increased the density of local station coverage and has led to the prompt provision of seismological data to the scientific community.

Data recorded in the gulf are used in a daily basis to locate earthquakes with high resolution. This permits the identification of seismogenic faults through seismological observations, in combination with GNSS and tectonics.

Another important application of the recorded waveforms is the determination of focal mechanisms. This is achieved either with the well-known method of first-motion P-wave polarities, enabled by the dense local station coverage, or through waveform modeling and moment tensor inversion (especially for the stronger events). The majority of the reliable fault-plane solutions indicate normal faulting in an approximate E-W direction, in agreement with the major active faults. However, focal mechanisms in NW Peloponnesus, and some in the Gulf of Corinth, indicate strike-slip faulting.

Off-shore faults imaging and monitoring in the Corinth Rift

Maria Geraga, George Papatheodorou

School of Natural Sciences, Department of Geology, University of Patras, Greece

Acoustic is fundamental energy to the mapping of seafloor. Sophisticated equipment produces sound waves which radiate in all directions away from the source. When the sound waves moving through water hits the sea floor, some of it is reflected, some is transmitted to the seafloor, some is refracted, and some is scattered. The basic components of a sound wave are frequency, wavelength and amplitude. Sound energy is used for the acquisition of seismic profiles and for the seafloor topography and texture. During the seismic profiling the transmitted acoustic energy is reflected from boundaries developed by changes in the acoustic impedance of the subsurface geology. Changes in acoustic impedance (density of the medium times the velocity of the sound within that medium) can generally be thought of as changes in density which indicate transitions from one stratigraphic layer to another. The sub-bottom profilers operate at different frequencies and this has an effect on the depth of acoustic penetration into the seabed and the resultant resolution. The reflected acoustic signal is received by hydrophones or by a transducer. Sidescan sonar is an acoustic device used to provide wide-area, high-resolution 2D images (called “sonographs”) of the seafloor. A towing sonar (usually called “tow-fish”) emits and later receives the acoustic energy in a specific frequency range. The acoustic energy received by the sidescan-sonar (backscatter) provides information for the morphology of the seafloor and the texture of the sediments covering the seafloor.

In the area of the Corinth gulf, the application of marine geophysical techniques together with extensive onshore studies have revealed significant findings in relation to seismic stratigraphy of the gulf, the rifting development and the evolution of the basin.

Sources:

1. Fish, J.P. and H.A. Carr, 1991, Sound Underwater Images, A guide to the generation and interpretation of sidescan sonar data, second edition, Lower cape Publishing, Orleans, MA,
2. Trabant, P.K. Applied High-Resolution Geophysical Methods Offshore Geoengineering Hazards; D. Reidel Publishing Company: Boston, MA, USA, 1984; p. 265
3. Nixon, C.W., McNeill, L.C., Bull, J.M., Bell, R.E., Gawthorpe, R.L., Henstock, T.J., Christodoulou, D., Ford, M., Taylor, B., Sakellariou, D., Ferentinos, G., Papatheodorou, G., Leeder, M.R., Collier, R.E.L., Goodliffe, A.M., Sachpazi, M. & Kranis, H. (2016) Rapid spatiotemporal variations in rift structure during development of the Corinth Rift, central Greece. Tectonics, 35, 1225– 1248.
4. Gawthorpe, Rob & Leeder, Mike & Kranis, Haralambos &Skourtsos, Emmanuel & Andrews, Julian &Henstra, Gijs & Mack, Greg & Muravchik, Martin & Turner, Jenni & Stamatakis, Michael. (2017). Tectono-sedimentary evolution of the Plio-Pleistocene Corinth rift, Greece. Basin Research. 30. 10.1111/bre.12260.

Tectonics, structural setting and tectono-sedimentary processes in the Corinth rift

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The Gulf of Corinth (GoC) Rift, one of the most active continental rifts worldwide, which develops within the broader plate convergence context of the Hellenic Arc. Extension and strain localization within the overriding Aegean Plate has led to the formation of this rapidly extending domain. The available data so far point to its inception at ca (?)5 Ma most probably linked to two interrelated processes, namely (i) the onset of the pronounced curvature of the Hellenic Arc; (ii) the propagation of the North Anatolian Fault into the Aegean domain.

The GoC rift has developed in two phases, namely the Rift 1 phase, from 5.0-3.6 to 2.2-1.8 Ma and Rift 2, from 2.2-1.8 Ma to present. Rift 1 is recorded in a >3 km thick syn-rift succession, (Lake Corinth) which shows upward deepening from fluviatile to lake-margin conditions and finally to sub-lacustrine, deposited in a 30 km-wide zone of distributed normal faulting. Rift 2 marks a 39 km northward shift in the locus of rifting, accompanied by footwall and regional uplift, which destroyed Lake Corinth in the central and eastern parts of the rift, while giant Gilbert deltas in the west built into a deepening lake depocenter in the hanging-wall of the newly developing border fault system. Self-organization and strain localization along co-linear border faults are considered to be responsible for the growth, linkage and death of normal faults during these two rifting phases. The major Patras dextral strike-slip fault controls the interaction between the GoC and the Patras rifts; this led to the opening of the Rio Straits at c. 400-600 ka.

The overall landscape and stratigraphic evolution of the rift was strongly influenced by factors related to structure of the Hellenide fold and thrust basement, which controlled regional palaeotopographic variations and local antecedent drainage, the latter especially visible at the southern shoulder or the rift. Along-strike, regional topography north and south of the rift is relatively high in the west, compared to the east; this exerted a first-order control on the depositional environments during rifting. The majority of sediment to the CoC rift has been supplied by north-flowing antecedent catchments on the southern flank. However, the contribution of S-flowing catchments appears to be increasing over time.

On a crustal scale, the extensional thinning of the Hellenide nappe stack, which is observed in the Peloponnesos, is overprinted by the high-angle normal faulting that controls the GoC rift inception and evolution. The interplay between these two processes is another major factor and geochronological and structural data are sought to further constrain rift evolution.

Use of CRL data for detailed seismological studies

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University of Patras, Greece

The rift of Corinth in Greece has been long identified as a site of major importance for earthquake studies in Europe, producing one of the highest seismic activities in the Euro-Mediterranean region. The occurrence of earthquakes of magnitude greater than 5, the north–south extension up to 1.5 cm/year, the frequent seismic swarms, and the destructive historical earthquakes, indicate the Corinth rift as an area of major seismological interest, leading in the last decades to the development of the Corinth Rift Laboratory (CRL, http://crlab.eu) project, concentrated in the western part of the rift. The CRL seismological network was installed in April 2000 operating complementary to the existing networks of HUSN (Hellenic Unified Seismic Network) and its primary objective is to provide continuous monitoring of the seismicity and accurate locations of events down to magnitude 1 in order to constrain active structures at depth in this restricted area.

Today the Corinth Rift Laboratory operates a dense seismological array of 11 stations with 2Hz seismometers, 9 stations with broad band seismometers and one antenna of 7 broad band stations. Furthermore, the CRL arrays of gravity stations, tide gauges, GPS stations and meteorology fulfill the objective of continuous monitoring of the area. All seismological stations are transmitted in real time and merged to provide real time earthquake location. The seismological data are available since April 2000 and are both automatically and manually processed in order to study the major events and aftershock sequences but also the seismic swarms, which take place frequently in the area. The various monitoring arrays of CRL have produced new, high resolution, data allowing a better understanding of the seismicity and deformation pattern of the western rift of Corinth, and an improved assessment of the related seismic hazard.

Historical elements for sciences and observatories

Fiori-Anastasia Metallinou

National Observatory of Athens, Institute for Astronomy, Astrophysics, Space Applications and Remote Sensing (IAASARS)

The National Observatory of Athens was established in 1842 and it is the first Research Institute in Greece. An important service it used to provide to public, from 1846 until 1964 was the calculation of the “Official Time of Greece”. The “Service of Time” used to be one of the most important services provided by observatories, as well as meteorological measurements and geodynamic studies. During the current talk historical instruments, scientific measurements, data and services provided by an observatory, during the previews centuries, will be presented.

Hand on simple seismic software packages provided on-line in the CRL portal

George Kaviris & Ioannis Spingos

National and Kapodistrian University of Athens

Department of Geology and Geoenvironment

Section of Geophysics and Geothermics

Introduction to Phase Picking with SeisGram2K

Accurately identifying and determining the arrivals of seismic phases is one of the fundamental analysis routines in seismology. From event location to seismic tomography, arrival times of different phases (commonly called “picks” in the seismological community) form the basis of most advanced processing techniques and statistical analyses. In this exercise, we will learn to identify the arrivals of longitudinal (P) and shear (S) waves in local recordings of the Corinth Rift Laboratory Network. We will then use their arrival times to locate an earthquake. The goal of this exercise is to pick the arrival times of P and S phases in at least three stations and, then, find the epicenter of the earthquake.

Triangulating the location by using travel-time curves is one of the simplest (and least accurate) methods to find the position of an earthquake. Modern location techniques involve sophisticated software that use tens or hundreds of phase arrivals.

Sky gazing

Fiori-Anastasia Metallinou

National Observatory of Athens, Institute for Astronomy, Astrophysics, Space Applications and Remote Sensing (IAASARS)

During this activity we are going to observe the constellations of the night sky and some planets of our solar system. The brightest stars visible by naked eye and their characteristics will be mentioned. The connection between the constellations and the Greek mythology will be presented.

A concise overview of the lithostratigraphy architecture and its implications to the Quaternary evolution of the Gulf of Corinth (Greece)

Petros Koutsovitis

University of Patras, Department of Geology

The Gulf of Corinth is located in central Greece, is a bathymetrically restricted marine elongated embayment, extending as long as ~105 km at an E-W direction. It displays a width of ~320 km, with the deepest water depths being identified at the central parts of the Gulf, reaching even up to 1 km. It comprises of Quaternary marine terraces, as well as hanging-wall surface subsidence and Gilbert-type fan deltaic sedimentary formations. It is considered as one of Earth's most active basin systems that includes three basement offsets, namely the Akrata-Derveni, Sithas and Xylocastro. Specifically, regarding that of the Akrata-Derveni, the common tripartite has been identified, which includes the topset, foreset and bottomset formations. The large Gilbert-type fan deltas correspond to the Middle Group of the Corinth Rift infill, with their lithostratigraphy being highly affected by the active evolution of the rift structure. Eight facies associations have been identified, denoting an evolution from deep to shallow marine environment. Thus, the Lower and Middle Groups (fluvio-lacustrine deposits and thick alluvial fan conglomerates) are characterized by an overall increase in accommodation space at the deposition stages, followed by a significant decrease in sediment supply during deposition of the Upper Group (mainly uplifted terrace deposits and slope breccias).

Data mining at school: some examples to address geosciences cases studies at school with online data

Jean-Luc Berenguer

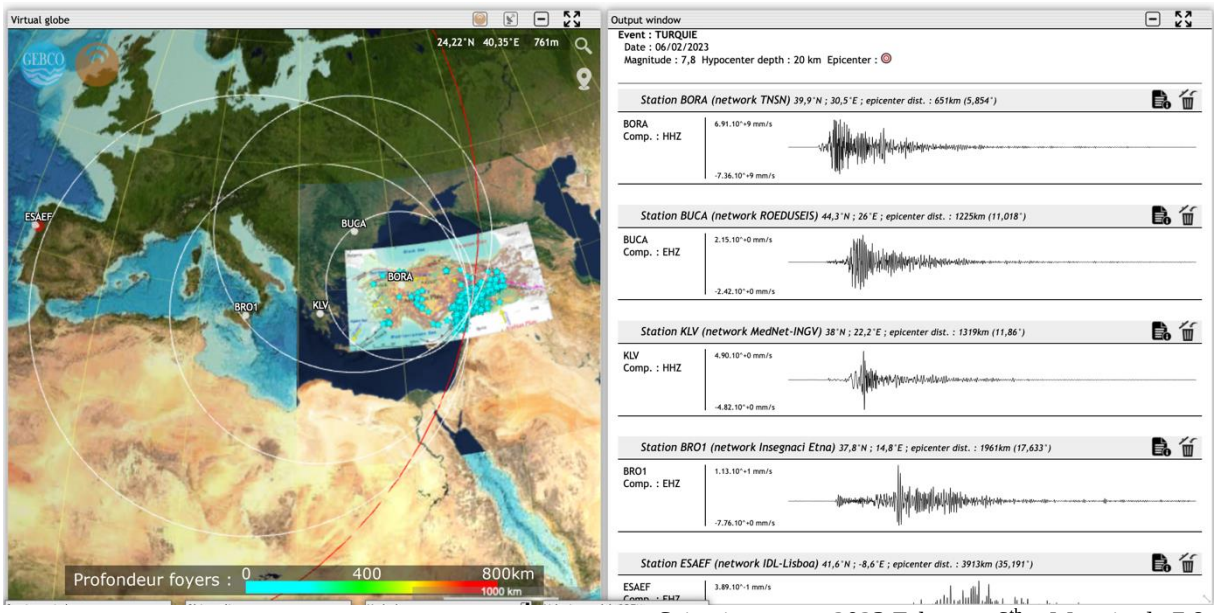
GEOAZUR Education & Outreach – University Côte d'Azur

Whether from the atmosphere or from the dynamics of the earth's crust, populations are exposed and vulnerable to brutal and violent episodes and events.

This is the case for earthquakes whose magnitude and location constitute a real risk because of the populations exposed to this hazard.

On 6 February, two earthquakes along the Anatolian Fault shook the populations of southern Turkey and Syria. In this densely populated region, which is also cross-crossed by numerous faults, the seismic risk is very high. The damage is even greater when the event occurs at night or affects buildings that are not very resistant to vibrations.

These two seismic events have been widely recorded in Europe, particularly by seismological stations in Greece. The data available online can be used to build knowledges to understand earthquakes with students.



Seismic event – 2023 February 6th – Magnitude 7.8

This hands-on workshop presents examples of a case study that can be conducted in the classroom with students, using online data.

This 'data mining' exercise is an opportunity to look back at a natural hazard with the case of the very recent 6 February earthquake in Turkey/Syria.

The earthquake suitcase

Dr. Vasiliki Kouskouna

Professor, National and Kapodistrian University of Athens

Using live data in school science lessons adds relevancy and real-world experience to classrooms. In this project, supported through Fulbright's alumni network and part of the Global Teacher Grant, secondary school students of nine schools in Kefalonia and Ithaca, Greece, used Raspberry Shake and Boom devices to look at real-time data of plate tectonic movement and earthquake activity. The Earthquake Suitcase, an educational system for information about - and familiarization with – earthquakes, was designed an integrated in the Laboratory of Seismology, Department of Geology and Geoenvironment, National and Kapodistrian University of Athens, was also presented.

Prior to school visitations, teachers participated in virtual trainings to learn about how the Raspberry Shake and Boom device can be used to both simulate earthquake data as well as record actual seismic activity and upload it to a global network of live data. Teachers and students can access the real-time data from all over the world, including from stations in their area, and use this data for classroom instruction.

During classroom lessons, students learned how to interpret seismograms, including using P-wave and S-wave intervals to triangulate an epicenter and relate concepts like amplitude and duration to a seismogram.

The multiple goals achieved with such educational activities are to educate students of all age groups on what an earthquake is, where, how and why earthquakes occur, and the preventive measures that can be taken. The schoolchildren gain experience though earthquake simulation by creating their own earthquake, familiarize themselves with the feeling of an earthquake, and learn to take the necessary self-protection measures.

The educational material is included in the “Earthquake Suitcase”, which contains interactive educational toys, an experiential shake table for earthquake simulation, a model accelerometer recording in real time the simulation, books, leaflets and an earthquake emergency bag.

The training is conducted by the specialized staff of the project’s scientific team. During the training and, in collaboration with the educators in charge, the effectiveness of the earthquake suitcase is evaluated, with the schoolchildren drafting their own individual emergency plan.

Results from educational applications to schools in Greece and the US (Boulder, CO), the Researcher’s Night and the Athens Science Festival are presented.

The project was sponsored by the Hellenic Petroleum Group and the US Department of State.

Teaching Earthquakes in classroom using stem tools

Fotios Danaskos

8th Junior High School in Chalandri

EGU GEFO HELLAS

For school students, most Geological processes and Geotectonic phenomena remain quite abstract concepts, especially in countries where Geology is not adequately covered in the School curriculum.

Traditional teaching methods do not allow students to adequately understand and get the necessary explanations for the various Geotectonic phenomena, often creating misunderstandings.

The solution to the problem is given, to a large extent, with the laboratory approach to the phenomenon and the physical processes that accompany it.

The Seismobox educational tool combines scientific knowledge, know-how and STEM in the classroom with three main goals:

- To motivate the students, as future active citizens, in the knowledge of the natural phenomenon and the possibility of predicting them.
- To know the consequences of the phenomenon on the surface of our planet and on man-made constructions in relation to the type of soil on which the buildings are located, as well as the type and quality of buildings in the areas already most affected by earthquakes;
- Stimulating students to participate in modern practical STEM laboratory activities, through the creation of experimental devices and the awareness of teachers, Primary and Secondary Education, in the use of new educational techniques and tools regarding the education of students

Scientific research on earthquakes, in countries with strong seismicity, is of very high quality and leads to significant development of knowledge about seismicity. If this knowledge is transmitted to the population (starting with young students), seismic risk will become part of the culture. If the same knowledge is effectively transmitted to all social and political levels you will start a new spatial and urban planning combined with the laws and rules of the state.

When these aspects are combined then perhaps we can talk about prevention, because all citizens know the area where we live and are part of it, respecting the rules and becoming active citizens.

Teaching Earthquakes in classroom using open data, case study: active fault bases

Kiki Makri,

Institute of Environmental Research, National Observatory of Athens, Penteli

Open data is “digital data that is made available with the technical and legal characteristics necessary for it to be freely used, reused, and redistributed by anyone, anytime, anywhere”.

Natural hazards and their management are a major subject of research in the applied/technological, social, and human sciences. The object of the proposed educational scenario is, in harmony with the objectives of the Sendai Framework, it deals with the development, implementation and evaluation of an educational proposal in the field of Seismology. The main objective of the proposed teaching action is to introduce to the students the research and investigative way of thinking so that they can understand, clarify, and relate the principles of natural sciences they receive in their analytical curriculum with the concepts of Seismology and in particular active faults. The scenario is aimed at students aged 10-15. The basic tool of the educational scenario is the database of active faults in Greece by Institute of Geodynamics NOAFaults v4.0 and the Greek Database of Seismogenic Sources (GreDaSS). Also, this teaching example can be implemented using similar databases.

GNSS: from the planning of a continuous network to the analysis and interpretation of the relative data

Pierre Briole

Ecole Normale Supérieure, Paris Sciences et Lettres Research University, Département des Géosciences

During the last two decades, the scientific community observed a growing number of permanent GPS networks developed for monitoring the evolution of the deformation in active tectonics and volcanic areas. This development was performed at different spatial scales depending on the investigated target, i.e. from a single fault system or a volcano to regional or plates kinematics. Furthermore, thanks to the continuous technical development of the instrumentation, the frontiers of the studies on the deformation have been pushed also at different temporal scales, i.e. from years for the detection of long-term strain accumulation to seconds (and even below) for observing and modeling earthquake sources or dike intrusions and for early warning applications. The capability to observe a target geophysical phenomenon (i.e. plate movement, earthquake deformation or ground motion, volcanic deformation) strongly depends on the effort for planning the monitoring network and on the characteristics of the chosen instrumentation. Further steps are represented by the data analysis and the interpretation of the results. Different GPS data analysis strategies can be adopted for monitoring the deformation of a given target (Precise Point Positioning, Double-Difference, Real-time Kinematic). All of these strategies have their advantages and disadvantages, in terms of noise level (and then accuracy) and reliability with respect to the investigated phenomenon, that should be taken into account for an actual, aware and rigorous interpretation of the obtained results and products. In this presentation, some examples of science-driven GPS monitoring networks will be shown, from their conceptualization to the instrumentation. Examples of data analysis strategies, related accuracies and results will be also described.

Introduction to the Differential SAR Interferometry for measuring ground deformation

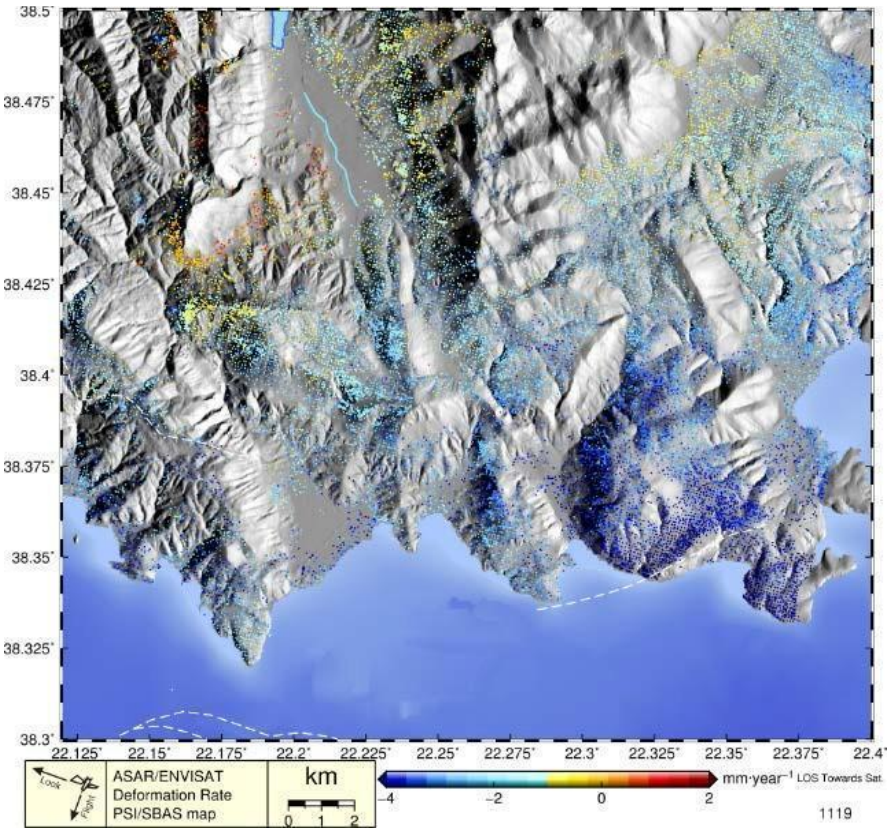
Panagiotis Elias

National Observatory, Athens, Greece

How can we measure a seismic fault buried many kilometres under the ground from 600km away? How can we map a displacement of a few mm or cm from such distances? The technological advancements of the recent decades in the remote sensing permitted the sensing and measuring of the deformation of the earth crust due to earthquakes, aseismic tectonic processes, volcanoes and landslides but also to manmade activities. How can we link the deformation of the surface to the fault in depth through modelling? The basics of the satellite Synthetic Aperture Radar (SAR) characteristics and properties of its provided data as well as the basics for differential and multi-temporal interferometry methodologies will be presented. Links with the presentation of GNSS will be shown. We will focus on the case of the Corinth Rift Observatory area and present our findings so far.

The Corinth Rift is one of the narrowest and fastest extending continental regions worldwide and has one of the highest seismicity rates in the Euro-Mediterranean region. At its western termination, several active faults are located beneath the city of Patras and the surrounding area, a region of major socio-economic importance to Greece.

Apart from moderate earthquakes striking often, additional non sudden geological phenomena, such as slow and continuous ground displacements, are occurring. Both are being provoked by the movement of the tectonic plates. In many cases slow displacements are part of the seismic cycle occurring before an earthquake.



Velocity map produced from ASAR/ENVISAST Multitemporal interferograms of Psaromita and Galaxidi area in the North Gulf of Corinth. The coast of Central Greece is moving away from the coast of North Peloponnesus with a maximum velocity of about 1.5 cm per year.

Ground Deformation Studies in Seismic Active Areas using Local GPS/GNSS networks. The Case of Central Ionian Islands and Patras Gulf

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Section of Geophysics and Geothermics

Satellite geodesy (GPS/GNSS) and satellite radar Interferometry (InSAR) are the main techniques that are been used over the last few decades to study ground deformation in tectonic active areas. In early 90's the Department of Geophysics and Geothermics of NKUA started to install several local benchmark GPS networks in tectonic active areas of Greece in an effort to study and monitor the ground deformation due to tectonic and seismic forces. On the framework of this work small local GPS networks were established in Patras Gulf (1994) in Cephallonia and Ithaca Islands (2001) and to Zakynthos Island (2005). These networks were designed aiming to study the ground deformation in both local and regional scale. The number of the benchmark stations and their position was selected in a way to fully cover the study areas, measuring the ground deformation along major/regional and minor/local faulting zones and also to study motion of the neotectonics blocks that were defined in the selected areas. The networks were remeasured periodically, and after few re-measurement periods that lasted 5-10 years, provided sufficient evidences of both the regional and local kinematic regime of the study areas. When strong seismic events occurred in the vicinity of the GPS networks the results offered more insight on the activated faults. The displacement vectors associated with the co-seismic motions as well as with the post-seismic relaxation period were the main elements to describe the motions along the seismogenic fault planes, via modelling procedures. Moreover, special effort was given to define pre-seismic displacements that could be associated with the forth coming seismic events, in order to contribute to the earthquake prediction studies.

Based on the GPS results from the local networks in Patras Gulf and in central Ionian Islands regional and local scale motions were detected and interpreted jointly with the tectonic, geologic, seismic and interferometric data that were available aiming to define the seismic status of the study areas. Pre-seismic motion patterns were defined, co-seismic displacements were calculated and post-seismic relaxation behavior was identified in the complex tectonic environment of the western Greece.

Since 2008 in the broader area of Patras Gulf and Central Ionian islands permanent GNSS stations were started to established providing a daily image of the ground motion, and accurately define the velocity field of the area. The data from the permanent GNSS stations were elaborated with the campaign data providing a more detailed image of the ground deformation occurred in this area, as well as the strain filed that is controlled by the local and regional tectonism.

The combination of the satellite geodetic data (GPS/GNSS) with the interferometric results succeed to accurate map the spatial and temporal ground deformation and kinematic status of the Central Ionian and Patras Gulf, providing crucial tools towards the better understanding of the current seismic status of the area. The results are expected to enable the scientists to better evaluate the seismic and associated hazards, in such tectonically active areas and planning processes in respect to minimis damages from future strong seismic events.

Multitemporal monitoring of active faults with close-range (t-LiDAR, UAS) remote sensing equipment

Emmanuel Vassilakis
Assoc. Professor in Remote Sensing & Tectonic Geomorphology, NKUA

During the last years, close-range remote sensing data (point clouds) interpretation and equipment (terrestrial laser scanners and drones) are being used, among other, for the 3D representation of active fault surfaces and for capturing the micro-movements or displacements that may happen on them. The successful combination of such techniques, through a diachronic monitoring is being used to reveal and quantify the landscape evolution involving the surface alterations on the fault plane. Quantitative analysis of Digital Surface Model data, acquired at several time periods compared in three-dimensional sophisticated software, provide visualization of the geometrical properties across the fault plane, along with the earth processes that the fault slip movement causes at the surrounding area (rockfalls, displaced notches etc).

The Corinth Gulf is surrounded by active faults that control significant parts of the shoreline and one of them is the Psatha fault, located at its easternmost coast. In June 2011, a terrestrial LiDAR point cloud was generated, representing the micro-topography of the fault surface and the debris covering part of it. In a later phase, in July 2022, a terrestrial LiDAR scanner was also utilized, and the data acquisition was concentrated on the contact between the debris and the carbonate fault surface, where significant rockfalls and slope failures were observed, in comparison to the previous campaigns. Several quantification techniques were applied, and specific volumes of rock particles were found, either displaced on top of the hanging wall, due to rock falling, or as debris. These alterations on the fault surface are mainly attributed, either to severe weather phenomena and/or small earthquake events, that continue to happen at the very seismically active Gulf of Corinth.

Static and dynamic gravity investigations within Corinth Rift Laboratory project

Jan Mrlina

Institute of Geophysics, Prague, Czechia

Gulf of Corinth in Central Greece (GOC) represents a very active geological structure on the Aegean plate, prolonged in the WNW-ESE direction, with 1 – 2 cm/y of horizontal extension in the N-S direction and high earthquake activity. On the southern coast of the Gulf, there is a set of active normal faults parallel to the axis of the Gulf and dipping to N at about 60 deg angle – Aigion, Helike and Pirgaki. Gravity survey was aimed at location of such structural and tectonic phenomena.

The survey was performed with LaCoste-Romberg gravity meters model D and Graviton EG, with support of GPS instrumentation. Total of 600 points were measured, terrain corrections and other usual reductions were applied. Two reduction densities 2.50 and 2.67 g.cm-3 were used to calculate Bouguer gravity anomalies. Co-ordinates were processed in WGS84/UTM, and also in the HGRS87 local Greek system. Adjustment of the GPS network showed a significant northward displacement of a Greek geodetic pillar located NE of Aigion city as a consequence of the coastline collapse during the 1995 earthquake.

We collected 145 rock samples in order to obtain the density and porosity characteristics from laboratory measurements. The two principal rock types were compared, limestone with 2.67 g.cm-3 and conglomerate 2.55 g.cm-3 (2.45 g.cm-3 for the youngest sequence) provide the difference 0.12 g.cm-3.

Various processing techniques enabled to prove the existence of transverse faults of NNE-SSW direction that had not been considered before. These faults might have been reactivated, or originated, during the recent extension of the Corinth Rift. Some other indications of density contrasts from filtered gravity data could be explained by faults as well. However, the control analysis of possible effects of topographic features and absolute vertical levels of various types of sedimentary formations is essential. It means that rough topography has strong effect not only in the gravity data processing sense, but also in the geological-interpretative sense. Positive and negative blocks (relative density character) were defined. They show that the mutual position of basement carbonates and young sedimentary rift-related formations is more complicate than a simple regular normal faulting scheme.

We also observed temporal changes of gravity within our network extended between Patras and Corinth. Interesting signals were recorded around Aigion, e.g. in the period 1997-1999 before the exceptional swarm-like earthquake activity that occurred in 2000 – 2001. These signals had the maximum amplitude up to -60 microGal right in the area under study between the Aigion and Helike faults. The negative gravity change could reflect increased tensional stress before the swarm; moreover, it confirmed what we suggested from gravity survey – the existence of active transverse faults, as many of the seismic fault plane solutions showed unusual N-S strike.

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Open Seismic Data Retrieval through EIDA Nodes and Automated Moment Tensor Analysis

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Institute of Geodynamics, National Observatory of Athens

ORFEUS (Observatories and Research Facilities for European Seismology) EIDA (European Integrated Data Archive) is a collaborative initiative aimed at facilitating access to seismological data across Europe. It serves as a centralized platform for storing and distributing seismic data collected by numerous research institutes and observatories within the European seismology community. EIDA implements webservices to provide standardized and open access to data. These include FDSN standardized webservices for mSEED waveform data, station metadata and data availability. Additional EIDA specific standardized webservices for routing between services and for waveform metadata ensures a centralized point of entrance into the federated infrastructure and user specific quality checks on the actual data. EIDA plays a crucial role in promoting data sharing, fostering international collaborations, and enabling advanced research in seismology. By providing a standardized and easily accessible data infrastructure, EIDA contributes to a deeper understanding of Earth's structure, seismic hazard assessment, and earthquake monitoring efforts.

The availability of near-realtime seismic waveform data from many European countries with dense seismic networks allows the application of semi-automatic fast processing workflows that can be triggered after significant earthquakes. GISOLA is one tool that determines automatically moment tensors (MT), essential for real-time seismological applications. It is a highly evolved software for MT determination, oriented toward high-performance computing. It employs enhanced algorithms for waveform data selection via quality metrics, such as signal-to-noise ratio, waveform clipping, data and metadata inconsistency, long-period disturbances, and station evaluation based on power spectral density measurements in parallel execution.

The National Observatory of Athens (NOA) functions as a primary EIDA node, catering to seismic networks in Greece, Cyprus, and Montenegro. It plays a crucial role as the developer of GISOLA software and has integrated it into the datacenter, enabling quick determination of moment tensor (MT) solutions for earthquakes in Greece and the surrounding areas with magnitudes exceeding 3.5Mw. The MT database contains numerous solutions starting from 2012 onwards.

Seismic hazard in Greece with a focus in the Western Gulf of Corinth

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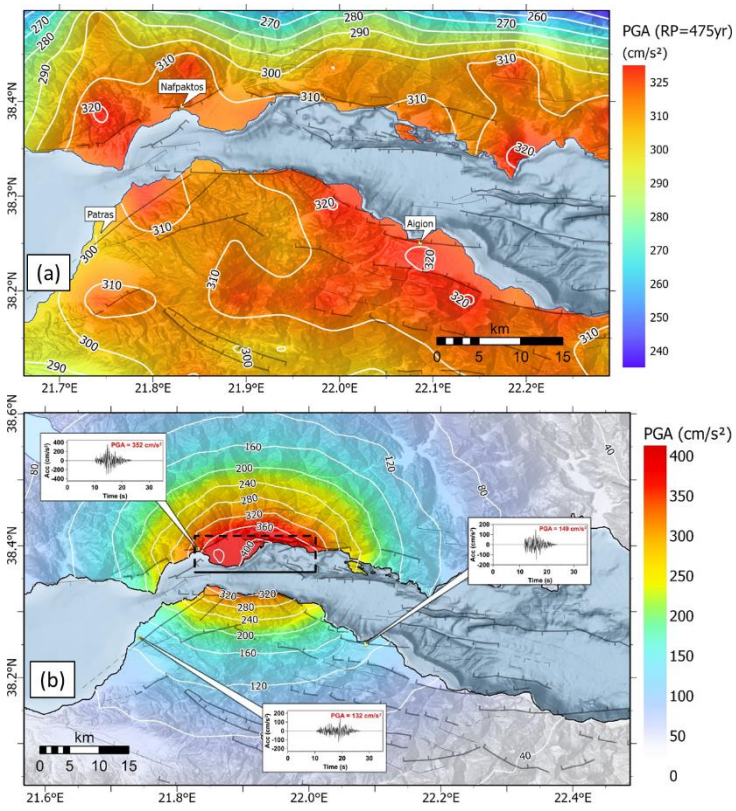
Seismic hazard describes the natural phenomena generated by an earthquake, such as ground movement and fault rupture. The catalyst of possible secondary phenomena is ground motion. Seismic Hazard Assessment (SHA) is an effort to quantify seismic hazard and its associated epistemic uncertainties. This quantification process is executed by the computation of Peak Ground Acceleration, Velocity (PGA, PGV) and others. There are two main ways to perform SHA. The first is called Probabilistic Seismic Hazard Assessment (PSHA), and the second is Scenario-Based Seismic Hazard Assessment. The first, uses an earthquake catalog and a seismotectonic model and the results are generated for certain return periods. On the other hand, Scenario-Based considers a single fault rupture without a specific time frame.

Greece possesses a significant seismic hazard (Danciu et al., 2021). This can be attributed to the direct contact of the European and African tectonic plates in Southern Greece, with Africa subducting beneath Europe. Positioned to the north of this subduction zone is the Gulf of Corinth, which is an active rift that is expanding in a North-South direction. This particular seismotectonic configuration is accountable for the frequent occurrence of numerous earthquakes, positioning Greece among the European countries if the highest seismic hazard. As a result, the entire nation, or specific areas within, have served as focal points for numerous seismic hazard studies.



In recent study conducted by Kaviris et al. (2022) the seismic hazard of western Gulf of Corinth was assessed using both the probabilistic and the scenario-based methodology. In the initial approach, a range of input data variations were considered to address epistemic uncertainties through computational variability. The outcomes of the PSHA demonstrated that the land in proximity to the gulf exhibit elevated PGA values, which decrease towards the south and north for a 475-year return period (Figure a). The subsequent approach comprised two main components. The first involved parameter optimization, wherein simulated and recorded PGA values of the most recent strong (Mw ≥ 6.0) earthquake in the study area; namely, the 1995 Aigion MS = 6.2 mainshock were compared. This comparison was conducted to adjust input data such as the stress parameter. The second component pertained to simulating strong ground motion for hypothetical rupture scenarios, one of which was the Psathopyrgos Fault (Figure b). The results indicated that the highest PGAs, situated at the surface projection of the fault or in close proximity, exhibited relatively consistent values ranging from approximately 350 to 450 cm/s².

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Physical mechanisms behind seismic site response - Some examples from Aegion

Olga-Joan Ktenidou

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This short lecture will show us how analyzing a large number of earthquakes recorded at a seismic station can reveal particular characteristics of that site's seismic response. Coupling such an analysis of recorded data with numerical tools -where the site's geometry and soil properties are modeled in 2 dimensions as a grid and a seismic input is propagated through it- can help us validate our observations on the data and explain the physical mechanisms behind the observed site response.

We will look at examples from a study performed on over 500 earthquake records from a vertical array of acceleromteters in Aegion, Greece. The array is installed inside an alluvial basin and it includes five stations all at different depths, so as to record ground motion in various kinds of soil as well as in the underlying rock. Aegion, which is situated in the Gulf of Corinth, is a location of high seismicity and so during a few years, hundreds of earthquakes were recorded by this array. The array was installed inside the basin in order for the recordings to shed light on how this complex geological feature affects seismic ground motion at the surface, which in turn can affect the seismic response of the structures and infrastructure in the vicinity.

We estimate site effects using the technique of empirical spectral ratios, with and without a reference site (standard and horizontal-to-vertical spectral ratio). We find significant site amplification which cannot be accounted for by 1D model predictions, and also a significant difference between the two horizontal components. These are indications that the response is dominated by 2D effects, due to strong surface waves generated at the basin edge and propagating laterally towards its interior. Our numerical model simulations corroborate the results of our empirical data analysis and can help inform us about the geological features that cause the various features of the site response. The strongest amplification takes place in the direction parallel to the basin edge, and is up to 2 times higher than in the perpendicular direction. We link this to the nature of surface waves, the Love waves generated being stronger than the Rayleigh waves. We also consider different time windows to study the effect on different wave packages, such as S-waves and coda.

Finally, we make some comparisons with the way the European seismic design code (Eurocode-8) addresses and -of necessity- simplifies such complex phenomena. We compute soil-to-rock amplification factors for peak ground acceleration and find hey are significantly higher than what is predicted by current design codes. With that opportunity, we make a short overview of the limitations in predicting complex ground motion based on simple proxies.

Climate and Earthquakes: Recent Research and Potential Contribution of Near Fault Observatories

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Department of Geology, University of Patras

“Earthquake Weather” is the notion of people across times and civilizations that a certain type of weather precedes the occurrence of earthquakes. In the past, the scientific community has repeatedly examined the proposition, without being able to find a solid link between weather and the occurrence of earthquakes, thus placing people’s notion among myths. During the past few years, however, advances in seismological instrumentation and networks and the achievement of long-term monitoring of micro-movements of the earth’s crust through satellite technologies have been revealing hints of truth in this myth. Although the relation is certainly not of a direct cause-effect type, there is considerable evidence that the earth’s atmosphere and its shallow crust interact in ways often imprinted in seismicity catalogues and earthquake records. This is suggested by an increasing number of studies that correlate weather/climate to localized changes in microseismicity and even to the impact of large earthquakes. Near Fault Observatories, with their dense and multidisciplinary monitoring networks, present inherent prerequisites for being valuable contributors toward a deeper understanding of the interactions between atmosphere and lithosphere, their exact mechanism and effects. This potential will be discussed through a review of the pertinent literature and the presentation of example studies.

Relative sea level changes in the Corinth Gulf during the late Holocene

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Remains of past sea levels, such as tidal notches, benches, beachrocks, etc. may provide valuable information for the investigation of relative sea level changes of eustatic and/or tectonic origin. Tidal notches are usually formed in limestone cliffs in the mid-littoral zone, are well known as precise sea-level indicators and they can attest to the modality of sea level change (rapid or slow) allowing to identify palaeo-seismic events.

In this presentation, we focus on case studies of earthquake-driven coastal changes from the Corinth Gulf, where impacts of past earthquakes can be traced mainly through tidal notches. A reanalysis of published measurements of submerged and uplifted tidal notches in the Corinth Gulf may provide useful indications concerning the long-term tectonic trends that are active in the study area.

Earthquake structural response of Rion Antirrion Bridge: 15yrs of continuous structural surveillance through permanent instrumentation system

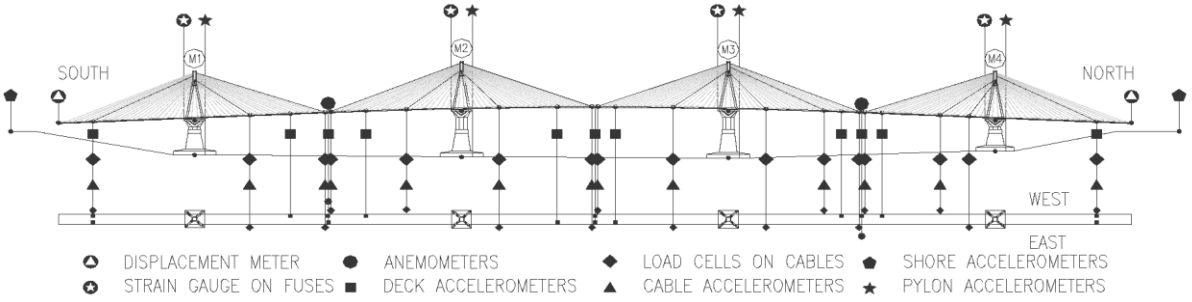
Akis Panagis

GEFYRA SA

Rion-Antirrion Bridge is a multi-span cable-stayed bridge with a total deck length of 2,252m fully suspended from the pylons top located on an area of significant seismicity (West Corinth Gulf). During structural design phase unique solutions were implemented to mitigate consequences of a major earthquake event and to allow significant ground displacement without extensive restoration actions.

Rion Antirionbridge in in operation since 2004 and over this period more than 30 earthquake events, yielding to noticeable structural excitation, have been recorded through the instrumented monitoring system that is permanently installed. The intensity of events ranges from small events at the vicinity of the structure –having epicenter distance less than 10 km to major events at an epicenter distance exceeding 250 km (JAN 8th 2006 Kythira Event).

Current presentation discusses the structural response of Rion Antirrion Bridge focusing on apparent differences observed for different earthquake events while JUN 08th 2008 Achaia-Ilia EQ consequences are extensively presented since this was the most severe event up to now.



Rion Antirrion Bridge SHM Instrumentation.

Recent sedimentary processes in the western Gulf of Corinth, Greece: seismic and aseismic Turbidites

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Laboratory of Marine Geology and Physical Oceanography, Geology Department, University of Patras, Greece

The Corinth rift is counted among the most active tectonic grabens in the world, with extension rates up to 15 mm/yr (Western part). These high extension rates are associated with very strong seismic events that are, occasionally, responsible for submarine mass movements. These movements, their consequential bottom currents, and the differential river-discharging sediment accumulation in the whole gulf, strongly affect the modern marine sedimentary processes. The definition and understanding of these processes is the main aim of this project. This is attempted through via sedimentological, mineral and geochemical analyses on two gravity sediment cores from a WE submarine canyon (10 km long, 3 km wide) that lies in the Western tip of the gulf. The general sedimentation motif reveals the presence of hemipelagic deposits which are occasionally interrupted by sandy turbidites. A number of these turbidites correlate with past seismic events. The sedimentation rates range between 2.57 mm/yr in the western part and 0.67 mm/yr in the eastern part.

Laboratory class: Study of Archaeomaterials in

"KERAMos Lab

Ioannis Iliopoulos[1] and Vayia Xanthopoulou[1,2]

[1]Department of Geology, University of Patras, Greece

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The KERAMOS research group adopts an interdisciplinary approach to tackle archaeological challenges by conducting scientific investigations into material culture and the related Earth's mineral resources. For the past decade, the group has been actively engaged in Archaeometric research at the Department of Geology, University of Patras. Our research endeavours encompass the study of cultural artefacts from diverse regions and historical periods, spanning from the Paleolithic to the modern era. Accredited methods are employed to sample, analyse, and assess clays, sands, and rocks, determining their suitability as raw materials for ceramic production and their use for stone artefacts. To address archaeological inquiries, the group utilizes non-destructive and minimally destructive analytical techniques for ceramics, stones, metals, glass objects, and historical manuscripts.

In our lecture, we are going to present you briefly how an archaeometric research is conducted through several case studies, which are either completed or on going. We will begin from the sampling campaigns, the laboratory processes, the applied analytical techniques, the results and how these contribute to responding to the archaeological questions.

Field trip to the Helike fault

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Department of Geophysics and Geothermics

The Helike fault is the most prominent high-angle, normal fault on the south side of the western Gulf of Corinth (Fig. 1). It is well visible in satellite images, air-photos, DEMs and it forms impressive footwall landscapes. Its seismic potential is M=6.8 (Doutsos and Poulimenos, 1992) and its probabilistic rupture forecast for the next 30-yr is among the highest in this region of central Greece (Ganas et al., 2014). It is divided into two north-dipping segments with a right step near the exit of the gorge of the Kerynitis river (Koukouvelas et al 2001; Pavlides et al. 2004). The western fault segment bounds a thick sedimentary basin (a few hundred metres) and it has cut across incised streams, however the fault scarp is less pronounced. The eastern fault segment has a total length 24-26 km (20 km onshore and 4-6 km offshore). It ruptured on 26 December 1861 during the famous Helike earthquake that created surface breaks for a distance of 13 km (mapped from Julius Schmidt, then NOA Director) with a vertical displacement up to 1 m. Paleoseismological data showed that the eastern segment was activated three times during the last 2000 years, including that of the 1861 event. The event magnitude was estimated at M=6.7-6.8 and most probably they occurred sometime between 190BC-110AD the former, and around 600AD the latter. Based on the radiocarbon dating of the sediments the slip rate increased dramatically after a strong earthquake event near 1400BP. The faster slip rate evidently increased the sedimentation rate. The average slip rate on the fault over the past 2000 years is estimated at about 1.5 mm/year while the horizontal extension accommodated from this fault is about 1 mm/year. The field visit will focus on scarp morphology (Fig. 2; sketch by Koukouvelas and Papoulis), fault plane geometry and kinematics of one prominent site (Kalanteri), to the east of village Selinountas.

Figure SEQ Figure * ARABIC 1. Field view of the eastern Heliki fault. Source: helikeproject.gr

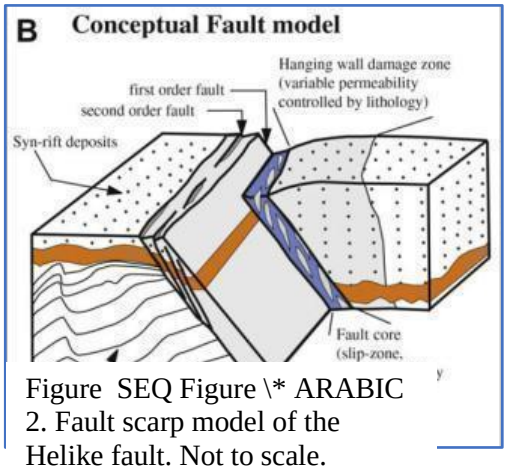

Figure SEQ Figure * ARABIC 2. Fault scarp model of the Helike fault. Not to scale.

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Introduction to satellite SAR interferometry

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During the last two decades, the scientific community observed a growing number of permanent GPS networks developed for monitoring the evolution of the deformation in active tectonics and volcanic areas. This development was performed at different spatial scales depending on the investigated target, i.e. from a single fault system or a volcano to regional or plates kinematics. Furthermore, thanks to the continuous technical development of the instrumentation, the frontiers of the studies on the deformation have been pushed also at different temporal scales, i.e. from years for the detection of long-term strain accumulation to seconds (and even below) for observing and modeling earthquake sources or dike intrusions and for early warning applications. The capability to observe a target geophysical phenomenon (i.e. plate movement, earthquake deformation or ground motion, volcanic deformation) strongly depends on the effort for planning the monitoring network and on the characteristics of the chosen instrumentation. Further steps are represented by the data analysis and the interpretation of the results. Different GPS data analysis strategies can be adopted for monitoring the deformation of a given target (Precise Point Positioning, Double-Difference, Real-time Kinematic). All of these strategies have their advantages and disadvantages, in terms of noise level (and then accuracy) and reliability with respect to the investigated phenomenon, that should be taken into account for an actual, aware and rigorous interpretation of the obtained results and products. In this presentation, some examples of science-driven GPS monitoring networks will be shown, from their conceptualization to the instrumentation. Examples of data analysis strategies, related accuracies and results will be also described.

Seismic Parameters and Microseismicity in the Gulf of Corinth

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School of Geology

Geophysics Department

The Gulf of Corinth is one of the most seismically active areas in the Mediterranean area, associated with extensional crustal faulting. The Gulf has the general shape of an asymmetric half–graben with the southern footwall being uplifted. Its western end is connected through the Rio–Antirrio strait to the Gulf of Patras, which does not have any major faults comparable to the ones affecting the Gulf of Corinth. The eastern part truncates the Megara basin through a complex pattern of faults with a more NE–SW strike. The geodetically measured N–S extension is about 15 mm/yr in the western part, around Rio, and about 10 mm/yr in the eastern part, around Corinth. A comparison between several GPS surveys measured over shorter duration gives slightly higher values, but with the same difference between the western and eastern ends of the Gulf. It therefore seems clear that the present deformation is relatively well confined in the center of the Gulf on a very narrow deforming zone.

Information on the strong ($M \geq 6.0$) earthquakes in the study area is available for more than 25 centuries. They may be considered as characteristic ones, associated with certain fault segments independently of their epicentral uncertainties. Their occurrence rate reveals that all $M \geq 6.0$ earthquakes are included in the regional catalog since 1700 AD, and they occur in clusters. The dimensions of the fault segments do not exceed 20 – 25 km, which implies an upper limit for the magnitude of the earthquakes that can occur on an individual fault segment. The last $M \geq 6.0$ earthquake to rupture the area occurred in 1995 and is associated with Aigion fault segment.

Accurate determination of the source parameters of microseismicity is crucial in understanding the seismicity evolution. The spatial and temporal evolution of the abundant low magnitude shocks can be used to define thoroughly the seismotectonic properties of the area which are related with the occurrence of strong earthquakes. We use the P and S phase picks of the recordings at the stations of the Hellenic Unified Seismological Network (HUSN), which is rather dense in the broader area particularly in the central and western part of the gulf. Initially shocks are located by the hypoinverse program using a one dimension local velocity model of the P waves, the Vp/Vs ratio and travel time corrections to take into account lateral heterogeneities of the model. Then, the double difference technique is applied to relocate the events. In the final step, cross–correlation differential travel times derived from phase–picked data and waveform cross–correlation are included. Jointly relocated data have reliable relative positions. Focal mechanisms based on the first motion polarities exhibit mostly normal faulting on almost E–W striking nodal planes. For the $M>3.0$ moment tensor solutions are determined. Both, the spatial distribution of the earthquakes and their focal mechanisms, show a dominant strike of 270^o in the westernmost part changing to 270^o – 290^o at the center of the Gulf, perpendicular to the almost N–S extension of the rift. Further to the east, a gradual change in fault orientation is observed. In the easternmost part, the strike becomes 240^o, in agreement with the geometry of the rift.

The spatial and temporal evolution of the microseismicity is thoroughly investigated and remarkable characteristics, among which similarities and differences have been found. To better understand the microseismicity evolution both the seismicity rate change and the static stress changes due to the coseismic slip of the stronger earthquakes are examined. Since the early days of detailed seismic monitoring of the area, frequent earthquake clusters or swarms have been recorded. These swarms are mostly located in the western part of the study area, in shallow depths and associated with different north or south–dipping fault segments. The seismicity in the shallow north–dipping seismic zone is continuous and free of earthquake clusters, probably defining the boundaries between brittle and ductile layers.

Innovative ideas and activities for Earth Science Environmental and Physical Geography teaching and learning, «E.L.I.»

Fotios Danaskos

8th Junior High School in Chalandri

EGU GEFO HELLAS

Among the different STEM subjects, Geosciences are probably the most neglected, both in school curricula and in the teaching practices of many countries too.
Earth learning idea, began as an idea on 6th May 2007 and from 2008 to 2023, has spread across the Geosciences Teaching world more than 400 activities with explanatory videos, translated into different languages.
There have been visits from 213 countries and over 6 million downloads. ELI is publishing FREE Earth-related teaching ideas, designed to be practical resources for School Teachers and Teacher-trainers all over the world.
A new Earth Learning Idea is published every two weeks.The ELI Blog is updated every Monday and new videos are uploaded all the time.
New ideas and activities are very well designed and explained and of these activities require the use of some basic school laboratory equipment and some include abstract ideas, labeled ELI+ activities. Each activity is designed to create pupil participation for maximum learning.
All activities are free to download and most require minimal cost and equipment. Best of all, they are fun and bring fun and happiness o the school classroom.!
The original inspiration came from Professor Chris King, who sadly passed away on February 17, 2022. The team behind this idea today consists of 3 experts (**Peter Kennett**, **Elizabeth Devon, Pete Loader**) and is currently trying to maintain his credentials, so the wealth of experience and his dedication to the teaching of Geosciences, to spread throughout the world.

You can find ELI:

https://www.facebook.com/earthlearningidea
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Natural Catastrophes in the Helike Delta: From Prehistory to Late Antiquity

Dora Katsonopoulou

The Helike Project & The Helike Society

The most impressive destructive event occurred in ancient times in the area ofHelike on the southwestern shore of the Gulf of Corinth, was undoubtedly the 373 BC earthquake and flood. To this catastrophic event has been compared the earthquake that happened in the same area in the winter of 1861.

In the search for Helike's lost site, our team located the ancient city's settlement(s) buried from about 2-4 m, in today's coastal plain about 7 km southeast of Aigion, mainly in the zone between the Selinous and Kerynites Rivers. Archaeological data from the excavations and geoarchaeological studies have provided evidence on recurrence of earthquake phenomena in the Helike region since prehistoric times, thus augmenting our knowledge on the seismic history of the area.

It is noted that apart from the discovery of ruined Classical buildings in mid-plain that seem to be associated with the famous 373 BC earthquake, excavations brought to light evidence on the occurrence of unknown earthquakes that caused the destruction and abandonment of settlements in the Helike area. Among them, the most important refer to:

a. The destruction of the coastal proto-urban town of Early Helladic Helike ca. 2100 BC by an earthquake accompanied by extensive fire,
b. The destruction and abandonment of Geometric Helike ca. 700-680 BC,
c. The abandonment of the revived Late Classical-Hellenistic Helike settlement ca. 130/120 BC,
d. The destruction of Roman Helike by an earthquake ca. 400-450 AD.

On the basis of the collected scientific data, a final observation can be made about the close interaction between people and their natural environment, in a region of high seismic activity and intense geological processes over a long period of time. By correlating and interpreting the physical remains, we are able to trace the settlements' relocation/shifting, with reference to natural catastrophes that befell in the area.