CRL School 2020

Corinth Rift Observatory




18-20 September 2020

via Zoom teleconference Platform

Welcome!!!

Dear **teachers and students**, welcome to the 2020 edition of the CRL School!

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

Unfortunately, due to the restrictions imposed by the Covid Pandemia, the CRL School 2020 will be held via teleconference platform Zoom. One of the main characteristics of the CRL School is the educational field component, performed in the natural area of the Corinth Rift. Since this is not the case for this year, the CRL School 2020 is not considered as a 'normal' one and certificates of attendance to the students will not be given. A certification of attendance of the online 'version' of the School will be given only to the secondary level teachers, to facilitate their admission from their supervisors. Moreover, the number of the participant, for the first time, is not limited and all the participants of 2020 may apply for the next CRL Schools, which will hopefully be held on site.

At the School, scientific issues at various disciplines of Earth Sciences, including seismology, geodesy, geology and geophysics will be examined from a theoretical point of view, as well as from the point of view of their applications in the research studies and results at 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 broad scientific signification.

We foresee that the participants will gain understanding of all these methods and their results and will be engaged in discussions about the interpretation of the results and how they can be used in teaching.

The Scientific Committee has been one of the actors in preparing this School, but other persons and/or Institutions have contributed to it. We would like to acknowledge all the lecturers and Mrs. Annita Panteleli who assisted the organization of the School.

We would like to continue to offer to students and teachers the opportunity to participate 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**.

We also encourage you to write reports for the School in publications specifically intended for geosciences, science and geography teachers.

For now, please enjoy your CRL School 2020.

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 Scientific Committee of the CRL School

Scientific Committee

CHAIR

Panagiotis Elias
National Observatory,
Athens, Greece
pelias@noa.gr

MEMBERS

George Kaviris

National & Kapodistrian University
Faculty of Geology and Geoenvironment
Department of Geophysics and
Geothermics
gkaviris@geol.uoa.gr

Fotios Danaskos

Geologist, School Teacher
8th Junior - Senior High School
in Chalandri, HELLAS
fdanas@yahoo.gr

George Foumelis

BRGM | French Geological Survey
Orleans, France,
m.foumelis@brgm.fr

Corinth Rift Laboratory School – 2020

via Zoom teleconference Platform

(September 18-20, 2020)

Program

Friday September 18, 2020

(Time in EET, UTC+2)

10:00 – 10:20 **Welcome to the CRL School 2020**

- Panagiotis Elias, National Observatory, Athens, Greece, Chair of the CRL School
- Fokion Zaimis, Vice Governor for Entrepreneurship, Research and Innovation of the Region of Western Greece
- Nikolaos Voulgaris, Vice Rector of Research and Lifelong Learning of the National and Kapodistrian University of Athens, Greece

10:20 – 10:40 **Why CRL?**
Ann Deschamps, Université Côte d'Azur, GeoAzur & EduMed, Nice, France
[CV: page 10, Abstract page 35]

10:40 – 11:00 **Tectonics, large earthquakes and the growth of faults in the western rift of Corinth**
Athanassios Ganas, National Observatory, Athens, Greece
[CV: page 11, Abstract page 37]

11:00 – 11:20 **The geodetic monitoring of the Corinth Rift Observatory with GPS and SAR interferometry**
Pierre Briole, CNRS, Paris, France
[CV: page 12, Abstract page 38]

11:20 – 11:40 **Break**

11:40 – 12:00 **The Corinth Rift through the use of marine remote sensing techniques**
Maria Geraga, University of Patras, Greece
[CV: page 13, Abstract page 39]

12:00 – 12:20 **Age, origin and history of the rocks that can be found along the north coast of the Corinth Rift**
Christian Beck, Savoie-Mont-Blanc University, France
[CV: page 14, Abstract page 40]

12:20 – 13:00 **Break**

13:00 – 13:20 **Large Earthquakes and Focal Mechanisms in the Gulf of Corinth**
George Kaviris, National & Kapodistrian University, Athens, Greece
[CV: page 15, Abstract page 41]

13:20 – 13:40 **Seismic Parameters and Microseismicity in the Gulf of Corinth**
E. Papadimitriou - V. Karakostas, Aristotle University, Thessaloniki, Greece
[CV: page 16 & 17, Abstract page 42]

13:40 – 14:00 **Use of CRL data for detailed seismological studies**
Anna Serpetsidaki, University of Patras, Greece
[CV: page 18, Abstract page 43]

14:00 – 14:20 **Seismological studies in the broader CRL region**
Zafireia Roumelioti, University of Patras, Greece
[CV: page 19, Abstract page 44]

14:20 – 14:40 **Tectonics, structural setting and tectono-sedimentary processes in the Corinth Rift**
Haralambos Kranis, National & Kapodistrian University, Athens, Greece
[CV: page 20, Abstract page 45]

14:40 – 15:00 **Open Discussion**

Saturday September 19, 2020

(Time in EET, UTC+2)

10:00 – 10:20 **Global Positioning System: from the planning of a monitoring network to the data analysis and the interpretation of the relative results**
Antonio Avallone, Istituto Nazionale di Geofisica e Vulcanologia, Rome, Italy
[CV: page 21, Abstract page 46]

10:20 – 10:40 **Ground Deformation Studies in Seismic Active Areas using Local GPS/GNSS networks. The Case of Central Ionian Islands and Patras Gulf**
Vassilios Sakkas, National and Kapodistrian University, Athens, Greece
[CV: page 22, Abstract page 47]

10:40 – 11:00 **Quantification of N. Peloponnese shoreline displacement using very high spatial resolution remote sensing data**
Emmanouel Vasilakis, National and Kapodistrian University, Athens, Greece
[CV: page 23, Abstract page 48]

11:00 – 11:20 **European Space Agency Earth Observation Programme**
Michael Foumelis, BRGM – French Geological Survey, Orleans, France
[CV: page 24, Abstract page 49]

11:20 – 11:40 **Break**

11:40 – 12:00 **Geographical Information Systems (GIS) – Introduction to QGIS**
Antonios Mouratidis, Aristotle University, Thessaloniki, Greece
[CV: page 25, Abstract page 50]

12:00 – 12:20 **Introduction to the Differential SAR Interferometry for measuring ground deformation**
Panagiotis Elias, National Observatory, Athens, Greece
[CV: page 26, Abstract page 51]

12:20 – 12:40 **A Geospatial Intelligence Application Based on SAR Interferometry to Support Immediate Post-seismic Infrastructure Inspections: The Cases of Earthquakes in the Balkan Peninsula**
Isaak Parcharidis, Harokopio University, Athens, Greece

12:40 – 13:20 **Break**

13:20 – 13:40 **Ground acceleration produced by earthquakes and their local amplifications depending on the properties of the underlying soils**
Ioannis Kassaras, National and Kapodistrian University, Athens, Greece
[CV: page 27, Abstract page 52]

13:40 – 14:00 **Physical mechanisms behind seismic site response - Some examples from Aegion**
Olga Ktenidou, National Observatory, Athens, Greece
[CV: page 28, Abstract page 54]

14:00 – 14:20 **Structural morphology and geometric control of the Rio-Antirrio bridge**
Akis Panagis, GEFYRA, Greece
[CV: page 29, Abstract page 55]

14:20 – 15:00 **Open Discussion**

Sunday September 20, 2020

(Time in EET, UTC+2)

10:00 – 10:20 **Earthquakes in the classroom: "The SEISMO-BOX: DO IT YOURSELF"**
Francesca Cifelli, Università Roma Tre, Roma Italy
[CV: page 30, Abstract page 56]

10:20 – 10:40 **Tuned in to the Earth : Using data online at school**
Jean-Luc Berenguer, University Côte d'Azur, Valbonne, France
[CV: page 31, Abstract page 58]

10:40 – 11:00 **Diffusion of SEISMOBOX in Hellenic schools**
Fotis Danaskos, 8th Junior - Senior High School in Chalandri
[CV: page 32, Abstract page 59]

11:00 – 11:20 **Incorporating the seismobox into school teaching**
Kiki Makri, National Observatory, Athens, Greece
[CV: page 33, Abstract page 61]

11:20 – 11:40 **Break**

11:40 – 12:40 **Hand on simple seismic software packages provided on-line in the CRL portal**
George Kaviris, Ioannis Spingos, National & Kapodistrian University, Athens, Greece
[CV: page15, Abstract page 62]

12:40 – 13:20 **Break**

13:20 – 13:40 **The Geohazards Lab initiative**
Michael Foumelis, BRGM – French Geological Survey, Orleans, France
[CV: page 24, Abstract page 63]

13:40 – 14:00 **Hosted Processing Services on Geohazard Exploitation Platform (GEP)**
Michael Foumelis, BRGM – French Geological Survey, Orleans, France
[CV: page 24, Abstract page 63]

14:00 – 15:00 **Overall discussion – Conclusions**

End of the CRL 2020 School

Curricula Vitae

Dr. Anne Deschamps
Emeritus Research Director
Université Côte d'Azur
Géoazur, EduMed
250 rue A. Einstein, 06560 Sophia Antipolis
Deschamps@geoazur.unice.fr

EDUCATION

Studies in France.
University studies at ENS.
Agregation of Physics Sciences, Thesis in Seismology at the University of Paris.

CAREER

After three years as Assistant Professor at ENS, I joined the CNRS (Centre National pour la Recherche Scinetifique) as research scientist in seismology. From 1979 to 1992, I was affected at IPGP (Institut de Physique du Globe de Paris). In 1992, I moved to Géoazur (CNRS/University of Nice Sophia Antipolis) were I was in charge of the regional seismic network in Provence Alpes Côte D'Azur region and developed the broad band seismological observation on land and more recently on sea floor in the frame of ESONET and EMSO programs.

RESEARCH INTERESTS

Working on seismic sources studies, I have participated to the characterisation of the Mediterranean large seismic events (in Algeria, Italy and Greece). I contributed to seismological studies in different countries (Colombia, Mongolia, Tanzania, Haiti, Ecuador…) to understand of relation between faults, large earthquakes and seismic crisis.
Since late 1980's I am strongly involved in different projects in Greece on large earthquake, seismicity, seismogenesis and tectonics and since 2000 I contribute to the development of the Corinth Rift Laboratory recently integrated in EPOS as an European Near Fault Observatory.
More recently, I turned also my interest towards effects of strong ground motions produced by earthquakes: characterisation, site effects, site/structure interaction.
Since 15 years I am following "Sismo à l'Ecole", an initiative to bring seismology at schools and more recently EduMed (http://edumed.unice.fr/fr), a program to provide to teachers and undergraduate students with easy access to controlled data sets on meteorology, hydrology, oceanography and seismology across Mediterranean area for teaching applications.
I have published over 180 articles in international scientific journals.
I supervised 10 PhD students in seismology and different Masters of Science, mostly at the Université Côte d'Azur

Athanassios Ganas
Research Director
Institute of Geodynamics, National Observatory of Athens
Email address aganas@noa.gr

Education

He holds a BSc degree in Geology from the National-Kapodistrian University of Athens (1986), an MSc in Structural Geology from Carleton University, Ottawa (1990) and a PhD in Geological Remote Sensing from the University of Reading, UK (1997).

Career

date	Position
2012-2020	Research Director NOA
2000-2011	Researcher NOA

Research interests

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

Publications and services

Ganas, A., Elias, P., Briole, P., Cannavo, F., Valkaniotis, S., Tsironi, V., Partheniou, E.I. 2020. *Ground Deformation and Seismic Fault Model of the M6.4 Durres (Albania) Nov. 26, 2019 Earthquake, Based on GNSS/INSAR Observations*. Geosciences, 10 (6), 210 https://www.mdpi.com/2076-3263/10/6/210/htm

Ganas A, Briole P, Bozionelos G, Barberopoulou A, Elias P, Tsironi V, Valkaniotis S, Moshou A, Mintourakis I, 2020. *The 25 October 2018 Mw= 6.7 Zakynthos earthquake (Ionian Sea, Greece): a low-angle fault model based on GNSS data, relocated seismicity, small tsunami and implications for the seismic hazard in the west Hellenic Arc*, Journal of Geodynamics doi: https://doi.org/10.1016/j.jog.2020.101731

Since May 2009 he serves as Member of the Greek National Committee for Seismic Hazard Assessment. On March 2010 he was elected Member of the Executive Board of the Geological Society of Greece (position held until currently). He is President of the Remote Sensing and Space Applications Committee http://etde.space.noa.gr/ He is the Editor-in-Chief of BGSG https://ejournals.epublishing.ekt.gr/index.php/geosociety . During 2010-2017 he served as regular member at the Board of Directors of the EPPO (Earthquake Planning and Protection Organisation, Greece). Since 2010 he is involved with the Geodetic Data group of the EPOS project https://epos-ip.org/

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.

Pierre Briole

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

briole@ens.fr

Education

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

Career

2007-today	Research Director CNRS Ecole Normale Supérieure/Paris Sciences et Lettres Research University - Département des Géosciences - Laboratoire de Géologie 09/2008-2009: Directeur des études, 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 – Laboratoire d'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

Name: Maria Geraga

Position: Associate Professor

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

Email address: mgeraga@upatras.gr

Education

2000:	Phd in Oceanography, Department of Geology, University of Patras, Greece.
1993:	B. Sc. in Geology, University of Patras, Greece

Career

2015-2016	**Permanent Assistant Professor** School of Natural Sciences, Department of Geology, University of Patras, Greece
2012-2015	**Under Appointed Assistant Professor** School of Natural Sciences, Department of Geology, University of Patras, Greece
2012-2006	**Lecturer** School of Natural Sciences, Department of Geology, University of Patras, Greece
2000-2006	**Under Appointed Professor** Department Fisheries & Aquaculture, Polytechnics (Higher Educational Technological Institute), Mesolonghi, Greece
1993-2000	**Research Associate** Laboratory Marine Geology, Department of Geology, University or Patras, Greece

Research interests

Palaeoclimatology-Palaeoceanography, Marine Geoarchaeology, Marine Geology, Marine hazards and Marine natural and cultural heritage sites.

Publications and services

45 papers in scientific journals of science citation index and peer reviewed International journals, 20 book chapters and Special Publications, over of 60 full-length papers in Proceedings of International and National Conferences and 60 abstracts. More than 1200 citations (Google scholar). 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.

Christian Beck

Emeritus Professor
Earth Sciences Institute (*ISTerre*), Savoie-Mont-Blanc University, and Grenoble Universe Sciences Observatory (*OSUG*)
beck@univ-smb.fr, https://isterre.fr/spip.php?page=auteur&id_auteur=136&lang=fr

CAREER

+ Assistant Professor (University of Lille, 1978-1987)
+ Professor (Savoie-Mont-Blanc University, 1988 to 2013)
+ Advisor in Ministry of Research and Higher Education (*M.E.S.R.-D.G.E.S.I.P.,* 2010-2013)

+ Chair of ECOS South-American / French Scientific Cooperation Committee (2013-2019)

RESEARCH INTERESTS

C.B. focused his research on the **sedimentary recording of tectonic processes at different space and time scales**, for long term processes as well as for instantaneous events as earthquakes (based on field work, coring, high-resolution seismic imagery, and laboratory analyses). Since 1991, he is dedicating his work to **recent paleoseismic sedimentary archives** (lacustrine and marine) within integrated projects dedicated to major seismogenic active faults systems, developing sedimentological tools to characterize earthquakes and tsunamis imprints and provide long term archives for hazards estimation.

Main investigated areas are: south-eastern Caribbean Margin (Boconó-San Sebastian-El Pilar transform boundary and Lesser Antilles subduction), Sea of Marmara (North Anatolian Fault), Gulf of Corinth. C.B. participated to different International Oceanographic Surveys: **O**cean **D**rilling **P**roject, Leg 110 (Barbados Accretionary Complex) aboard R/V JOIDES RESOLUTION, Turkish/French MARMACORE and MARMARASCARPS projects. C.B.'s last cruise participations were dedicated to earthquakes and tsunami hazards assessment in Lesser Antilles forearc (GWADASEIS and CASEIS Cruises, 2009 and 2014). Beside, he designed and conducted lacustrine coring campaigns (Chile, French Alps, Venezuela, Albania). Within the frame of SISCOR Project (2011-2013) C.B. conducted two offshore surveys on the western Gulf of Corinth. He is presently achieving analyses of recent sediments cored during I.O.D.P. Expedition 381 (Gulf of Corinth).

SELECTED PUBLICATIONS

Beck, C., 2009. Late Quaternary lacustrine paleo-seismic archives in north-western Alps: Examples of earthquake-origin assessment of sedimentary disturbances. *Earth-Science Reviews*, 96:327–344.

Beck, C, et al., 2007. Late Quaternary co-seismic sedimentation in the Sea of Marmara's deep basins. *Sedimentary Geology*, 199:65–89.

Beck, C., 2012. Identification of deep subaqueous co-seismic scarps through specific coeval sedimentation in Lesser Antilles: implication for seismic hazard. *Natural Hazards and Earth System Sciences*, doi:10.5194/nhess-12-1-2012.

Chapron, E., Beck, C., et al., 1999. 1822 earthquake-triggered homogenite in Lake Le Bourget (NW Alps). *Terra Nova*, 11:86-92.

Campos, C., Beck, C., et al., 2013. Late Quaternary paleoseismic sedimentary archive from deep central Gulf of Corinth: time distribution of inferred earthquake-induced layers. *ANNALS OF GEOPHYSICS*, 56, 6, S0670:1-15; doi:10.4401/ag-6226.

Beckers, A., Beck, C., et al., 2016. Sedimentary impacts of recent moderate earthquakes from the shelves to the basin floor in the western Gulf of Corinth. *Marine Geology*, 384:81–102, doi.org/10.1016/j.margeo.2016.10.018

George Kaviris
Assistant Professor
National and Kapodistrian University of Athens
Faculty of Geology and Geoenvironment
Department of Geophysics and Geothermics
Email: gkaviris@geol.uoa.gr
Tel: +30-210-7274841
http://dggsl.geol.uoa.gr/cv/en_kaviris.html

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

2016 – today: Assistant Professor of “Seismology – Seismic Anisotropy”, Department of Geophysics and Geothermics, Faculty of Geology and Geoenvironment, NKUA

2013 – 2016: Lecturer of “Seismology”, Department of Geophysics and Geothermics, Faculty of Geology and Geoenvironment, NKUA

2006 – 2013: Research Associate (IDAX) at the Laboratory of Seismology, Department of Geophysics and Geothermics, Faculty of Geology and Geoenvironment, NKUA.

2004 – 2007: Post-Doc Researcher in the 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 16 MSc and 18 BSc students. I am currently supervising 2 PhD Theses.
I have 140 publications in international scientific journals and congress proceedings. Among my publications for the Gulf of Corinth:

1. 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.
2. 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 the publication "Karst collapse susceptibility mapping considering peak ground acceleration in a rapidly growing urban area" in which I was a co-author. This publication was awarded being among the five (5) most cited works of the international journal "Engineering Geology" for the period January 2014 - June 2016. The award was given in recognition for the contribution of this work to the quality of the scientific journal "Engineering Geology". A certificate has been issued by Elsevier.

Papadimitriou Eleftheria

Professor of Seismology
Aristotle University of Thessaloniki
School of Geology
Geophysics Department
e–mail: ritsa@geo.auth.gr

Education: B. Sc. In Geology – University of Thessaloniki, Greece (1981)
Ph. D. Thesis in Seismology – University of Thessaloniki, Greece (1984)

Former career: Research Assistant of the Geophysics Department of the Aristotle University of Thessaloniki (1982–1985)
Lecturer (1985–1990)
Assistant Professor (1990–1994)
Associate Professor (1994–2001)

Research activities

1. Long–term earthquake prediction on the basis of seismicity and probabilistic models
2. Studies of seismic sequences
3. Seismotectonics
4. Fault plane solutions and stress patterns
5. Source parameters by synthetic seismograms
6. Time dependent seismicity by the application of the Time Predictable Model.
7. Fractal analysis of the global seismicity and the seismicity of Greece
8. Stress evolution by the use of Coulomb Failure Function changes
9. Statistical Seismology
10. Seismic hazard assessment

Publications and services

Karakostas, V., Mirek, K., Mesimeri, M., Papadimitriou, E. & Mirek, J. The aftershock sequence of the 2008 Achaia, Greece, earthquake: joint analysis of seismicity relocation and persistent scaterrers interferometry. *Pure & Applied Geophysics*, 174, 151–176, DOI 10.1007/s00024–016–1368–y, 2017.
Mangira, O., Console, R., Papadimitriou, E. & Vasiliadis, G. A restricted Linked Stress Release Model (LSRM) for the Corinth gulf (Greece). *Tectonophysics*, 723, 162–171, 2018.
Bountzis, P., Papadimitriou, E. & Tsaklidis, G. Estimating the earthquake occurrence rates in Corinth Gulf (Greece) through Markovian arrival process modeling. *Journal of Applied Statistics*, 46(6), 995–1020, doi:10.1080/02664763.2018.1531977, 2019.

Supervision of young researchers

Supervision of Master theses (completed): **14**
Supervision of Ph D theses (completed): **6**
Supervision of Master theses in progress: **1**
Supervision of Ph D theses in progress: **3**
Member of the advisory committee of Master theses: **12**
Member of the advisory committee of Ph D theses: **8**
Member of Examination Committees for Ph D theses: **14**
Member of the advisory committee of Ph D theses in progress: **5**

Karakostas Vassilis

Professor of Seismology
Aristotle University of Thessaloniki
School of Geology
Geophysics Department
e–mail: vkarak@geo.auth.gr

Education: B. Sc. In Geology – University of Thessaloniki, Greece (1981)
Ph. D. Thesis in Seismology – University of Thessaloniki, Greece (1988)

Former career: Cooperating Researcher of the Geophysics Department of the Aristotle University of Thessaloniki (1988–1991)
Seismologist of the Central Seismological Station of Thessaloniki of the same Department (1991–1999)
Lecturer of Seismology (1999–2003)
Assistant Professor of Seismology (2003–2009)
Associate Professor of Seismology (2009–2014)

Research activities

1. Long–term earthquake prediction on the basis of seismicity and probabilistic models.
2. Studies of seismic sequences
3. Seismotectonics
4. Fault plane solutions and stress patterns
5. Tsunamis and tsunami hazard
6. Fractal analysis of the global seismicity and the seismicity of Greece
7. Stress evolution by the use of Coulomb Failure Function changes
8. Statistical Seismology
9. Seismic Hazard Assessment
10. Induced Seismicity

Publications and services

Karakostas, V., Mirek, K., Mesimeri, M., Papadimitriou, E. & Mirek, J. The aftershock sequence of the 2008 Achaia, Greece, earthquake: joint analysis of seismicity relocation and persistent scaterrers interferometry. *Pure & Applied Geophysics*, 174, 151–176, DOI 10.1007/s00024–016–1368–y, 2017.

Mesimeri, M., Karakostas, V., Papadimitriou, E., Tsaklidis, G. & Jacobs, K., (2018). Relocation of recent seismicity and seismotectonic properties in the Gulf of Corinth (Greece), *Geophys. J. Int.*, 212, 1123-1142. doi: 10.1093/gji/ggx450.

Mesimeri, M. & Karakostas, V. Repeating earthquakes in western Corinth Gulf (Greece): implications for aseismic slip near locked faults. *Geophys. J. Int.*, 215, 659-676. doi: 10.1093/gji/ggx301, 2018.

Supervision of young researchers

1. Supervision of undergraduate theses: 46
2. Supervision of Master theses: 15
3. Supervision of Ph D theses: 1
4. Member of the advisory committee of Master theses: 11
5. Member of the advisory committee of Ph D theses: 8
6. Member of Examination Committees for Ph D theses: 14
7. Supervision of Ph D theses in progress: 2
8. Member of the advisory committee of Ph D theses in progress: 4

Name: Anna Serpetsidaki

Title: Dr.

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

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

Sokos, E., Gallovič, F., Evangelidis, C., **Serpetsidaki, A.**, Plicka, V., Kostelecký, J., and J., Zahradník. (2019) The 2018 Mw 6.8 Zakynthos, Greece, Earthquake: Dominant Strike-Slip Faulting near Subducting Slab, Seismological Research Letters 91 (2A), pp. 721–732.

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.

Zafeiria Roumelioti

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

zroumelioti@upatras.gr

Education

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

Career

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; Determination of the spatio-temporal characteristics of earthquake rupture by i) inversion of full waveforms at regional and/or teleseismic distances, geodetic data, strong ground motion records and surface offset data and ii) inversion of relative source time functions
- 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
- Moment tensor determination
- Study of non-linear site response during earthquakes
- Seismicity studies (relocation, determination of source parameters, seismotectonic implications)
- Seismic Hazard
- Earthquake Early Warning

Publications and services

- Roumelioti, Z., F. Hollender and Ph. Gueguen (2020). Rainfall-Induced Variation of Seismic Waves Velocity in Soil and Implications for Soil Response: what the ARGONET (Cephalonia, Greece) vertical array data reveal, *Bull. Seism. Soc. Am.*, 110(2), 441-451.
- Hollender, F., Z. Roumelioti, E. Maufroy, P. Traversa and A. Mariscal (2020). Can we trust high-frequency content in strong-motion database signals? Impact of housing, coupling and installation depth of seismic sensors, 91(4), 2192-2205.
- Cushing, E. M., F. Hollender, D. Moiriat, C. Guyonnet-Benaize, N. Theodoulidis, E. Pons-Branchu, S. Sepulcre, P.-Y. Bard, C. Cornou, A. Dechamp, A. Mariscal and Z. Roumelioti (2020). Building a three dimensional model of the active Plio-Quaternary basin of Argostoli (Cephalonia Island, Greece): an integrated geophysical and geological approach, *Engineering Geology*, 265, 105441.
- Riga, E., F. Hollender, Z. Roumelioti, P.-Y. Bard and K. Pitilakis (2019). Assessing the applicability of deconvolution of borehole records for determining near-surface shear wave attenuation, *Bull. Seism. Soc. Am*, 109(2), 621-635.

Haralambos Kranis

Assistant Professor
National and Kapodistrian University of Athens
Department of Geology and Geoenvironment
Panepistimiopolis, 15784 Zographou, Greece
hkranis@geol.uoa.gr

Secretary General, Geological Society of Greece

Education:

Degree in Geology (NKUA), Post-graduate Diploma, in Seismology, (International Institute for Seismology and Earthquake Engineering), Ph.D. in Geological Sciences, (NKUA)

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

Antonio Avallone

Researcher
Istituto Nazionale di Geofisica e Vulcanologia

antonio.avallone@ingv.it

Education

In 19998, he obtained a Master Degree in Geological Sciences with specialization in geophysics at University of Naples "Federico II" (Italy). Title of the manuscript is "Study of the deformation in active tectonic and volcanic area through SAR interferometry: examples of the Colfiorito (central Italy) and Campi Flegrei (Naples) areas.
In 2003, he defended his PhD Thesis in Geophysics at the Institut de Physique du Globe de Paris (France). Topic of the PhD was the "Analysis of ten years of deformation in the Corinth rift (Greece) by means of GPS and InSAR data and techniques".

Career

2004-present	He got a position of Researcher at the Istituto Nazionale di Geofisica e Vulcanologia (INGV) to study the strain accumulation along with the seismogenc faults and to contribute in developing a permanent GPS network in Italy.

Research interests

His research interest is focused on the study of the ground deformation at different spatial and temporal scales, to determine and model the strain accumulation on the seismogenic faults and the ground motion associated with the earthquakes. He contributed to the creation and the development of a permanent real-time GNSS network (RING) in Italy and of the relative data, metadata and products infrastructure. He is recently working on earthquake source characteristics and real-time GPS analysis for early warning applications. This activity is performed at the euro-mediterranean level in the active deformation studies at the Eurasia-Africa plate boundary. He recently participated in the deployment of RING stations on the Hellenic Arc to study the long-term and short-term deformation associated with the subduction zone and to contribute to the tsunami early warning in the Ionian area.

Publications and services

Cirella, A., F. Romano, **A. Avallone** *et al.* (**2020**), The 2018 M_w 6.8 Zakynthos (Ionian Sea, Greece) Earthquake: Seismic source and local tsunami characterization, *Geophys. J. Int.*, https://doi.org/10.1093/gji/ggaa053.

Cheloni, D., N. D'Agostino, L. Scognamiglio, E. Tinti, C. Bignami, **A. Avallone** *et al.* (**2019**), Heterogeneous Behavior of the Campotosto Normal Fault (Central Italy) Imaged by InSAR GPS and Strong-Motion Data: Insights from the 18 January 2017 Events, *Remote Sensing*, *11*(12), 1482; https://doi.org/10.3390/rs11121482.

Twardzik, C., M. Vergnolle, A. Sladen and **A. Avallone** (**2019**), Unravelling the contribution of early postseismic deformation using sub-daily GNSS positioning. *Scientific Reports*, vol. 9, 1775, ISSN: 2045-2322, doi: https://doi.org/10.1038/s41598-019-39038-z

Ragon, T., A. Sladen, Q. Bletery, M. Vergnolle, O. Cavalié, **A. Avallone** *et al.* (**2019**), Joint Inversion of Coseismic and Early Postseismic Slip to Optimize the Information Content in Geodetic Data: Application to the 2009 M_w6.3 L'Aquila Earthquake, Central Italy, J. Geophys. Res – Solid Earth, https://doi.org/10.1029/2018JB017053.

Avallone A. *et al.* (**2017**), Near Source High-Rate GPS, Strong Motion data and InSAR to Image the Rupture History of the 2015, Mw 6.5, Lefkada, Greece, Earthquake, *Scientific Reports,* https://doi.org/10.1038/s41598-017-10431-w.

RING website http://ring.gm.ingv.it; **RING data repository** ftp://gpsfree.gm.ingv.it;

Vassilis Sakkas (Ph.D)

Laboratory Teaching Personnel

Laboratory of Geophysics
Department of Geophysics & Geothermics
School of Geology and Geoenvironment
National and Kapodistrian University of Athens

Email: 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-Present Laboratory Teaching Personnel, Department of Geophysics and Geothermics, NKUA

Research interests

Exploration geophysicist with twenty five years 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

Ass. Professor in Remote Sensing & Tectonic Geomorphology
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

April 2016	Ass. Professor (NKUA)
April 2012	Lecturer (NKUA)
March 2003	Researcher (NKUA)
June 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 140 papers) has been published in international scientific journals or conference proceedings and have been cited more than 400 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).

Michael Foumelis

Senior researcher
BRGM – French Geological Survey
m.foumelis@brgm.fr

Education

He obtained his degree in Geology from the National and Kapodistrian University of Athens (NKUA). During his MSc, at the Department of Dynamics, Tectonics and Applied Geology of NKUA, he worked on Remote Sensing and GIS for geohazards' assessment, whereas for his PhD at the Geophysics Department of NKUA on ground deformation monitoring using GNSS and InSAR. From 2010 to 2011 he was an adjunct Lecturer in the Geography Department of the Harokopio University of Athens (HUA). In 2012 he started a Post Doc at ESA-ESRIN focusing on the development of SAR and InSAR products and services from geohazards.

Career

03/2017 – present	Senior Researcher in Remote Sensing at BRGM
09/2014 – 02/2017	Earth Observation scientist at ESA-ESRIN
02/2012 – 08/2014	Research Fellow at ESA-ESRIN
01/2010 – 01/2012	Adjunct Lecturer (Academic staff under contract) at HUA
09/2006 – 01/2012	Associate researcher at HUA

Research interests

Applications of Remote Sensing, Imaging Geodesy and Geoinformatics to geohazards.

Publications and services

He has several publications in scientific journals and international conference proceedings and participated in numerous research projects funded by national and international organizations. He has been supporting the integration of processing services on exploitation platforms.

Most recent publication:

Bacques, G., de Michele, M., Foumelis, M., Raucoules, D., Lemoine, A. & Briole, P., 2020. Displacement field of the Mw7.5 Sulawesi earthquake from Copernicus Sentinel 1-2 offset tracking and modeling: Strike slip motion on two sub-parallel faults branches could explain the tsunami genesis. Nature Scientific Reports 10, 9103, https://doi.org/10.1038/s41598-020-66032-7.

Awards and honors

He has received scholarships from NKUA and the General Secretariat of Research and Technology of Greece for postgraduate and doctoral studies, respectively. He has received the "2014 ESA TEAM ACHIEVEMENT AWARD" in recognition of the contribution to the Sentinel-1 development and operations.

Antonios Mouratidis

Assistant Professor,
Head of Remote Sensing and GIS Application Lab

Department of Physical and Environmental Geography
Aristotle University of Thessaloniki, Greece

amourati@geo.auth.gr

Education

Antonios Mouratidis graduated from the Aristotle University of Thessaloniki, Greece, with a diploma in Rural and Surveying Engineer and a B.Sc. in Geology. His post-graduate studies included an M.Sc. diploma in Geography and Environment and a PhD in Remote Sensing - GPS - GIS, focused on land applications in the domain of Geomorphology.

Career

2019-to date Assist. Prof., Aristotle University of Thessaloniki, Greece
2014-2018 Lecturer, Aristotle University of Thessaloniki, Greece
2015-2017 Assist. Prof. (visiting), Charles University in Prague, Czech Republic
2013-2015 Consultant, European Space Agency (ESA), Italy
2010-2013 Post-doctoral Research Fellow, European Space Agency (ESA), Italy
2007-2008 PhD student, Ecole Normale Supérieure de Paris, France
2005-2010 PhD student, Aristotle University of Thessaloniki, Greece

Research interests

Applications of Geospatial Science and Technology to Geosciences and Education [Earth Observation/Remote Sensing, Digital Elevation Models (DEMs), Global Navigation Satellite Systems (GNSS), Geographical Information Systems (GIS)]

Publications and services

1. Pennos, C., Lauritzen, S.-E., Vouvalidis, K., Cowie, P., Pechlivanidou, S., Gkarlaouni, C., Styllas, M., Tsourlos, P., and **Mouratidis, A.** (2019) From subsurface to surface: a multidisciplinary approach to decoding uplift histories in tectonically-active karst landscapes. Earth Surf. Process. Landforms, https://doi.org/10.1002/esp.4605.
2. **Mouratidis A.**, Ampatzidis D. (2019). European Digital Elevation Model Validation against Extensive Global Navigation Satellite Systems Data and Comparison with SRTM DEM and ASTER GDEM in Central Macedonia (Greece). ISPRS Int. J. Geo-Inf. 8, 108 DOI:10.3390/ijgi8030108.
3. Papageorgiou, E., Foumelis, M., Trasatti, E., Ventura, G., Raucoules, D., **Mouratidis, A**. (2019). Multi-Sensor SAR Geodetic Imaging and Modelling of Santorini Volcano Post-Unrest Response. Remote Sens., 11 (3), 259. DOI: 10.3390/rs11030259

Awards and honors

2011: Research grant for the project entitled “Contribution of earth observation data and geographical information systems to mapping and managing flood events in Greece’’, by the John S. Latsis Public Benefit Foundation
2011: Ranked first in the competition for a business proposal on GNSS, organized within the 2011 “ESA International Summer School on GNSS”, Berchtesgaden, Germany
2008: Award Grant from the Research Committee of the Aristotle University of Thessaloniki, for the scientific achievements within the PhD studies
2006: Award Grant from the Research Committee of the Aristotle University of Thessaloniki, for the scientific achievements within the PhD studies
2004-2010: I.K.Y. (Greek State Scholarships Foundation), postgraduate scholarship, in the field of "Remote Sensing and Geographical Information Systems in Geosciences”

Panagiotis Elias

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

pelias@noa.gr

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

2005-today 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 23 peer refereed publications in international journals, 6 peer refereed proceedings of SPIE more than 60 presentations in international conferences.

Selected publications and services

1. Elias, P., Benekos, G., Perrou, T., & Parcharidis, I. (2020). Spatio-Temporal Assessment of Land Deformation as a Factor Contributing to Relative Sea Level Rise in Coastal Urban and Natural Protected Areas Using Multi-Source Earth Observation Data. *Remote Sensing*, *12*(14), 2296.
2. Elias, P., Valkaniotis, S., Ganas, A., Papathanassiou, G., Bilia, A., & Kollia, E. (2020, August). Satellite SAR interferometry for monitoring dam deformations: the case of Evinos dam, central Greece. In *Eighth International Conference on Remote Sensing and Geoinformation of the Environment (RSCy2020)* (Vol. 11524, p. 115241I). International Society for Optics and Photonics.
3. Ganas, A., Elias, P., Briole, P., Cannavo, F., Valkaniotis, S., Tsironi, V., & Partheniou, E. I. (2020). Ground Deformation and Seismic Fault Model of the M6. 4 Durres (Albania) Nov. 26, 2019 Earthquake, Based on GNSS/INSAR Observations. *Geosciences*, *10*(6), 210.
4. Ganas, A., Briole, P., Bozionelos, G., Barberopoulou, A., Elias, P., Tsironi, V., ... & Mintourakis, I. (2020). The 25 October 2018 Mw= 6.7 Zakynthos earthquake (Ionian Sea, Greece): A low-angle fault model based on GNSS data, relocated seismicity, small tsunami and implications for the seismic hazard in the west Hellenic Arc. *Journal of Geodynamics*, 101731.

Co-responsible for the operation of 22 GNSS stations of the CRL observatory

Awards and honors

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

Member of the executive secretary of the Remote Sensing and Space Applications Committee of the Geological Society of Greece.

Ioannis Kassaras

National & Kapodistrian University of Athens
Department of Geology and Geoenvironment
Division of Geophysics-Geothermics
Panepistimiopolis, Zografou
Athens 15784
Greece
Kassaras@geol.uoa.gr

Education:

Secondary school in Athens, BSc in Geology at Dept. of Geology, National & Kapodistrian University of Athens (NKUA), PhD in Seismology at Dept. of Geology, National & Kapodistrian University of Athens

Career:

- July 2013 - today: Assistant Professor of Seismology, Dpt. Geophysics-Geothermics, NKUA.
- January 2009 - July 2013: Lecturer of Seismology, Dpt. Geophysics-Geothermics, NKUA.
- 2003-2009: Laboratory Teaching Staff, Dpt. Geophysics-Geothermics, NKUA.
- 1995-2003: Research, Technical and Administrative Staff, Dpt. Geophysics-Geothermics, NKUA.
- 1993-1995: Research Fellow, Dpt. Geophysics-Geothermics, NKUA.
- 1991: Research Fellow at LGIT (Grenoble, France).
- 1989-1991: Research Fellow, Dpt. Geophysics-Geothermics, NKUA.

Research Interests:

- Earthquake source properties
- Seismotectonics and active deformation
- Seismic structure of the Earth's interior, surface waves
- Engineering seismology, microzonation
- Seismic Risk analysis

Educational activities:

Undergraduate courses

- Seismology
- Plate Tectonics, Seismology of Greece
- Engineering Seismology
- Earth structure

Postgraduate courses

- Advanced Seismology
- Signal processing
- Data analysis
- Supervision of MSc and PhD dissertations

Publications (of educational purpose):

Kassaras I. & Kazantzidou-Firtinidou D. 2017. "Earthquakes", Chapter in N. Dalezios (Ed), "Environmental Hazards Methodologies for Risk Assessment and Management", IWA Publishing, Water Intelligence Online, 16, doi: 10.2166/9781780407135.

Kassaras I. & Kapetanidis V., 2018. Resolving the tectonic stress by the inversion of earthquake focal mechanisms. Application in the region of Greece. A TUTORIAL, Chapter in: "Moment Tensor Solutions A Useful Tool for Seismotectonics", D'Amico, S. (Ed.), Springer Natural Hazards, ISBN 978-3-319-77359-9.

Name: Olga-Joan KTENIDOU

Position: Associate researcher

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

Email address: olga.ktenidou@noa.gr

Education

2020 (exp'd)	**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 –	**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

Olga's niche expertise is in engineering seismology and strong ground motion: site character-risation and reference station definition, site effects and soil amplification (experimental study and numerical analysis), seismic hazard and ground motion prediction, ground motion attenuation, uncertainty and variability. Also interested in geotechnical/earthquake engineering, earthquake reconnaissance, and structural response under low gravity.

Publications and services

- Publication summary: 20 articles in int'l journals, 29 full articles in peer-reviewed conferences, 19 invited talks, 36 int'l conf. abstracts, 5 technical reports, 3 book sections
- GoogleScholar: >650 citations (>580 after 2015) • h-index=12 • i10-index=20
- 2020 - : Head of 24/7 seismicity monitoring at NOA and NOA formal representative at ISC
- 2019 - : Executive Committee of EFEHR (European Facilities for Earthquake Hazard & Risk)
- 2019: User Feedback Group of EU consortium EPOS (European Plate Observing System)
- 2018 - : UAG of ORFEUS (Observatories & Research Facilities for European Seismology)
- Referee for 18 international journals and 2 UK proposal schemes
- Convener or co-convener for 7 international conference sessions
- Consulting services for critical facilities

Awards and honors

- 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, https://walls.io/s/10O6Jb)
- 2020: Featured alumnus, 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

Akis PANAGIS

Civil Engineer MSc UPatras

Monitoring engineer GEFYRA SA

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

2008-Present: 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 continous 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

BFrancesca Cifelli

Associate Professor

Dipartimento di Scienze

Università degli Studi di Roma TRE

francesca.cifelli@uniroma3.it

Education

November 1999-October 2003 PhD position
March 1997 Master's degree in Geology

Career

Since February 2015 Associate Professor in Structural geology at the University of Roma TRE
March 2011-Jenuary 2015 Non permanent researcher in Structural Geology
November 2003-February 2007 Post-doc position

Research interests

- Paleomagnetic rotations and structural evolution of curved mountain chains
- Extension and dynamics of back-arc spreading in Mediterranean region
- Recent tectonics in Central Iran
- Neogene tectonic evolution of the Central Anatolian Plateau
- Seismic effects in urban areas
- Outreach activities

Publications and services

Author or co-author of 50 peer reviewed scientific papers in international and national journals.
Participant at several national and international congresses (80 abstracts)
Reviewer of several international scientific journals on structural geology, magnetic fabric, paleomagnetism and tectonic topics.
Participant at several research projects (EU, National, and International).
Member of Educational Committee of Education (CoE) of the European Geosciences Union (EGU) for the organization of the GIFT (Geophysical Information for Teachers) workshop.

BERENGUER Jean-Luc

Science Teacher

Geoazur (University Côte d'Azur)
Education & Outreach team

Jean-luc.berenguer@univ-cotedazur.fr

Education & Career

Agregation Sciences Naturelles (1990) in France
IESO 2017 FRANCE - Organization Committee Leader (2017)
EduMed Observatory project leader - University Côte d'Azur (since 2017)
InSight Education project leader in France (since 2016)
EGU Committee of Education member (since 2003)
IGEO Senior Council (since 2018)
French educational seismological network leader (since 1996)

Publications and services

Berenguer J.-L. et *al.*, Tuned into the Earth from the school EduSismo: French educational seismological network, *Bull. Soc. Géol. de France*, **184**, 183, 10.2113/gssgfbull.184.1-2.183, 2013.

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Balestra J., **Berenguer J.-L.** et al., The InSight Blind Test: An Opportunity to Bring a Research Dataset into Teaching Programs, Seis. Res. Letters ., 91 , 2020

Berenguer J.-L. et *al.,* Schools Tuned In to Mars with InSight space mission, Poster session, AGU 2018

Berenguer J.-L., Virieux J., How to teach natural hazards in school: Raising awareness on earthquake hazard, Office for Official Publications of the European Communities, 2008

Berenguer J.-L., Ferry H., Pascucci F., Book, 'Le cahier du sismo', CRDP Nice, 2010

Awards and honors

Palmes Académiques – Officer (France)

Fotios Danaskos

Geologist, School Teacher

8th Junior - Senior High School in Chalandri, HELLAS

fdanas@yahoo.gr

Education

- **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. 2008.
- **National and Kapodistrian University of Athens Hellas**, Department of Communication & Media Studies, Annual Teacher Training Seminar, "Professional Identity and Communication Counseling", 2004.
- **Technological Educational Institute of Athens Hellas**, Faculty of Health and Caring Professions, Physiotherapy Department, BSc, 1994.
- **National and Kapodistrian University of Athens Hellas**, Department of Geology, Athens, BSc, 1986.

Career

1997 – 2007 Freelance Physiotherapist
1994 - 2013 Physiotherapist School Teacher
2013- 2020 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

- 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.
- Participation in C.R.L. 2018
- Presenting SEISMOBOX in C.R.L.2019
- Co-Presenting SEISMOBOX in INSEGNACI ETNA 2019

Dr Kiki Makri

Postdoctoral Researcher/ Teacher of Geosciences at Secondary Education

Institute of Environmental Research and Sustainable Development
of National Observatory of Athens.

kikimakri@noa.gr

Education

- **PhD:** 2015, Department of Geology, Aristotle University of Thessaloniki. Prof. Spyridon Pavlides. Study of historical development of geological education in Greece, (Greece). **ND36236**
- **M.Sc.:** 2007, Teaching of Chemistry and New Educational Technologies, Department of Chemistry, Aristotle University of Thessaloniki, Assoc. Prof. Evaggelia Varella. Study of comparative research of Geology teaching in relation to physics and chemistry, in Greece at 1830-1930, (Greece).
- **B.Sc.:** 2005, Department of Geology, Aristotle University of Thessaloniki Prof. Michalis Fytikas, Study of geothermical research methods, (Greece).

Career

10/2020 - 12/2021	Postdoctoral Researcher, Institute and department: Institute of Environmental Research and Sustainable Development of National Observatory of Athens.
10/2019 - 5/2020	Educator at the school program "Sustainable Planet", Stavros Niarchos Foundation Cultural Center, Athens.
10/ 2017 - 6/ 2020	Assistant Coordinator MSc in Space Sciences Technologies and Applications at National Observatory of Athens.
2016-2018	Contract Lecturer: 2016-2018. Teaching for the course "Teaching of Geology". Department of Geology, Aristotle University of Thessaloniki, Greece.

Research interests

My research interests is focused on History of Geoscience, History of Education, Epistemology, Teaching Methodology, Curriculum Design, Curriculum Studies.

in peer-reviewed scientific conferences all of which as first author:

1. **Kyriaki Makri**, Elissavet Galanaki, Ioannis Koletsis, Vassiliki Kotroni, Konstantinos Lagouvardos, Assessment of informal learning program on weather phenomena: its perception and necessity in Greece. International Journal of Educational Research Review. https://doi.org/10.24331/ijere.753774.
2. **Makri Kyriaki,** Sp. Pavlides: Conceptual changes in the Geosciences textbooks of Secondary Education. A timeless view. 4th Hellenic Conference "Education in the 21st Century: School and Culture, Athens, May 2019.
3. **K. Makri,** S.B. Pavlides. Classification of contents of Geosciense in secondary curricula in Greece, 1 830 2015. 14th International Congress, Thessaloniki, May 2016.
4. **Makri Kyriakoula** & Pavlides Spyridon. The evolution of the content of geology textbooks in Greece at 1 9th - 20th century ESERA Conference 2013 Nicosia Cyprus.

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.

Abstracts

Why CRL?

Anne Deschamps,

Géoazur, Université Côte d'azur, CNRS

The Western part of Corinth Gulf which can be considered as the Western end of the North Anatolian fault, presents a high level of micro-seismicity which varies in time. The CRL seismological network starts in 2000/2001, with installation of a local network around Aigio to follow the seismicity on Aigio fault. Due to the important seismicity and a better understanding of the fault system, the network increase progressively towards West, including a participation of different institutions. The present state of the network was reached in 2013 and allows to addressing some scientific questions on the deformation of the crust in the area and the potential for large earthquakes:

- Distribution of main faults, migration of the deformation towards off shore faults.
- Near fault damaging in the upper crust.
- Clustering of micro earthquakes: what are the dimensions of the related fault segments? How they are connected with the faults on which have been observed the last main events?
- How explain de deformation budget? What is the part controlled by the seismicity?
- Role of fluids in the micro-seismicity, are these upper crust faults connected and large earthquakes.
- Can we observe creeping on low dipping normal fault…

To address these questions, CRL has developed a multidisciplinary set of observations. GNSS and deformation instruments have been very soon added, but also works on fault mapping, satellite images processing …

I will present the present state of the network, with some examples of the instrumentation and a discussion on the interest and the limitations of some specific points.

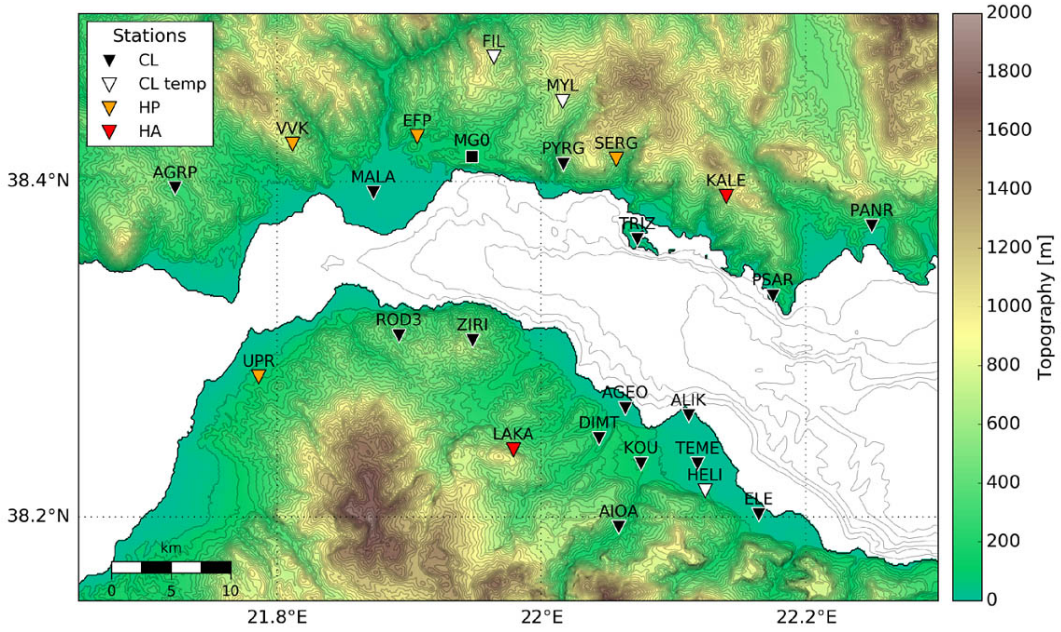

Figure 1: The main CRL seismic network (present state). Some stations on the border are also includes in CRL.

In the second part, I will present the knowledge on the background micro-seismicity from 2001 to 2015 and discuss the importance to develop methods to increase the resolution of the individual location of epicentres.
I will present in some details the relocation procedure (theory and data processing) with some examples on available data.
Obtained images for 15 years of seismicity (maps and cross sections) will be analysed in relation with known faults (faults mapped at the surface, and fault plane of 1995 event at depth).
Then, I will present the knowledge on the background micro-seismicity from 2001 to 2015 and discuss the importance to develop methods to increase the resolution of the individual location of epicentres. The relocation procedure [theory and data processing the obtained images (maps and cross sections)] will be analysed in relation with known faults (faults mapped at the surface, and fault plane of 1995 event at depth).

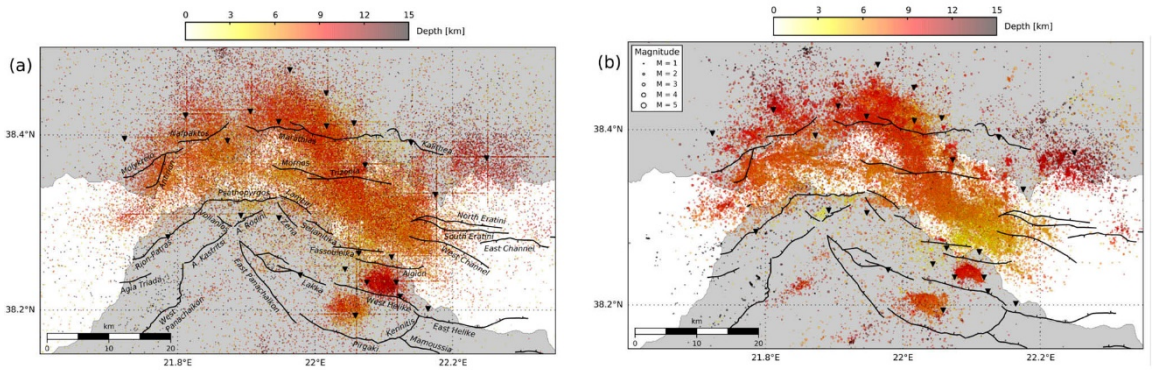

Figure 2: 15 years of micro-seismicity a) P and S automatic picking (205 000 events), b) after relocation procedure (95 000 events).

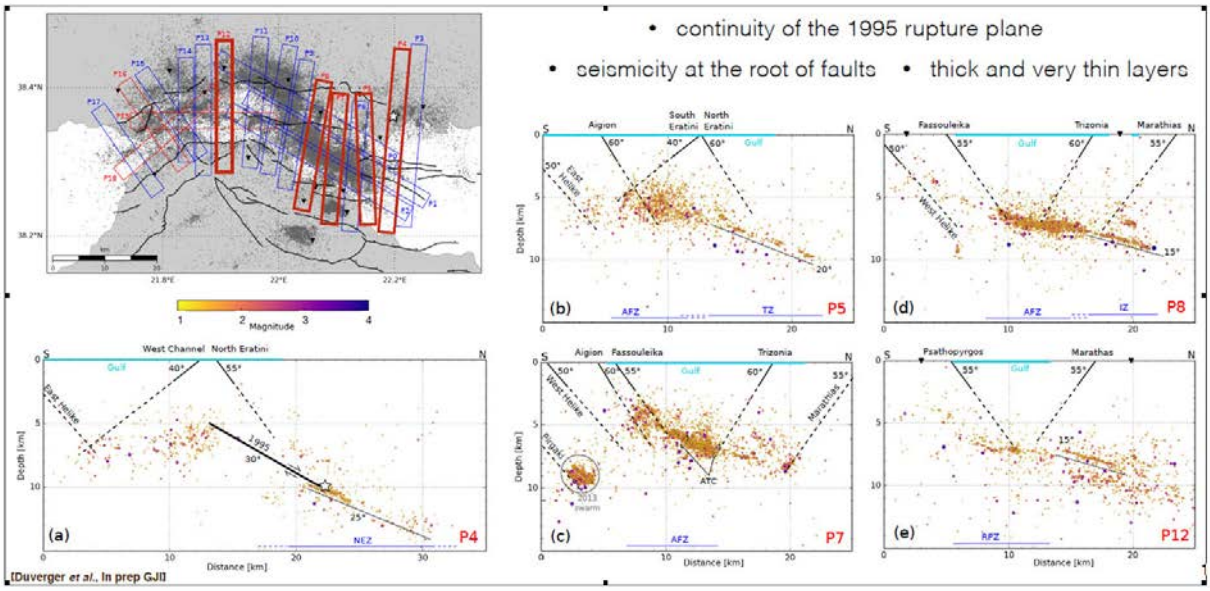

Figure 3: Selected cross sections on the micro-seismicity to discuss the relation with faults observed on the surface.

The last part of my presentation will be dedicated to the study of some swarms which have been studied in detail and I will show how fluids can be invoked to explain the time/spatial history of an almost permanent swarm in the middle of the Gulf, when such behaviour is not seen in the 2013 swarm South of Aigion.

Main bibliography:

1. Duverger, C., Godano, M., Bernard, P., Lyon-Caen, H., & Lambotte, S., 2015. The 2003/2004 seismic swarm in the western Corinth Rift: Evidence for a multiscale pore pressure diffusion process along a permeable fault system, *Geophysical Research Letters*, 42(18), 7374–7382.
2. Duverger C., S. Lambotte, P. Bernard, H. Lyon-Caen, A. Deschamps, A. Nercessian, 2018. Dynamics of microseismicity and its relationship with the active structures in the western Corinth rift (Greece), accepted to *Geophysical Journal International*, 2018
3. Godano, M., Deschamps, A., Lambotte, S., Lyon-Caen, H., Bernard, P., & Pacchiani, F., 2014. Focal mechanisms of earthquake multiplets in the western part of the Corinth Rift (Greece): influence of the velocity model and constraints on the geometry of the active faults, *Geophysical Journal International*, 197(3), 1660–1680.
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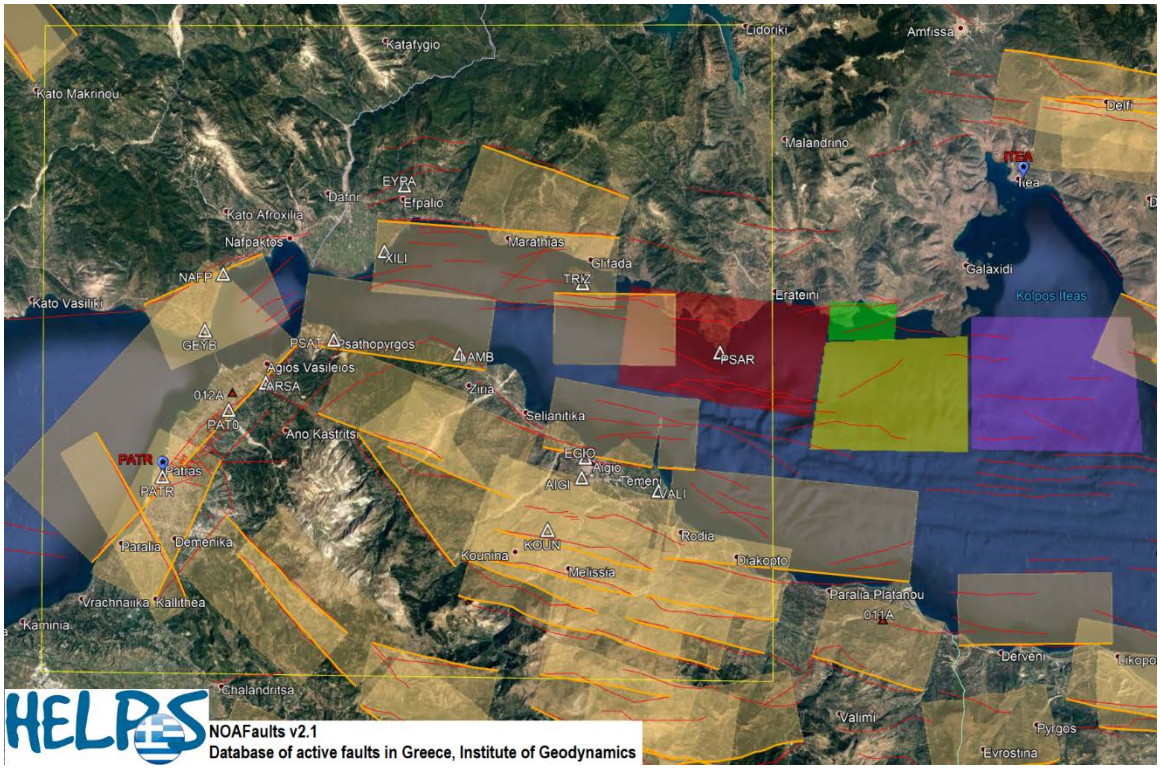
Tectonics, large earthquakes and the growth of faults in the western rift of Corinth

Dr Athanassios Ganas

National Observatory of Athens, Institute of Geodynamics, Athens, 11810 Athens, Greece,
aganas@noa.gr

The western 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 10+ 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 indicating: a) the existence of normal fault zones with varying activity, b) the continuation of the 1995 low-angle fault towards the west (Psathopyrgos area) and east (Galaxidi), c) new GNSS results mapping crustal extension near major faults d) unexplored kinematic links to the Gulf of Patras, the Rio-Movri strike-slip fault and the Ionia-Akarnania block. The uniqueness of the Corinth rift is revealed by the updated geological & geophysical datasets (active fault maps, fault geometry, fault slip rates, trenching data on past earthquakes, historical and instrumental seismicity, strain rate data) and recent models for earthquake generation processes suggested from observed seismicity patterns, magnitude-frequency distributions and calculated earthquake rates for individual faults.



The geodetic monitoring of the Corinth Rift Observatory with GPS and SAR interferometry

Pierre Briole

CNRS/ Ecole Normale Supérieure / PSL Research University

Since 1990 the deformation of the western rift of Corinth is monitored using the Global Positioning System (GPS) technique. In the first decade the observations were made during campaigns and since 2001 a permanent network has been gradually installed in the area. This network is nowadays composed of ~30 stations. The campaign network was also gradually developed and it gathers now more than 200 points. The western rift of Corinth is the fastest extending area in Europe and one of the fastest in the world. In my presentation, I will show the main results obtained in the last three decades and I will explain the basics of the GPS observation technique.

The Corinth Rift through the use of marine remote sensing techniques

Maria Geraga

The science of underwater sound is called ocean acoustics. The role of this science is very great, because of all the energy types discovered so far, the sound energy spreads in the water at the greatest distance providing a powerful tool for studying the ocean. Acoustic techniques can acquire detailed geologic information about the sea floor, such as seabed topography, sediment composition and distribution and underlying geologic structure. Underwater acoustics uses a variety of instruments such are single beam and multibeam echo sounders to obtain the seafloor topography, side scan sonar systems to obtain textural information on the seabed and profilers to acquire the seismic stratigraphy of the seafloor.

All the above acoustic techniques have been applied at the Gulf of Corinth which is an active rift. Corinth Rift is young, non-volcanic and is characterized by high extension rates and high levels of seismicity. Corinth's high rates of tectonic activity, high sediment fluxes, closed drainage system and preservation of the syn-rift record make it a unique laboratory for the study of extension, sedimentation and paleoenvironment in a young rift.

Over the past 20 years, a high density of seismic reflection data has been established which together with the onshore studies furthered our knowledge regarding the development and evolution of the Corinth Rift. The acquired data was fundamental for the IODP Expedition 381. IODP Expedition 381 drilled in October-December, 2017 aiming to record a continental rifting and to investigate the relative roles of and feedbacks between tectonics, climate, and eustasy in sediment flux, basin evolution, and basin environment.

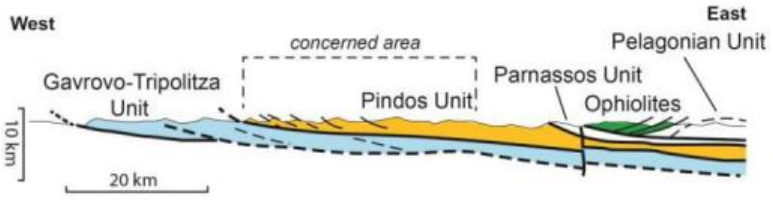
The presentation will include principles of marine remote sensing techniques and their application at the Gulf of Corinth.

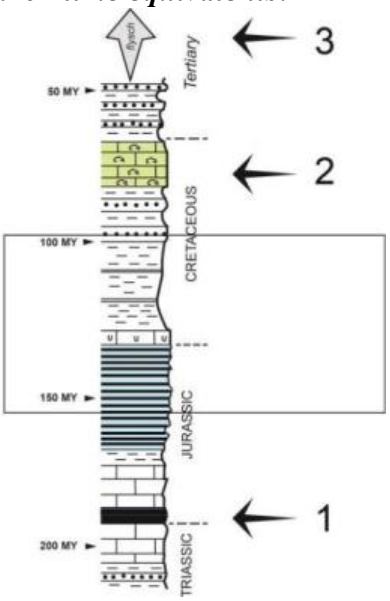
Age, origin and history of the rocks that can be found along the north coast of the Corinth Rift, preparation in the classroom of the geological field trip of Sunday morning

Christian Beck
Université de Savoie, France

The Corinth Rift (CR), which separates Peloponnese from "Continental" Greece, represents a major morphological discontinuity crosscutting the so-called Hellenic Chain (or Hellenides). This main extensional structure and its set of deep-rooted normal faults developed during the last 5 MY and probably most actively during the 2 last MY. The CR was overprinted, without any apparent inheritance and almost orthogonally, upon a much older collisional mountain chain system which long and complex story began at the Paleozoic/Mesozoic boundary (250 MY ago) resulting into huge horizontal shortening by mean of major thrusts (see oversimplified section here below). The whole plate tectonics evolution (birth and disappearance of the Tethyan Ocean) will be presented in order to precise the geodynamic setting of the different formations which will be observed on outcrops.

Both the CR's northern and southern sides exhibit a large variety - in age and in lithology - of sedimentary rocks; additionally, in its eastern part, basic volcanic rocks and oceanic lithosphere remnants (ophiolites) are present. The northern CR coast from Antirion to Itea is mainly concerned by the Pindos Unit's Triassic to Oligocene pile. Several outcrops (numbered on the here-below lithostratigraphic succession), ranging from upper Triassic to Paleocene, will be provided to illustrate ***highly different depositional processes***, and, overall, to discuss their ***time equivalents***.





Large Earthquakes and Focal Mechanisms in the Gulf of Corinth

Dr. George Kaviris

Assistant 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 considered a "natural laboratory" for seismology and geosciences, given that it is characterized by high tectonic activity, with the bulk of the 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 northern and southern sides. GNSN measurements in 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 that occurred in Helike in 2013.

The intense seismicity in the Gulf of Corinth has resulted to 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 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 indicate strike-slip faulting.

Seismic Parameters and Microseismicity in the Gulf of Corinth

Karakostas Vassilis & Papadimitriou Eleftheria

Geophysics Department, School of Geology, Aristotle University of Thessaloniki, GR54124 Thessaloniki, Greece vkarak@geo.auth.gr ritsa@geo.auth.gr

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.

Use of CRL data for detailed seismological studies

Anna Serpetsidaki

Laboratory of Seismology, Geology Department

University of Patras

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.

Seismological Studies in the Broader CRL Region

Zafeiria Roumelioti

Laboratory of Geophysics, Department of Geology, University of Patras

The lecture aims to provide a brief description of the broader, with respect to the CRL area, seismotectonic regime and highlight open scientific questions with respect to regional geodynamics. The questions to be briefly replied are: i) what are the seismological data available for such research? ii) what are the topics of elevated interest for seismological studies in the broader CRL area? iii) what are some recent research findings.

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

Haralambos Kranis

Department Geology and Geoenvironment, National and Kapodistrian University of Athens, Greece;
hkranis@geol.uoa.gr

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.

Global Positioning System: from the planning of a monitoring network to the data analysis and the interpretation of the relative results

Antonio Avallone

Istituto Nazionale di Geofisica e Vulcanologia

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.

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

Vassilis Sakkas (Ph.D.)

Department of Geophysics & Geothermics. School of Geology and Geoenvironment. National and Kapodistrian University of Athens

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.

Quantification of N. Peloponnese shoreline displacement using very high spatial resolution remote sensing

Emmanuel Vassilakis

Ass. Professor in Remote Sensing & Tectonic Geomorphology, NKUA

The radical displacement of the shoreline during time is one of the most important factors to be taken under consideration when designing infrastructure along the coastal zones. Serious changes in the topography along the southern Corinth Gulf shoreline, as well as severe erosion phenomena have been recorded and therefore it is an ideal location for studying coastline displacement.

The area selected for the application of the described methodology is a very characteristic segment of the Corinth Gulf and has an overall length of 12 km. It lies between the Town of Sykea (east) and the Town of Kamari (west) including the entire waterfront of the Town of Xilokastro, where significant residential and tourist development has occurred during the last decades.

This methodology aims to quantify the shoreline displacement rate by involving the processing of different remote sensing data types such as historical aerial photographs, satellite imagery and unmanned aerial system image data, as long as in-situ observations for validating the geo-statistic calculations. Several photogrammetric techniques were used in order to ortho-rectify, co-register and homogenize a quite dense time series of remote sensing data acquired from 1945 to 2017, representing a rapidly relocating coastal zone at the southern part of Corinth Gulf. All images were digitally processed and optically optimized in order to produce a highly accurate representation of the shoreline at the time period of each acquisition.

The data were imported into a Geographic Information System platform, where they were subjected to comparison, measurements and eventually geo-statistical analysis. High erosion rates were calculated, reaching the order of 0.18 m/year on average whilst extreme rates of 0.70 m/year were also observed in specific locations leading to the segmentation of the coastal zone according to its vulnerability and consequently the risk for further development as well as the effectiveness of measures already taken by the authorities.

All the steps of the applied methodology will be described in this presentation, as it introduces a simple but very convenient way of combining a dataset containing all the available shoreline traces throughout a given time period, in order to quantify its displacement rate for certain segments and therefore evaluate the risk or vulnerability of a coastal zone.

European Space Agency Earth Observation Programme

Michael Foumelis

BRGM

Brief overview of the European Space Agency's EO programme, including recent developments and initiatives, the Copernicus missions and other satellite assets for the monitoring the environment and solid earth

Geographical Information Systems (GIS) – Introduction to QGIS

Antonios Mouratidis

Aristotle University of Thessaloniki

- Introduction and overview of a GIS
- Issues and constraints of using a GIS
- Open source GIS – QGIS
- Demonstration of QGIS for handling 2D and 3D geospatial information from various sources (satellite imagery, Digital Elevation Models, GNSS data etc.)
- The future of GIS

Introduction to the Differential SAR Interferometry for measuring ground deformation

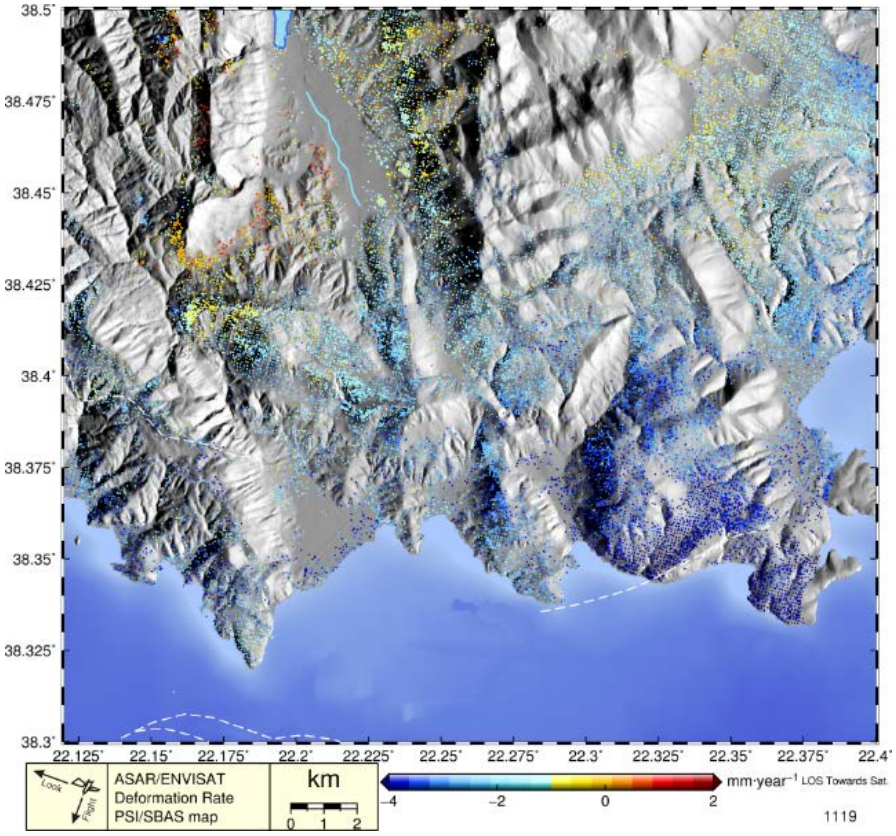
Panagiotis Elias

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 acceleration produced by earthquakes and their local amplifications depending on the properties of the underlying soils. Case study the city of Aigion (W. Corinth Gulf)

Ioannis Kassaras, Assistant Professor

Department of Geophysics & Geothermics, National and Kapodistrian University of Athens, Panepistimiopolis, 15784 Athens, Greece, kassaras@geol.uoa.gr*, tel. +30 6977289490*

Abstract

Earthquake hazards caused the most deadly natural disaster in the last two decades, resulting in over 800,000 deaths and 1.7 million injuries. The issue is particularly crucial nowadays, as manifested by extremely high losses during several recent seismic crises (i.e. Sumatra, 2004; Haiti, 2010; Christchurch, 2011; Japan, 2011; Nepal, 2015). Reason for this is in particular (a) the rapid urbanization of large parts of the population, resulting in growth of cities towards areas susceptible to earthquake hazards, (b) the economically driven reduction of the suburban construction behavior, as largely viewed in less-developed countries, (c) the increasing exposure into technological hazards in the developed countries, i.e. nuclear power plants (as it happened in the Fukushima nuclear plant during the 2011 Japan earthquake).

Such disastrous earthquake phenomena have proven that the generic provisions of the seismic codes, underestimate the seismic hazard potential in earthquake prone areas, and so, crisis management planning is often unrealistic, thus ineffective. Remedy to this is the reconsideration of seismic codes on the basis of small-scale risk models taking into account the local seismic potential, the site's structural and societal vulnerability, and also site conditions. In other words, site-specific estimates are prerequisite towards a tailored seismic risk assessment that will guide through effective risk mitigation policies and disaster management measures.

During the last years, our working group has elaborated intense work on seismic risk assessment in several Greek cities, targeting site-specific models and allowing for tailor-made management actions in case of a crisis. We present the core and the outcome of the applied methodologies, indicating pros and cons, and highlighting future perspectives. Our approach includes: (a) Deterministic seismic hazard assessment based on the stochastic simulation of ground motion taking into account the areas' seismotectonics and site conditions. To this, new data concerning the location, geometry, and the seismic potential of faults, together with free-field ambient noise recordings have been collected through numerous field surveys; (b) Vulnerability assessment of elements at risk informed by newly created observed damage databases and in-situ observations; (c) Development of physical risk models including structural damage, and economic loss for several earthquake scenarios.

Case study

Our basic example is a scenario-based seismic risk assessment for the earthquake prone city of Aigion (W. Corinth Gulf). Within this approach, the stochastic finite-fault method is applied towards simulation of strong ground motion for three near-field earthquake scenarios, capable of occurring given the well-established seismotectonics of the area. The three scenarios are: (a) a repetition of the June 15th 1995 (Mw=6.4) devastating earthquake, (b) a repetition of the December 26th 1861 historical earthquake of Mw=6.7, and (c) an earthquake of Mw=6.0 on the nearest Aigion Fault, underlying the city. The stochastic model parameterization is validated by comparisons with available recordings from permanent accelerometric stations. Site amplification is approximated by the use of ambient noise Horizontal-to-Vertical-Spectral-Ratios (HVSR) derived from in-situ free-field measurements in Aigion.

The structural exposure model of the city is developed on a building-by-building level through in-situ inspection, census data, and satellite navigation tools. The macroseismic method of RiskUE-LM1 is applied for the estimation of the structural vulnerability of 3216 inspected buildings in Aigion, based on the vulnerability classes per EMS-98 and semi-empirical indexes, accounting for the buildings' typology and structural characteristics.

Three scenarios of structural damage are presented on a building block scale, in terms of EMS-98 Damage Grades and their probability of occurrence. The obtained risk assessment indicates that the northeastern and

partly the southern part of Aigion are more susceptible to damage, in accordance with the real damage distribution from the most recent devastating M6.4 1995 earthquake, the site amplification inferred from HVSR, and the macroseismic vulnerability of the constructions.

In conclusion, the current building stock of Aigion demonstrates significantly enhanced seismic behavior compared to the pre 1995-era, due to rehabilitation after the 1995 earthquake, strengthening post-earthquake interventions to damaged buildings of 1995 and replacement of vulnerable ones with new constructions. Despite unavoidable uncertainties intrinsic to both the method and data, being open to future improvements, the inferred seismic risk assessment provided realistic and consistent results, thus allowing its exploitation towards loss evaluation and mitigation purposes for the city of Aigion.

Perspectives

Future improvements that fall in with, and/or are beyond the global state-of-the-art, include: (a) Implementation of technological capabilities of remote sensing towards buildings' inventory and vulnerability assessment; (b) Socioeconomic impact analyses towards the mitigation of risk, enhancement of preparedness and resilience of the social and economic fabric, and (c) Applications for near real-time damage assessment.

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Physical mechanisms behind seismic site response - Some examples from Aegion

Olga-Joan KTENIDOU

National Observatory of Athens

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.

Structural Morphology and Geometric control of the Rio-Antirrion Bridge

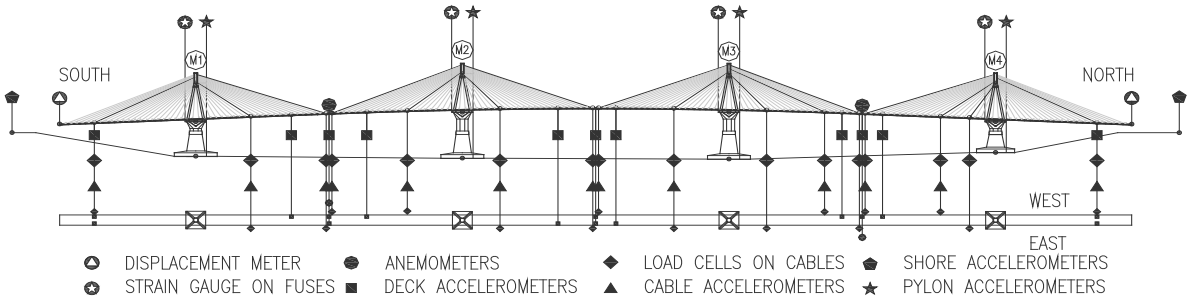
Akis Panagis

GEFYRA SA

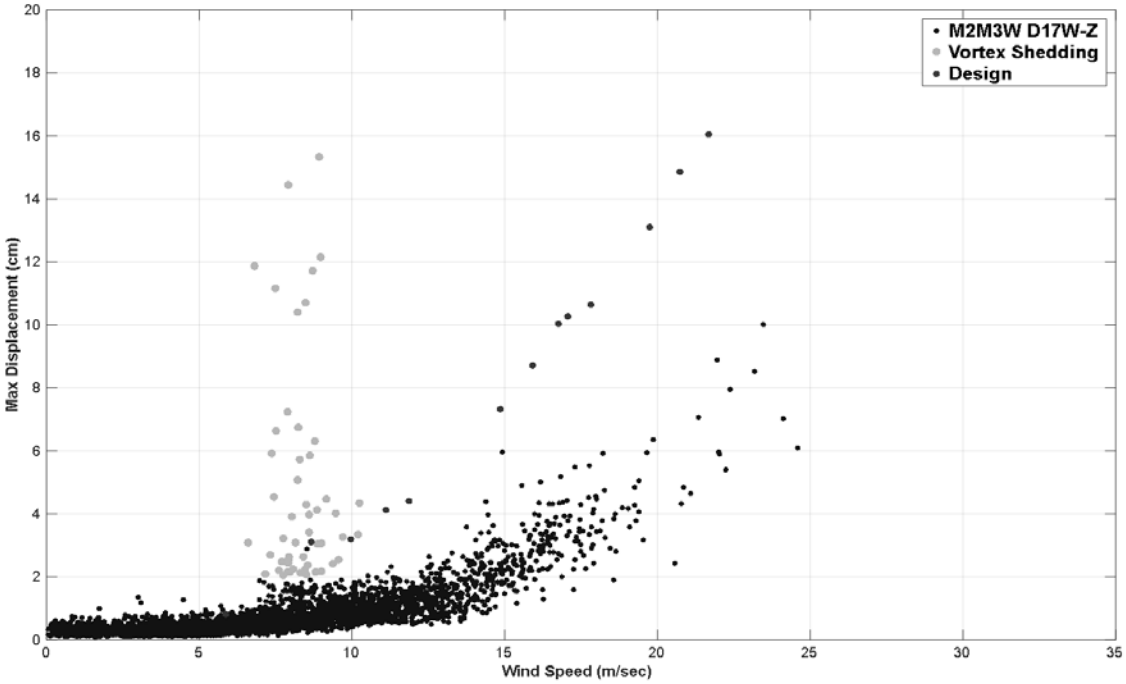
This presentation focuses on the implementation of a complete monitoring scheme on the Rion-Antirrion Bridge that includes both permanent instrumentation, forming SHM system, and periodic Geometric control campaigns.

Initially the main characteristics of RA Bridge are presented (multi-span cable-stayed bridge with a total deck length of 2,252m fully suspended from the pylons top) focusing on unique engineering features such as the shallow foundation of the main piers at 65m below sea level.

Consequently, the permanently installed SHM system, in terms of instrumentation & operation process, is explained as well as the regular analysis of collected data focusing on deck vibration measurements particularities. Also the methodology of Geometric control is discussed, as implemented during the last 15 years of operation.



Rion Antirrion Bridge SHM Instrumentation



Deck vibration amplitude vs Windspeed

EARTHQUAKES IN THE CLASSROOM: "THE SEISMO-BOX: DO IT YOURSELF"

Francesca Cifelli

Università degli Studi Roma TRE, Italy

Several geological processes remain abstract phenomena, difficult to visualize and therefore to understand. Often, traditional instruction methods are not enough to allow students to construct coherent explanations about the natural phenomena, nor to reduce students' misconceptions.

For this reason, laboratory approach helps in visualizing natural processes.

The Seismo-box project was intended as an educational kit that combines knowledge and know-how, with three main objectives 1) to stimulate the students, intended as future citizens, to the knowledge of earthquake as a natural phenomenon, and in particular to the awareness of the consequences that an earthquake may have in relation to the sub-surface geology and the type and quality of buildings in the areas most affected by earthquakes; 2) to stimulate students to practical laboratory activities, also through the creation of experimental devices; 3) to promote in students the acquisition of methodological/didactic skills in the field of dissemination of scientific culture.

This educational kit highlights the key-role of school in forming students as conscious and responsible citizen. The scientific research on earthquake in many seismic countries is very high in quality and lead to important advancement of knowledge about the seismicity in our country. If this knowledge is transmitted to population (starting from young students!) it will become awareness of seismic risk and seismic culture. If the same knowledge is effectively transmitted to politicians and stake holders it will become territorial and urban planning, laws and rules. Where these two aspects run together it is possible to talk about prevention, because all the citizens are aware about the territory where they live and they be part of it, respecting rules and becoming active citizens (Fig. 1).

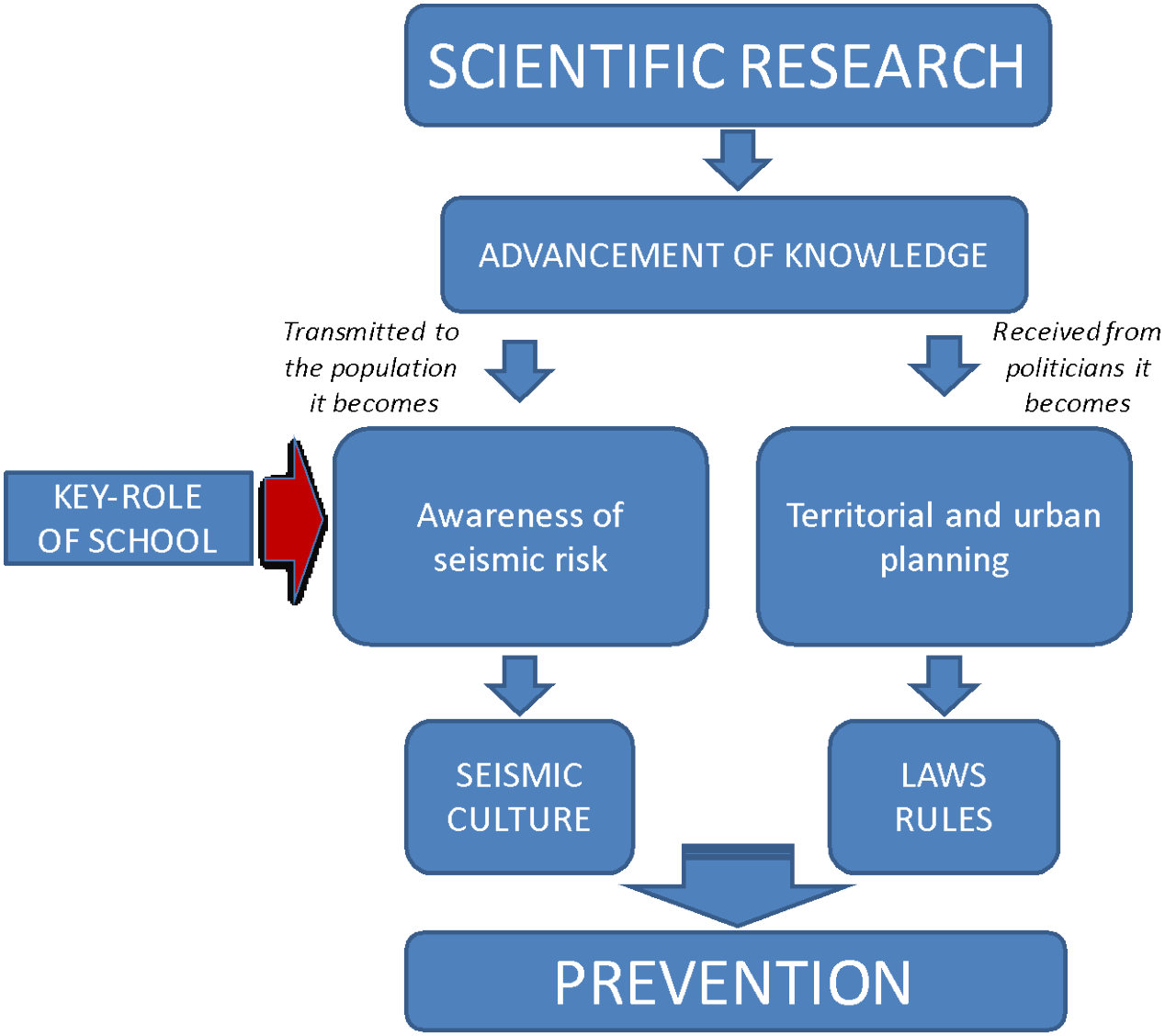


Fig. 1 Modified from Ciaccio and Cultrera 'Terremoto e rischio sismico' (Ediesse Ed.)

Tuned in to the Earth : Using data online at school

Jean-Luc BERENGUER

Geoazur, University Côte d'Azur

Today, seismic activity in the Mediterranean basin is well recorded by a large number of sensors. For several years now, these databases have been easily accessible to the general public and especially to the educational world.

Schools host also seismometers for educational purposes and contribute to increase the databases. Numerous educational seismological networks exist, particularly around the Mediterranean (France, Greece, Italy, Portugal …).

The installation of seismometers in schools promotes learning based on original records. Such learning makes students familiar with scientific data.

The University Côte d'Azur, with the program called Educational Mediterranean Observatory ("EduMed-Obs", http://edumed.unice.fr), focuses on implementing an interface based on a geoscience dataset concerning the Mediterranean basin. EduMed-Obs also provides datasets from research centers. These datasets are intended not only for middle and high schools, but also for university students.

The aim of this practical workshop is to show, through some examples, the resources (data, software) available for teaching. We will work on some case studies to show how, quite easily, we can use real data online to study earthquakes. Classical and less classical activities will be discussed such as the location of an epicentre, the site effect, the structure of the globe revealed by the seismic waves ...

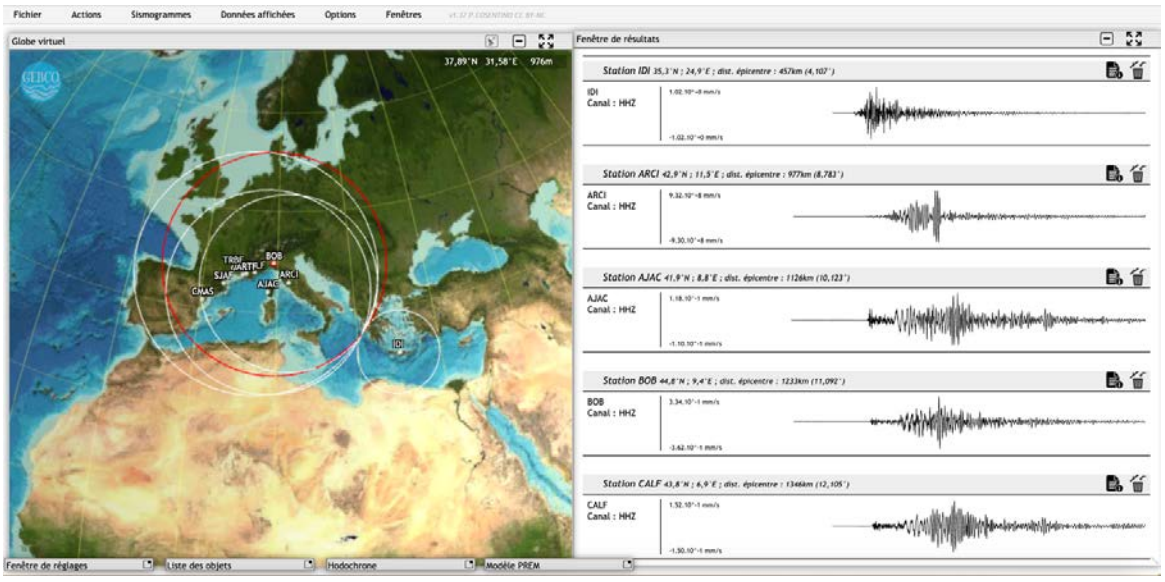
We will use :

the Edumed-Obs seismo data-center >

http://edumed.unice.fr/fr/data-center/seismo

and Tectoglob3D, the software online >

https://www.pedagogie.ac-nice.fr/svt/productions/tectoglob3d/

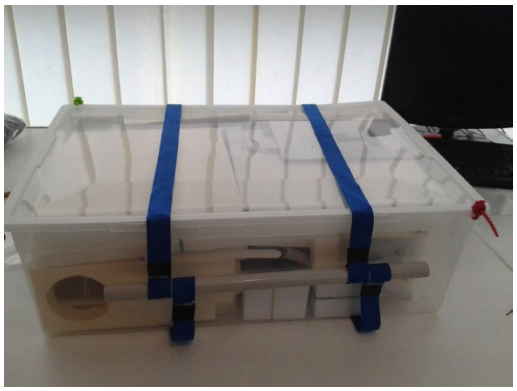


C.R.L. 2020 DIFFUCION SEISMOBOX IN HELLENIC SCHOOLS

Fotis Danaskos

EARTHQUAKES IN MEDITERANEAN COUNTRIES

Teaching the Geology course at my school and implementing each year, in the context of the implementation of Environmental Programs, programs focused on Geosciences, we dared with my students to participate in the CRL WORKSHOPS.



We tried to give simple answers to the main questions that trigger this phenomenon.

1. WHAT IS AN EARTHQUAKE?

Most of the people believe that an earthquake is a shake of the surface of the Earth as a result of the sudden movement of the ground. During this release of energy seismic waves travel in the Earth's lithosphere.

2. ARE EARTHQUAKES PREDICTABLE?

These are the questions everybody asks: When, where, and how big the next earthquake will be?

3. CONSEQUENCES OF AN EARTHQUAKE?

Which houses are more susceptible to ground vibrations and what kind of house should I have in order not to be scared

No, they are all at risk!!

But for all these questions the answers come from Plates Tectonics
THE EARTH IS a 'RESTLESS' PIANET….

Using the know-how and knowledge gained in CRL 2018, we built our uploaded SEISMOBOX and replica / models of the tectonic plates.

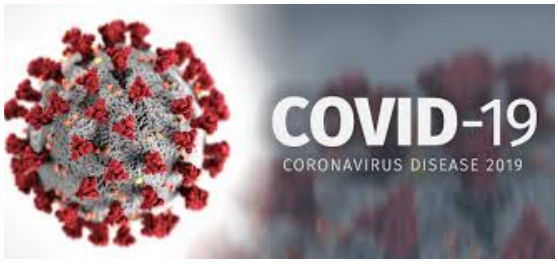
The main goals i tried to explain using the SEISMO-BOX are:

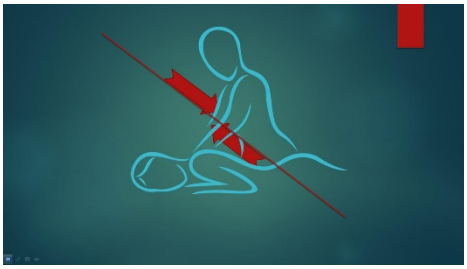
- Stimulate students (citizens of tomorrow) to the knowledge of earthquake as a natural phenomenon
- To sensitize students to the consequences that an earthquake may have on buildings in relation to the type of soil (rock) on which buildings are constructed and the type of buildings itself.

- To raise awareness of school teachers to use new educational techniques in order to educate students.

Then, respecting our commitment, as a group and school, to creators and sponsors of SEISMOBOX (CRL - EGU), we began disseminating this educational material to partner schools.

Through the implementation of our environmental programs, we have spread SEISMOBOX to four schools in Hellas and hope to reach every school in our country through the OSOS platform.





In relation to the educational level of our students we focused on the best teaching performance and it was done with the purpose to understand the phenomenon of earthquakes and the impact on human structures.

Incorporating the seismobox into school teaching

Dr Kiki Makri,

National Observatory of Athens.

The use of appropriate teaching tools is essential for the implementation of classroom teaching. The input of the seismobox at schools can be used for the introduction of the basic principles of geology/seismology and science. Its success depends on the contribution to the familiarization of students with scientific processes, such as the observation, classification, measurement, communication, predictions, drawing conclusions, hypotheses, interpretation, and model construction. In this way, in addition to cognitive skills, students will also acquire psychomotor skills.

But how can we use seismobox in the classroom and in making teaching successful? As a teaching tool, we can classify the seismobox as a model. The model is the simplification of a reality. The purpose of its use is to support the interpretation of phenomena and to describe or predict real situations. The construction of the seismobox must be done by the teacher in collaboration with the students. Through this work, examples and good practices for the use of seismobox in classrooms will be presented.

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

Dr. George Kaviris
Assistant Professor of Seismology-Seismic Anisotropy,

Ioannis Spingos
MSc Seismologist, PhD Candidate

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

Topic 1: 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.

Topic 2: Introduction to Shear-wave Splitting with Pytheas

The properties of shear-wave splitting (the polarization direction of the fast shear-wave – φ – and the time-delay – t_d) can be acquired by analysing waveforms of local earthquakes. The density of the seismological network in the Western Gulf of Corinth provides a vast wealth of available data. In the current exercise, we will use the *Pytheas* software to determine the splitting in the upper crust of the Gulf of Corinth. The goal of this exercise is to measure splitting from local waveforms recorded by stations of the Corinth Rift Laboratory Network in the Western Gulf of Corinth.

The Geohazards Lab initiative

Michael Foumelis

BRGM

Presentation of activities under the CEOS Geohazards Lab initiative enabling the greater use of EO data and derived products to assess geohazards and their impact.

Hosted Processing Services on GEP

Michael Foumelis

BRGM

Demonstration of online processing services available on the Geohazards Exploitation Platform (GEP) for mapping and monitoring geohazards.