

Advances in Science, Technology & Innovation
IEREK Interdisciplinary Series for Sustainable Development

Amjad Kallel · Maurizio Barbieri · Jesús Rodrigo-Comino ·
Helder I. Chaminé · Broder Merkel · Haroun Chenchouni ·
Jasper Knight · Sandeep Panda · Nabil Khélifi ·
Ali Cemal Benim · Stefan Grab · Hesham El-Askary ·
Santanu Banerjee · Riheb Hadji · Mehdi Eshagh *Editors*

Selected Studies in Environmental Geosciences and Hydrogeosciences

Proceedings of the 3rd Conference of
the Arabian Journal of Geosciences (CAJG-3)

Advances in Science, Technology & Innovation

IEREK Interdisciplinary Series for Sustainable Development

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ASTI series has now been accepted for Scopus (September 2020). All content published in this series will start appearing on the Scopus site in early 2021.

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of the Arabian Journal of Geosciences
(CAJG-3)

Editors

Amjad Kallel
ENIS, University of Sfax
Sfax, Tunisia

Jesús Rodrigo-Comino
Departamento de Análisis Geográfico Regional
y Geografía Física
Facultad de Filosofía y Letras
Campus Universitario de Cartuja
University of Granada
Granada, Spain

Broder Merkel
Freiberg, Germany

Jasper Knight
University of the Witwatersrand
Johannesburg, South Africa

Nabil Khélifi
Springer, a part of Springer Nature
Heidelberg, Germany

Stefan Grab
School of Geography, Archaeology and
Environmental Studies
University of the Witwatersrand
Johannesburg, South Africa

Santanu Banerjee
Indian Institute of Technology Bombay
Mumbai, India

Mehdi Eshagh
New Technologies Information Society (NTIS)
University of West Bohemia
Pilsen, Czech Republic

Maurizio Barbieri
Department of Chemical Engineering Materials
Environment
Faculty of Engineering
Sapienza University of Rome
Rome, Italy

Helder I. Chaminé
Polytechnic of Porto
School of Engineering (ISEP)
Porto, Portugal

Haroun Chenchouni
Higher National School of Forests
Khenchela, Algeria

Sandeep Panda
Gujarat Biotechnology University
Gandhinagar, Gujarat, India

Ali Cemal Benim
Düsseldorf University of Applied Sciences
Düsseldorf, Germany

Hesham El-Askary
Chapman University
Orange, USA

Riheb Hadji
Laboratory of Applied Research in Engineering
Geology, Geotechnics, Water Sciences, and
Environment
University of Farhat Abbas
Setif, Algeria

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About the 2nd Springer Conference of the *Arabian Journal of Geosciences* (CAJG-3), Online November 2–5, 2020



The *Arabian Journal of Geosciences* (AJG) is a Springer journal publishing original articles on the full range of Earth sciences in partnership with the Saudi Society for Geosciences. The journal focuses on, but is not limited to, research themes which have regional significance for the Middle East, the Euro-Mediterranean, Africa, Asia, and some other regions of the world. The journal receives on average 3500 submissions a year and accepts around 800 papers for publication in its 24 annual issues (acceptance rate around 20%). It benefits from the participation of an editorial team of 15 topical chief editors and 100 international associate editors who generously help in evaluating and selecting the best papers.

In 2008, Prof. Abdullah Al-Amri, in close partnership with Springer, founded the *Arabian Journal of Geosciences* (AJGS). In 2018, the journal celebrated its tenth anniversary. To mark the event, the founder and the editor-in-chief of the AJGS organized the 1st Conference of the *Arabian Journal of Geosciences* (CAJG) in close collaboration with Springer on November 12–15, 2018. The conference was an occasion to endorse the journal's long-held reputation and brought together 450 authors from 70 countries, who work in the wide-ranging fields of Earth sciences. The dynamic four-day conference in a stimulating environment in Hammamet, Tunisia, provided attendees with opportunities to share their latest unpublished findings and learn about the latest geosciences studies. The event also allowed attendees to meet and talk to the journal's editors and reviewers.



In a continuation of the successful 1st CAJG and 2nd CAJG, this year's conference aims to bring geoscientists from all over the world to present and discuss their most recent findings. The 3rd CAJG will continue to publish the newest findings in its proceedings and some special issues by Springer, with a clear mission to drive greater North–South (Europe–Africa) scientific cooperation and to open doors to new and enriching collaborations with geoscientists based in Asia and the Americas. Research studies from the wide-ranging fields of Earth sciences can be submitted for evaluation by the Conference Scientific Committee. In particular, the 3rd CAJG will devote a special session to

studies focusing on unraveling the undiscovered oil and gas resources in the Mediterranean and North Africa. Many international experts will be invited to take part in the discussion, in particular we are expecting a massive participation of researchers from North Africa Research Group (NARG) of Manchester University (UK) and other scientists based in North Africa.

Conference Tracks

The scientific committee of the 3rd CAJG invites research papers on all cross-cutting themes of Earth sciences, with a main focus on the following 15 conference tracks:

- Track 1. Atmospheric Sciences, Meteorology, Climatology, Oceanography
- Track 2. Biogeochemistry, Geobiology, Geoecology, Geoagronomy
- Track 3. Earthquake Seismology and Geodesy
- Track 4. Environmental Earth Sciences
- Track 5. Exploration and Theoretical Geophysics, Seismic and Well-Logging Methods, Mathematical Geosciences
- Track 6. Geo-Informatics and Remote Sensing
- Track 7. Geochemistry, Mineralogy, Petrology, Volcanology
- Track 8. Geological Engineering, Geotechnical Engineering
- Track 9. Geomorphology, Geography, Soil Science, Glaciology, Geoarcheology, Geoheritage
- Track 10. Hydrology, Hydrogeology, Hydrochemistry
- Track 11. Marine Geosciences, Historical Geology, Paleoceanography, Paleoclimatology
- Track 12. Numerical and Analytical Methods in Mining Sciences and Geomechanics
- Track 13. Petroleum and Energy Engineering, Petroleum Geochemistry
- Track 14. Sedimentology, Stratigraphy, Paleontology, Geochronology
- Track 15. Structural Geology, Tectonics and Geodynamics, Petroleum Geology

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Preface

The proceedings of the 3rd Springer Conference of the *Arabian Journal of Geosciences* (CAJG-3) which was held online in November 2020 consists of four volumes titled:

Proceedings Volume 1: New Prospects in Environmental Geosciences and Hydrogeosciences

Proceedings Volume 2: Advances in Geophysics, Tectonics, and Petroleum Geosciences

Proceedings Volume 3: Recent Research on Geomorphology, Sedimentology, and Geochemistry

Proceedings Volume 4: Research developments in Geotechnics, Geo-Informatics and Remote Sensing

These volumes are based on the accepted conference papers for either oral/poster presentations or selected for online publication during the CAJG-3.

The first volume offers a broad range of recent studies that discuss the latest advances in geoenvironmental and hydrogeosciences from diverse backgrounds including climate change, geocology, biogeochemistry, water resources management, and environmental monitoring and assessment. It shares insights of experienced scientists from, but not limited to, research institutes worldwide, focused the Mediterranean and Middle East regions on how the understanding of ecological, climatological, oceanic, and hydrological processes is the key for improving practices in environment management, including the eco-responsibility, scientific integrity, and social and ethical dimensions.

The second volume includes a series of research methods that are nowadays in use for measuring, quantifying, and analyzing the targeted geological domains. Remote sensing with high-resolution satellite imagery, seismology, geochemistry, theoretical geophysics and related profiles with tomographic images, earthquake geology with times series radar interferometry and related geodetic-GPS campaigns, and well-logging contribute to scrutinizing the Earth tectonic architecture. Fundamental questions that address the genesis and evolution of our planet are built upon data collection and experimental investigations under physical constitutive laws which are the conditions for a successful scientific research. These multidisciplinary approaches combined with the geodynamics of tectonic provinces and investigations of potential zones of natural resources (petroleum reservoirs) provide the basis for the economic development.

The third volume presents an updated unique view in conjugating field studies and modeling to better quantify the process-product binomial unusual in geosciences. Earth systems require a comprehensive understanding of processes and dynamics of geology, morphotectonics, sedimentology, stratigraphy, and geochemistry. In the geomorphology section, several studies deal with topics related to fault slip and incision rates, soil science, landslides and debris flows, coastal processes, and geoaerology and geoheritage. Under the sedimentology section, researchers present recent advances in stratigraphy, environmental, tectonic and diagenetic processes, together with evolutionary, biostratigraphic and paleoenvironmental significance of paleontology are presented. Additionally, this section also contains papers on

marine geosciences, from molecular proxies related to climate to geophysical surveys. Last but not least, the third section on geochemistry focuses on sedimentary geochemistry and mineralogical characterization, magmatic and metamorphic processes and products, and the origin and exploration of mineral deposits. This volume resumes the current situation related to the above-mentioned topics mainly in the Mediterranean realm, testifying the geological importance of this area and surroundings.

The fourth volume contains research studies in the fields of three sections; (1) geological and geotechnical engineering, (2) geomechanical studies based on numerical and analytical methods, and (3) geo-informatics and remote sensing. The content of these research studies would provide new scientific knowledge for further understanding on landslides, new stabilization techniques, importance of geophysics for engineering geology investigations as well as new empirical approaches for easily predicting some physical and hydrogeomechanical properties of geomaterials.

The proceedings of the CAJG-3 is of interest to all researchers, practitioners, and students in all fields of geosciences, including the environmental geosciences.

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Amjad Kallel
Maurizio Barbieri
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Santanu Banerjee
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Mehdi Eshagh

Contents

Atmospheric Sciences, Meteorology, Climatology, Oceanography

Trend and Variability of Sea Surface Temperature Over the Arabian Gulf 3
Kamal Aldien Alawad, Abdullah Al-Subhi, Mohammed Alsaafani,
and Turki Alraddadi

**A Probabilistic Approach to Estimate Design Wave Parameters and Extreme
Wave Return Values for 100 Years in the Indian Ocean** 7
Mourani Sinha and Mrinmoyee Bhattacharya

On the Formation of Storm Surges in the Azov Sea 11
Victor Arkhipkin and Stanislav Myslenkov

**Projecting Spatiotemporal Extent of Hydrological Drought in a North African
Watershed: Outlooks on Hydrological Response** 15
Youssef Brouziyne, Lahcen Benaabidate, Lhoussaine Bouchaou, Aziz Abouabdilah,
and Abdelghani Chehbouni

Estimation and Analysis of Global Solar Radiation in Bangkok, Thailand 19
Siriluk Ruangrungrrote

Ambient VLF Noise Levels in the Lower Latitude Region 23
Mario Batubara, Timbul Manik, Musthofa Lathif, Peberlin Sitompul,
and Rizal Suryana

Biogeochemistry, Geobiology, Geocology, Geoagronomy

**Estimating Vegetation CO₂ Sequestration in Grombalia Region
(Northeastern Tunisia) Using Remote Sensing and GIS** 31
Rim Mehdaoui and Makram Anane

**Assessment of Acid Sulfate Soils' Physicochemical Properties for Oil Palm
(*Elaeis guineensis* Jacq.) Cultivation in South-South Nigeria** 35
Ajoke Adegaye, Segun Oladele, and Kehinde Erinle

**Forecasting Lower Tigris Basin Landscapes' Vegetation Response to Regional
and Global Climate Variability** 39
Ali Subhi Alhumaima and Sanjar Mutalovich Abdullaev

**Calibration and Evaluation of AquaCrop Model Under Different Irrigation
Methods for Maize (*Zea mays* L.) in Central Region of Iraq** 43
Diaa Hassan, Thamer Thamer, Rafal Mohammed, Ayad Almaeini, and Nadine Nassif

**Pistachio Tree As a Source of Bioactive Molecules With Biological
Properties** 49
Manel Elakremi, Leyre Sillero, Lazher Ayed, Jalel Labidi,
and Younes Moussaoui

In vitro Seed Germination of Some Wild Plants from Algeria: An Effective Means for Plant Biodiversity Preservation	53
Souad Mehalaine and Haroun Chenchouni	
Assessment of Moscow's New Territory for Biodiversity Conservation Using Remote Sensing	57
Anna M. Aleynikova, Elizaveta V. Karpukhina, Natalya V. Marsheva, and Elena A. Parakhina	
Smartest Countries, Happiest Countries: The World's Fight Against COVID-19 During the First Wave	61
Yasser Farhat and Wided Batita	
Environmental Earth Sciences and Geohazards	
Assessment of Heavy Metal Contamination in Soil of El Eulma Area (Algeria)	71
K. Khemmoudj and S. Kissar	
Naturally Occurring and Artificial Geochemical Barriers in Landfills of Northwestern Russia	75
Anatoly Belyi and Victor Shmakin	
Water Quality Influencing the Distribution of Benthic Macroinvertebrates at El Harrach River (North-Central Algeria)	79
Mouna Hafiane, Rania Maldji, Ghania Imekraz, Djaouida Bouchelouche, Imane Saal, Mohammed Mebarki, and Abdeslem Arab	
Environmental Impact Assessment of the Algerian Cement Industry: A Case Study with Life Cycle Assessment Methodology	83
Ali Makhlof, Ramdane Kardache, Raouf Chaabia, Abdelmadjid Drouiche, and Boualem Brahmi	
Vulnerability of Beaches Nourished by Dunes: A Fight Between Waves, Winds, and Sediments. A Case Study of Mira Beach, Portugal	87
José Pinho, Ana Gomes, and Helena Granja	
Use of the BCG Henderson Matrix as a Tool for Differentiating Areas by the Cost of Housing, Depending on the Ecological State	91
Kamila Akhmedinova	
Mercury Exposure from Artisanal Small-Scale Gold Mining in Bunikasih, West Java, Indonesia	95
Idham Andri Kurniawan, Mirzam Abdurrachman, Masayuki Sakakibara, Kuang Xiaoxu, Irwan Meilano, Nurcahyo Indro Basuki, I. Gusti Bagus Eddy Sucipta, and Adzkia Noerma Arifa	
Soil Mercury Along an Elevation Gradient in Northern Borneo	99
Francis Q. Brearley, Giacomo Sellan, David McKendry, Sukaibin Sumail, and Antony van der Ent	
Evaluation of Reliability, Resilience, and Vulnerability Application for Watershed Health Assessment—A Review	103
Kuswantoro Marko, Dwita Sutjiningsih, and Eko Kusratmoko	
Iraq's Contemporary Environmental Problems, Their Causes, and Sustainability	109
Hassan Hassoon ALDelfi	

Contributing Factors in Respirable Dust Lung Deposition in Underground Coal Mines: Short Review	117
Elham Rahimi, Younes Shekarian, Wei-Chung Su, and Pedram Roghanchi	
Impacts of CO and Air Quality-Related Emissions on the Urban Environment—A Case Study (Bhimavaram, India)	121
Pala Gireesh Kumar, Patnala Lekhana, and Musini Tejaswi	
Sociospatial Inequality Conceptual Space and Hexagonal Binning Technique: An Application in Albay Philippines	127
Ana Marie Rico Abante	
Multi-source Earth Observation Derived Data for Delineating the 2011 High Flood Line in the Okavango Delta (Botswana) for Flood Risk Mitigation and Management	135
Kelebogile Botseo Mfundisi, Stella Gachoki, Elfatih Abdel-Rahman, Tobias Landmann, and Alex M. Mudabeti	
Overview of Research on the Behavior of Mines to Climate Change	141
Sabrina Zitouni	
Cemented Surface Paste Disposal as a Mine Tailings Management Scenario: In Situ Long-Term Hydro-Geochemical Behavior Using Field Experiments	145
Abdellatif Elghali, Mostafa Benzaazoua, and Abdelkabar Maqsoud	
Statistical Study of Rainfall and Sediment Transport in the North-West of Algeria	149
Faiza Hallouz, Mohamed Meddi, Gil Mahé, Salah Eddine Ali Rahmani, and Fateh Chebana	
The Effects of Landfill Leachate Irrigation on Soil Properties	153
Soukayna Rhouat, Mohammed Salaheddine El Youbi, and Fouad Dimane	
Cavitant Flow Characterization Through the Opening of a Flat Valve in a Rectangular Channel	159
Wahiba Mokrane and Amina Messaoudi	
Determination of Pesticide Residue in Soil and Groundwater of Gezira Scheme (Sudan)	163
Ahmed Hammad, Rowida Yousif, Azhari Abdelbagi, Abd Elaziz Ishag, Anna Mohamed, Jang-Hyun Hur, and Mark Laing	
Morphological Features of Soils in the Low-Mountain Relief of the Southeastern Crimea (The Area of Karadag Nature Reserve)	167
Polina Drygval, Anna Drygval, Elena Stanis, Yaroslav Lebedev, and Roman Gorbunov	
Cinnamon Wood as a Low-Cost Adsorbent for the Removal of Methylene Blue from Aqueous Effluents	171
Dilendra Wijesekara and Chandani Udawatte	
The Structures and the Vibrational Frequencies of Organic Cd Complexes with Forced Symmetry	175
Yang Zhao, Yongbing Li, Qi Cheng, Jianming Liu, and Yaolin Shi	

Hydrology, Hydrochemistry, Hydrogeology	
Water Balance and Streamflow Modelling Using the Soil and Water Assessment Tool (SWAT): A Case of Gaojiaping Watershed in South China	181
Hamza Jakada and Abdulazeez Rotimi	
Good Data Handling in Hydrogeology	185
Broder Merkel	
Hydrogeochemical and Groundwater Flow Studies in El Oued Region (Southeast Algeria)	189
Mohammed Ouarekh, Boualem Bouselsal, Mohamed Salah Belksier, and Maha Kharroubi	
Comparison of Water Quality Parameters in Two Regions (Northern Cameroon, Central Africa) Based on Statistical Tools	193
Estelle Gaëlle Dammi Djimi, Placide Désiré Belibi Belibi, Patrice Takam Soh, Andrew Ako Ako, Godwin Tabi Agbor, Rachel Nkwaju Yanou, Julius Ghogomu Numbonui, and Joseph Ketcha Mbadcam	
Mineralization Mechanisms and Water Quality of the Complex Terminal Aquifer in Algerian Desert (Ouargla)	197
Maha Kharroubi, Boualem Bouselsal, Samia Hadj Said, Aziez Zeddouri, and Mohammed Ouarekh	
Geology and Geochemistry of Geothermal Water in Northwestern Algeria, Bouhanifia Area	201
Mohammed Abdel Illah Benamar, Azzaz Habib, Maarten W. Saaltink, Albert Folch, and Khaldi Abdel Kader	
Identifying the Potential Geothermal Zones Based on Probability Mapping of Radon Gas Concentration, Lineaments Density, Geochemistry, and Alteration Data	205
Mohamad Nur Heriawan, Maisyita Azizah Oetomo, Arie Naftali Hawu Hede, Taiki Kubo, Yohei Tada, Koki Kashiwaya, and Katsuaki Koike	
Operating Principle of the M'Chaki Spring-Jijel (North-East Algeria)	209
Tekkouk Mustapha and Benzaid Riad	
Diagnosis of Shallow Aquifer Dynamics and Problem of Groundwater Rising in Ouargla City (Algeria)	213
Fadila Hafsi, Samia Hadj-Said, and Aziez Zeddouri	
Conceptual and Numerical Hydrogeological Modeling of the Shallow Aquifer of Sidi Bouzid: Discussion of the Different Hypothesis	217
Asma Gharbi, Zouhaira IbnAli, Mouna Abidi, Amal Kammoun, and Moncef Zairi	
Delineation of the Groundwater Potential Zones of Upper Tigris Diyarbakır Sub-basin in Turkey Using GIS and Analytical Hierarchical Process (AHP) Techniques	223
Recep Çelik	
Geological, Geophysical and Geochemical Characterization of the Salinization of the Plio-Quaternary Coastal Aquifer in the Chiba Downstream Basin, Eastern Cap-Bon Tunisia	229
Farah Nefzaoui, Haifa Boussiga, Trabelsi Emna, Mohamed Fethi Ben Hamouda, and Jamila Tarhouni	

Irrigation Strategies and Crops Selection as a Sustainable Water-Resource Management in Water Limited Environments: Tunisian Case Study	237
Hacib El Amami, Abdelaziz Zaïri, and Insaf Mekki	
A Decision Support Tool for the Dynamic Groundwater Management of Coastal Aquifers Under Uncertainty	241
Chefi Triki, Mohammad Mahdi Rajabi, Ali Al-Maktoumi, and Slim Zekri	
Policy Interventions to Improve Groundwater Management: Case of a Depleted Aquifer in Mahdia (Tunisia)	245
Rania Soula, Ali Chebil, Rajouene Majdoub, Daniel Crespo, Taher kahil, and José Albiac	
Understanding the Value of Water—a Comparison Between Policy and Public Attitudes in Saudi Arabia and Ireland	249
Omar K. M. Ouda and Stephen J. McIlwaine	
Rainwater Conservation and Its Viability in the Semi-Arid City: A Case of Ahmedabad, India	253
Mona Khakhar and Keshvi Ahir	
A Qualitative Assessment of a Hydrometric Network for Monitoring an Integrated Hydropower and Water Supply System	259
J. Kibiyi and J. Kihamba	
Estimation of Peak Discharge by Slope-Area Method for a Channel Reach Encompassing a Bridge	263
Joel Kibiyi and Wangai Ndirangu	
Water for Mining in the Kingdom of Saudi Arabia: An Overview	267
Omar K. M. Ouda, Abdulaziz M. Al Shaibani, and Abdulaziz M. Al-Bassam	

About the Editors



Amjad Kallel ENIS, University of Sfax, Sfax, Tunisia

Dr. Amjad Kallel is currently an Associate Professor of Environmental Geology in the Sfax National School of Engineers at the University of Sfax, Tunisia. He holds a B.Eng. in Georesources and Environment (1998) from the University of Sfax (Tunisia) and an M. Sc. degree and a Ph.D. degree in Georesources and Environment (2004) from Hokkaido University (Japan). He joined the Venture Business Laboratory (VBL) at Akita University, Japan (2005–2006) as a researcher focusing on refining and recycling technologies for the recovery of rare elements from natural and secondary sources. On his return to Tunisia, he worked at the University of Gabes from 2006 to 2011, where he contributed to the elaboration of teaching programs at the Higher Institute of Water Sciences and Technologies of Gabes. Since 2011, he has joined the Sfax National School of Engineers. There, he has also been involved in various research projects related to Environmental Geology and Environmental Geotechnics. He has co-organized many prestigious workshops, seminars, and international conferences. In 2016, he joined the *Arabian Journal of Geosciences* (Springer) and the *Euro-Mediterranean Journal for Environmental Integration* (Springer) as Chief Editor and Managing Editor, respectively.



Maurizio Barbieri Department of Chemical Engineering Materials Environment, Faculty of Engineering, Sapienza University of Rome, Italy, Italy

Prof. Barbieri holds a degree in Geological Sciences (1994) and a Ph.D. degree in Earth Sciences (1998) from Sapienza University of Rome, (Italy). He is currently Full Professor of Environmental Geochemistry and Hydrogeochemistry at Sapienza University of Rome (Italy). Job-related skills Geochemical tracers in hydrological studies; interactions between water and the geological and chemical environment; quantitative understanding of chemically based processes in hydrogeochemical environments and complementary physical and biological processes and conditions; kinetics and equilibria of geochemical reactions; the movement of isotopes and soil chemistry; freshwater–seawater interactions in coastal aquifers; basic and applied research on speciation and transformation of trace metals and metalloids during biogeochemical processes in both natural and anthropogenic environments; radiogenic and stable isotope geochemistry. Other fields of expertise are Ion chromatography, ICP-MS, water, soil and

geological mapping, univariate and multivariate analysis of geochemical datasets, Isotope analyses of Sr, H, O, and B. Editorial board member for Springer, Elsevier and MPDI Journals (topics: Geochemistry, Water, and Environment). Water Quality Advisory for the LIFE ACTION GRANTS: Restoration, management and valorization of PRIority habitats of MEDiterranean coastal areas—LIFE17 NAT/GR/000511. Coordinating beneficiary: Hellenic Society for the Protection of Nature (2018–2020). International Project (2018–2020) LIFE17NAT/GR/000511 “Restoration, management, and valorization of PRIority habitats of MEDiterranean coastal areas.” Environmental Advisor (Hydrogeochemistry) for the International Project (2016–2019) SECOSUD II—Conservation and equitable use of biological diversity in the SADC region. The project is financed by the Italian Agency for Development Cooperation and implemented through Eduardo Mondlane University, South African National Park, and Sapienza University of Rome. Scientific Coordinator (2014–2016) for the Geochemical model of the Vico Lake (Central Italy), with particular regard to environmental arsenic. Client: Regional Agency for Environmental Protection of Lazio. Environmental Advisor (Hydrogeochemistry) for the International Project (2012–2014) “Institutional Support to the Management of Protected Areas in Albania.” Project supported by the International Union for Conservation of Nature (IUCN).



Jesus Rodrigo-Comino University of Granada, Granada, Germany

Dr. Jesús Rodrigo-Comino, graduated in Geography, currently works as Assistant Professor at the University of Granada. He carried out a thesis with an extraordinary degree award with the work: “The soils of the province of Malaga: Revision according to the classification criteria of FAO-WRB (2006).” He holds a master’s degree in Territorial Planning and Geographic Information Systems (2013) from the University of Granada, whose final work was divided into three national publications and a monograph. During his predoc stage, he obtained three scholarships for doctoral studies: DAAD (German Academic Exchange Service), La Caixa Foundation, and FPU (Ministry of Education, Spain). During this period, he completed his doctoral thesis between the University of Trier (Germany -2 years-) and Malaga (2 years). Doctor in Geography (2018) from the University of Malaga with a doctoral thesis consisting of eight international publications, international mention and outstanding cum laude: “Actual geomorphological processes in sloping vineyards. A comparison between Ruwer-Mosel Valley (Trier, Germany) and Montes de Málaga (Málaga, Spain).” Currently, he is also preparing a second doctorate in Geomatics engineering at the Polytechnic University of Valencia. His research career consists of four full monographs (Nova, Springer, etc.) and one edited alone (Elsevier), 171 indexed publications (Scopus)/130 JCR, leading international collaborations with research teams from Iran, China, Kazakhstan, Sudan, India, Brazil, Croatia, Iraq, or the USA. Regular reviewer in more than 140 international indexed journals (e.g., *Scientific Reports*, *Science of the Total Environment*,

PLOS One, Catena, Geoderma, Agriculture, Ecosystem and Environment or Earth-Science Review), member of the panel of two doctoral theses, evaluator of projects for the Ministries of Science of Chile, Peru, the USA, Serbia, Switzerland, Kazakhstan, or Poland, and postgraduate scholarships for DAAD. He has organized several scientific meetings and congresses (e.g., Action Cost, V Biohydrology, Fire in the Earth, etc.), sessions at international conferences (EGU, TerraEnvision, Conference of the *Arabian Journal of Geosciences*, etc.), oral presentations and conferences magisterial (Germany, Bulgaria, Norway, etc.). Editor-in-Chief of the indexed journal (Scopus and ESCI; Q2) *Air Soil and Water Research* (SAGE). In addition, he is an associate editor at *Scientific Reports* (Nature-Springer), *Hydrological Science Journal* (Taylor & Francis), *Arabian Journal of Geosciences* (Springer), *Euro-Mediterranean Journal for Environmental Integration* (Springer), and *Journal of Mountain Science* (Springer). He has participated as a researcher in R&D&I projects on social issues related to housing or the census, or transfer and knowledge at European level such as the INTERREG Smart-Light HUB project (light pollution) or COST FIRElinks (fires). He has been invited to give lectures on agriculture, sustainable management, and erosion in several universities. He has supervised five final degree projects and three completed master's degrees in Germany. He has taught regulated and certified teaching at the Universities of Granada, Valencia, Malaga, León, Oviedo, and Trier (in German) on development, geomorphology, Geographic Information Systems, remote sensing, and statistical techniques. He was recently awarded with a Leonardo Grant (BBVA Foundation).



Helder I. Chaminé School of Engineering (ISEP), Polytechnic of Porto, Portugal

Helder I. Chaminé is a skilled Geologist and Professor of engineering geosciences at the School of Engineering (ISEP) of the Polytechnic of Porto, with over 32 years' experience in multidisciplinary geosciences research, consultancy, and practice. He studied geological engineering and geology (B.Sc., 1990) at the Universities of Aveiro and Porto (Portugal), respectively. He received his Ph.D. in geology at the University of Porto in 2000 and spent his postdoctoral research in applied geosciences at the University of Aveiro (2001–2003). In 2011, he received his Habilitation (D.Sc.) in geosciences from the University of Aveiro. Before joining the academy, he worked for over a decade on international projects for mining, geotechnics, groundwater industry and/or academia related to geodynamics and regional geology, hard rock hydrogeology and water resources, engineering geosciences and applied geomorphology, rock engineering and georesources. His research interests span fundamental to applied fields: GIS mapping techniques for applied geology, structural geology and regional geology, engineering geosciences and rock engineering, slope geotechnics, mining geology and hydrogeomechanics, hard rock hydrogeology, exploration hydrogeology, urban groundwater and hydromineral resources. He is interested in mining geoheritage, history of cartography, military geosciences and higher-education dissemination, skills, and core

values. Presently, he is Head of the Laboratory of Cartography and Applied Geology (LABCARGA | ISEP), Senior Researcher at Centre GeoBioTec | U. Aveiro and Centre IDL | U. Lisbon, as well as belongs to the executive board of the M.Sc. + B.Sc. Geotechnical and Geoenvironmental Engineering Programs (OE + EUR-ACE Label) and the Department of Geotechnical Engineering (ISEP). He currently belongs to the board of the Technical Commission of Environmental Geotechnics from SPG. He was a Board Member of APGeom—Portuguese Association of Geomorphologists (2009–2013), SPG—Portuguese Geotechnical Society (2016–2020), APG—Portuguese Association of Geologists (2020–2021), and AIH-GP—Portuguese Chapter of the International Association of Hydrogeologists (2019–2022). He was a consultant and or responsible for over 75 projects of applied geology, hydrogeomechanics, slope geotechnics, mining geology, exploration hydrogeology, hard rock hydrogeology, water resources, urban groundwater, and applied mapping (Mozambique, Portugal, and Spain). He has co-authored over 210 publications in indexed journal articles, conference proceedings/full papers, chapters, technical, and professional papers. He co-edited over 15 special volumes and is presently involved in editing themed issues for some international journals (e.g., *Environmental Earth Sciences*—Springer, *Springer Nature Applied Sciences*, *Discover Water*—Springer, *Arabian Journal of Geosciences*—Springer, *Water*—MDPI). As a referee for several international journals in applied mapping, geosciences, geotechnics, hydrogeology, water resources, and geohazards, he has a broad activity. He served as Invited Expert Evaluator of Bologna Geoscience Program for DGES (Portugal) and Scientific Projects Evaluation for NCST, 2017–2019 (Kazakhstan), and NRF | RISA, 2019 (South Africa), as well as Coordinator of “Geology on Summer| Ciência Viva” Program at ISEP (2005–2019) for geoscience dissemination. He has also been active in teaching and supervising many Ph.D., M.Sc., and undergraduate students. He has been on the editorial board, among others, of the *Arabian Journal of Geosciences* (SSG + Springer), *Hydrogeology Journal* (IAH + Springer), *Euro-Mediterranean Journal for Environmental Integration* (Springer), *Springer Nature Applied Sciences* (Springer), *Mediterranean Geoscience Reviews* (Springer), *Discover Water* (Springer), *Geotechnical Research* (ICE), *Geosciences* (MDPI), *Revista Geotecnica* (Portugal), and *Geología Aplicada a la Ingeniería y al Ambiente* (Argentina). He integrates as Moderator or Session Chair in several conferences, workshops, and meetings. He was the Scientific Chair of the 1st International Conference on Georesources, Geomaterials, Geotechnologies and Geoenvironment, 4GEO (Porto, Portugal, November 7–8, 2019). He is currently on the organizing and scientific committees of the 3rd International Workshop on Natural Hazards—NATHAZ’22 (Terceira Island, Azores, May 2022), supported by Springer.

**Broder Merkel** TUBAF, Freiberg, Germany

• Dissertation (Ph.D.) Dr. rer.nat. as Hydrogeologist (TU München) • Habilitation (Dr. habil) Christian-Albrechts Universität Kiel • Full Professor for Hydrogeology at TUBAF (1993–2015) Hydrogeology, hydrochemistry, modeling chemical thermodynamics and reactive transport, geo-statistics, GIS and remote sensing • Dean of the Faculty Geoscience, Geotechnics and Mining • DFG liaison officer of TUBAF • Vice-rector of TUBAF • Head of the Scientific Diving Center of TUBAF • Field work in Bolivia, China, Chile, Czech Republic, Iraq, Iran, Israel, Italy, Jordan, Hungary, Mexico, Mozambique, Namibia, Palestine, Russia, Spain, USA • Organization of seven International Conferences Uranium Mining and Hydrogeology

**Haroun Chenchouni** Higher National School of Forests, Khenchela, Algeria

Dr. Haroun Chenchouni is an associate professor and research scientist (Ecologist) at the Higher National School of Forests (Khenchela, Algeria). He is a former associate professor at the University of Tebessa (Algeria). He holds a M.Sc. (Magister) in Dryland Ecology from the University of Ouargla (Algeria) and a doctorate degree in Ecology and Environment from the University of Batna. He graduated as an engineer in Plant Ecology and Forest Ecosystems from the Department of Biological Sciences (University of Batna, Algeria). His research interests are fairly broad; he uses statistical modeling approaches to understand how natural environments, mainly climatic and edaphic factors, and anthropogenic perturbations influence biological interactions, shape trends in population dynamics, and influence community diversity. He uses various biological models to investigate biological interactions and community ecology of arid and semiarid ecosystems of North Africa. At various universities in Algeria, he teaches forest ecology, biostatistics, and ecological modeling. He has published more than 100 peer-reviewed publications and internationally recognized research papers. He is also involved in national and international research projects. In 2017, he joined the *Arabian Journal of Geosciences* (AJGS) as an associate editor. Then in 2019, he was assigned as a chief editor of Topic 2 (biogeochemistry, geobiology, geocology, geoagronomy) to handle submissions dealing with various fields of biogeosciences, geocology, climate change, plant and soil science, agricultural and forest environment, and environmental sciences.



Jasper Knight University of Witwatersrand, South Africa

Professor of Physical Geography, University of the Witwatersrand, Johannesburg, South Africa.

I am a geoscientist with research interests in the spatial and temporal variability in landscape system responses to climate and environmental changes during the late Pleistocene and Holocene, looking at sediments and geomorphology. I focus thematically on glaciers, rivers, coasts, and mountains. I focus geographically on the UK and Ireland, northwest USA, Australia, European Alps, various locations in Asia, and across both southern and northern (Saharan) Africa. I am editor of three major international journals (*Sedimentary Geology*, *Journal of Maps*, and *Land Degradation & Development*). My teaching and student supervision focuses on the interconnections between the physical and human environments, landscape change, and environmental resources of the past, present, and future.



Dr. Sandeep Panda is currently working as Assistant Professor at the Department of Industrial Biotechnology, Gujarat Biotechnology University, Gujarat, India. His main research areas include (Bio) hydrometallurgical approaches for metal extraction from primary and secondary resources, Bio-desulphurization of Coal, Bio and Chemical approaches for Mine Water treatment and application of eco-friendly approaches for sustainable mineral-metal waste recycling and management. He has been involved as Principal/Co-principal Investigator and as Team Member in several R&D and Industrial research projects (at both national and international levels) since 2009. As of 2023, he has published 55 International journal papers; four book chapters and five Editorial books of high quality and impact that have received nearly 1950 citations (h-index—25). One of his articles published in the journal NATURE related to Tech-Metal supply is receiving much attention and appreciation from global leaders working in his area. His research works have invited the attention of several press and media. He has been featured in the World Ranking of the Top 2% Scientists in the Domain of Mining and Metallurgy (Sub Domain—Environmental Sciences) as per the Stanford University list of top-cited scientists in 2020, 2021, and 2022. He is an active member of several prestigious professional bodies and technical/scientific committee member in several reputed international conferences. He has served as a reviewer in over 40 reputed International Journals and is currently serving as: (1) Associate Editor of the *Arabian Journal of Geosciences* and *Euro-Mediterranean Journal of Environmental Integration* (Springer Nature) and Editorial Board Member of, (2) *Frontiers in Microbiology* and *Frontiers in Environmental Sciences* (Frontiers Publications), (3) *Mineral Processing and Extractive Metallurgy Review Journal* (Taylor & Francis Group), and (4) Editorial Advisory Board of *Detritus Journal* (IWWG).



Nabil Khélifi Springer, a part of Springer Nature, Heidelberg, Germany

Dr. Nabil Khélifi undertook fellowships at the System for Analysis, Research and Training (START) in 2005 and the German Academic Exchange Service (DAAD), as part of his Ph.D. studies in Marine Geosciences at the University of Kiel in Germany (2006–2010). After his Ph.D., he received a research grant from the German Science Foundation (DFG) to conduct research projects at the GEOMAR Ocean Research Centre in Kiel, Germany on oceanography and climate reconstructions in the North Atlantic and the Mediterranean (2010–2013). His research findings have been presented at many conferences and published in esteemed journals. He co-organized workshops on the Pliocene climate in Bordeaux, France (2009) and Bristol, UK (2013), funded by the European Science Foundation (ESF). In late 2013, he received the Swiss Government Excellence Scholarship (SGES). In 2014, he joined Springer in Heidelberg, Germany as an Editor, and was promoted to Senior Editor in 2017 responsible for developing their publishing program in the MENA region. He is active in educational seminars for authors, reviewers, and editors to help improve publication output and quality. He is Visiting Lecturer at King Saud University, KSA where he gives M.Sc. lectures on scientific presentations and publishing techniques, as well as career development workshops. He has launched two Springer conferences (more details at www.emcei.net and www.cajg.org). In 2016, he was awarded the Africa Green Future Leadership Award for his promotion of publications from Africa. In 2020, he received the Saudi Society for Geosciences Award for successful management of the *Arabian Journal of Geosciences*.



Ali Cemal Benim Düsseldorf University of Applied Sciences, Düsseldorf, Germany

Prof. Dr.-Ing. habil. Ali Cemal Benim received his B.Sc. and M.Sc. degrees in Mechanical Engineering at the Boğaziçi University, Istanbul, Turkey. He received his Ph.D. degree at the University of Stuttgart, Germany, in 1988, on the topic “Finite Element Modeling of Turbulent Diffusion Flames” with “Degree of Distinction.” Following a post-doctoral period at the University of Stuttgart, in 1990 he joined ABB Turbo Systems Ltd. in Baden, Switzerland, where he was the manager of the “Computational Flow and Combustion Modeling” group. Since January 1996, he is Professor for Energy Technology and Head of Center of Flow Simulation at the Duesseldorf University of Applied Sciences, Duesseldorf, Germany.