



International Course and Field Seminar

Characterization and Engineering of Karst Aquifers

Trebinje, Bosnia & Herzegovina



EPC



REPORT

of the 11th International Course and Field seminar

“Characterization and Engineering of Karst Aquifers”

Trebinje, Bosnia & Herzegovina, 26 May – 01 June, 2024



Participants of the CEKA 2024 course with certificate of attendance

The 11th International Course and Field Seminar *Characterization and Engineering of Karst Aquifers* (CEKA) was held in Trebinje, Bosnia & Herzegovina, between 26 May – 01 June, 2024.

On May 26 the course officially started. As it was the case in previous year, the CEKA 2024 course was organized by the **Centre for Karst Hydrogeology** of the Department of Hydrogeology, University of Belgrade - Faculty of Mining & Geology, the **Geological Survey of the Republic of Srpska**, Zvornik, our host **Hydroelectric Powerplant on the Trebišnjica River (HET)** and with support of **Municipality of Trebinje** and **MH Power Utility of Republic of Srpska**. This year, the Course was attended by 27 participants from 7 countries (China, USA, Poland, Slovenia, Serbia, Bosnia & Herzegovina, Togo), while lectures were provided by 10 professors and experts.



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Experts who delivered their lectures during this year course were: **Dr Zoran Stevanović**, Ret. Prof. University of Belgrade, Serbia; **Dr Petar Milanović**, Ret. Prof. University of Mostar, Bosnia & Herzegovina; **Dr Saša Milanović**, University of Belgrade, Serbia, **Dr Ljiljana Vasić**, University of Belgrade, Serbia, **Dr Vesna Ristić Vakanjac**, University of Belgrade, Serbia, MSc **David Evans**, CEO FloGlobal / General Manager Peru, FloSolutions Peru, **Dr Ryan Lima**, Northern Arizona University, USA, **Zhenjie ZHANG** Institute of Hydrogeology and Engineering Geology, China, **Dr Branislav Petrović**, University of Belgrade, Serbia, **Dr Veljko Marinović**, University of Belgrade, Serbia.

The registration of participants took place on May 26th, at the hall of the HET in Trebinje. All participants received course materials (gift box with wireless phone charging powerbank, thermos bottle, notebook, pencil and Trebinje touristic promotive materials).



Entrance to the HET and the conference hall



Registration desk (left) and gift box (right)

A course CEKA 2024 started at 9.00 AM with the welcome speech of **Prof. Dr. Saša Milanović**, Head of the Centre for Karst Hydrogeology, who expressed his pleasure that the course is being held again in Trebinje, at the heart of the karst and also wished a productive



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work and pleasant stay in Trebinje and at HET to the participants. The participants of the course were addressed by **Duško Vujović**, civil engineer, as a representative of HET, **Dr. Cvjetko Sandić**, deputy director of Geological Survey of the Republika Srpska, and **Dr. Dragoslav Banjak**, on behalf of the City of Trebinje, who welcomed the attendees, expressed their satisfaction with the holding of the course in Trebinje, and wished successful work to the course participants.



After welcome words, **Prof. Dr. Saša Milanović** invited **Prof. Dr. Zoran Stevanović**, founder of the Centre for Karst Hydrogeology and this Course as well. After the welcome address and introductory note of **Dr. Stevanović**, the Course was officially opened. First session was reserved for **Dr. Stevanović** who provided lecture "*Historical development of karstology and karst hydrogeology and karst distribution worldwide, Porosity and permeability of karstic rocks; Groundwater circulation in karst: recharge, flow types and directions, discharge*". After coffee break, **Dr. Stevanović** continued with lecture in second session titled "*Methods in karst hydrogeology – an overview; geology, remote sensing, geophysics, water points inventory, groundwater tapping, hydrogeological properties and field tests*".



First lecture of Professor Zoran Stevanović

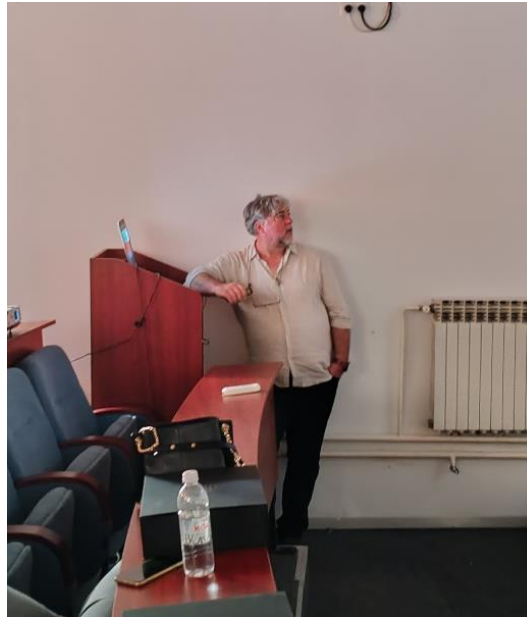


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After lunch break, **Prof. Dr. Saša Milanović** gave his lecture which included methods in karst hydrogeology, titled “*Specific investigation and research techniques of complex karst systems as a base for hydrotechnical construction and remediation problems in karst - monitoring, tracing tests, speleodiving, spatial modeling etc*”.



Lectures of **Prof. Dr. Saša Milanović**

After him, **Dr. Ljiljana Vasić** continued with methods in karst hydrogeology, presenting lecture titled “*Quality dynamics at karst springs. Isotopic methods in karst, GW ageing*”. This lecture closed the first day of the CEKA 2024 course.



Lectures of **Dr. Ljiljana Vasić**



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On the next morning, focus was mainly on the practical aspects of karst hydrogeology, engineering concepts, and solutions. The morning session was reserved for lectures of **Prof. Dr. Petar Milanović**, who delivered a lecture titled *“Problems related to construction of dams, reservoirs and other structures and buildings in karst; Investigation, design, corrective measures, case studies”*. Afterwards, a half-day field trip took place, when students, together with the lecturers, visited Grančarevo dam and intake for water supply of Trebinje (spring “Oko”). First stop was Grančarevo dam, where **Dr. Petar Milanović** talked about hydrogeology and geophysical survey, dam design, constructive and monitoring elements as well as remedial works for leakage prevention. After visiting Grančarevo dam, next stop was at the Oko spring, situated several meters above the riverbed of the Trebišnjica River, upstream of the town of Trebinje. **Dr. Petar Milanović** briefly explained hydrogeology characteristics of the “Oko” spring catchment area and talked about tapping structure after initial spring site was submerged by new reservoir. After the completion of field visit of the aforementioned sites, the students returned to Trebinje and watched the movie “Waters of Trebišnjica” and “Forgotten species” by **Dr. Saša Milanović** at HET facility.



Lectures by **Prof. Dr. Petar Milanović** (upper left); Half-day field trip to Grančarevo Dam (upper right) and the Oko Spring (down photo)



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Third day of course was reserved for all-day field trip. The field trip was guided by **Prof. Dr. Petar Milanović** and **Prof. Dr. Saša Milanović**, who gave explanations at each observation point. The trip started in Popovo Polje, one of the world's largest karst poljes. The first stop was the Vjetrenica cave, known for its extreme windiness in the entrance area, as well as for the presence of protected endemic specie *Proteus anguinus* ("human fish") in its deep channels.



Prof. Dr. Petar Milanović talks about the Popovo polje



Entrance to the Vjetrenica Cave in Popovo polje



The interior of the Vjetrenica Cave in Popovo polje



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After the cave tour a short break was made at the viewpoint overlooking Popovo karst polje.



Viewpoint above Popovo karst polje

After that, the excursion headed in the direction of Mostar, where the participants enjoyed a tour of the old bridge and the town.



Old bridge in the city of Mostar

Immediately after that, the course participants visited the Buna karst spring near Blagaj (Mostar) which, with its discharges in range of 3-300 m³/s, is listed among the thirty world's largest karst springs. Further on, the students were able to see Dabar and Fatnica karst poljes with springs Vrijeka and Sušica and estavelle Obod. On the way back to Trebinje **Dr. Petar Milanović** showed to participants from bus where is the Trebišnjica River spring (Dejanova cave), which is submerged and flooded by the Bileća Reservoir and the tunnel that connecting Fatnica Polje and the Bileća Reservoir.



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Buna Spring



Fatnica karst polje above estavelle Obod

Morning session on the fourth day of the CEKA 2024 course was reserved for presentations of **David Evans**, who provided lectures titled: “*Mining hydrogeology in complex karst systems - related to tailings, waste dumps, water supply etc.*”, **Prof. Dr. Vesna Ristić Vakanjac** titled “*Modeling of karst aquifer – Springs hydrograph analysis and stochastic models*”, and **Dr. Ryan Lima** titled “*Estimating potential groundwater recharge volume in forested Karst terrain on the Mogollon Rim, Arizona*”.

After the lunch break, the course was continued with the lecture titled “*Karst and epikarst; Karst aquifer vulnerability (overview/examples: EPIK; PI; COP; TDM...); Anthropogenic impact and hazards; Karst Disturbance Index*” by **Dr. Branislav Petrović**, “*Groundwater management and transboundary aquifers in karst: problems and solutions*” by **Dr. Veljko Marinović** and “*Research on Subway Construction and Spring Protection Technology in Jinan*” by **Zhenjie Zhang**, who closed the last day of lecturing on this year’s course.



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David Evans (left) and Prof. Dr. Vesna Ristić Vakanjac (right)
providing lectures on CEKA 2024 course



Dr. Branislav Petrović (left) and Dr. Veljko Marinović (right)
providing lectures on CEKA 2024 course



Dr. Ryan Lima (left) and Zhenjie Zhang (right)
providing lectures on CEKA 2024 course



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Fifth and the last day of the course was dedicated to the all-day field trip, when the participants visited Čepelica tunnel, Korićka jama, Cernica karst polje and the Ključka Rijeka River, well known because of a surface flow only 300 meters long from the Vilina pećina karst spring to the ponor of Ključka Rijeka river. In the spring zone, **Prof. Dr. Saša Milanović** gave lectures on the basic characteristics of the Cernica karst polje and the spring of Ključka Reka from the hydrogeological aspect. Participants had opportunity to measure physico-chemical characteristics of the Ključka Reka river with field portable laboratory equipment and to perform tracer test with sodium-fluorescein as a tracer.



First stop on the all-day field trip –Čepelica tunnel (left); Korićka jama – (right)



Lectures in Cerničko polje at the Studenac spring, near the ponor of Ključka River



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Performing of tracer test on the Ključka Reka river in Cernica Polje

Finally, participants reached the last stop on the all-day field excursion on the Klinje dam, where **Prof. Dr. Saša Milanović** gave short talk about the dam and the system, while afterwards all attendees had lunch.



Lunch break on the Klinje dam

The last day of the course was reserved for the exam, which was taken by 9 students, out of which 8 students from the Faculty of Mining and Geology and 1 from Poland. After the successful completion of the exam, the closing ceremony was held. Attendants who completed the course received a Certificate of Attendance, and all lecturers received Certificate of Appreciation for participation in the course.



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Exam on the CEKA 2024 course





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Closing ceremony and awarding of certificates

After the closing ceremony, we moved to a local restaurant “Stara Hercegovina” on farewell party, where participants and lecturers were enjoyed local food and wines. They also enjoyed music and dance, which continued till late hours.





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Farewell party

Reported by

MS Petar Vojnović, Junior Researcher

Dr Veljko Marinović, Research Associate



CEKA TEAM OF THE YEAR 2024 !