REGIONAL GROUNDWATER FLOW COMMISSION

ANNUAL PROGRESS REPORT

January – December 2024

1. Annual meeting of the Commission

Our annual official meeting was held in person at the IAH 2024 Congress in Davos, in September 2024. The Commission's Board and some supporters (~10) attended the meeting. After presenting our annual activities, we focused on discussing future plans and the involvement of young scientists in the Commission. We have stated that the application of the regional groundwater flow system approach to current practical problems is still of great importance and that, alongside technological advances, the correct knowledge and application of basic concepts are crucial. Therefore, the Commission intends to continue its activities to promote the concept of groundwater flow systems in the future. To achieve our plans we continued to recruit new people, particularly ECHN members. At the event, four new members joined the commission. One of them, the young scientist, Petra Baják has taken on the role of managing the social media interfaces of the RGFC.
Our former board member Rene Le Febvre has retired, so the North American region will continue to be represented by John Molson.

Group photo from the meeting

2. Sessions at Conferences

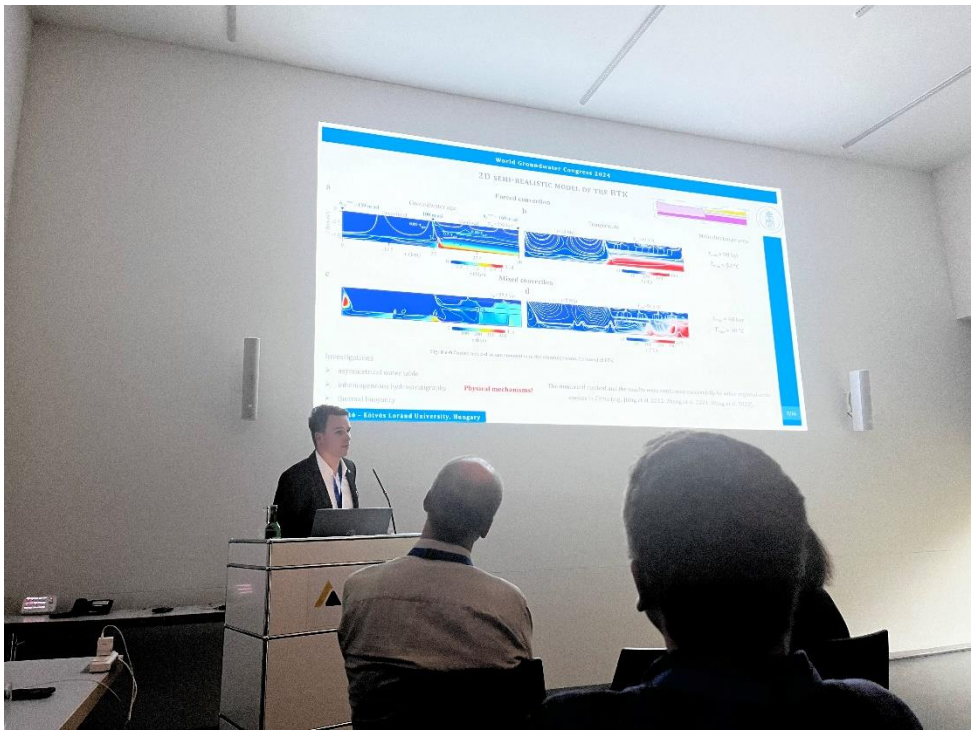
In 2024, the annual **EGU General Assembly** was organised in a hybrid form in Vienna. The event was held between 14–19 April 2024. In the event, the RGFC co-organised the session HS8.2.2, entitled: *The role of groundwater flow systems in solving water management and environmental problems*. The session convener was Manuela Lasagna, and the co-conveners were Judit Mádl-Szőnyi, John Molson, Jim LaMoreaux, and Stefania Stevenazzi.

“The session aimed to bring together scientists studying various aspects related to 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 protection of groundwater resources. In this context, the session intends to analyze issues connected to groundwater management and its protection from degradation and deterioration concerning quantity and quality (e.g. due to over-exploitation, conflicts in use, climate change, resource development or contamination). Papers related to methods for characterising groundwater flow systems, and preventing, managing and mitigating harmful environmental impacts related to groundwater are also welcome.”

The session has increasing interest from year to year, with a growing number of applicants presenting their work in the frame of this session. In 2024, twenty oral presentations were performed in on-site and virtual formats in the form of short 10-minute long presentations. Thirteen posters were also presented during the session. The EGU General Assembly 2024 provided an excellent opportunity to share knowledge and research ideas about applying regional groundwater flow system concepts to different theoretical and practical problems. New connections could be established with scientists from all over the world.

Group photo from the EGU

At the **World Groundwater Congress** (IAH 2024) in Davos the RGFC also represented itself by organising session 1.08, entitled *„Basin-scale groundwater flow, heat & mass transport processes: Looking beyond individual aquifers to address current hydrogeological challenges”*. The description of the session was as follows: ”A regional, or basinal approach to groundwater flow and transport from recharge to discharge areas is required for effectively resolving resource issues such as freshwater and energy supplies. This approach contributes to all practical aspects of the UN’s Sustainable Development Goals for water. This session encourages contributions on regional groundwater flow and transport topics such as new approaches and methods in hydrogeologic characterization, advances in modeling techniques, and scenario analysis. The evaluation of uncertainty in predictions, new insights into coupled flow, heat, and/or mass transport systems at the basin scale, and discussions about the concept of regional groundwater flow systems and associated terminology are also welcome. Relevant fields of application include but are not limited to water and energy transition; offshore assessment of fresh groundwater discharge; mountain-block hydrogeology; interpretation of various tracers in groundwater (heat, hydrochemistry, and isotopes); and regional aspects of managed groundwater recharge. Presentations discussing the role of regional groundwater flow systems in the expected transition period due to climate change, intensive extraction, quality concerns, and ecosystem services also align with the session’s objectives. Regional groundwater governance, water conflicts, societal response, and the role of education and outreach will also be considered.” The convener was Etienne Bresciani and the co-conveners were Laura Condon, Hanneke Verweij, Xioawei Jiang, Joel Carrillo, Judit Mádl-Szőnyi, Szilvia Simon, Chunmiao Zheng, and Reed Maxwell. The session was popular. Twelve papers and seven posters were presented, and an active scientific discussion followed the presentations. The keynote speaker was Grant Fergusson, talking about fossil groundwater in the Anthropocene. The session provided a good opportunity to follow the latest research results concerning basin-scale groundwater flow systems and the concept’s application in practical problems. The presentations and posters proved that basic research in and practical application of groundwater flow systems is essential in all hydrogeological activities.



Márk Szijártó is presenting in the Session

3. Dissemination of Knowledge

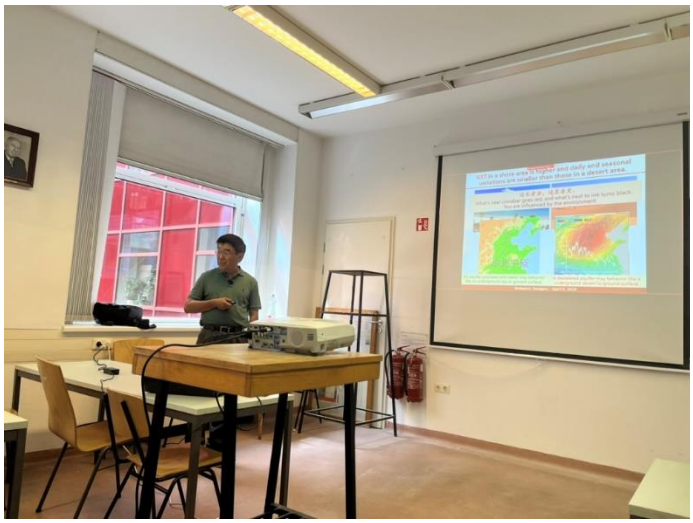
RGFC has been using its LinkedIn page as an information platform and a forum for scientific discussion. The number of members is growing continuously reaching 390 (~ 25 new members during this reporting period).

The RGFC's Instagram profile @rgfc_iah is also available and the news and activities can be followed there, too. 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 have 125 followers.

4. Events, commemoration

In the framework of the RGFC we had two scientific presentations streamed online for the members.

In April, **Prof You-Kuan Zhang**, professor emeritus at the University of Iowa (USA) and professor at the School of Environmental Science & Technology (ESE) of Southern University of Science & Engineering (SUSTech) (China) performed his presentation online. The talk was available online via MS Team for all commission members. The presentation was entitled: "Climate Change and Groundwater: Effect of Groundwater Over-Pumping on The Air Temperature in the North China Plain". People from all over the world followed the presentation online, and an interesting discussion followed the talk.



You-Kuan Zhang's presentation in April

In 2024, GSA Birdsall-Dreiss lectures were performed by our member, **Prof Ben Rostron** (emeritus professor, University of Alberta, CA). Ben Rostron visited Eötvös Loránd University (Budapest) in May, and his three talks were streamed via MS Teams for the commission members. The presentations covered a wide range of aspects related to regional groundwater flow:

”Lithium in brines (Duperow Aquifer) in southeast Saskatchewan: A modern-day gold rush

Geology and hydrogeology at Aquistore: Canada's first CO2 storage project associated with a commercial-scale

Groundwater and native orchids: Is there a link (and why might anyone care)?”

The presentations were a great success, these hot topics were followed by numerous people online and in person, too.

Ben Rostron's presentation in May

Prof. Dr. José Joel Carrillo-Rivera, one of the initiators and Co-Chair of the RGFC-IAH, passed away on October 3, 2024. Dr. Carrillo-Rivera was a distinguished hydrogeologist with over 40 years of experience. His contributions to modern hydrogeology, particularly regarding Tóthian groundwater flow systems, have been invaluable. His work at the Institute of Geography at UNAM has advanced scientific understanding and has significantly impacted water management practices in Mexico and internationally.

Prof. Dr. José Joel Carrillo-Rivera

The RGFC-IAH pays tribute to his memory with the attached memorial and short video. The short video was recorded at the congress in Davos, sadly one of his last interviews.

UNAM's obituary: https://lnkd.in/eaTHMvxC
Memorial: https://lnkd.in/eYfYAPUC
Short video: https://lnkd.in/eRvve7NW

5. Future plans

- We plan regular online presentations and talks about the application of the regional groundwater flow system concept and its application. We aim to invite speakers from many areas of the world, where our membership comes from. It would provide a good opportunity to discuss the new results with experts, who are interested in the topic.

- We intend to collect all RGF-related papers and books monthly and publish them on the RGFC website. It helps all scientists to follow updates and new results in the given topic.

- At the IAH 2024 Congress we recorded short interviews with several experts about the significance of regional groundwater flow for them. The interviews will be compiled in the form of a video. This material is intended to raise awareness of the importance of the regional groudnwater flow concept and its application. We plan to publish it on our website and also on our infiormation platforms.

- The NGWA has selected Dr Grant Fergusson (University of Saskatchewan) as the Darcy Lecturer in 2025. Eötvös Loránd University (Budapest) invited him and we would like to stream his talk to the RGFC's members on the 6th of May.

- RGFC co-organizes a session at EGU General Assembly 2025 (28 April - 2 May 2025) (Session HS8.2.3). The session HS8.2.3, entitled: The role of groundwater flow systems in enhancing sustainable water management and solving environmental issues.

- RGFC will be represented at the IAH 2025 - The 52nd Congress of the International Association of Hydrogeologists in Melbourne. We plan to dedicate a session to the memory of Prof. Joel Carrillo.

7. Publications

Selected papers and books

Baják, P., Csepregi, A., Szabó, P., Chappon, M., Tóth, Á., Hegedűs-Csondor, K., Erőss, A. (2024) Quantifying the overlooked groundwater component in the water budget of a shallow soda lake in Hungary amidst climate change concerns. Journal of Hydrology Regional Studies, 56, 101961.

Banks, E.W., Noorduijn, S., Post, V.E.A., Munday, T., Sorensen, C., Cahill, K., Jolly, P., Ellis, J., Werner, A.D., Batelaan, O. (2024) Island hydrogeology in the tropics: Constraining a 3D variable-density groundwater flow and solute transport model with geophysics. Journal of Hydrology 635: 131037. https://doi.org/10.1016/j.jhydrol.2024.131037

Czauner, B., Simon, Sz., Mádl-Szőnyi, J. (2024) How to consider groundwater flow systems in the Earth's Critical Zone? – Demonstration in the Central Pannonian Basin, Hungary. Journal of Hydrology Regional Studies, 53, 101833. https://doi.org/10.1016/j.ejrh.2024.101833

Czauner, B., Szijártó, M., Sztanó, O., Mahrez, H.B., Molson, J., Oláh, S., Mádl-Szőnyi, J. (2024) Re-interpreting renewable and non-renewable water resources in the over-pressured Pannonian Basin. Scientific Reports 14, 24586. https://doi.org/10.1038/s41598-024-76076-8

Fokker, E. and Carpentier, S. (2024) Complementary geophysical methods for monitoring groundwater pressure and saturation. Netherlands Journal of Geosciences, 103. https://doi.org/10.1017/njg.2024.23

Han, P.F., Zhan, H.B., Wan, L., Wang, X.S., Wang, J.Z., Jiang, X.W. (2024) Special seepage paths among nested groundwater flow systems linking surface water bodies. Hydrological Processes, 38(11): e15304.

Han, P.F., Wang, X.S., Zhou, Y.X., Yang, Z., Wan, L., Chen, J.S., Jiang, X.W. (2024) Three-dimensional inter-basin groundwater flow toward a groundwater-fed stream: Identification, partition, and quantification. Journal of Hydrology, 629: 130524. https://doi.org/10.1016/j.jhydrol.2023.130524

Ji, T.T., Jiang, X.W., Han, G.L., Li, X.Q., Wan, L., Wang, Z.Z., Guo, H.M., Jin, Z.D. (2024) Contrasting behaviour of K isotopes in modern and fossil groundwater: Implications for K cycle and subsurface weathering. Earth and Planetary Science Letters. 626: 118526. https://doi.org/10.1016/j.epsl.2023.118526

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

Lubczynski, M.W., Leblanc, M. and Batelaan, O., 2024, Remote sensing and hydrogeophysics give a new impetus to integrated hydrological models: A review. Journal of Hydrology 633: 130901. https://doi.org/10.1016/j.jhydrol.2024.130901

Schutten, W.A., Pezij, M., Hogeboom, R.J., Jungermann, U.N., and Augustijn, D.C.M., (2024) Understanding groundwater droughts using detrended historical meteorological data and long-term groundwater modelling. Netherlands Journal of Geosciences, 103. https://doi.org/10.1017/njg.2024.22

Tran, Q.-C., Vu, T.-T., Batelaan, O. and Pham, Q.-N. (2024) Factors controlling land subsidence in the Southern Hau River Region, Vietnam. Groundwater for Sustainable Development 27: 101383. https://doi.org/10.1016/j.gsd.2024.101383

Zhang, Y.P., Jiang, X.W., Ge, S., Zhang, Z.Y., Han, P.F., Wang, X.S., Wang, L.Z., Liu, Q., Wan, L. (2024) Effect of climate warming on subsurface temperature in basins with topography-driven groundwater flow. Journal of Hydrology, 644: 132024. https://doi.org/10.1016/j.jhydrol.2024.132024

Zhang, Y.P., Jiang, X.W., Zhang, X.L., Zhang, Z.Y., Wang, X.S., Cao, G.L., Wei, W., Wan, L. (2024) Pumping-induced groundwater ageing and rejuvenation in layered basins: a perspective from regional groundwater flow. Journal of Hydrology, 632: 130718. https://doi.org/10.1016/j.jhydrol.2024.130718

Budapest, 13 February 2025

Szilvia Simon, Secretary of RGFC

Judit Mádl-Szőnyi, Chair of RGFC