IAMG Newsletter

Official Newsletter of the International Association for Mathematical Geosciences

Contents

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IAMG is on LinkedIn, Twitter and Facebook!

Join the conversation using @IAMG_Math_Geo for news, journal and conference updates

Congratulation to the winners of the 2022 IAMG awards, Prof. E.J.M. (John) Carranza, Prof. Philippe Renard and Ms. Zhe Wang! Nominations are currently open for next year's awards, the 2023 Georges Matheron Lecturer and the 2024 Distinguished Lecturer. Please consider who you could nominate for these awards.

The new IAMG website is now live at https://iamg.org! While work is still ongoing, it's exciting to have it working.

Plans for IAMG2022 in Nancy, France, are well underway. The keynote speakers and short courses now announced, see pages 6 and 7 for more details. CoDaWork 2022 will also be on in June 27-July 1, Toulouse, France. Hopefully I'll see some of you there.

IAMG2023 will be held in Trondheim, Norway. The association is searching for proposals to from groups interested in hosting and organising IAMG2025, see page 5 for details.

Katie Silversides

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August 29 - September 3, 2022
NANCY, FRANCE

Student Travel Grants Available

Applications for grants to assist students travelling to IAMG2022 and other approved conferences now open! See https://iamg.org/guidelines/curriculum-quality-guidelines/student-travel-grant-applications/

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The mission of the IAMG is to promote, worldwide, the advancement of mathematics, statistics and informatics in the Geosciences

International Association for Mathematical Geosciences

IAMG Office (official address)

611 Pennsylvania Av, SE #440
Washington, DC 20003-4303, USA

E-mail: support@iamgmembers.org

Tel. Messages: +1-832-380-8833
Fax: +1-800-983-1346

Website: IAMG.org

Officers of the Executive Committee

President: **Peter Dowd**
School of Civil, Environmental and Mining Engineering,
University of Adelaide, Australia, Tel. 618 8313 4543,
Email: peter.dowd@adelaide.edu.au

Vice President: **Christien Thiart**
University of Cape Town, Department of Statistical Sciences,
Rondebosch, South Africa, Tel: 27-21-650-3223,
Email: christien.thiart[at]uct.ac.za

Secretary General: **Juliana Leung**
School of Mining & Petroleum Engineering,
Dept. of Civil & Environmental Engineering, University of Alberta
Tel. (780) 492-3338
Email: juliana2@ualberta.ca

Treasurer: **Madalyn Blondes**
USGS Eastern Energy Resources Science Center USA
Tel: +1 703-648-6509,
Email: mblondesIAMG@gmail.com

Other Voting Council Members

Past President: **Jennifer McKinley**
School of Geography, Archaeology and Palaeoecology,
Queen's University, Belfast, UK
Tel: 44 (0)28 90973827
Email: j.mckinley[at]qub.ac.uk

Special IGC Councilor: **Jonggeun Choe**
Department of Energy Resources Engineering,
Seoul National University (SNU), Korea, Tel: 880-8081
Email: johnchoe@snu.ac.kr

Editors

Mathematical Geosciences **Roussos Dimitrakopoulos**
Department of Mining, Metals and Materials Engineering,
McGill University, Montreal H3A 2A7, Canada
Tel: +1 514 398-4986, E-mail: roussos.dimitrakopoulos@mcgill.ca

Computers & Geosciences **Pauline Collon**
University of Lorraine National Graduate School of Geology,
Vandœuvre-les-Nancy, France
Tel: +33 3 72 74 45 23, E-mail: pauline.collon@univ-lorraine.fr

University of Wyoming, Laramie, **Dario Grana**
Wyoming, USA,
Tel: +1 307-223-2079, dgrana@uwyo.edu

Edith Cowan University, **Ute Mueller**
Joondalup, WA, Australia
Tel: +61863045272, Email: u.mueller@ecu.edu.au

Natural Resources Research **John Carranza**
University of KwaZulu-Natal,
Durban, South Africa
Email: ejmcarranza@gmail.com

Applied Computing and Geosciences **Boyan Brodaric**
Natural Resources Canada Earth Sciences,
Ottawa, Ontario, Canada
Email: Brodaric@gsc.nrcan.gc.ca

IAMG Newsletter and Website **Katherine Silversides**
DARE Centre,
University of Sydney, NSW, Australia
E-mail: newsletter@iamg.org

Councilors

Jie Zhao
School of the Earth Sciences and Resources, China University of
Geosciences, Beijing (CUGB) Tel: +(86) 135-2070-9895
Email: jiezhao2014@163.com

Renguang Zuo
State key Laboratory of Geological Processes and Mineral
Resources (GPMR), China University of Geosciences (CUG),
Wuhan 430074, China, Tel:+86-13667264536
Email: zrguang@cug.edu.cn; zrguang1981@126.com

Pauline Collon
University of Lorraine National Graduate School of Geology,
Vandœuvre-les-Nancy, France Tel: +33 3 72 74 45 23,
E-mail: pauline.collon@univ-lorraine.fr

Alessandra Menafoglio
MOX - Dept. of Mathematics, Politecnico di Milano, Piazza
Leonardo da Vinci, Milan – Italy, Tel: +39 02 2399 4642
Email: alessandra.menafoglio@polimi.it

Natalie Caciagli
Barrick Gold Corp and Mineral Exploration Research Centre at
Laurentian, University, Canada.

Karel Hron
Palacky University, Olomouc,
Czech Republic, Tel: +39 02 2399 4642
Email: hronk@seznam.cz

Committee Chairs

Awards Committee: **Xiaogang "Marshall" Ma**
Department of Computer Science, University of Idaho,
Moscow, United States,
Tel: +1.208.885.6592, E-mail: max[at]uidaho.edu

Curriculum Quality Committee: **Julián Ortiz**
Department of Mining Engineering, Queen's University
Kingston, Canada
Tel: 613-533-2910, Email: julian.ortiz@queensu.ca

Lectures Committee: **Christien Thiart**
University of Cape Town, Department of Statistical Sciences,
South Africa, Tel: 27-21-650-3223,
E-mail: christien.thiart@uct.ac.za

Meetings Committee: **Regina van den Boogaart**
Balthasar-Rößler-Str. Freiberg
Email: support@iamgmembers.org

Outreach Committee: **Eric Grunsky**
Dept. of Earth and Environmental Sciences,
University of Waterloo
E-mail: egrunsky@gmail.com

Publications Committee: **Jaime Gómez Hernández**
Univ. Politecnica de Valencia, Departamento de Ingeniería
Hidráulica, Valencia, Spain, Tel: 963879614 (Ext.:79614)
E-mail: jgomez[at]upv.es

Students Affairs Committee: **Ute Mueller**
Edith Cowan University,
Joondalup, WA, Australia
Tel: +61863045272, E-mail: u.mueller@ecu.edu.au

Archivist

Graeme F. Bonham-Carter
110 Aaron Merrick Drive, Merrickville, ON K0G 1N0, Canada
Tel: +1 (613) 269-7980
E-mail: Graeme.bc1[at]gmail.com

PRESIDENT'S FORUM

Dear IAMG Members,

The new IAMG website is now accessible at https://iamg.org. There are some pages that require updating and some for which material was missing on the old website. These issues will be addressed over the next few months. Your comments on the new website are welcome as are your suggestions for additions to the website.
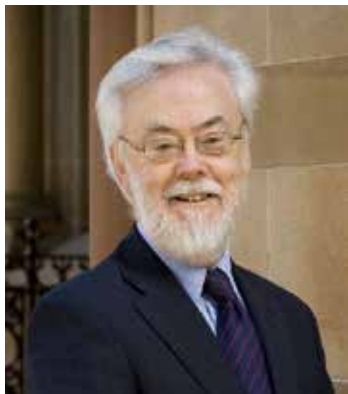
At its meeting on 21st March your Council discussed whether the IAMG should make a public statement on the situation in Ukraine. Statements had already been made by many other scientific organisations including those with which IAMG is associated such as the International Union of Geological Sciences. The discussion continued after the meeting and Council agreed that a statement should be made. Several versions of the statement were proposed by Council members and a vote ultimately decided on the following version that is now on the new IAMG website:

The International Association for Mathematical Geosciences joins the ever-growing number of voices of concern over events in Ukraine. We join with, and support, the more than 8,000 Russian academics, scientists, and science journalists who signed an open letter condemning the Russian invasion of Ukraine.

We add our voice and support to the unprecedented world-wide condemnation of the invasion of Ukraine and the attempt to depose its democratically elected government.

At its meeting on 21st March, Council also discussed its Awards and noted that there are often insufficient nominations for each award. I encourage members to access the award descriptions and criteria on the Awards and Honours page of the IAMG website and consider nominating colleagues and others whose work satisfies the requirements.

As most of you will know, IAMG2022 (the 21st annual conference of the IAMG) is proceeding as both an in-person event in Nancy, France (30th August to 2nd September) and online. Abstracts have been assessed and successful applicants have been informed. Keynote speakers will be Bruno Lévy (Director of the INRIA Nancy Grand-Est Research Centre), Malcolm Sambridge (Professor in the Research School of Earth Sciences, Australian National University), Colin Daly (Advisor - Modelling at Schlumberger Information Solutions) and Marie Colette Van Lieshout (Centre for Mathematics and Computer Science, Amsterdam). The IAMG awardees presenting at the conference are John Carranza (the 2022 Krumbein Medallist), Philippe Renard (John Cedric Griffiths Teaching Award 2022) and Qiuming Cheng (the 2022 Distinguished Lecturer).

Thank you for your contributions to IAMG. Your suggestions for engaging our members and promoting the mathematical geosciences are always welcome.

Yours sincerely,
Professor Peter Dowd, FREng, FTSE
President, International Association for Mathematical Geosciences

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Announcement of the 2022 IAMG Awards

Prof. E.J.M. (John) Carranza from the University of the Free State, South Africa is the recipient of the 2022 William Christian Krumbein Medal. Prof. Philippe Renard from the University of Neuchatel, Switzerland is the recipient of the 2022 John Cedric Griffiths Teaching Award. Ms. Zhe Wang from the University of Idaho is the recipient of the 2022 Founders Scholarship. Congratulations to all the awardees! The Awards Committee coordinates the publication of award laudations on IAMG journals. Laudations of the 2022 awardees will soon appear online.

Xiaogang (Marshall) Ma

E.J.M. (John) Carranza

Philippe Renard

Zhe Wang

Distinguished Lecturer Updates

Distinguished Lecturer 2022
Qiuming Cheng

Qiuming Cheng has delivered several presentations and lectures either virtually or in person at various places. He is looking for more opportunities to deliver lectures and presentations virtually and in person when the Covid-19 pandemic is over. He welcomes anyone, including IAMG student chapters, who are interested to contact him for arranging lectures. So far, he has offered or plans to offer the following lectures:

• Plenary presentation "Data + Math + Supercomputing driven modern earth science innovation" at the User Conference held by Chinese Supercomputing Guangdong Center, Guangzhou, Dec. 2-4, 2021.

• Plenary presentation "Progresses and Frontiers of Mathematical Geosciences", at Japan National Conference of Geoinformatics held by Japan Society of Geoinformatics, Dec. 3, 2021 (virtual)

• Plenary presentation "IUGS-DDE – Mineral Resources" at the Workshop on Advances in Marginal Sea Research sponsored by IAMG and DDE, Guangzhou, Dec. 14-15, 2021.

• Plenary presentation "Fractal Density for Dynamic Modelling of Singular Geological Processes" at the SEG 4th International Workshop on Mathematical Geophysics: Traditional & Learning, Dec. 17-19, 2021 (Virtual).

• Plenary presentation "Data + Math + Supercomputing driven modern earth science innovation" at the Forum for IT Education held by Guangdong Society of Computers, Zhuhai, Dec. 24-26, 2021.

• Plenary presentation "Data-Driven Earth Science Learning and Discovery", at the 36th International Geological Congress (36th IGC), Delhi, India, March 21, 2022 (Virtual).

• Invited presentation "Fractal density of lithosphere and heat flow over the mid-ocean ridges", at Zhuhai Ocean Forum, South China Center of Ocean Science and Engineering, Zhuhai, China, March 11, 2022. The forum had invited the IAMG Student Chapters in Sun Yat-Sen University and in China University of Geosciences.

• Lecture on "Digital Earth and Mineral Resources" at the Division of Strategic Exploration of Mineral Resources, Academy of Geological Sciences (CGS), Beijing, April. 25, 2022.

• IAMG DL Plenary presentation at the 21st Annual Conference of the IAMG (IAMG2022) to be held in Nancy, France, Aug. 29 – Sept. 3, 2022.

• AAG Gold medal awardee plenary presentation "Fundamental Laws of Geochemical Elements and Anomaly Recognition for Mineral Exploration" at the 29th International Symposium of Applied Geochemistry (ISAG), to be held in Viña del Mar, Chile October 2022.

• Presentation "Deep-time Digital Earth and Mineral Resources", at the Deep-time Digital Earth (DDE) Forum to be held in UNESCO Headquarter, Paris, Nov. 8, 2022.

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Distinguished Lecturer 2023
Jennifer McKinley

Professor Jennifer McKinley, Director of the Centre for GIS and Geomatics, is based in Geography, in the School of Natural and Built Environment, Queen's University Belfast. Her research expertise comprises the development and application of spatial analysis techniques, geostatistics and compositional data analysis in ground and remote sensed earth processes, health and the environment, criminal and environmental forensics. Jennifer's recent research seeks to gain a greater understanding of the link between human health and environmental impacts from natural and anthropogenic sources, including air pollution and more recently surveillance of SARS-CoV-2. She has authored more than 150 scientific articles, including peer-reviewed journal articles and numerous international conference contributions which have helped shape policy development. Interdisciplinary collaboration, strong partnership working and a commitment to generate actionable insight, are familiar hallmarks of her research. Jennifer's international leadership roles include: Councillor of the International Union of Geosciences (IUGS 2020-2024), current President of the Governing Council of the Deep-time Digital Earth Initiative (DDE) and Past President of the International Association for Mathematical Geosciences (IAMG). Jennifer has served on learned committees including the Royal Irish Academy and Geological Society of London and sits on the Giant's Causeway UNESCO World Heritage Site Steering Group.

Contact by email at j.mckinley@qub.ac.uk

Lecture Series

1. Environmental Geochemistry and Compositional Data Analysis

Geochemical data are recognised to be compositional in nature in that they convey relative information. As a result, correlations between raw geochemical compositional data are spurious, prone to artefacts and potentially unrelated to any natural processes. Compositional data analysis (CoDA) methods are frequently used to extract information from geochemical data by treating log ratio or equivalently transformed data of analysing the raw constant sum values. However, the results obtained from the use of compositionally-compliant methods can be difficult to interpret. In this lecture series, Jennifer will present case studies involving the use of compositional data analysis, including the use of log ratios and balances, to analyse geochemical data. Case studies in natural resource estimation and assessment, medical geology and environmental management with be used to demonstrate the approaches.

2. Exploring the effects of environmental factors on health

Jennifer's research in this area examines possible links between soil elements, social deprivation and chronic disease (including cancer and chronic kidney disease) to investigate the impact of environmental toxins including from anthropogenic sources such as air pollution on human health. The approaches presented acknowledge the compositional nature of the environmental data such as geochemistry data and offer the opportunity to identify environmental toxins with relative abundances most associated with elevated incidences of chronic disease. Human-environmental relations are explored including recent work in the application of spatial data analysis in the integrated wastewater testing and geographic surveillance programme for SARS-CoV-2. Jennifer's collaboration in this area involves a multidisciplinary team from geography, geoscience, biological science, mathematics, public health practitioners and government policy makers. The findings from this work are important to gain a greater understanding of the link between human health and environmental toxins.

3. Forensic geoscience and Spatial Data Analysis

Jennifer's role within the IUGS Initiative on Forensic Geology (IFG) has increased awareness in the use of GI Science and geoinformatics in forensic geoscience in collaboration with UK, European Forensic Science Regulators, and law enforcement agencies worldwide. In this lecture series, Jennifer will present case study examples involving ground-based geological and geochemical data in addition to remotely sensed data and will explore the importance of spatial thinking in forensic geoscience.

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CoDaWork 2022
June 27- July 1, Toulouse, France

The biennial meeting of the Association for Compositional Data (CoDa-Association), initially scheduled for 2021, was posponed to 2022 due to the pandemic. It will, finally, take place in Toulouse (France) from June 27 to July 1.

It will be again a presential meeting, and we expect 50-60 attendants. This meeting, sponsored by IAMG right from the first edition back in 2003, brings together scientists from different disciplines, like geosciences, chemistry, biology, health and forensic sciences, tourism or economy. It allows for a crossbreeding of ideas, and has proven to be one of the most successful ways to provoke progress in research.

https://www.coda-association.org/en/codawork2022/

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IAMG 2023

The 22nd annual IAMG conference will be in Trondheim, Norway in 2023.

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28th IUGG General Assembly
11-20 July 2023, Berlin, Germany

The 28th IUGG General Assembly (IUGG2023) will be held from 11 to 20 July 2023 at the CityCube in Berlin, Germany.

This General Assembly is a special opportunity for participants from around the world to come together and discuss the full range of geodetic and geophysical themes, and further enhance the important interdisciplinary collaboration for a better understanding of our Earth System. IUGG2023 will provide a platform for personal meetings, exchange of ideas and developing new concepts for international science collaboration, all of which have suffered a setback during this pandemic crisis. IUGG2023 will help to create a new spirit to address pressing large societal challenges such as global environmental change and natural hazards and to stimulate novel geoscience research.

The Berlin-Brandenburg region has one of the largest geoscientific clusters in the world. Participants will have a unique opportunity to meet their scientific partners from many projects in person, here in Berlin, or to combine this with a visit to the research organizations GFZ, AWI or DLR. We are planning an exciting excursion program, in particular, an attractive program for young scientists to provide them with opportunities for exchange, presentation and discussion beyond the sessions.

https://www.iugg2023berlin.org/

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Request for Proposals to host IAMG 2025

The Association has started the search process for the selection of a site to hold its 23rd annual scientific and technical conference sometime in the summer or fall of 2025.

Parties interested in hosting and organizing the event are welcome to visit the site

https://iamg.org/guidelines/curriculum-quality-guidelines/meetings-committee/guidelines-for-organizing-iamg-conferences/

for details of the guidelines.

IAMG 2022 will be held in Nancy, France and IAMG 2023, is planned in Trondheim, Norway.

Please contact the Chair of the Meetings Committee, Regina van den Boogaart, to submit proposals or to clarify questions at regina@boogaart.de

no later than 10 January 2023.

Nominations for 2023 Georges Matheron Lecturer and the 2024 IAMG Distinguished Lecturer close October 31, 2023

The Association invites all members to submit nominations for the 2023 Georges Matheron Lecturer and the 2024 IAMG Distinguished Lecturer.

Please note the Deadline for all awards is **31 October 2023**.

For details about prerequisites for nominations please see the IAMG web site (https://iamg.org/awards-and-honours/). There is also a list of past recipients and their laudations on the web site. Please have a look at it before sending your nominations!

The documents which should accompany a proposal are:

• A nomination letter/email (preferably by one of your colleagues)

• A short statement summarizing the relevant qualifications of the nominee

• A curriculum vitae of the nominee, or link to webpage.

Nobody gets an award without a nomination, so please support your colleague when you believe he/she deserves an award by submitting a nomination. Nominations can be submitted by a single person or by a group.

The Laudations written over the last few years and published in Mathematical Geosciences are a good source of inspiration on how to write a nomination. Nominations for the awards can be submitted via e-mail to christien.thiart@uct.ac.za

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Dear IAMG members,

After two years of isolated work, remote courses, canceled meetings and virtual conferences, we are very happy to welcome the 21th annual IAMG conference in Nancy, with the possibility to meet most of you in "reality". We hope this IAMG conference being a time for exchange of ideas, scientific expertise and discoveries.

We received many high quality contributions and made all efforts with the session chairs and the scientific Committee to include them in this year's programme. Thank you!

Overall, the conference will consist of 7 plenary presentations (keynotes speakers and IAMG awardees), and 73% oral presentations -split in 5 parallel sessions- , and 27% poster presentations with 2 dedicated moments. Several courses are already planned as well as 3 field trips to allow you discovering the history, landscapes and specificities of our nice region.

Hacking for the future: during the weekend before the conference, a hackathon will let participants develop coding, problem solving, geoscience, mathematical and teamwork skills on an CO2 sequestration challenge. Prizes, fame and fun expected !

We look forward to seeing you,   **The local organizing Committee.**

Sessions

+ Beyond Gaussianity: what is the status of the GANs, MPS, Cumulants or Copula approaches?
  J. Straubhaar, T. Mejer Hansen, P. Renard
+ Recent developments in machine learning techniques and quantum computing for geoscience applications *T. Kadeethum, D. O'Malley, H. Yoon, H. M. Nick*
+ Random patterns and shapes in spatio-temporal data *A. Sarkka, R. Stoica*
+ Inverse problems *T. Bodin, K. Gallagher*
+ Knowledge graphs in the cyberinfrastructure ecosystem of geosciences *X. Ma, C. Wang*
+ Fractured geological media and fracture networks: flow, graphs, morphology *R. Ababou, I. Canamon*
+ Computational Petrology and Geochemistry *P. Lanari, M. Garçon, P. Sossi*
+ Analyzing compositional data in geosciences *J. McKinley, K. Hron, A. Menafoglio*
+ Filters and smoothers. Filters or smoothers? *J. Gomez-Hernandez, L. Li*
+ Mining geostatistics, optimization and geometallurgy
  J. Benndorf, J. Ortiz Cabrera, R. Tolosana Delgado, K. G. van den Boogaart
+ Preserving realistic geology in statistical and mathematical geomodels *I. Aarnes, J. Skauvold, C. Jacquemyn*
+ Spatial Associations *Y. Song, Q. Cheng*
+ Parametrisation and Interpolation of Sub-Surface Architectures *G. Laurent, L. Grose, S. Lopez*
+ Machine learning-based mineral prospectivity mapping *R. Zuo, J. M. Carranza*
+ Time series analysis in Geosciences: an homage to Professor Walther Schwarzacher
  J. McKinley, E. Pardo-Igúzquiza
+ Reservoir/Petroleum Geostatistics *J. Leung, S. Srinivasan*
+ Spatiotemporal Geostatistics *D. Hristopulos, S. De Iaco*
+ Up-Scaling of Flow and Transport Models *B. Noetinger*
+ Meshing and simulation of subsurface processes *C. Boehm, T. LaForce, J. Pellerin*
+ Uncertainty Modeling *F. Wellmann, C. Bond*
+ Climate and Land Use *G. Mariethoz, J. Lave*
+ Mathematical Geodynamic *P. Cupillard, F. Wellmann*
+ Digital Outcrop *P. Collon, S. Viseur, A. Bistacchi*

International Association for Mathematical Geosciences
21st annual conference
August 29 – September 3, 2022
NANCY, FRANCE

www.iamgconferences.org/iamg2022

Keynote Speakers

IAMG2022 orginized by:

Bruno Lévy, Inria Nancy Grand-Est research center, France - Optimal Transport
Malcolm Sambridge, Australian National University, Australia - Geophysical Inverse problems
Colin Daly, Schlumberger - Geostatistics and machine learning
Marie Colette Van Lieshout, CWI Amsterdam and Univ Twente, Netherlands - Spatial statistics and applications to seismicity analysis

IAMG Awardees

William Christian Krumbein Medal 2022: **John Carranza,** University of the Free State, South Africa - Statistics and applications to mineral resources
John Cedric Griffiths Teaching Award 2022: **Philippe Renard,** University of Neuchatel, Switzerland - Stochastic hydrogeology
Distinguished Lecturer 2022: **Qiuming Cheng,** Sun Yat-sen University, China - Geomathematics

Student Program

In addition to the 'Hack for the Future' event, students will have an opportunity to socialize during a festive bowling event organized by the Lorraine IAMG Student Chapter. Also, students can opt to have their work considered for the best oral and poster presentation awards.

Social Program

After a "posters and drinks" session on Wednesday Aug 31, on-site attendees will be invited to the Conference dinner at the Nancy City Hall on Place Stanislas on Sept 1st. City visits will also be proposed on Sept 2 after the closure ceremony.

Short Courses and Field Trips

IAMG2022 sponsored by:

+ Mathematical Morphology in Interpolations and Extrapolations
+ Large-Scale Geostatistical Data Science with ExaGeoStat
+ Global envelopes in R
+ 2D & 3D analysis of regional geoscience datasets with Loop open source libraries
+ Introduction to geological model building with UVT Transform™ technology

+ Meuse/Haute Marne Underground Research Laboratory
+ Historical mining and wine escapade in Alsace
+ One day in Verdun - First World War battlefields
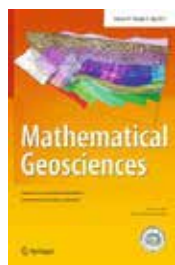
IAMG Journal Reports

CALL FOR PAPERS
MATHEMATICAL GEOSCIENCES SPECIAL ISSUE ON
Data-driven Discovery in Geosciences

Guest Editors

Guoxiong Chen (China University of Geosciences, Wuhan, China)

Qiuming Cheng (Sun Yat-sen University, China)

Steve Puetz (Progressive Science Institute, USA)

As a typical data-intensive discipline, the geosciences (in both academic and industrial communities) are seeing unprecedented opportunities in the era of big data and artificial intelligence (AI). This special section of Mathematical Geosciences will explore scientific research on Data-driven Discovery in Geosciences and will provide a timely presentation of critical progresses in the applications and developments of machine (deep) learning and other data science, as well as AI approaches to a wide range of Earth science topics. We welcome relevant contributions as review or research papers that provide new ideas, models and methods regarding the use of data-intensive scientific paradigm for addressing fundamental questions of Earth science, as well as assisting in mineral and oil/gas exploration and prediction.

Main topics:

(i) Data-driven discoveries focusing on major Earth science questions for exploring the Earth's past, present, and future.

(ii) Big data discovery for resources prediction and assessment.

(iii) Intelligent geophysical and geological modeling using machine (deep) learning.

Timelines:

A tentative title and an abstract (300–500 words) should be sent to the Guest Editors by November 30th, 2021. Full manuscripts should follow the journal's guidelines for authors and be submitted online using the Editorial Manager system.

• Paper submission before: June 30th, 2022

• Return of reviews to authors before September 30th, 2022

• Submission of final papers deadline: December 1st, 2022

• Publication: Late 2022 or Early 2023

Submit papers online through the journal's website: http://www.springer.com/journal/11004

When submitting, you must choose, under 'Select Article Type,' the SI: "Data-driven Discovery in Geosciences."

Submitted manuscripts must fully comply with the journal's Instructions for Authors in preparing manuscripts.

For inquiries, please contact the Guest Editors

Guoxiong Chen, gxchen@cug.edu.cn

Qiuming Cheng, qiuming.cheng@iugs.org

Steve Puetz, puetz.steve@gmail.com

<>

CALL FOR PAPERS
MATHEMATICAL GEOSCIENCES SPECIAL ISSUE ON
Machine Learning-based Mapping for Mineral Exploration

Guest Editors:

Renguang Zuo (China University of Geosciences, China)

John Carranza (University of the Free State, South Africa)

Mineral prospectivity mapping as a computer-based approach to delineate targeted areas for a specific type of mineral deposit has changed from being knowledge driven to data driven to today's big data analytics. There are increasing applications of machine learning algorithms in mapping mineral prospectivity and identifying geochemical anomalies association with mineralization. The proposed special issue will document case studies and current researchers demonstrating progress of machine learning-based mineral prospectivity mapping.

Main topics:

• Mineral prospectivity mapping by machine (deep) learning

• Geochemical anomaly mapping by machine (deep) learning

• Big data analytics for geochemical anomaly or mineral prospectivity mapping

• Numerical simulation for mineral exploration

Timelines:

A tentative title and an abstract (300–500 words) should be sent to the Guest Editors by August 31st, 2022. Full manuscripts should respect the journal's guidelines for authors and be submitted online using the Editorial Manager system.

• Paper submission before: December 31st, 2022

• Return of reviews to authors before: March 31st, 2023

• Submission of final papers deadline: July 31st, 2023

• Publication: Late 2023

Submit Papers online through the journal's website http://www.springer.com/journal/11004

When submitting, you must choose, under 'Select Article Type,' the SI: "Machine learning-based mapping for mineral exploration."

Submitted manuscripts must fully comply with the journal's Instructions for Authors in preparing manuscripts.

For inquiries, please contact the Guest Editors:

Renguang Zuo, zrguang@cug.edu.cn

John Carranza, ejmcarranza@gmail.com

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Journal Statistics

Mathematical Geosciences:
- 2020 ISI Impact factor: 2.576
- 5-Year Impact Factor: 2.659
- Ave. review time: 19 days (submission to first decision 2021)

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Computers & Geosciences:
- 2020 ISI Impact Factor: 3.372
- 5-Year Impact Factor: 3.696
- Ave. review time: 7 weeks (submission to first decision 2021)
- 15.2 weeks (submission to final decision 2021)

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Natural Resources Research:
- 2020 ISI Impact Factor: 5.146
- 5-Year Impact Factor: 4.269
- Ave. review time: 7 days (submission to first decision 2021)

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Member News

Nominations for 2023 IAMG Awards close October 31, 2023

The Association invites nominations for the Founders Scholarship, the Felix Chayes Prize and the Andrei Borisovich Vistelius Award. Please note the Deadline: **October 31, 2023**.

For details about prerequisites for nominations please see the IAMG web site http://www.iamg.org/ and click on Awards and Honors in the menu bar. There is also a list of past recipients and their laudations on the web site. Please have a look at it before sending your nominations! The (informal) documents which should accompany a proposal are:

• A short statement summarizing the relevant qualifications of the nominee

• A curriculum vitae of the nominee

The Founders Scholarship is a new IAMG award. The IAMG Bylaws state that, "The Founders Scholarship shall be presented annually to an outstanding student or post-graduate scientist." However, to avoid overlap with the Vistelius award, preference will be given to an outstanding undergraduate, Masters, or Ph.D. student. A motion will be put before the membership in a General Referendum in the near future to make this change official in the Bylaws.

Nobody gets an award without a nomination, so please support your colleague when you believe he/she deserves an award by submitting a nomination. Nominations can be submitted by a single person or by a group. The Laudations written over the last few years and published in Mathematical Geosciences and Computers&Geosciences are a good source of inspiration on how to write a nomination.

Nominations can be submitted via e-mail <max@uidaho.edu> or sent to:

Xiaogang (Marshall) Ma - Chair, IAMG Awards Committee
Department of Computer Science, University of Idaho
875 Perimeter Drive MS 1010, Moscow, ID 83844-1010, USA

Nominations for other Awards may also be submitted at any time.

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Qiuming Cheng's proposal to set up a UNESCO Chair is approved by UNESCO

UNESCO has recently approved the proposal by Qiuming Cheng, past President of IUGS and former President of IAMG, to establish a new UNESCO Chair in Deep-time Digital Earth and Mineral Resources (DDEMR) at China University of Geosciences (Beijing) in cooperation with other organizations.

The Chair Programme aims to develop and share exploration technologies, information processing methods, models and software for quantitative prediction and comprehensive assessment of mineral resources and environmental impacts. The Chair Programme focuses on: promoting digital transformation and inclusive participation in the development of big data and artificial intelligence, improving "green" skills in mineral resource and environmental assessment and management needed for sustainable development, integrating research and training to disseminate scientific knowledge, and raising public awareness of resource and environmental challenges and possible solutions to global development.

National Geological Survey of Congo, Research and Development Center of China Geological Survey, University of Namibia, Hanoi University of Mines and Geology, University of Hong Kong, University of South Africa, University of Eotvos Lorand, Copperbelt University, University of Lubumbashi, IUGS Big Science Program - The Deep Time Digital Earth (DDE), the UNESCO Centre for Global Scale Geochemistry Category 2 (ICGSG) and the UNESCO Category 2 Karst Centre (IRCK) have confirmed their participation and support of the Chair Programme. Professor Qiuming Cheng, the holder of the UNESCO Chair, and the host university of the Chair are seeking positive exchanges and cooperation with researchers and teaching staff from other universities and institutions around the world. Please contact Prof. Cheng at qiuming.cheng@iugs.org for more information. A website will be up and running soon.

According to UNESCO, the UNITWIN/UNESCO Chairs programme was launched in 1992 and has been established in more than 850 institutions in 117 countries. The main purpose is to foster international inter-university cooperation and networking through knowledge sharing and collaborative work to enhance institutional capacity. UNESCO Chairs and UNITWIN networks are built in UNESCO's key priority areas, including education, natural and social sciences, culture and communication. These chairs and networks act as thinktanks and bridge builders between academia, civil society, local communities, research and policy development. They support informing policy decisions, developing new teaching programs, generating innovation through research, and contributing to the enrichment of existing university programmes while promoting cultural diversity. In areas lacking expertise, chairs and networks have evolved into poles of excellence and innovation at regional or sub-regional levels. They also contribute to strengthening North-South-South cooperation (more information about UNESCO Chair programme can be found at https://www.unesco.org/en/education/unitwin).

Molei Zhao

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Student News

Student Travel Grants Available

Applications for grants to assist students travelling to IAMG2022 and other approved conferences now open! See https://iamg.org/guidelines/curriculum-quality-guidelines/student-travel-grant-applications/

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Nancy Student Chapter News

1. In Summer 2022, the board of the IAMG Nancy student Chapter was renewed: Julien Herrero is president, Enrico Scarpa is treasurer, and Augustin Gouy secretary.

2. In January 2022, we presented the IAMG and the Student Chapter in Nancy to our MSc students.

3. New PhD students have joined the team: Julien Herrero, Augustin Gouy, and Marius Rapenne.

4. Paul Baville defended his thesis in April 2022 about Stratigraphic correlation uncertainty. He is a Dr. now!

5. During the academic year, we maintained the weekly seminar, with presentations done by IAMG student Chapter members and also by outside speakers (you can find the news on our website: https://www.ring-team.org/home/iamg-student-chapter).

6. We have a new visting PhD student from the University of Milan-Bicocca: Gloria Arienti

7. Capucine Legentil published an article in Computers & Geosciences about local mesh modification. Zoe Renat works on her article revision

8. All Ph.D. students of the Student Chapter will present their works at the IAMG 2022 Annual Conference in Nancy. They will be pleased to see student members Tuesday evening for a bowling event.

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Abstracts from 2020 Student Journal Awards

MG-2020-5: **Vanessa A. Godoy** (Universitat Politecnica de Valencia) - Machine learning applied to the characterization of hydraulic conductivities on non-Gaussian fields

Abstract: Characterization of the subsurface heterogeneity is a critical issue for modeling groundwater flow since it requires heterogeneous values of hydraulic conductivity (K), which commonly are only sparsely available, if at all. State variables such as hydraulic head are generally more extensively sampled and can be assimilated to improve the characterization of parameters such as hydraulic conductivity. We propose a new inverse modeling approach by coupling machine learning (ML) and the Kalman-based data assimilation methods to improve K heterogeneity characterization. The validity of the proposed method was verified in two case studies. In the first case study, we assume a Gaussian reference field of K and uninformative a priori fields. In the second study case, we assume a non-Gaussian reference field of K and a variety of spatial configurations is used as a priori fields. The ML methods used for the first and second study cases were random forest and Dense Convolutional Network, respectively. Our results show that the proposed method have properly retrieved the patterns of spatial variability of the reference fields and reduced the uncertainty.Besides some limitations related to the subjectivity of the ML methods and time consumed to training models, the proposed method is a powerful strategy to characterize subsurface heterogeneity and could be used for large-scale problems.

MG-2020-9: **Geng Ting** (School of Earth Sciences and Engineering, Sun Yat-sen University) - Machine Learning Algorithm for Quantifying Soil Cd Influencing Factor

Abstract: Cadmium (Cd) is a highly toxic heavy metal element that exists widely in the environment and can cause extensive threats to human beings, animals, and plants. Karst soils, which have many unique hydraulic and hydrogeological characteristics, are particularly problematic for their high response to pollution caused by human activities. This study quantified the contribution of anthropogenic and natural factors on Cd accumulation and also identified the dominant interacting factors by machine learning method (random forest). The results showed that the Cd content in the karst soil was generally higher than the risk screening value.The interaction effect of pH and corg on distance is quantified and visualized. When pH is greater than 7.02 and corg content is higher than 1.53, they have a dominant influence on soil Cd concentration compared with distance. In addition, high background values of heavy metals in karst landforms are responsible for soil accumulation in Cd.

MG-2020-14: **Alvaro Riquelme** (Queen's University) - Random Fields on Manifolds and Applications to Geostatistical Modelling

Abstract:In geosciences, the use of classical Euclidean methods is unsuitable for treating and analyzing some types of data, as this may not belong to a vector space. This is the case for correlation matrices, belonging to a subfamily of symmetric positive definite matrices, which in turn form a cone shape Riemannian manifold. We propose two novel applications for dealing with the problem of accounting with the non-linear behavior usually presented on multivariate geological data by exploiting the manifold features of correlations matrices. First, we employ an extension for the linear model of coregionalization (LMC) that alters the linear mixture, which is assumed fixed on the domain, and making it locally varying according to the local strength in the dependency of the coregionalized variables. The main challenge, once this relaxation on the LMC is assumed, is to solve appropriately the interpolation of the different known correlation matrices throughout the domain, in a reliable and coherent fashion. The present work adopts the non-euclidean framework to achieve our objective by locally averaging and interpolating the correlations between the variables, retaining the intrinsic geometry of correlation matrices. A second application deals with the problem of clustering of multivariate data.

CG-2020-3: **Valeria Todaro** (University of Parma) - Ensemble Kalman methods: tools for the solution of inverse problems in the context of surface and subsurface hydrology

Abstract: The aim of the project was to develop a free software package for the solution of inverse problems by means of ensemble Kalman filter methods. The codes are written in Python programming language considering the Ensemble Smoother with Multiple Data Assimilation (ES-MDA) as reference method. However, the software package has a flexible workflow that can be easily adapted to any ensemble Kalman filter method. A tool package with various functionalities has been developed in order to give the possibility to implement different configurations of the algorithm. The proposed methodology can be applied to solve inverse problems in different application fields; this study focuses on applications in the context of surface and subsurface hydrology. The software package has been tested by means of three synthetic examples aimed at solving different type of inverse problems. The first application concerns the solution of the reverse flow routing for the estimation of the inflow hydrograph to a tributary reach based on observed water levels downstream the confluence and a calibrated forward model of the river system. Then, two

case studies in the groundwater field have been implemented. The first one aims to estimate the hydraulic conductivity field using piezometric observations and a known forward flow model. The last application attempts to estimate the release history of a contaminant spill in an aquifer based on measured concentration data. The good results of all tests demonstrated the capability of ES-MDA and the flexibility of the software package to solve different types of inverse problems.

CG-2020-8: **Caterina Gozzi** (Department of Earth Sciences, University of Florence) - Geostatistical modeling of geochemical landscapes as a tool to achieve a better understanding of river system resilience

Abstract: Attempting to understand the mechanisms controlling water system resilience is one of the main challenges of modern times. This implies to focus on environmental interconnections rather than single chemical variables, looking for macro scale laws governing the geochemical response of watersheds to external forcing (e.g. potential climatic or anthropogenic perturbations). A reliable assessment of the system as a whole requires an integrated geostatistical modeling of the geochemical landscapes of a river catchment, in which multidisciplinary approaches and Compositional Data Analysis (CoDA) are combined. In this study, water and stream sediment geochemical data from the intrinsically complex Tiber River Basin (TRB; central Italy) are analyzed. Interlinks between basin-wide chemical variations and spatial changes of some environmental drivers are explored by robust Principal Component Analysis and score-distance graphs. Results show a different resilience to perturbations for major and trace elements and a predominant role of lithological forcing. Secondly, source-to-mouth fluctuations were investigated through different techniques: the perturbation operator, the robust Mahalanobis distance (RMD), computed from a benchmark in a compositional context, and the geometric mean of the composition. Results highlight the potential and limits of the different methods, revealing the geometric mean to be a simple and effective monitoring index, tracing the sum of perturbations of the single variables for each composition. These methods appear extremely promising for geochemical exploration and environmental monitoring, providing a better understanding of the inner workings of the river system and its resilience to environmental pressures.

CG-2020-9: **Meli Reeves Fokeng** (The University of Bamenda, Cameroon) - Land Degradation Modelling and Implications in Southern Bui Plateau, Cameroon

Abstract: Land degradation is widespread in the Southern Bui Plateau, where human pressures of overgrazing and unsustainable resource exploitation and climatic changes are fuelling unprecedented soil degradation and landscape degradation with far reaching implications on food security and sustainability. The geomorphological dynamics on the Southern Bui Plateau have been reconstructed in a time-series based methodology using both remote sensing and GIS techniques

with field verifications. Soil biochemical degradation was assessed using soil quality indices while physical soil degradation by soil erosion was modelled over spatio-temporal timescales using GIS-based R/USLE. NDVI and NPP were the main remote sensing proxies used for the assessment of vegetation degradation (1984-2021) and land productivity (1984-2014) respectively. The Difference Normalised Burn Ratio was used for burn severity mapping alongside the MODIS and VIIRS active fire products over 20 years (2000-2020). A total of 97 Landsat, 08 ASTER and 01 Sentinel-2B images were acquired and used in this study. The Ordinary Least Square (OLS) Regression was used to test trend dynamic significance. The Pearson's Correlation was used to establish significant relationships between long-term changes of vegetation/productivity proxies and drivers. The methods refer to the UNCCD (2013b) recommendations for monitoring progress in SDG 15.3.1. It established that the main land degradation processes (physical soil degradation, chemical soil degradation, biological soil degradation, ecosystem degradation, and the degradation of surface and underground water resources). Vegetation dynamics showed greening and browning trends over 37 years (1984-2021). The SOC stocks and sequestration capacity of the soils were low, indicative of unsustainable soil management practices. The continuous biomass burning, direct and indirect anthropogenic drivers (main) and natural/biophysical triggers are responsible. Loss of soil resilience has led to increase C loss for erosion, alongside CO_2, CH_4, and N_2O from biomass burning, thus impacting climate change and food security. The rural population is trapped in a land degradation-climate change-poverty vicious cycle such that only an implementation of sustainable land management options can avert this situation.

NRR-2020-6: **Zhi Shang** (China university of geoscience (Beijing)) - Application of BEMD for extraction of Gravity-Magnetic anomalies associated with Pb-Zn-Fe polymetallic mineralization in Luziyuan orefield, Yunnan province, Southwestern China

Abstract: The methods of bi-dimensional empirical mode decomposition (BEMD) and entropy weight–Technique for Order of Preference by Similarity to an Ideal Solution (TOPSIS) were used to decompose gravity-magnetic data and evaluate targets in the Luziyuan Pb-Zn-Fe polymetallic orefield and surrounding areas. Three meaningful bi-dimensional intrinsic mode function (BIMF) images were obtained from BEMD at different wavelengths, depicting different layers of geological architectures in the study area. The results are: (1) the BIMF2 images depict the shallow local geological architecture and show positive gravity-magnetic anomalies of the skarn alteration and Pb-Zn-Fe mineralization distributed around the concealed granites. (2) The BIMF3 images depict the medium-depth geological architecture, indicating that the concealed granitic stocks, which are a shallow extension of the deeply concealed pluton, intruded along the NE trending fault. (3) The BIMF4 images depict the gravity-magnetic anomalies at greater depth which could reflect the regional geological architectures, indicating the potential presence of a large, concealed intermediate-acid pluton in the negative anomaly zone. Three potential targets (A, B, and C) are delineated based on BEMD results of the original gravity-magnetic data. The entropy weight-TOPSIS evaluation results show that the ranking of the metallogenic potential of the delineated targets in the study area is B, A, and C, with relative proximity values of 0.4576, 0.3925, and 0.1499, respectively. The results of this study can be used to guide future explorations.

NRR-2020-10: **Chunjie Zhang** (China University of Geosciences) - Recognizing geochemical anomalies using deep convolutional neural network supported by the pixel pair feature method

Abstract: Machine learning (ML) algorithms are widely applied in various fields owing to their strong ability to abstract high-level features from a large number of training samples. However, few supervised ML algorithms have been applied in geochemical prospecting and mineral exploration because mineralization is a rare geological event that leads to an insufficient number of training samples. Generating a large number of training samples is crucial for the application of supervised ML in geochemical prospecting and mineral exploration. In this study, a novel anomaly detection framework was proposed, which combined with a pixel-pair feature (PPF) method and a deep convolutional neural network (CNN). The former was used to increase the number of training samples, and the latter was employed to identify the multivariate geochemical anomalies associated with mineralization. The results showed the model has good performance, providing an alternative method of producing sufficient training samples for the application of supervised ML algorithms to geoscience.

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International Association for Mathematical Geosciences (IAMG)

c/o IAMG Office
Balthasar-Rößler-Str. 58
09599 Freiberg
Germany

McGill COSMO
Stochastic Mine Planning Laboratory

POST-DOCTORAL RESEARCH FELLOW POSITIONS IN Geostatistics and Stochastic Simulations

Post-doctoral research fellow positions are available at the COSMO research group at McGill University (http://cosmo.mcgill.ca). COSMO is a collaborative laboratory dedicated to the development of new orebody modelling and optimization frameworks for production planning needed to create value across the entire mining-mineral value chain. The related industrial environment requires particular focus on 'high-order' and 'multi-point' spatial mathematical models of geological uncertainty, which generate inputs for optimization frameworks and other applications. Research is funded by the National Sciences and Engineering Research Council of Canada (NSERC) and a consortium of major mining companies: AngloGold Ashanti, BHP, De Beers/AngloAmerican, IAMGOLD, Kinross Gold, Newmont, and Vale.

Job description
Successful candidates will work on one (or more) of related research areas:

- New data-driven, high-order and multi-point simulations
- High-order data analytics, related deep learning methods
- High-order simulation of multiple categorical variables
- Construction of data-based continuous training images
- Applications in modelling mining deposits
- Geological CO2 sequestration
- A commitment to – and in accordance with circumstances, a track record in – equity, diversity, and inclusiveness (EDI) is preferred.

Candidates will have the opportunity to apply their developments at sites worldwide, test newly developed methods on real-life applications and gain substantial experience with advanced digital technologies in industrial environments.
In conjunction with their research, candidates are expected to interact with graduate students and industry professionals, and be involved in diverse projects led by the COSMO Laboratory, including global knowledge mobilization activities. The position based in the Department of Mining and Materials Engineering at McGill University, in close collaboration with related research groups such as GERAD, IVADO and McGill's CIM.

Building future career opportunities
Post-doctoral research fellows from our lab develop major career opportunities; for example, our last three moved on to BHP principal scientist (geostatistics and computing), DeepMind research engineer, and faculty at University of Calgary.

Requirements
Candidates are required to have completed (or being close to completion) a PhD in areas including: Applied mathematics, computer science, image processing, mining engineering or a related discipline. They should have excellent programming skills (C/C++) and a suitable academic and publications record.

Terms and conditions
This research fellow position is a full-time employed position for one year with possible extension. Salary is commensurate to qualifications.

Application
The position is available immediately. The application procedure will remain open until the position is filled. If interested, please contact Roussos Dimitrakopoulos at
E-mail: roussos.dimitrakopoulos@mcgill.ca or tel. 514 398-4986, and forward a detailed CV, including a list of publications, research interests, and the names of three referees.

McGill University hires on the basis of merit and is strongly committed to equity and diversity within its community. We welcome applications from racialized persons/visible minorities, women, Indigenous persons, persons with disabilities, ethnic minorities, and persons of minority sexual orientations and gender identities, as well as from all qualified candidates with the skills and knowledge to productively engage with diverse communities. McGill implements an employment equity program and encourages members of designated groups to self-identify. Persons with disabilities who anticipate needing accommodations for any part of the application process may contact, in confidence, accessibilityrequest.hr@mcgill.ca or 514-398-3711.