



REGIONAL GROUNDWATER FLOW COMMISSION

ANNUAL PROGRESS REPORT

(January – December 2023)

1. Meeting and renewal of the Commission

Based on the official online meeting on the 30th of January with the attendance of board members, the Commission underwent a renewal process and structural change in 2023.

As part of the renewal of the RGFC-IAH, we intend to improve the understanding and practical application of the regional groundwater flow concept to solve recent hydrogeology challenges. Considering the regional groundwater flow of aquifer systems allows for handling groundwater issues on a larger scale than [single aquifers](#).

The regional flow approach contributes to all practical aspects of the UN's Sustainable Development Goals for water. The main goals of the RGF Commission are to (1) Advancing hydraulic characterisation of groundwater flow, (2) Advance concepts, approaches and methods, (3) Support the use of the correct terms and concepts related to regional groundwater flow, (4) Regional groundwater flow in water and energy transition, (5) Water use, (6) Advise and outreach.

Regarding the changes, based on the request and trust of the Board members, Judit Mádl-Szőnyi agreed to continue as a co-chair. Two additional co-chairs are planned to be appointed to enable the efficient functioning of the Board based on the request of the IAH-Executive. Our long-lasting secretary, Ádám Tóth, has now resigned. We are truly grateful for his efficient work and enthusiastic activity in the Commission in the last eight years. Fortunately, he remains a member of the Board and helps us with his experience in the future. Szilvia Simon, PhD, assistant professor at the ELTE University (Hungary), is following him in this position. We are also welcoming four new young professionals to the Board of the Commission:

- Etienne Bresciani, PhD, Researcher in Physical Hydrogeology, Universidad de O'Higgins, Chile,
- Xiaolang Zhang PhD, Assistant Professor, Hydrogeology, USA
- Alessia Kachadourian MSc, Hydrogeologist, Environmental Specialist, Mexico
- Brigitta Czauner PhD, Assistant Professor, Hydrogeology, ELTE, Hungary

We look forward to working together towards the widespread recognition and application of the regional groundwater flow concept.

We have also started recruiting new people, particularly ECHN members, to join the commission. ~Ten new candidates have already indicated their intention to join.

2. 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” was completed and published in *Water* at the end of 2023. The Regional Groundwater Flow Commission of the International Association of Hydrogeologists and the National Multidisciplinary Laboratory for Climate Change, RRF-2.3.1-21-2022-00014 project initiated this Special Issue. The guest editors, Dr Judit Mádl-Szőnyi and Dr Ádám Tóth invited contributions from the RGFC supported Session of the EGU2023 General Assembly. The Special issue connected to the 2022 World Water Day with the slogan “Groundwater: Making the invisible visible”. This can help visualise and understand the pattern 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 climate change, adjusting flow systems to modified climate, and the buffering capacity of the flow. In terms of the quantitative aspects, the qualitative aspects 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 significant in exploring geothermal energy and controlling hydrocarbon migration.

Please visit this website for more information:

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

Table of contents:

Baják, P.; Molnár, B.; Hegedűs-Csondor, K.; Tiljander, M.; Jobbágy, V.; Kohuth-Ötvös, V.; Izsák, B.; Vargha, M.; Horváth, Á.; Csipa, E.; Óvári, M.; Tóbi, C.; Völgyesi, P.; Pelczar, K.; Hult, M.; Erőss, A. Natural Radioactivity in Drinking Water in the Surroundings of a Metamorphic Outcrop in Hungary: The Hydrogeological Answer to Practical Problems. *Water* 2023, 15(9), 1637; <https://doi.org/10.3390/w15091637>.

Czauner, B.; Szabó, Z.; Márton, B.; Mádl-Szőnyi, J. Basin-Scale Hydraulic Evaluation of Groundwater Flow Controlled Biogenic Gas Migration and Accumulation in the Central Pannonian Basin. *Water* 2023, 15(18), 3272; <https://doi.org/10.3390/w15183272>

Hunt, M.; Marandi, A.; Retike, I. Water Balance Calculation for a Transboundary Aquifer System between Estonia and Latvia. *Water* 2023, 15(19), 3327; <https://doi.org/10.3390/w15193327>.

Männik, M.; Karro, E. Application of Modified DRASTIC Method for the Assessment and Validation of Confined Aquifer Vulnerability in Areas with Diverse Quaternary Deposits. *Water* 2023, 15(20), 3585; <https://doi.org/10.3390/w15203585>.

3. Sessions at Conferences

In 2023, the annual EGU General Assembly was held in a hybrid form in Vienna. The event was organised between 23–28 April 2023. In the very successful congress, the RGFC co-organised the session HS8.2.3, entitled: The role of groundwater flow systems in solving water management and environmental problems. The session convener was Judit Mádl-Szőnyi, and the co-conveners were Daniela Ducci, Jim LaMoreaux, Manuela Lasagna and John Molson.

The session aimed to bring together scientists studying various aspects of groundwater flow systems and their role in solving water management and environmental problems. Understanding groundwater flow systems requires knowledge of the governing processes and conditions from the local to regional and basin scales, including porous and fractured porous media. Moreover, problems connected to groundwater management underline the importance of sustainable development and the protection of groundwater resources. In this context of groundwater flow understanding, the session intended to analyse issues connected to groundwater management and its protection from degradation concerning quantity and quality (e.g. due to over-exploitation, conflicts in use, climate change, resource development or contamination). The role and importance of groundwater flow systems were highlighted. Papers related to methods of characterising groundwater flow systems and preventing, controlling and mitigating harmful environmental impacts related to groundwater, including those in developing countries, were also welcome.

There was a high interest in the session, and on the event, eighteen oral presentations were performed in on-site and virtual formats in the form of short 5-minute presentations followed by a Q&A session. Ten posters were also presented during the session. The EGU General Assembly 2023 provided an excellent opportunity to share knowledge and research ideas about the application of regional groundwater flow system concepts in different theoretical and practical problems. New connections could be established with scientists from all over the world. The session was once again a great success.

4. Dissemination of Knowledge

RGFC continues using the [LinkedIn page](#) as an information platform and a forum for scientific discussion. The number of members has reached 364 (~ ten new members during this reporting period).

Since last year, RGFC's news and activities have been followed on other social media platforms, including our @rgfc_iah Instagram profile. You can use the 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!

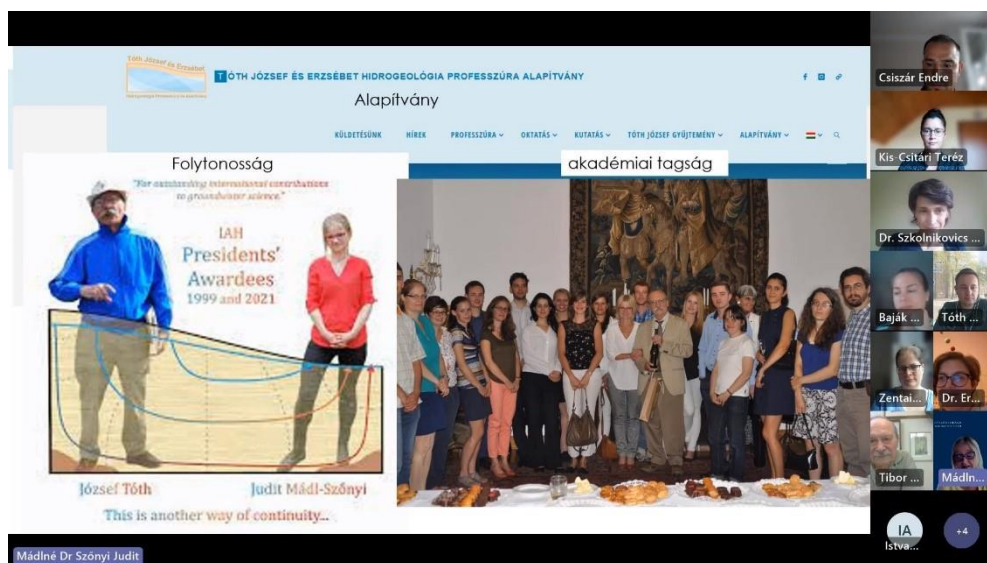
5. Events and awards

Prof. Dr József Tóth, the lifetime honorary chair of the Committee, celebrated his 90th birthday on 22 June 2023. Some of the several achievements associated with his name are:

- mathematical foundation of groundwater's basin hydraulics analysis;
- description of the systematic movement of groundwater flow;
- recognition of the role of groundwater flow systems as subsurface geologic agents;
- and, consequently, the formulation of the basic concept of modern hydrogeology.

IAH acknowledged him by Presidents' Award in 1999 and Honorary Membership in 2012.

On his 90th birthday, his former Hungarian students and colleagues (committee members) greeted him in an online meeting. He was also welcomed by friends and colleagues worldwide, whose kind words were collected in a small book and presented to him as a gift. We wish him many more happy and healthy years!

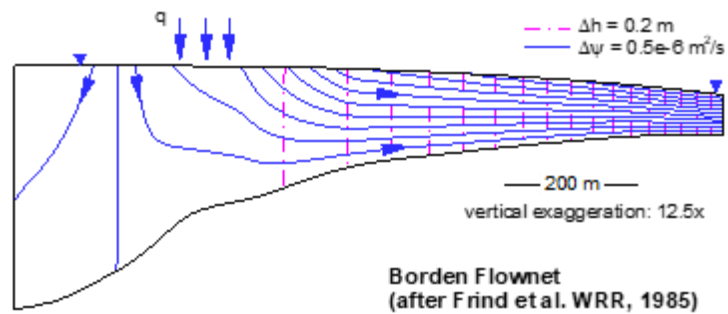


Our member in the Commission, **Prof. Dr. Carlos Molano**, the former IAH Vice-President for Latin America and the Caribbean, was awarded the prestigious Presidents' Award in 2023—we are very proud of this great honour for his excellent work.



In October, a scientific event was organised in memory of Prof. Dr. Emil Frind, **the Emil Frind Day**:

„A commemorative day recognising Dr. Emil O. Frind's contributions to hydrogeological modelling was held on October 18th 2023, at the University of Waterloo, Ontario, Canada. Dr. Frind passed away on december 25, 2022, after over 50 years as a Professor in the Department of Earth Sciences at U. Waterloo. With over 60 attendees from Europe, North and South America, many former colleagues and students highlighted his research, teaching, and dedication to groundwater protection for the local communities and beyond. Among many awards, Emil received the NGWA's M. King Hubbert and Life Member awards, the IAH-CNC Robert N. Farvolden Award and the Grand River Conservation Authority Watershed Award. Emil was widely known for developing new modelling approaches, including the first finite element groundwater flow model (with George Pinder), modelling density-dependent and reactive mass transport systems, and introducing numerical groundwater flow nets. The Emil Frind Day was a great success and an opportunity to meet old friends and colleagues in memory of one of the pioneers in modern hydrogeology.” (J. Molson, PhD, Ing, Department of Geology & Geological Engineering, Université Laval, Quebec, Canada and D. Rudolph, PhD, P.Eng, Department of Earth Sciences, University of Waterloo, Waterloo, ON, Canada).



6. Future plans

- Foundation of a Mexican Working Group, MWG (a task-orientated team) under the umbrella of IAHR and RGFC to review and encourage GWFS-related papers, their teaching, and related activities; that would be the MWG-GWFSR.
- The establishment of a GWFS Foundation in UNAM has been put forward to the authorities of the Institute of Geography to assist the flow systems in being part of the curriculum of academic activities in geography. The aim is to encourage students (in Mexico and perhaps from other countries) at the MSc and PhD levels to do their research on the RGWFS. The foundation will be meant to give some incentives to highly dedicated students and a prize for the best thesis on applying RGWFS. This effort is looking for possible links with Hungary and China.
- A Network related to a Scientific Program of the GWFS is planned to be initiated by colleagues having the required background in the definition and application of the flow systems. This Network will focus on the specific topic areas of the Groundwater Flow Systems. The network will be primarily designed to stimulate interaction between groundwater scientists, both locally and internationally, and sometimes with the broader community in areas of common interest. The Network is expected to organise technical conference sessions, exchange and disseminate knowledge, maintain a website, be active on social media, and contribute to the Association's educational objectives. However, while Networks are also encouraged to engage in the full range of activities expected of Commissions, they are not obliged to do so. Networks will generally advise the Board on all scientific and other relevant matters within their sphere of competence.
- The GSA Hydrogeology Division has selected Dr. Ben Rostron (University of Alberta), a former student of Joe Tóth, as its 2024 Birdsall-Dreiss Distinguished Lecturer. This is an excellent opportunity to listen to a highly related talk on manifestations of regional groundwater flow. He will visit many places, including Hungary, and gives all three talks in the framework of RGFC.

- RGFC co-organizes a session at EGU General Assembly 2024 (14–19 April 2024) ([Session HS8.2.2 \(copernicus.org\)](#)). The session HS8.2.2, entitled: The role of groundwater flow systems in solving water management and environmental problems.
- RGFC will be represented at the [IAH 2024 Congress](#) in Davos. Our session has been accepted and entitled Basin-scale groundwater flow, heat & mass transport processes – Looking beyond individual aquifers to address current hydrogeological challenges.

7. Publications

Papers and books

Baják, P, Molnár, B, Hegedűs-Csondor, K, Tiljander, M, Jobbágy, V, Kohuth-Ötvös, V, Izsák, B, Vargha, M, Horváth, Á, Csipa, E, Óvári, M, Tóbi, C, Völgyesi, P, Pelczar, K, Hult, M, Eröss, A. (2023) Natural Radioactivity in Drinking Water in the Surroundings of a Metamorphic Outcrop in Hungary: The Hydrogeological Answer to Practical Problems. *Water*, 15(9), 1637.

Czauner, B, Szabó Zs, Márton, B, Mádl-Szőnyi, J. (2023) Basin-Scale Hydraulic Evaluation of Groundwater Flow Controlled Biogenic Gas Migration and Accumulation in the Central Pannonian Basin. *Water*, 15(18), 3272.

Korhonen K, Markó Á, Bischoff A, Szijártó M, Mádl-Szőnyi J (2023) Infinite borehole field model—a new approach to estimate the shallow geothermal potential of urban areas applied to central Budapest, Hungary. *Renewable energy*, 208, 263-274.

Jiang XW, Cherry J. (2024) History and Hydraulics of Flowing Wells. The Groundwater Project, Guelph, Ontario

Lubczynski, MW, Leblanc M, Batelaan O. (2024) Remote sensing and hydrogeophysics give a new impetus to integrated hydrological models: A review. *Journal of Hydrology*, 633, 130901.

Rusydi AF, Setiawan T, Maria R, Firmansyah F, Damayanti R, Mulyono A, Rahayudin Y, Bakti H, Perdananugraha GM, Carrillo Rivera JJ (2023) Groundwater nitrogen concentration changes in an urbanized area of Indonesia over ten years period. *Earth and Environmental Sciences*, 1201, 012035.

Schmidt S, Hatch Kuri G, Carrillo Rivera JJ (2023) *Water, the Invisible Gold* (in Spanish). Editorial Iberlibro.com, ISBN 13:9798429829272, 105 p.

Schmidt S, Hatch Kuri G, Carrillo Rivera JJ (2023) *Agua Subterránea. Visibilizando lo Invisible. (Groundwater: Making the Invisible Visible)*, Editorial: El Colegio de Veracruz. *Materia: Aguas subterráneas (aguas subsuperficiales)*, ISBN 978-607-8040-31-5. 145 p.

Shi JX, Jiang XW, Zhang ZY, Zhang YP, Wang XS, Wan L (2023) Interaction of focused recharge and deep groundwater discharge near a wetland: a study in the Ordos Basin, China. *Journal of Hydrology*, 626, 130361.

Simon Sz, Déri-Takács J, Szijártó M, Szél L, Mádl-Szőnyi J (2023) Wetland Management in Recharge Regions of Regional Groundwater Flow Systems with Water Shortage, Nyírség Region, Hungary. *Water*, 15(20), 3589.

Szabó Z, Pedretti D, Masetti M, Ridavits T, Csiszár E, Falus Gy, Palcsu L, Mádl-Szőnyi J (2023) Rooftop rainwater harvesting by a shallow well – Impacts and potential from a field experiment in the Danube-Tisza Interfluvium, Hungary. *Groundwater for Sustainable Development*, 20, 100884.

Szabó Z, Szijártó M, Tóth Á, Mádl-Szőnyi J (2023) The Significance of Groundwater Table Inclination for Nature-Based Replenishment of Groundwater-Dependent Ecosystems by Managed Aquifer Recharge. *Water*, 15(6) 1077.

Tóth, Á, Baják P, Szijártó M, Tiljander M, Korkka-Niemi, Hendriksson N, Mádl-Szőnyi J. (2023) Multimethodological Revisit of the Surface Water and Groundwater Interaction in the Balaton Highland Region—Implications for the Overlooked Groundwater Component of Lake Balaton, Hungary. *Water*, 15(6), 1006.

Yahyaoui I, Carrillo-Rivera JJ (2022) Importance of Vertical Groundwater Flow as a Discharge Component in Transboundary Chotts, Western Tunisia, *Hydrology*, 10(3), 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*, 617, 128913.

Conference Presentations

Baják P, Hegedűs-Csondor K, Csepregi A, Chappon M, Bene K, Erőss A (2023). Numerical modeling and time series analysis to quantify the neglected groundwater component in Lake Velence's water budget – a case study from Hungary. *European Geosciences Union (EGU) (2023) p. EGU23-12278*

Carrillo Rivera JJ, Kachadourian Marras A, Alconada Magliano M (2023) Recognizing groundwater visible features, usefulness of the flow system understanding. *Université Echahid Cheikh Larbi Tebessi, Tebessa, Algeria, 5th Colloque International CIGSDD2022, 15/02/23.*

Czauner B, Szkolnikovics-Simon Sz, Mádl-Szőnyi J. (2023) The influence of deep groundwater flow systems on the Earth's critical zone. *European Geosciences Union (EGU) (2023)*

Egidio E, Molson JW, de Luca A, Lasagna M (2023) Groundwater temperature variations in the Turin metropolitan area (Piedmont, NW Italy): Building a flow and heat

transport model for the assessment of future climate change scenarios, Flowpath : National Conference of the Italian Chapter of the International Association of Hydrogeologists (IAH) Malta, 16-23 June, 2023.

Eröss A, Baják P, Molnár B, Hegedűs-Csondor K, Tiljander M, Izsák B, Vargha M, Horváth Á, Jobbágy V, Hult M, Pelczar K, Völgyesi P, Tóbi Cs, Óvári M, Csipa E, Kohuth-Ötvös V. (2023) Natural radioactivity in drinking water in the surroundings of a metamorphic outcrop in Hungary: interpretation of practical problems in groundwater flow system context. European Geosciences Union (EGU) (2023) p. EGU23-12238

Guertin, E, Lemieux JM, Allard G, Molson J (2023) Stratigraphic and hydrogeological controls on the development of suffusion cavities in undisturbed fluvio-glacial sediments, GeoSaskatoon2023: Canadian Geotechnical Conference and Joint IAH-CNC-CGS, Saskatoon, Saskatchewan, 1-4 October 2023

Kachadourian Marras A (2023) Basic hydrological concepts to understand water. Seminario Agua Subterránea y Cambio Climático. Instituto de Geografía. Universidad Nacional Autónoma de México.

Kachadourian Marras A (2023) Caracterización hidrogeológica en superficie del territorio de las comunidades Punta Chueca y Desemboque, Hermosillo, Sonora. Introduciendo criterios del diálogo de saberes. 4° Simposio de Nutrición, Alimentación y Salud. Centro de Investigación en alimentación y Desarrollo. Consejo Nacional de Humanidades, Ciencia y Tecnología (CONAHCYT). Gobierno de México.

Markó Á, Tóth M, Brehme M, Mádl-Szőnyi J (2023) Investigation of a deltaic thermal water reservoir formation in the Zala region (SW Hungary) to estimate the “geothermal reinjection potential”. 36th International Meeting of Sedimentology, p. 250.

Mádl-Szőnyi J, Molson J, Batelaan O, Verweij H, Jiang XW, Carrillo-Rivera JJ, Tóth Á (2023) Evolving concepts and communication: what do we need to evaluate better regional groundwater flow? European Geosciences Union (EGU) (2023) EGU23-14159

Suilmann J, Perin A, Broggi M, Graf T, Molson JW (2023) Risk-based assessment of salt domes as disposal sites for nuclear waste: Uncertainty of groundwater age in the salt dome problem, In Proceedings, EGU General Assembly 2023, Session ERE3.2: Deep Geological Repositories.

Szijártó Márk, Vatai Zsuzsanna, Galsa Attila (2023) Numerical investigation of the groundwater age and heat transport processes in asymmetric hydrogeological situations. European Geosciences Union (EGU) (2023) p. EGU23-3840

Budapest, 30 March 2024

Szilvia Simon, Secretary of RGFC

Judit Mádl-Szőnyi, Chair of RGFC