



# IAMG Newsletter

Official Newsletter of the International Association for Mathematical Geosciences

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In September the IAMG celebrated it's 50th anniversary during the annual conference (IAMG2018) in both Olomouc and Prague. The conference was attended by 225 delegates, with 186 oral and poster presentations. B. S. Daya Sagar was awarded an IAMG Certificate of Appreciation for his work on the Handbook of Mathematical Geosciences and Harald Poelchau was awarded an Honorary Life Membership.



In addition to the serious side, plenty of fun had been organised. Delegates were treated to a wonderful performance by Karel Martínek on the organ in St. Maurice Church. The social program also included a trip to the Palacký University Interactive Science Centre, a walking tour of Olomouc, dinners with old and new friends, and a field trip to see the Hranice Abyss and the Zbrašov Aragonite Cave. The Compositional Data Song was even written for the occasion. See page 4 for the lyrics and photos.

The week was topped off by a commemorative day in Prague where 45 delegates visited sites important to the beginning of the IAMG and heard about the tumultuous 23rd IGC in Prague where it all started.

A big thank you to Karel Hron, Regina van den Boogaart and all their team who put so much effort into making it a memorable conference!

Another part of our 50th anniversary celebrations has been the preparation of the book 'Handbook of Mathematical Geosciences - Fifty Years of IAMG', which was launched at the conference. The book includes 45 chapters covering both current mathematical geoscience topics and information about the IAMG's history.

*Katie Silversides*



**50th anniversary celebration in Prague**



**50th anniversary meeting in Olomouc**

International Association for Mathematical Geosciences

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## PRESIDENT'S FORUM

This year 2018, as we mark our 50th Anniversary, is a key milestone in the timeline of the IAMG. Milestones or landmarks are useful to reflect on how the IAMG has developed both in scale of membership and scope. Are we achieving our aim and objectives? The 50th Anniversary Celebration in Praha (Prague) was an important time to acknowledge the legacy of the IAMG's founding members but also to think about the future strategy of the IAMG. As I mark mid-point in my own timeline as the IAMG President, it is also timely to consider the three important objectives that I, with the current Executive and Council, set for the IAMG. The first was to consider the strategic direction of the IAMG. The mission of the IAMG, as set out in 1968 in Prague, is to promote worldwide the advancement of mathematics, statistics and informatics in the geosciences. What does fulfilment of our mission look like in 2018 and onwards? In an age of increasing access to information (Big Data) and technological advance (both deep earth, terrestrial and through remotely sensed earth observations), the advancement of mathematics, statistics and informatics in geological research and applications remains essential to advance scientific understanding and address global issues. Changes in climate patterns may act as a multiplier effect in areas susceptible to geological volcanic and tectonic activity, adversely affecting some of the most vulnerable communities and increasing populations in coastal areas.



The word milestone is synonymous with breakthrough or pioneering. Innovations in scientific thinking is evidenced by the scientific quality obvious at IAMG conferences, pioneer papers and continued increasing Impact Factors (IF) of our IAMG journals. Mathematical Geosciences (MG; one year IF = 1.573), Computer and Geosciences (C&G; 1 year IF = 2.567) and Natural Resources Research (NRR; first IF = 3.094) continue to increase in quantity, quality, and citations due to the hard work and dedication of all of the EICs and the Associate Editors. As a Council we continue to consider how to ensure that our journals continue to achieve the mission of the IAMG. Scientific advancements include, but not exclusively, geostatistics, multifractals, compositional data analysis, machine learning, big data analytics, multipoint geostatistics, spatial, temporal and 3D modelling, simulation and optimisation multivariate statistics, singularity analysis, numerical modelling mathematical morphology and geoinformatics. As an applied mathematical geoscientist, I believe that the interdisciplinary nature of the IAMG and collaborative approach of IAMG members remains a strength. I'm constantly encouraged at IAMG conferences to see participants moving beyond siloed thinking and instead explore how innovation in one area of mathematical geoscience may result in collaborative approaches in another field that help generate deeper insight and fresh perspectives. I'm convinced that a collaborative, co-producing approach is the best way to provide a robust foundation and advance mathematical, statistical and numerical modelling in geoscience applications to address the real world problems that we face: geohazards, increasing unpredictability in our climate, sea level change, sea surges, the need for the development of quantitative methods to explore deeper into the Earth's crust and how to ensure energy resilience and sustainable development. There are several initiatives, including Deep Digital Earth and Silk Roads Disaster Sustainable Development, in which the IAMG has the opportunity to work with IUGG, IUGS and the whole international scientific community to address these global challenges.

The second objective is to increase the awareness of the IAMG and, as a result, increase the scope and reach of the IAMG. Co-working with international associations, geological surveys, industry, NGOs and educational institutions remains a key focus. Increasing membership has never been the end goal of the IAMG, our membership fees remain extremely low. More important is increasing geographic and gender diversity to make training and knowledge exchange in mathematical geosciences accessible to as many as possible. This is why our conference short courses, workshops and the Distinguished lecturer role are so important. The IAMG is in a process of self-assessment with the establishment of a commission exploring the past and current opportunities for women in the IAMG. Our past record of nominations and awards for women is very low, as such we are not recognising the full potential of excellence in mathematical geoscience research. To provide equivalent opportunities for all promising researchers, we have established two Visetilius awards (male and female). The aim is to encourage excellence in research and provide a strong foundation for mathematical geoscience in the future.

This naturally leads to the third objective, to develop and encourage the next generation of mathematical geoscientists. This is currently foremost in my mind as I fly to Bangalore to meet with early career scientists and students encouraged by long standing IAMG members. In my term of IAMG President I have made it a priority to meet and hear from IAMG student chapters and early career members. Your voices have been loud and clear, you want to be involved and engaged in the IAMG conferences, committees and network between Student Chapters. It is our role as the Executive and Council to enable and facilitate this to happen. This is the best way to ensure that the IAMG continues to remain active and ground-breaking in promoting mathematical geosciences. Looking ahead, our annual conference IAMG2019 in Penn State, USA, short courses and workshops and opportunities to invite the 2019 Distinguished lecturer, Philippe Renard, are some ways to do this. I continue to look forward to working with IAMG members in many diverse ways to advance worldwide the advancement of mathematics, statistics and informatics in the geosciences.

*Jenny McKinley*

### Calling for nominations for the 2020 Distinguished Lecturer

**Deadline - 10 January 2019**

**For details about prerequisites for  
nominations please see the IAMG web  
site <http://www.iamg.org/> and click on  
Awards**

**Nominations should be sent to Christien  
Thiart – Chair of the IAMG Lectures  
Committee**

# IAMG2018!

My cordial thanks to all participants of IAMG2018, that they came to Olomouc and Prague and made IAMG's annual conference their meeting with colleagues and friends.

They made IAMG2018 a Golden Anniversary to remember! I would like also to express my gratitude and thanks to the Scientific Committee and the whole organizing team, without their efforts organizing such a great conference would be by far not possible.

*Karel Hron  
Conference Chair*



*The wonderful team who made everything run smoothly!*



Daya Sagar receiving the IAMG Certificate of Appreciation



Hranice Abyss



## Compositional Data Song

Tune - Can't help falling in love  
words by Peter Filzmoser

Wise man say: All your tools will fail. Your data set is compositional.

Shall I help? Don't ignore this fact: Your data set is compositional.

Like the river flows surely to the sea, all results are wrong!  
The answer is clear to me. Take my hand, my transformation too.

The CoDa approach is falling in love with you.



*Some of the IAMG council members in attendance*



*Student chapters meeting*



*Student award winners*

## Commemorative Event in Prague

Our day started with a tour of Prague, including Wenceslas Square and the Jewish Quarter. After a commemorative photo the group split, with the faster walkers taking in the sights of Charles Bridge and the more relaxed delegates catching the metro. After lunch and some sightseeing at Prague Castle we headed to the University of Chemistry and Technology building to see the place where the IAMG started. Unfortunately the exact room could not be visited due to renovations, but many photos were still taken.

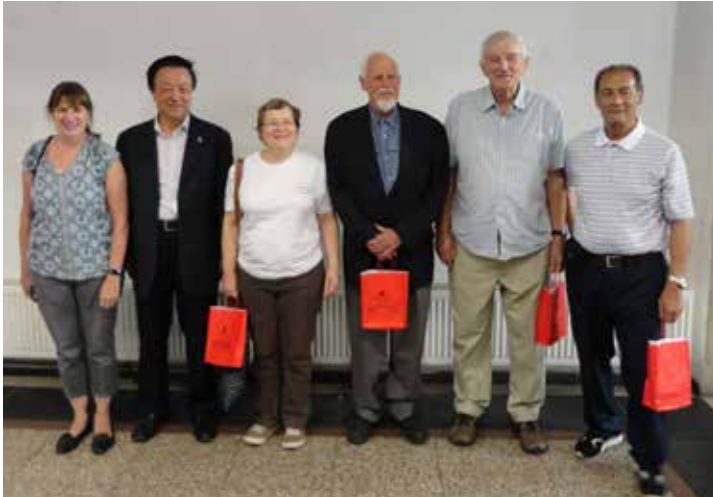
That afternoon we had the scientific meeting, with presentations on the history of the IAMG and the recollections of some founding members, including one who didn't quite get to Prague. The speakers included Qiuming Cheng, Jennifer McKinley, Tim Whitten (read by Frits Agterberg), Václav Němec, Hannes Thiergärtner, Graeme Bonham-Carter, and Frits Agterberg. The day concluded with a celebratory banquet.



Above: Hannes Thiergärtner presenting at the scientific meeting



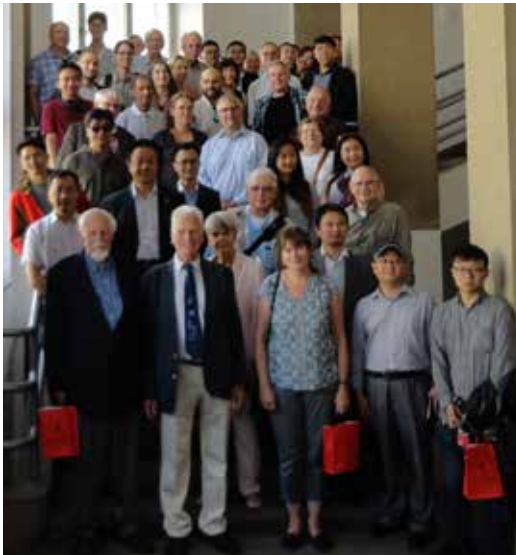
Right: IAMG delegates outside the St. Vitus Cathedral



IAMG presidents current and past (since 1996)

## Student Chapter News

### Bangalore Student Chapter



Commemorative event attendees at the University of Chemistry and Technology.



B. S. Daya Sagar welcomes Dr Jenny McKinley to the Systems Science and Informatics Unit, Indian Statistical Institute-Bangalore Centre



IAMG founding members Václav Němec, Frits Agterberg and Hannes Thiergärtner.



Early career and PhD Student workshop hosted by IAMG ISI Student Chapter and the Bangalore Section IEEE GRSS Chapter and at the IEEE Bangalore Headquarters World Trade Centre, Bangalore.

## Conference News

### Updates from GSA 2018, Indianapolis, IN

The 2018 Geological Society of America (GSA) Annual Meeting took place at Indianapolis, IN, USA during November 2-7 2018. Below are a few key items that might be of interest to the IAMG community.

1) I tried to set up a meeting between Dr. Bob Hazen and Prof. Qiuming Cheng for discussing a collaboration on Deep Time Data Science. Dr. Hazen has been the leader of an initiative called Deep Time Data Infrastructure (DTDI, <https://dtdi.carnegiescience.edu>) since 2015, of which I am an affiliate scientist. Prof. Cheng, as the IUGS president, is currently promoting an international program called Deep Time Digital Earth (DDE). There will be a few follow-up meetings at the AGU Fall Meeting 2018 in Washington DC and the DDE 2019 workshop at Beijing.



*A working lunch at GSA2018 between Prof. Cheng and DTDI team members.*

2) I took my place as chair of the GSA Geoinformatics Division. The first activity I organized as part of that role was presenting the 2018 GSA Outstanding Contributions in Geoinformatics Award to Dr. Steve Richard. Steve is an internationally-known geoinformatician. He has made significant contributions to international standards for geoscience data exchange, including the GeoSciML, an output from the CGI commission of IUGS. Within the Geoinformatics Division we are organizing a GSA special book for geoinformatics and we will welcome submissions from the IAMG community. Also, we have proposed to change the name of the division to Geoinformatics and Data Science Division.



3) A side topic is that I found a hard copy of the IAMG 50-year anniversary book "Handbook of Mathematical Geosciences" at the Springer booth at GSA2018. Proud to see my name as a chapter author in a book on exhibition!

*Xiaogang (Marshall) Ma*

*Marshall Ma with the book "Handbook of Mathematical*

## Distinguished Lecturer Reports

### Gregoire Mariethoz

#### 2018 Distinguished Lecturer

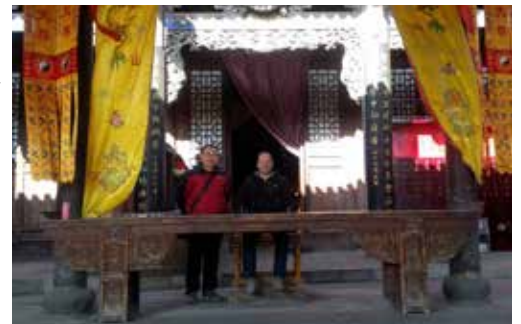
Being the 2018 IAMG lecturer was a great honor. It gave me the occasion to travel to new countries and speak about some of my research topics. It has been an opportunity to share ideas with other IAMG members around the world about a range of scientific topics. These include the integration of data coming from different sources, the design of geostatistical simulation algorithms, inverse problems, multiple-point geostatistics and their applications to new fields of science such as remote sensing data processing or weather generation.



I also was able to see places where I would not have gone otherwise, such as India, China or Japan. In all the places I have visited this year, the welcome has been heart-warming. I have established not only collaborations, but also friendships. I particularly thank Hexiang Bai at the University of Taiyuan, Yong Ge at the Chinese Academy of Sciences, Damien Jougnot at UPMC Paris, Daya Sagar at the Indian Statistical Institute Bangalore, Katsuaki Koike at Kyoto University, Jennifer McKinley for inviting me at the Geoenv

conference in Belfast and Karel Hron for inviting me at the IAMG conference in Olomouc.

In academia, we are used to regularly meet fellow IAMG members at conferences and discuss science during poster sessions or around evening drinks. However I found it very different to meet colleagues at their home institution, discuss with their students and see their daily work environment.



I was also thrilled by the little pleasures of travelling to far away places and having the time to enjoy. Some highlights have included: the frozen Tien-An-Men Square and deserted Forbidden city in the early hours of a polar morning, delicious Asian meals of an indefinite nature (animal, vegetal, mineral?),



the pubs of Belfast and the cafés of Paris, the animated encounter of enthusiastic Russian scientists in a Czech restaurant, the traditional Chinese town of Pingyao, the beautiful city of Kyoto and its surroundings of peaceful rivers and monkey-inhabited forests, being stuck for days in Moscow airport, and liquid nitrogen based ice creams in Bangalore.

Overall, I had the time of my life in 2018 from both academic and personal point of views, and I am deeply grateful to the IAMG for this.

*Gregoire Mariethoz*

**Philippe Renard**

**2019 Distinguished Lecturer**

Professor Philippe Renard is offering several talks as the IAMG 2019 Distinguished Lecturer on the subject:

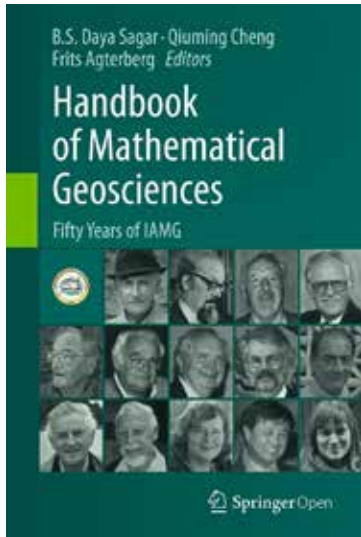
Stochastic modeling of karstic system: structure, parameters and inversion. Does geological realism of heterogeneous aquifers pay off?

More information will be on <https://iamg.org/special-lectures/current-distinguished-lecturer.html>

Please contact [support@iamgmembers.org](mailto:support@iamgmembers.org) for further details

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**Springer Handbook of Mathematical Geosciences: Fifty Years of IAMG**



"The Handbook of Mathematical Geosciences: Fifty Years of IAMG" was released during the 2018 IAMG conference. This book is open access so that IAMG members as well as all other scientists can freely read the electronic version. The book presents work consisting of a fusion of geology, hydrology, mining engineering, geoengineering, and applications of quantitative techniques and methodology in these fields. It also gives a historical overview of IAMG's development over 50 years.

Read it at [www.springer.com/us/book/9783319789989](http://www.springer.com/us/book/9783319789989).

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**IAMG Journal Reports**

**Natural Resources Research**

NRR has received its first Impact Factor - 3.094! Congratulations to the editor John Carranza and all the editorial team for this fantastic result. Thank you to all the IAMG members who committed to publishing in NRR and helped achieve this outcome.

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**Computers & Geosciences**

Calling for submissions for the special issue of Computer & Geosciences "Quantitative understanding of natural phenomena in Earth Sciences: concepts and tools for data analysis".

Papers can be submitted at:

<https://www.evise.com/profile/api/navigate/CAGEO>

To ensure that your manuscript is correctly identified for inclusion into the special issue, it is important that you select 'Quantitative analysis' during submission.

Final submission deadline : 31-Dec-2018

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**Helmholtz Institute Freiberg for Resource Technology**



**PhD and Post-doc positions opening soon at HIF!**

The Helmholtz Institute Freiberg for Resource Technology is seeking to strengthen its division on modelling and evaluation with people interested on working in a highly interdisciplinary team on the interface between stochastic modelling, minerals processing and economics of mineral commodities.

If you are interested, keep an eye on our webpage (<https://www.hzdr.de/db/Cms?pNid=2423> > Education, Career and Training > Job vacancies) and apply!

Application period will close 31 January 2019.

**IAMG Journal Contents**

**Natural Resources Research**

**NRR - Volume 27, Issue 3, July 2018**

Identifying Groundwater Potential in Crystalline Basement Rocks Using Remote Sensing and Electromagnetic Sounding Techniques in Central Western Mozambique — Luis André Magaia, Tada-nori Goto, Alaa Ahmed Masoud, Katsuaki Koike

A MaxEnt Model for Mineral Prospectivity Mapping — Yue Liu, Kefa Zhou, Qinglin Xia

Interactive 3D Modeling by Integration of Geoscience Datasets for Exploration Targeting in Luanchuan Mo Polymetallic District, China — Zhiqiang Zhang, Gongwen Wang, Zhenbo Ma, Xinyuan Gong

Geostatistical Simulation with a Trend Using Gaussian Mixture Models — Jianan Qu, Clayton V. Deutsch

Modeling India's Coal Production with a Negatively Skewed Curve-Fitting Model — Jianliang Wang, Yongmei Bentley, Roger Bentley

Multiple Regression-Based Calculation of Iron Ore Resource Royalty Rate and Analytical Study of Its Influencing Factors: Example from Anhui Province of China — Jian-ming Jiang, Ying-hong Wang, Weijia Liu, Yang-guang Xie

**NRR - Volume 27, Issue 4, October 2018**

New Method of Fitting Pareto-Lognormal Size-Frequency

*continued on next page*

**Journal Statistics**

**Mathematical Geosciences:**

2017 ISI Impact factor: 1.573 (SJR=0.760)

5-Year Impact Factor: 1.909 (SNIP=0.943)

Ave. review time: 83 days (submission to first decision 2017)

**Computers & Geosciences:**

2017 ISI Impact Factor: 2.567 (SJR=1.350)

5-Year Impact Factor: 2.895 (SNIP=1.583)

Ave. review time: 12.1 weeks (submission to final decision 2017)

**Natural Resources Research:**

2017 ISI Impact Factor: 3.094 (SJR = 0.800)

2017 SNIP: 1.326

Ave. review time: 20 days (submission to first decision 2017)

*NRR continued from p. 7*

Distributions to Worldwide Cu and Zn Deposit Size Data — Frits Agterberg

Grade and Tonnage Uncertainty Analysis of an African Copper Deposit Using Multiple-Point Geostatistics and Sequential Gaussian Simulation — Amol Paithankar, Snehamoy Chatterjee

Selection of Optimal Thresholds for Estimation and Simulation Based on Indicator Values of Highly Skewed Distributions of Ore Data — Hemn Rahimi, Omid Asghari, Farnusch Hajizadeh

Economics, Helium, and the U.S. Federal Helium Reserve: Summary and Outlook — Steven T. Anderson

Geothermal Characterization of the St. Lawrence Lowlands Sedimentary Basin, Québec, Canada — Karine Bédard, Félix-Antoine Comeau, Jasmin Raymond, Michel Malo, Maher Nasr

Analyzing Factors of Groundwater Potential and Its Relation with Population in the Lower Barpani Watershed, Assam, India — Raihan Ahmed, Haroon Sajjad

Improved Minimum Miscibility Pressure Prediction for Gas Injection Process in Petroleum Reservoir — Mohammad Reza Tarybakhsh, Mehdi Assareh, Mohammad Taghi Sadeghi, Ali Ahmadi

Numerical Model of Two-Phase Flow in Dissolvable Porous Media and Simulation of Reservoir Acidizing — Eduard Khrumchenkov, Maxim Khrumchenkov

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## Mathematical Geosciences

**MG - Volume 50, Issue 4, May 2018**

Detection of Outliers in Geochemical Data Using Ensembles of Subsets of Variables — Mehala Balamurali, Arman Melkumyan

Discrimination and Variance Structure of Trace Element Signatures in Fe-Oxides: A Case Study of BIF-Mineralisation from the Middleback Ranges, South Australia — Marija Dmitrijeva, Andrew V. Metcalfe, Cristiana L. Ciobanu, Nigel J. Cook, Max Frenzel, William M. Keyser, Geoff Johnson, Kathy Ehrig

Timescale Monitoring of Vesuvian Eruptions Using Numerical Modeling of the Diffusion Equation — Julien Amalberti, Xavier Antoine, Pete Burnard

Multifractal Topography: A Tool to Measure Tectonic Complexity in the Zagros Mountain Range — Amir Pirooz Kolahi-Azar, Sahereh Goltiz

Characterizing Fracture Geometry from Borehole Images — Michael D. Prange, Marie LeFranc

Geostatistical Inversion of Seismic Oceanography Data for Ocean Salinity and Temperature Models — Leonardo Azevedo, Xinghui Huang, Luis M. Pinheiro, Rúben Nunes, Maria Helena Caeiro, Haibin Song, Amílcar Soares

**MG - Volume 50, Issue 5, July 2018**

Special Issue on Multiple scale modeling of geophysical processes

Issue Editors: Eugénio M. Rocha, Francisco Curado

Multi-scale Study of Pollutant Transport and Uptake in Compacted Bentonite — Fatiha Bouchelaghem

Application of Binary Permeability Fields for the Study of CO<sub>2</sub> Leakage from Geological Carbon Storage in Saline Aquifers of the Michigan Basin — Ana González-Nicolás, Domenico Baù, Brent M. Cody

Simulating Oxygen Intrusion into Highly Heterogeneous Fractured Media Using High Performance Computing — Paolo

Trinchero, Jorge Molinero, Hedieh Ebrahimi, Ignasi Puigdomenech, Björn Gylling, Urban Svensson, Dirk Bosbach, Guido Deissmann

Accurate Ocean Bottom Seismometer Positioning Method Inspired by Multilateration Technique — Omar Benazzouz, Luis M. Pinheiro, Luis M. A. Matias, Alexandra Afilhado, Daniel Herold, Seth S. Haines

Diagnosis of Free and Convectively Coupled Equatorial Waves — Carlos A. F. Marques, José M. Castanheira

Correction to: Accurate Ocean Bottom Seismometer Positioning Method Inspired by Multilateration Technique — Omar Benazzouz, Luis M. Pinheiro, Luis M. A. Matias, Alexandra Afilhado, Daniel Herold, Seth S. Haines

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Geostatistical Modelling of Cyclic and Rhythmic Facies Architectures — Thomas Le Blévec, Olivier Dubrule, Cédric M. John, Gary J. Hampson

Compositional Data Analysis of Coal Combustion Products with an Application to a Wyoming Power Plant — J. A. Martín-Fernández, R. A. Olea, L. F. Ruppert

Analysis of a GPS Network Based on Functional Data Analysis — Sonia Pérez-Plaza, Fernando Fernández-Palacín, Manuel Berrocoso, Raúl Páez, Belén Rosado

New Approach for Mapping the Vulnerability of Agroecosystems Based on Expert Knowledge — F. M. Vanwindekens, A. Gobin, Y. Curnel, V. Planchon

A Fault Model with Two Asperities of Different Areas and Strengths — Emanuele Lorenzano, Michele Dragoni

Book Review — Coryn A. L. Bailer-Jones: Practical Bayesian Inference: A Primer for Physical Scientists — Dario Grana

**MG - Volume 50, Issue 7, October 2018**

Probabilistic Aggregation of Uncertain Geological Resources — G. M. Kaufman, R. A. Olea, R. Faith, M. S. Blondes

High-Order Spatial Simulation Using Legendre-Like Orthogonal Splines — Ilnur Minniakhmetov, Roussos Dimitrakopoulos, Marcelo Godoy

Porous Structure Reconstruction Using Convolutional Neural Networks — Yuzhu Wang, Christoph H. Arns, Sheik S. Rahman, Ji-Youn Arns

A Study of the Influence of Measurement Volume, Blending Ratios and Sensor Precision on Real-Time Reconciliation of Grade Control Models — T. Wambeke, J. Benndorf

Anisotropic Continuous-in-Scale Universal Multifractal Cascades: Simulation, Analysis and Correction Methods — Arun Ramanathan, A. N. V. Satyanarayana, M. Mandal

Geostatistical Methods for Reservoir Geophysics by Azevedo, L. and Soares, A. — Michael Ed. Hohn

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**MG - Volume 50, Issue 8, November 2018**

Data Assimilation in Truncated Plurigaussian Models: Impact of the Truncation Map — Dean S. Oliver, Yan Chen

Fuzzy Clustering with Spatial Correction and Its Application to Geometallurgical Domaining — E. Sepúlveda, P. A. Dowd, C. Xu

A New Computational Model of High-Order Stochastic Simulation Based on Spatial Legendre Moments — Lingqing Yao, Roussos Dimitrakopoulos, Michel Gamache

A New Model of Campi Flegrei Inflation and Deflation Episodes Based on Brownian Motion Driven by the Telegraph Process — F.

Travaglino, A. Di Crescenzo, B. Martinucci, R. Scarpa

Optimization of Well Pattern Parameters for Waterflooding in an Anisotropic Formation — Zhaoqi Fan, Linsong Cheng, Daoyong Yang, Xiaoli Li

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## Computers & Geosciences

**C&G - Volume 116, July 2018**

An investigation into preserving spatially-distinct pore systems in multi-component rocks using a fossiliferous limestone example — Zeyun Jiang, Gary D. Couples, Helen Lewis, Alessandro Mangione

Semantics-informed geological maps: Conceptual modeling and knowledge encoding — Vincenzo Lombardo, Fabrizio Piana, Dario Mimmo

An algorithm for fast elastic wave simulation using a vectorized finite difference operator — Ajay Malkoti, Nimisha Vedanti, Ram Krishna Tiwari

Global tectonic reconstructions with continuously deforming and evolving rigid plates — Michael Gurnis, Ting Yang, John Cannon, Mark Turner, Simon Williams, Nicolas Flament, Dietmar Müller

An active monitoring method for flood events — Zeqiang Chen, Nengcheng Chen, Wenying Du, Jianya Gong

Computation of continuum percolation threshold for pore systems composed of vugs and fractures — Evgeny Pervago, Aleksandr Mousatov, Elena Kazatchenko, Mikhail Markov

Arc-Malstrøm: A 1D hydrologic screening method for stormwater assessments based on geometric networks — Thomas Balstrøm, David Crawford

Estimating habitat volume of living resources using three-dimensional circulation and biogeochemical models — Katharine A. Smith, Zachary Schlag, Elizabeth W. North

Estimation of the displacements among distant events based on parallel tracking of events in seismic traces under uncertainty — Samuel G. Huamán Bustamante, Marco A. Cavalcanti Pacheco, Juan G. Lazo Lazo

Efficient 3D inversions using the Richards equation — Rowan Cockett, Lindsey J. Heagy, Eldad Haber

**C&G - Volume 117, August 2018**

Fibonacci lattices for the evaluation and optimization of map projections — Sergio Baselga

A structural rank reduction operator for removing artifacts in least-squares reverse time migration — Min Bai, Juan Wu, Shaohuan Zu, Wei Chen

Advancing interoperability of geospatial data provenance on the web: Gap analysis and strategies — Liangcun Jiang, Peng Yue, Werner Kuhn, Chenxiao Zhang, Changhui Yu, Xia Guo

Reconstruction of seismic data with missing traces based on optimized Poisson Disk sampling and compressed sensing — Yuan-Yuan Sun, Rui-Sheng Jia, Hong-Mei Sun, Xing-Li Zhang, Yan-Jun Peng, Xin-Ming Lu

Computation of analytical sensitivity matrix for the frequency-domain EM data: MATLAB code — Jide Nosakare Ogunbo

DOUBLE FIT: Optimization procedure applied to lattice strain model — Célia Dalou, Julien Boulon, Kenneth T. Koga, Robert Dalou, Robert L. Dennen

GPU acceleration of time gating based reverse time migration using the pseudospectral time-domain algorithm — Jiangang Xie, Zichao Guo, Hai Liu, Qing Huo Liu

Corrigendum to 'Gamra: Simple meshing



for complex earthquakes' [Comput. Geosci. 90PA (2016) 49–63] — Walter Landry, Sylvain Barbot

**C&G - Volume 118, September 2018**

Sparse regression interaction models for spatial prediction of soil properties in 3D — Milutin Pejović, Mladen Nikolić, Gerard B.M. Heuvelink, Tomislav Hengl, Milan Kilibarda, Branislav Bajat

Enhanced IT2FCM algorithm using object-based fuzzy set modeling for remote-sensing clustering — Tao Jiang, Dan Hu, Xianchuan Yu

Modular implementation of magnetotelluric 2D forward modeling with general anisotropy — Zeqiu Guo, Gary D. Egbert, Wenbo Wei

Focal beam analysis for 3D acquisition geometries in complex media with GPU implementation — Jun Su, Li-Yun Fu, Wei Wei, Junhua Hu, Weijia Sun

Identification of geochemical anomalies through combined sequential Gaussian simulation and grid-based local singularity analysis — Jian Wang, Renguang Zuo

A mesh-free finite-difference method for elastic wave propagation in the frequency-domain — Junichi Takekawa, Hitoshi Mikada

Plumetrack: Flux calculation software for UV cameras — Nial Peters, Clive Oppenheimer

Improved workflow for unguided multiphase image segmentation — Brendan A. West, Taylor S. Hodgdon, Matthew D. Parno, Arnold J. Song

E-Wave software: EBSD-based dynamic wave propagation model for studying seismic anisotropy — Xin Zhong, Marcel Frehner

Context-dependent image quality assessment of JPEG compressed Mars Science Laboratory Mastcam images using convolutional neural networks — Hannah R. Kerner, James F. Bell, Heni Ben Amor

Multi-scale segmentation algorithm for pattern-based partitioning of large categorical rasters — Jarosław Jasiewicz, Tomasz Stepinski, Jacek Niesterowicz

Detection of transverse cirrus bands in satellite imagery using deep learning — Jeffrey Miller, Udaysankar Nair, Rahul Ramachandran, Manil Maskey

**C&G - Volume 119, October 2018**

Interpreting Self-Organizing Map errors in the classification of ocean patterns — Frano Matic, Hrvoje Kalinic, Ivica Vilibic

Taner filter settings and automatic correlation optimisation for cyclostratigraphic studies — Christian Zeeden, Stefanie Kaboth, Frederik J. Hilgen, Jacques Laskar

Evaluation of periodicities and fractal characteristics by wavelet analysis of well log data — Man-Hyok Song, Kyong-Ho Li, Song-Nam Kim

Near real-time coastal flood inundation simulation with uncertainty analysis and GPU acceleration in a web environment — Janne Kovanen, Juha Oksanen, Tapani Sarjakoski

Multi-objective unstructured triangular mesh generation for use in hydrological and land surface models — Christopher B. Marsh, Raymond J. Spiteri, John W. Pomeroy, Howard S. Wheeler

A new approach to the openness index for landform characterisation — F. Alonso-Sarría, F. Gomariz-Castillo, F. Cánovas-García

How do we efficiently generate high-resolution hydraulic models at large numbers of riverine reaches? — Matthew Nahorniak, Joe Wheaton, Carol Volk, Phillip Bailey, Matt Reimer, Eric Wall, Kelly Whitehead, Chris Jordan

Adaptive Pareto-based approach for geontology matching — Ujwala Bharambe, Surya S. Durbha

Fast matrix inversion and determinant

computation for Polarimetric Synthetic Aperture Radar — D.F.G. Coelho, R.J. Cintra, A.C. Frery, V.S. Dimitrov

CaveCalc: A new model for speleothem chemistry & isotopes — Robert Owen, Christopher C. Day, Gideon M. Henderson

PETGEM: A parallel code for 3D CSEM forward modeling using edge finite elements — Octavio Castillo-Reyes, Josep de la Puente, José María Céla

SHADE: A MATLAB toolbox and graphical user interface for the empirical de-correlation of GRACE monthly solutions — Dimitrios Piretzidis, Michael G. Sideris

A fast approach for unsupervised karst feature identification using GPU — Luis C.S. Afonso, Mateus Basso, Michelle C. Kuroda, Alexandre C. Vidal, João P. Papa

Corrigendum to "WFCatalog: A catalogue for seismological waveform data" [Comput. Geosci. 106 (2017) 101–108] — Luca Trani, Mathijs Koymans, Malcolm Atkinson, Reinoud Sleeman, Rosa Filgueira

**C&G - Volume 120, November 2018**

Forward modeling of gravity anomalies based on cell merge and parallel computing — Tao Chen, Guibin Zhang

OpenHVSRR - Processing toolkit: Enhanced HVSRR processing of distributed microtremor measurements and spatial variation of their informative content — Samuel Bignardi, Anthony J. Yezzi, Simone Fiussello, Albert Comelli

AMORPH: A statistical program for characterizing amorphous materials by X-ray diffraction — Michael C. Rowe, Brendon J. Brewer

HydroSedFoam: A new parallelized two-dimensional hydrodynamic, sediment transport, and bed morphology model — Zhenduo Zhu, Jessica Zinger LeRoy, Bruce L. Rhoads, Marcelo H. Garcia

GCH\_gravinv: A MATLAB-based program for inverting gravity anomalies over sedimentary basins — Luan Thanh Pham, Erdinc Oksum, Thanh Duc Do

An automatic variogram modeling method with high reliability fitness and estimates — Zhanglin Li, Xialin Zhang, Keith C. Clarke, Gang Liu, Rui Zhu

Geochemical property modelling of a potential shale reservoir in the Canning Basin (Western Australia), using Artificial Neural Networks and geostatistical tools — Lukman Mobolaji Johnson, Reza Rezaee, Ali Kadkhodaie, Gregory Smith, Hongyan Yu

Towards justifying unsupervised stationary decisions for geostatistical modeling: Ensemble spatial and multivariate clustering with geomodeling specific clustering metrics — Ryan Martin, Jeff Boisvert

An automatic methodology for analyzing sorting level of rock particles — Lei Shu, Gordon R. Osinski, Kenneth McIsaac, Dong Wang

Robustness of Extreme Learning Machine in the prediction of hydrological flow series — Md Atiquzzaman, Jaya Kandasamy

Bridging the information gap of disaster responders by optimizing data selection using cost and quality — Marc van den Homberg, Robert Monné, Marco Spruit

**C&G - Volume 121, December 2018**

DGeoSegmenter: A dictionary-based Chinese word segmenter for the geoscience domain — Qinjun Qiu, Zhong Xie, Liang Wu, Wenjia Li

A workflow for building surface-based reservoir models using NURBS curves, coons patches, unstructured tetrahedral meshes and open-source libraries — Zhao Zhang, Zhen Yin, Xia Yan

Antithetic random fields applied to mine planning under uncertainty — S. Gonzalo

Nelis, Julián M. Ortiz, V.Nelson Morales

Fieldwork in Geosciences assisted by ARGeo: A mobile Augmented Reality system — Nicolás F. Gazcón, Juan M. Trippel Nagel, Ernesto A. Bjerg, Silvia M. Castro

Static load balancing using non-uniform mesh partitioning based on ray density prediction for the parallel wavefront construction method — Abdullah Fahad Alyabes, Richard L. Gibson

A framework for natural phenomena movement tracking – Using 4D dust simulation as an example — Manzhu Yu, Chaowei Yang, Baoxuan Jin

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**2017 Student Research Grants**

**Mathematical Geosciences Scholarship**

**MG-2017-9 - Jianan Qu**

**Title:** Practical Trend Modeling for Geostatistical Simulation

**Advisor:** Clayton V. Deutsch

**Institution:** Centre for Computational Geostatistics, University of Alberta

**Abstract:** Geostatistical simulation techniques generate multiple realizations that are used to characterize geological heterogeneity and uncertainty. The choice of stationary domains to work within is a prerequisite for geostatistical simulation. The decision of stationarity combines data together for common analyses and often assumes that the key statistics are location invariant within each domain; however, most geological data exhibit a large-scale deterministic trend together with short-scale variations. This location dependence in the average contradicts the assumption of location invariant statistics. The trend-like deterministic features could be modeled prior to geostatistical calculations and may lead to improved predictions. This paper focuses on creating practical trend models. A trend function using moving window averages is considered. An objective function is established to minimize the mean squared error between the modeled trend and the true trend for cases when the true trend is known.

**MG-2017-3 - Xuesong Ding**

**Title:** Building a quantitative framework of stratigraphic analysis in a source-to-sink numerical scheme pyBadlands

**Advisor:** Tristan Salles

**Institution:** School of Geoscience, The University of Sydney

**Abstract:** The sedimentary architecture on continental margins reflects the interplay between the rate of change of accommodation creation ( $\delta A$ ) and the rate of change of sediment supply ( $\delta S$ ) - the  $\delta A/\delta S$  ratio concept. Understanding the link between deposition patterns and changes in  $\delta A/\delta S$  is crucial of applying this concept to practical stratigraphic interpretations. Here, I use a landscape modelling framework pyBadlands as a tool to explore the stratigraphic sequences formation and apply the accommodation succession method to quantitatively

analyze the predicted strati-graphic architectures. I present a numerical experiment that takes into account periodic sea-level variations and passive margin thermal subsidence over 30 million years, under uniform rainfall. Here, sea-level variation is the primary but not the only control on strata stacking. It interacts with the amount of sediment input and the basin physiography to determine the distribution of depositional packages. pyBadlands maintains an advantage of providing self-organized sediment supply to basin margins without user-control as it simulates sediment routing from source to sink. A set of post-processing numerical tools are developed to quickly extract stratal stacking patterns, Wheeler diagrams and synthetic cores at any location within the simulated domain. Based on the temporal evolution of changes in accommodation and sedimentation, automatic stratigraphic interpretations are obtained. This work provides an efficient and flexible quantitative sequence stratigraphic framework to evaluate the main drivers (climate, sea level and tectonics) controlling sedimentary architectures and investigate their respective roles in sedimentary basins development.

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## Computers and Geosciences Scholarship

**CG-2017-04** - Yasin Dagan

**Title:** Development of a New Grade Control Technique for Laterite-Type Bauxite Deposits

**Advisor:** Oktay Erten

**Institution:** Curtin University

**Abstract:** Geological contacts in lateritic metal deposits (footwall topographies) often delineate the orebody boundaries. Spatial variations seen in such contacts are frequently higher than those for the metal grades of the deposit. Therefore, borehole spacing chosen based on the grade variations cannot adequately capture the geological contact variability. Consequently, models created using such boreholes cause high volumetric uncertainties in the actual and targeted ore extraction volumes, which, in turn, lead to high unplanned dilution and ore losses. In this research, a method to design optimum ore/mining boundaries for lateritic metal deposits is presented. The proposed approach minimizes the dilution/ore losses and comprises two main steps. First, the uncertainty on the orebody boundary is represented using a set of stochastic realizations generated with a multiple-point statistics algorithm. Then, the optimal orebody boundary is determined using an optimization technique inspired by a model calibration method called Pilot Points. The pilot points represent synthetic elevation values and they are used to construct smooth mining boundaries using the multilevel B-Spline technique. The performance of a generated surface is evaluated using the expected sum of losses in each of the stochastic realizations. The Simulated Annealing algorithm is used to iteratively determine the pilot point values which minimize the expected losses. The results show a significant reduction in the dilution volume as compared to those obtained from the actual mining operation.

**CG-2017-6** - Chengbin Wang

**Title:** Text Information Extraction and Knowledge Graph Construction from Geoscience Literature

**Advisors:** Pengda Zhao (1), Jianguo Chen (1), Xiaogang Ma (2)

**Institution:** (1) China University of Geosciences (Wuhan); (2) University of Idaho

**Abstract:** Geoscience literature published online is an important part of open data, and brings both challenges and opportunities for data analysis. Compared with studies of numerical geoscience data, there are limited works on information extraction and knowledge discovery from textual geoscience data. This paper presents a workflow and a few empirical case studies for that topic, with a focus on documents written in Chinese. First, we set up a hybrid corpus combining the generic and geology terms from geology dictionaries to train Chinese word segmentation rules of the Conditional Random Fields model. Second, we used the word segmentation rules to parse documents into individual words, and removed the stop-words from the segmentation results to get a corpus constituted of content-words. Third, we used a statistical method to analyze the semantic links between content-words, and we selected the chord and bigram graphs to visualize the content-words and their links as nodes and edges in a knowledge graph,

respectively. The resulting graph presents a clear overview of key information in an unstructured document. This study proves the usefulness of the designed workflow, and shows the potential of leveraging natural language processing and knowledge graph technologies for geoscience. Some details are available in:

Wang C., Ma X., Chen J. and Chen J. 2018. Information extraction and knowledge graph construction from geoscience literature. *Computer and Geosciences*, 112: 112-120.

**CG-2017-11** - Name: Jian Wang (CUG)

**Title:** Mapping local singularities of uncertain geochemical patterns

**Advisor:** Renguang Zuo

**Institution:** China University of Geosciences, Wuhan

**Abstract:** Exploration geochemistry plays increasingly important role in the discovery of mineral resources for the past couple of decades. Among the many proposed or introduced methods for identifying geochemical anomalies, local singularity analysis (LSA) has been proven to be an effective tool for especially detecting weak anomalies. The common practice of grid-based LSA is to firstly interpolate irregularly distributed samples onto a raster map by using kriging, inverse distance weighting (IDW), etc. The inherent nature of weighted moving average of these methods typically subject the interpolated map to a smoothing effect. In addition, the conventional procedure did not consider the uncertainties on the values of geochemical attribute at unsampled locations. As such, these two aspects might affect the result of grid-based LSA, which has not yet been investigated. In this work, a hybrid method combining stochastic simulation and LSA is proposed to address the two issues above and for identifying geochemical anomalies. A case study was also carried out to illustrate and validate the procedure. The findings indicate that (1) the uncertainties of values at unsampled locations could have a significant effect on the results of grid-based LSA, and (2) singularity exponents obtained from kriging-based LSA roughly reflect the trend of singularity exponent distribution derived from stochastic simulation-based LSA. But the latter also provides a measure of uncertainty of singularity propagated from the uncertain values at unsampled locations, which can be used as additional information to support decision making.

More details can be found in the published paper by Wang and Zuo (2018) on C&G.

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## Natural Resources Research Student Award

**NRR-2017-7** - Yihui Xiong

**Title:** Integration of multi-elemental information and extraction of geochemical anomalies via local RX anomaly detector

**Advisor:** Renguang Zuo

**Institution:** State Key Laboratory of Geological Processes and Mineral Resources, China University of Geosciences, Wuhan

**Abstract:** Multivariate geochemical anomalies are of great significance to the mineral exploration. The general method for multivariate geochemical anomalies is application of a hybrid method such as combining principal component analysis (PCA) and local singularity analysis (LSA). However, the unknown multivariate complex probability distribution of the geochemical data does not meet the application condition of PCA for the detection of multivariate geochemical anomalies. In this project, the local RX anomaly detector based on double sliding windows was used to detect local multivariate geochemical anomalies. Based on the idea of the local data of nonlinear manifold can be approximated linearly, the local RX anomaly detector converted the global nonlinear problem into a local linear problem in the multidimensional feature space of the geochemical data. The geochemical data from southwestern Fujian district (China) (SFD) were carried out to validate the method. The anomaly map showed that majority of skarn Fe deposits are situated in areas with high value of RX(x), demonstrating that the detected anomalies may have a close spatial relationship with Fe mineralization. The comparing results with deep autoencoder network and the hybrid method combining with PCA and LSA, suggest that the local RX anomaly detector is a potential method to identify multivariate geochemical anomalies in a complex geological background.

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# Upcoming Meetings

## 2019

EGU General Assembly 2019, 7–12 April, Vienna, Austria.  
<https://www.egu2019.eu/>

Engineering and Mining Geophysics 2019, 22 - 26 April,  
 Gelendzhik, Russia. <https://events.eage.org/2019/>

AAPG 2019 Annual Convention & Exhibition, 19-22 May, San  
 Antonio, Texas, United States

8th International Workshop on Compositional Data Analysis  
 (CoDaWork2019), 3-8 June, Terrassa, Spain. [https://webs.  
 camins.upc.edu/codawork2019/](https://webs.camins.upc.edu/codawork2019/)

81st EAGE Conference & Exhibition, 3 - 6 June, London,  
 United Kingdom. [events.eage.org/en/2019/eage-annual-2019](https://events.eage.org/en/2019/eage-annual-2019)

Application Of Computers And Operations Research In The  
 Mineral Industry (APCOM2019), 4-6 June, Wroclaw, Poland.  
<https://apcom.info/>

CoDaCourse, 1-5 July, Girona. [http://www.compositionaldata.  
 com/codacourses.php](http://www.compositionaldata.com/codacourses.php)

2019 Joint Statistical Meetings, 27 July-1 Aug, Denver,  
 Colorado. <http://www2.amstat.org/meetings/jsm/2019/>

**IAMG2019, 10-16 Aug, Pennsylvania, USA. [www.iamgconferences.org/iamg2019](http://www.iamgconferences.org/iamg2019)**

62nd ISI World Statistics Congress, International Statistical  
 Institute, 18-23 Aug 2019, Kuala Lumpur, Malaysia.

AAPG International Conference & Exhibition, 27-30 August,  
 Buenos Aires, Argentina. [https://www.aapg.org/events/  
 conferences/ice](https://www.aapg.org/events/conferences/ice)

GSA Annual Meeting, 22–25 Sept, Phoenix, Arizona, USA.  
[https://www.geosociety.org/GSA/Events/Annual\\_Meeting/  
 GSA/Events/gsa2019.aspx](https://www.geosociety.org/GSA/Events/Annual_Meeting/GSA/Events/gsa2019.aspx)

AGU 2019 Fall Meeting, 9-13 Dec, San Francisco, California.  
<https://fallmeeting.agu.org>

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## First announcement for GeoMATES '19

### International Congress on Geomathematics in Earth & Environmental Sciences

The conference will be held from 16-18 May 2019 in Pécs,  
 Hungary at the Pécs Regional Committee of the Hungarian  
 Academy of Sciences.

The planned sections of the congress will cover geoinformatics,  
 reservoir geology assessment, big data, climate modelling,  
 geostatistics, analysis of monitoring time series, automation &  
 industry 4.0 in geo-services, and so on.

Participants will have the chance to get to know the city of Pécs  
 with all of its attractions: ancient tombs, Turkish remains, the  
 Zsolnay Porcelain Manufactory, University of Pécs, champagne  
 and wine cellars etc.

A pre-conference short computer course will be held by Dr.  
 Manfred Mudelsee on the topic of Trend Analysis. The course  
 lectures will present bootstrap resampling as a powerful,  
 robust, computing-intensive tool able to meet the challenge.  
 Real-world climate data serve to illustrate the methods in  
 computer tutorials. Participants are welcome to bring own data.

Special issues of the conference will be published in International  
 Journal on Geomathematics (Springer) and Central European  
 Geology.

For further information please visit [www.geomates.eu](http://www.geomates.eu) or  
 contact us at [geomat.  
 mft@gmail.com](mailto:geomat.mft@gmail.com)



Registration and  
 abstract submission  
 will open on  
 02.01.2019.

Abstract submission  
 deadline: 07.04.2019

# GEOMATES 2019

## 20th annual conference of the International Association of Mathematical Geosciences (IAMG2019)

**August 10-16, 2019**

University Park campus in State College, Pennsylvania

**Abstract Submission Deadline: Jan. 8th, 2019**

Early bird registration closes April 30, 2019

Topics of Interest: Geo-mathematics, Geostatistics,  
 Geoinformatics and Geomodeling

For more information see:

**[www.iamgconferences.org/iamg2019](http://www.iamgconferences.org/iamg2019)**

*Additional details are included on the back page*



## CoDaWork2019

It is a pleasure to announce the 8th International Workshop  
 on Compositional Data Analysis (CoDaWork2019), to be held  
 in Terrassa (Spain), 3-8 June 2019. The event has recently  
 received the support from IAMG.

The website of the event contains updated information about  
 the workshop: <https://webs.camins.upc.edu/codawork2019/>

CoDaWork2019 is the eighth edition of the international  
 Workshop on Compositional Data Analysis. CoDaWork2019  
 is a forum intended for discussion of research issues related  
 to the quantitative treatment and modelling, interpretation of  
 models, and all sorts of applications involving compositional  
 data.

We keep CoDaWork pivoting around applications in different  
 fields. On previous editions, those included: engineering,  
 econometrics, psychology, official statistics, linguistics,  
 medicine, biology, genetics, microbiome, demography,  
 morphology, earth, planetary and environmental sciences,  
 archaeometry, forensics...

Prior to the Workshop, a one-day course on compositional  
 data will be offered.

The workshop will take place in Terrassa, at the Universitat  
 Politècnica de Catalunya and the Hotel Don Cándido. Terrassa  
 is located 28km from Barcelona and it is the third city in  
 Catalonia with respect to its population.

Please, save the date for attending CoDaWork2019. Abstracts  
 of the contributions are due for December 19, 2018.

We hope to meet you at the conference next June. Please  
 don't hesitate to contact us with any questions at organizing.  
[codawork2019@upc.edu](mailto:codawork2019@upc.edu).

*M. Ortego*

*Chair of CoDaWork2019*

*J.J. Egozue and J. Graffelman*

*Chairs of the Scientific Committee of CoDaWork2019*

International Association for Mathematical Geosciences  
(IAMG)

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



For the first time in 10 years, the Annual Conference of the International Association for Mathematical Geosciences (IAMG) will be hosted in the United States. Penn State, a tier-one research university, will host the 20th annual conference August 10-16, 2019 on the University Park campus in State College, Pennsylvania. The conference will include such topics as geomathematics, geostatistics, geoinformatics and geomodeling, with a special focus on geomodeling issues at the intersection of food, water and energy.

The conference's theme will be examined through oral and poster presentations, plenary presentations and short courses along with select articles to be published in a special edition journal. Interested researchers can submit a short abstract through the conference website by January 8, 2019. Any contributions to the development and application of mathematics and information theory focused on geoscientific problems are welcome. Selected attendees will have the opportunity to present their research through either an oral presentation along with a poster. Authors can also choose to submit a manuscript which will be considered for publication in a special edition journal. A complete timeline for abstract submission, review and notification is available on the IAMG 2019 website:

[www.iamgconferences.org/iamg2019](http://www.iamgconferences.org/iamg2019)

The conference will cover the usual topics in geo-mathematics, geostatistics, and geomodeling but in particular will bring to fore geomodeling issues at the intersection of food, water, and energy. The challenge of meeting the increased demand for food, water, and energy and the resultant stress on our geo-sphere is broadly accepted as one of the major scientific challenges facing mankind. The feedback processes intrinsic to this tri-partite cycle are best-studied using sophisticated mathematical and statistical modeling tools. One of the broad themes of the proposed conference will be to highlight research being performed to address these issues.

Sessions include: +Classical Geostatistics +Classical Statistics +Compositional Data Analysis +Fractal and Multifractal Modeling +Geohydrology +Geoinformatics +Geometry and Topology in Geosciences +Geophysical Data Processing, Interpretation and Machine Learning +Geotechnical Engineering +Coupled Modeling of Food, Water and Energy Systems +Machine Learning and Optimization Methods +Marine Geosciences: Coasts and Gateways +Medical geology +Mining modeling +Unconventional oil and gas resources modeling +Pattern Recognition Contributions to Inverse Methods in Geosciences +Spatiotemporal Geostatistics +Analysis, Simulation, and Optimization of Subsurface Systems +Fracture Characterization and Modeling +Coupling Geomechanics and Flow Systems in Subsurface Applications +Atmospheric and Earth System Science

Short courses include: +Geological Applications of Compositional Data Analysis: A Practical Introduction +Introduction to Digital Rock Physics +Machine Learning for Geoscience Modelling: Introduction and Advanced +Topics with Case Studies +Shale Analytics +Subsurface Fracture Characterization