



REGIONAL GROUNDWATER FLOW COMMISSION

ANNUAL PROGRESS REPORT

(January – December 2022)

1. Special Issue “From Groundwater Flow Understanding to Sustainable Water Management”

Strategic management of water resources is the key to a sustainable environment and future economic development. This requires knowledge of gravitational groundwater flow systems from the local to regional and basin scales. This Special Issue aims to analyze topics connected to the physicochemical processes of groundwater flow systems and their economic resources, geogenic and anthropogenic contamination and hazards of fluids, fluid–rock interactions in deep and shallow flow systems, vulnerability and management of aquifer recharge, water-based heat utilization in the light of climate change, and also legislative frameworks toward sustainable development goals.

Original research articles, theoretical, field, experimental, and numerical studies, and comprehensive review papers in the field of hydrogeology and geochemistry focusing on defining groundwater flow and preventing, controlling, and mitigating negative environmental impacts (quality and quantity) related to groundwater, including those in developing countries, are welcome.

This Special Issue brings together manuscripts from different fields of groundwater studies with the common aspect of understanding regional groundwater flow systems for improved water management. The Special Issue is initiated by the Regional Groundwater Flow Commission of IAH and the ENeRAG H2020 project and is connected to the [International Symposium on Geofluids](#) held in July 2021.

Guest editors: Prof. Dr. Judit Mádl-Szőnyi, Prof. Dr. Marco Masetti, Dr. Hanneke Verweij, Dr. Ádám Tóth, Dr. Brigitta Czauner, Prof. Dr. John Molson

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Dalla Libera, N.; Pedretti, D.; Casiraghi, G.; Markó, Á.; Piccinini, L.; Fabbri, P. Probability of Non-Exceedance of Arsenic Concentration in Groundwater Estimated Using Stochastic Multicomponent Reactive Transport Modeling. *Water* 2021, 13(21), 3086; <https://doi.org/10.3390/w13213086>.

Rivera, A.; Calderhead, A.I. Glacial Melt in the Canadian Rockies and Potential Effects on Groundwater in the Plains Region. *Water* 2022, 14(5), 733; <https://doi.org/10.3390/w14050733>.

Baják, P.; Hegedűs-Csondor, K.; Tiljander, M.; Korkka-Niemi, K.; Surbeck, H.; Izsák, B.; Vargha, M.; Horváth, Á.; Pándics, T.; Erőss, A. Integration of a Shallow Soda Lake into the Groundwater Flow System by Using Hydraulic Evaluation and Environmental Tracers. *Water* 2022, 14(6), 951; <https://doi.org/10.3390/w14060951>.

Déri-Takács, J.; Rostron, B.J.; Mendoza, C.; Mádl-Szőnyi, J. Hydrogeochemical Characteristics Refine the Conceptual Model of Groundwater Flow in Wood Buffalo National Park, Canada. *Water* 2022, 14(6), 965; <https://doi.org/10.3390/w14060965>.

Czauner, B.; Molnár, F.; Masetti, M.; Arola, T.; Mádl-Szőnyi, J. Groundwater Flow System-Based Dynamic System Approach for Geofluids and Their Resources. *Water* 2022, 14(7), 1015; <https://doi.org/10.3390/w14071015>.

Lin, H.; Xu, X.; Yang, J. Effect of Fault Extension Relevant to Unconformity on Hydrothermal Fluid Flow, Mass Transport, and Uranium Deposition. *Water* 2022, 14(7), 1097; <https://doi.org/10.3390/w14071097>.

Ortega Guerrero, M.A. Numerical Analysis of the Groundwater Flow System and Heat Transport for Sustainable Water Management in a Regional Semi-Arid Basin in Central Mexico. *Water* 2022, 14(9), 1377; <https://doi.org/10.3390/w14091377>.

Ortega Guerrero, M.A. Correction: Ortega Guerrero, M.A. Numerical Analysis of the Groundwater Flow System and Heat Transport for Sustainable Water Management in a Regional Semi-Arid Basin in Central Mexico. *Water* 2022, 14(11), 1797; <https://doi.org/10.3390/w14111797>.

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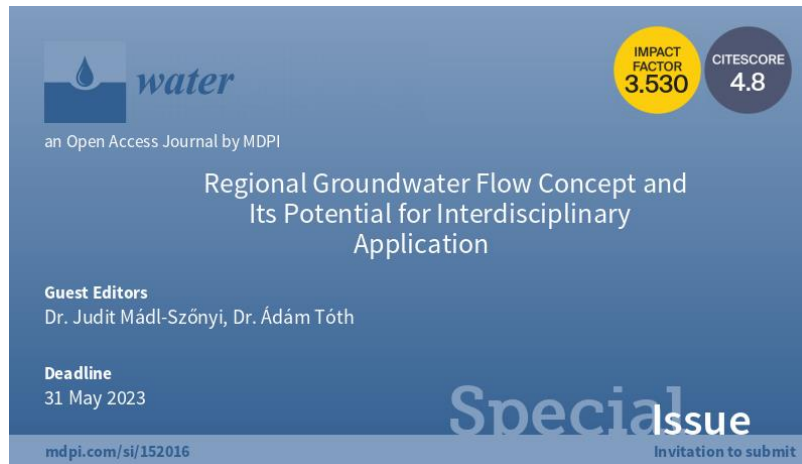
https://www.mdpi.com/journal/water/special_issues/ground_flow

2. Sessions at Conferences

In 2022, the annual [EGU General Assembly](#) was held in a hybrid form in Vienna. The events of the EGU 2022 conference were scheduled between 23-27 May 2022. The EGU General Assembly 2022, the first-ever fully-hybrid EGU meeting, was a great success with 12,332 presentations in 791 sessions. 7,315 colleagues from 89 countries participated on-site in Vienna, accompanied by 7,002 virtual attendees from 116 countries.

3. Call for Papers: Special Issue – Regional Groundwater Flow Concept and Its Potential for Interdisciplinary Application

The Special Issue “Regional Groundwater Flow Concept and Its Potential for Interdisciplinary Application” is now open for submission.



The 2022 World Water Day slogan is “Groundwater: Making the invisible visible”, which can help visualise and understand patterns of groundwater flow. There is a great need for a systematic basin-scale approach to reveal the regional relationships in groundwater. These can open new possibilities for scientists and professionals to understand the frontiers of hydrogeology with different disciplines. The main challenges are connected to climate change and for adjustment of flow systems to modified climate and the buffering capacity of flow. In addition to quantitative aspects, qualitative impacts induced by pollution, especially emerging contaminants, are also challenging. Groundwater flow and quality will influence groundwater-dependent ecosystems and the future water supply. Groundwater flow patterns are also important in exploring geothermal energy and controlling hydrocarbon migration. We await innovative papers on the topic, considering theoretical and practical aspects, regional studies and generalised conclusions.

The Regional Groundwater Flow Commission of the International Association of Hydrogeologists and the National Multidisciplinary Laboratory for Climate Change, RRF-2.3.1-21-2021 project initiated the Special Issue. The guest editors are waiting for contributions from the EGU2023 General Assembly.

Keywords: groundwater flow, ecosystems, climate change, adaptation, pollution, geothermal energy

Deadline for manuscript submissions: 31 May 2023

https://www.mdpi.com/journal/water/special_issues/H4I7230H76

Guest Editors: Dr. Judit Mádl-Szőnyi & Dr. Ádám Tóth

4. Dissemination of Knowledge

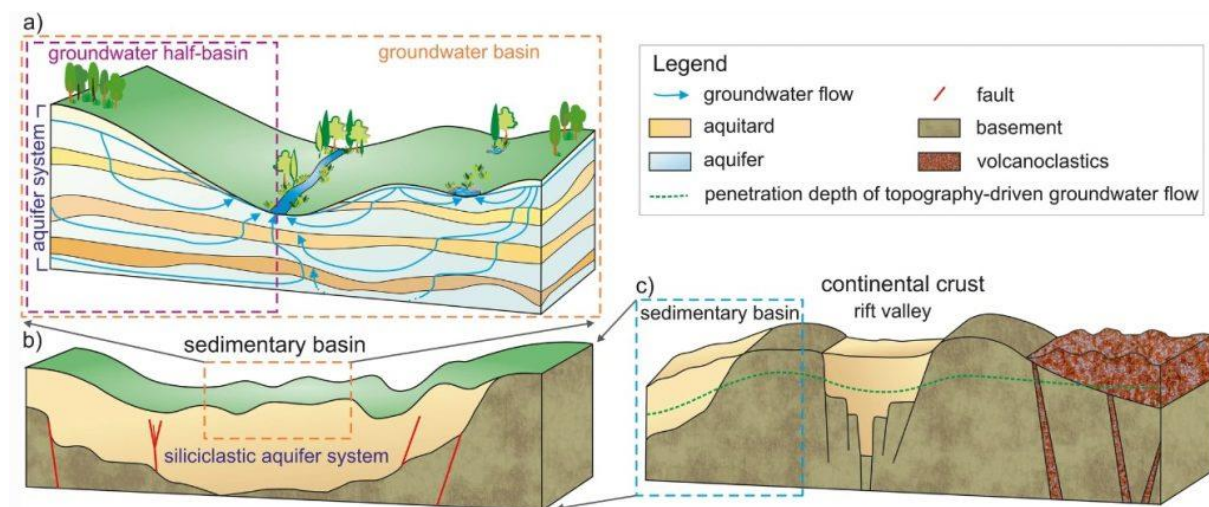
At the invitation of the IAH Executive, the board members of the RGFC-IAH published an [essay about regional groundwater flow](#) in Hydrogeology Journal. The article is part of the “International Year of Groundwater” topical collection. We would like to thank the significant efforts of the essay authors, and we hope we can continue the discussion of the subject in the IAH.

In this essay, the authors outlined the significance of groundwater flow systems in the context of current and future hydrogeological challenges. They reviewed the extension of the concept for interpreting complex aquifer systems and different hydrogeological environments. In addition, the article revealed terminology issues and introduced complex aquifer connectivity as a framework.

You can read the essay here (open access):

<https://link.springer.com/article/10.1007/s10040-022-02577-3>

Judit Mádl-Szőnyi, Okke Batelaan, John Molson, Hanneke Verweij, Xiao-Wei Jiang, José Joel Carrillo-Rivera & Ádám Tóth: Regional groundwater flow and the future of hydrogeology: evolving concepts and communication. Hydrogeology Journal 31, pages 23–26



Relation of different frameworks to groundwater flow interpretation: a) groundwater basins; b) sedimentary basin; c) terrestrial crustal aquifer system (modified after Yardley and Bodnar (2014))

Access all the Essays produced for the Topical Collection “Year of Groundwater”, which is entirely available as open access: https://link.springer.com/journal/10040/topicalCollection/AC_fa79a32dc5b38b7b0b78e5be26c97dd0

Several interviews have resulted in [communications](#) in written media as the topic Water a politicized issue, subject to business; communication signed by JJ Carrillo-Rivera made by Hugo Maguey, of the Gaceta Universitaria Journal, UNAM; 14:08; of the General Direction of Social Communication 20th June 2022

An [interview](#) was done with JJ Carrillo-Rivera by MVS Radio Interview. The general question was: Is there really water scarcity? Posted 24th June 2022 in <http://radiobilingue.org/noticias/medio-ambiente/edicion-mexico-459/>

RGFC launched its [LinkedIn](#) page, which is a forum for scientific discussion, in the autumn of 2014 and since then, the number of members has reached 353 (~5 new members during this reporting period).

Now, the news and activities of RGFC can be followed on other social media platforms. We will share conference pictures and update our @rgfc_iah [Instagram](#) profile, as well. You can use hashtag #rgfc_iah if you would like to share a photo of regional groundwater-related topics or even a memory of your daily hydrogeology practice. We already have 118 followers!

The Commission launched a [ResearchGate](#) project entitled *Selection of papers related to Regional Groundwater Flow*. This project was created and is managed by the Regional Groundwater Flow Commission of the International Association of Hydrogeologists (RGFC-IAH) in cooperation with the József & Erzsébet Tóth Endowed Hydrogeology Chair. This project is a selection of international papers related to the research and practical application of regional groundwater flow theory. The project has 1116 reads (~40 new ones) at the end of this reporting period. Unfortunately, ReserachGate will retire these projects, so the RGF Commission is looking for another way of disseminating scientific advancement.

5. Meeting of the Commission

We had an official online meeting on the 30th of January with the attendance of Board members discussing the requests of the IAH Council. The board members decided on the topical renewal of the Commission because of the following reasons: considering regional groundwater flow in aquifer systems allows for solving groundwater issues on a larger scale than single aquifers. Therefore regional flow approach contributes to all practical aspects of the UN's Sustainable Development Goals for water. The renewing Regional Flow Commission of IAH intends to contribute to the following goals with the help of new supporters, board members and co-chairs: advancing hydraulic characterization of groundwater flow; advancing concepts, approaches and methods; supporting the use of the correct terms and concepts related to regional groundwater flow; regional groundwater flow in water and energy transition; water use; advise and outreach. Since that, four new, including two ECHN professionals, expressed their wish to help with active support to the commission in this process: Etienne Bresciani, Brigitta Czauner, Alessia Kachadourian, and Xiaolang Zhang.

6. Future plans

- International Seminar on Use and Misuse of Water Related Terms, will be organized in Mexico
- Hanneke Verweij, a member of the Board, plans to organize a meeting/workshop on the significance of RGF for transition in water management and spatial planning in the subsurface.
- John Molson and his colleagues are organizing a day event of groundwater talks in memory of Dr Emil Frind in October 2023.
- Joe Tóth published his original paper on regional groundwater flow in 1963. The 60th birthday of the theory and the 90th birthday of Joe Tóth are planned to be celebrated by the Commission.

7. Publications

Papers and books

Czauner B, Erőss A, Szkolnikovics-Simon Sz, Markó Á, Baják P, Trásy-Havril T, Szijártó M, Szabó Zs, Hegedűs-Csondor K, Mádl-Szőnyi J (2022) From basin-scale groundwater flow to integrated geofluid research in the hydrogeology research group of Eötvös Loránd University, Hungary. *Journal of Hydrology X*, Paper: 100142

Czauner B, Molnár F, Masetti M, Arola T, Mádl-Szőnyi J (2022) Groundwater Flow System-Based Dynamic System Approach for Geofluids and Their Resources. *Water* 14:7, Paper: 1015

Déri-Takács J, Rostron B, Mendoza C, Mádl-Szőnyi J (2022) Hydrogeochemical Characteristics Refine the Conceptual Model of Groundwater Flow in Wood Buffalo National Park, Canada. *Water* 14:6, Paper: 965

Galsa A, Tóth Á, Szijártó M, Pedretti D, Mádl-Szőnyi J (2022) Interaction of basin-scale topography- and salinity-driven groundwater flow in synthetic and real hydrogeological systems. *Journal of Hydrology*, Paper: 127695

Hatch-Kuri G, Carrillo-Rivera JJ (2022) Scientific concepts and their political implications in the management of Mexico-U.S. Transboundary water courses: Transboundary Aquifer or Transboundary Groundwater? *Journal Water and Landscape (in Spanish)* 21, pp. 37–52

Houben GJ, Batelaan O (2022) The Thiem team – Adolf and Günther Thiem, two forefathers of hydrogeology. *Hydrol. Earth Syst. Sci.* 26:15, pp. 4055–4091

Ji TT, Jiang XW, Gou LF, Jin ZD, Zhang H, Wan L, Han GL, Guo HM, Wang XS (2022) Behaviors of Lithium and its isotopes in groundwater with different concentrations of dissolved CO₂. *Geochimica et Cosmochimica Acta* 326, pp. 313–327

Mádl-Szőnyi J, Erőss A, Csondor K, Iván V, Tóth Á (2022) Hydrogeology of the Karst Regions in Hungary. In: Veress M, Leél-Őssy Sz (eds.) *Cave and karst systems of Hungary*, Cham, Switzerland, Springer-Verlag, pp. 137–160

Mádl-Szőnyi J, Batelaan O, Molson J, Verweij H, Jiang XW, Carrillo-Rivera JJ, Tóth Á (2022) Regional groundwater flow and the future of hydrogeology: evolving concepts and communication. *Hydrogeology Journal* 31, pp. 23–26

Schmidt S, Hatch-Kuri G, Carrillo-Rivera JJ (2022) *Water, the Invisible Gold*. Book in Spanish. Editorial Iberlibro.com, ISBN 13:9798429829272; 105 p.

Tabarmayeh M, Zarei M, Batelaan O (2022) A new approach to quantification of groundwater resource stress. *Journal of Hydrology: Regional Studies* 42, Paper: 101161

Tóth Á, Kovács S, Kovács J, Mádl-Szőnyi J (2022) Springs regarded as hydraulic features and interpreted in the context of basin-scale groundwater flow. *Journal of Hydrology*, Paper: 127907

Trásy-Havril T, Szkolnikovics-Simon Sz, Mádl-Szőnyi J (2022) How Complex Groundwater Flow Systems Respond to Climate Change Induced Recharge Reduction? *Water* 14:19, Paper: 3026

Yahyaoui I, Carrillo-Rivera JJ (2022) Importance of Vertical Groundwater Flow as a Discharge Component in Transboundary Chotts, Western Tunisia. *Hydrology* 10:3, pp. 56–64

Zhang H, Jiang XW, Li GJ, Ji TT, Wang XS, Wan L, Guo HM (2023) Geological carbon cycle in a sandstone aquifer: evidence from hydrochemistry and Sr isotopes. *Journal of Hydrology*, Paper: 128913

Zhang YP, Jiang XW, Cherry J, Zhang ZY, Wang XS, Wan L (2022) Revisiting hydraulics of flowing artesian wells: a perspective from basinal groundwater hydraulics. *Journal of Hydrology*, Paper: 127714

Conference Presentations

Yahyaoui I, Carrillo-Rivera JJ: Importance of Vertical Groundwater Flow as a Discharge Component in Transboundary Chotts, Western Tunisia. 12th International Hydrogeological Conference, Lefkosia (Nicosia), Cyprus, 20–22 March 2022

Schmidt S, Hatch-Kuri G, Carrillo-Rivera JJ: Introducing the book: *Water, the Invisible Gold* (in Spanish). CIDE, CONACYT. Center of Research and Teaching in Economics, CONACYT, Santa Fe, Mexico City, 29 March 2022

Szabó Zs, Pedretti D, Masetti M, Ridavits T, Csiszár E, Falus Gy, Palcsu L, Sütő V, Mádl-Szőnyi J : Rooftop Rainwater Harvesting by Shallow Well Infiltration – Challenges and Opportunities. ISMAR11, Long Beach, USA, 11–15 April 2022

Tóth Á, Huysmans M, Hartog N, Stefan C, Mádl-Szőnyi J: The use of regional groundwater flow characteristics for optimized screening of MAR potential and application conditions. ISMAR11, Long Beach, USA, 11–15 April 2022

Schmidt S, Hatch-Kuri G, Carrillo-Rivera JJ: Introducing the book: Water, the Invisible Gold (in Spanish). Senate of the Mexican Republic. Organized by Senator Eva Galáz Caletti. Auditorium Octavio Paz, Senate of Mexico, 27 April 2022

Schmidt S, Hatch-Kuri G, Carrillo-Rivera JJ: Introducing the book: Water, the Invisible Gold (in Spanish). Institute of Geography, CU, UNAM, Mexico City, 2 May 2022

Czauner B, Mádl-Szőnyi J: Determination and characterization of abnormal formation pressures in the Pannonian Basin, Hungary. AAPG Europe Regional Conference 2022: Revitalizing Old Fields and Energy Transition in Mature Basins, Budapest, Hungary, 3–4 May 2022

Mádl-Szőnyi J, Czauner B, Tóth Á: System approach, the base of coordinated geofluid research. AAPG Europe Regional Conference 2022: Revitalizing Old Fields and Energy Transition in Mature Basins, Budapest, Hungary, 3–4 May 2022

Markó Á, Korhonen K, Mádl-Szőnyi J: Shallow geothermal potential of central Budapest estimated using an infinite borehole field model. AAPG Europe Regional Conference 2022: Revitalizing Old Fields and Energy Transition in Mature Basins, Budapest, Hungary, 3–4 May 2022

Tóth Á, Szijártó M, Galsa A, Mádl-Szőnyi J: Interbasin flow as a major driver of heat accumulation in mature sedimentary basins. AAPG Europe Regional Conference 2022: Revitalizing Old Fields and Energy Transition in Mature Basins, Budapest, Hungary, 3–4 May 2022

Bouznari K, Molson J, Van De Ven CJC, Mumford K: Migration behavior of fugitive methane from oil and gas well casings, in porous media: Multiphase numerical modelling of field-scale conceptual models. GAC–MAC–IAH–CNC–CSPG Joint Meeting, GeoHalifax 2022, 15–18 May 2022

Gatel L, Arbour G, Coulon C, Tremblay Y, Germain A, Molson J, Lemieux JM: Quantitative groundwater resource management on small islands: The Magdalen Islands. GAC–MAC–IAH–CNC–CSPG Joint Meeting, GeoHalifax 2022, 15–18 May 2022

Mathis R, Lefebvre R, Molson J, Paradis D, Ballard JM: 3D numerical modelling of groundwater flow and residence time in an Appalachian aquifer system. GAC–MAC–IAH–CNC–CSPG Joint Meeting, GeoHalifax 2022, 15–18 May 2022

Parenteau-Thibault M, Lemieux JM, Molson J, Kinnard C, Germain A, Fortier P: Using numerical simulations to support the interpretation of thermal infrared remote surveys for mapping submarine groundwater discharge. GAC–MAC–IAH–CNC–CSPG Joint Meeting, GeoHalifax 2022, 15–18 May 2022

Baják P, Hegedűs-Csondor K, Tiljander M, Korkka-Niemi K, Izsák B, Vargha M, Pándics T, Tóth Á, Csepregi A, Eröss A: Regional Groundwater Flow Studies To Integrate A Shallow Soda Lake Into the Gravity-Driven Groundwater Flow System – A Case Study From Hungary. 49th IAH Congress, online, 19–22 September 2022

Czauner B, Szkolnikovics-Simon Sz, Mádl-Szőnyi J: Regional-scale normal and abnormal pore pressure regimes and groundwater flow systems – determination,

characterization, and climate change-related issues. 49th IAH Congress, online, 19–22 September 2022

Mádl-Szőnyi J, Batelaan O, Molson J, Verweij H, Jiang XW, Sterckx A, Carrillo-Rivera JJ, Tóth Á: Inspiration for integrating topics of regional groundwater flow and transboundary aquifers. 49th IAH Congress, online, 19–22 September 2022

Szabó Zs, Szijártó M, Masetti M, Mádl-Szőnyi J: Involvement of groundwater table inclination in nature-based GDE replenishment. 49th IAH Congress, online, 19–22 September 2022

Szokolnikovics-Simon Sz, Déri-Takács J, Szijártó M, Szél L, Czauner B, Mádl-Szőnyi J: Water shortage in recharge regions of groundwater flow systems – how can we manage the GDEs in the Nyírség Region, Hungary? 49th IAH Congress, online, 19–22 September 2022

Tóth Á, Kovács S, Kovács J, Mádl-Szőnyi J: Spring data analyses for revealing basin-scale groundwater flow characteristics. 49th IAH Congress, online, 19–22 September 2022

Budapest, 31 March 2023

Ádám Tóth, Secretary of RGFC

Judit Mádl-Szőnyi, Chair of RGFC