



International Course and Field Seminar

## Characterization and Engineering of Karst Aquifers

Trebinje, Bosnia & Herzegovina



United Nations  
Educational, Scientific and  
Cultural Organization



International  
Hydrological  
Programme



The Hydro-Energy  
System of Trebišnjica  
HET, Trebinje

### REPORT

of the Ninth International Course and Field seminar  
“*Characterization and Engineering of Karst Aquifers*”  
Trebinje, Bosnia & Herzegovina, 26 – 30. May, 2022.



The ninth international course and field seminar *Characterization and Engineering of Karst Aquifers* was held in Trebinje, Bosnia & Herzegovina, between 26 – 30 May, 2022. This was the first year after the pandemic caused by the coronavirus, and two years of online course, that the course was again held live in the building of our hosts - Hydro-electric power plant system of Trebišnjica River (hereafter HET).

The 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 hosts HET and Municipality of Trebinje with sponsorship of UNESCO. This year, the Course was attended by 14 participants from 3 countries (Bosnia & Herzegovina, Montenegro and Serbia), while lectures were provided by 7 lecturers.



International Course and Field Seminar  
**Characterization and Engineering of Karst Aquifers**  
Trebinje, Bosnia & Herzegovina

Experts who delivered their lectures during this year course were: Prof. Dr Zoran Stevanović, Ret. Prof. University of Belgrade, Serbia; Dr Petar Milanović, Ret. Assoc. Prof. University of Mostar, Bosnia & Herzegovina; Dr Vesna Ristić Vakanjac, prof. at University of Belgrade, Serbia and Dr Saša Milanović, assistant prof. University of Belgrade, Serbia, Dr Ljiljana Vasić, assistant prof. University of Belgrade, Dr Branislav Petrović, scientific researcher and Veljko Marinović, research assistant, both from University of Belgrade, Serbia.

The registration of participants took place on 26<sup>nd</sup> May, at the hall of the HET in Trebinje. All participants received course materials (bag, notebook, pencil, hat with the course logo).



Entrance to the HET and the conference hall



Registration desk

Opening ceremony started at 9<sup>00</sup> AM with the welcome speech of Dr Saša Milanović, Head of the Centre for Karst Hydrogeology, Cvijetko Sandić, Deputy Director of the Geological Survey of the Republic of Srpska, Zvornik and Duško Vujović, graduate civil engineer, HET representative, and all of them expressed their pleasure that the course is being held again in Trebinje, at the heart of the karst and also wished a productive work and pleasant stay in Trebinje and at HET to the participants. After welcome words, Dr Saša Milanović invited Prof. Zoran Stevanovic, the founder of the Centre for Karst Hydrogeology and this Course as well, to give an introductory note on the beginning steps and development of the course throughout years.



International Course and Field Seminar  
**Characterization and Engineering of Karst Aquifers**  
Trebinje, Bosnia & Herzegovina



Opening ceremony

After the welcome address and introductory note of Prof. Stevanović, the Course was officially opened. First session was reserved for Prof. 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 lunch break, prof. 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

After him, Dr Saša Milanović continued with methods in karst hydrogeology presenting lecture titled "*Methods in karst hydrogeology – geomorphology, speleology, speleo diving, tracer tests*". After coffee break, two more lectures were delivered. The first one titled "*Quality dynamics at karst springs. Isotopic methods in karst, GW ageing*" was given by Dr Ljiljana Vasić, while the last one "*Exploration of coastal karst groundwater (problems of seawater intrusion in karst aquifer)*" was presented by Dr Josip Terzić, special guest from Croatian Geological Survey, Croatia.



International Course and Field Seminar  
**Characterization and Engineering of Karst Aquifers**  
Trebinje, Bosnia & Herzegovina



Lectures of Dr Saša Milanović, Dr Ljiljana Vasić and Dr Josip Terzić

On the next morning, participants had an opportunity to learn practical aspects of karst hydrogeology, engineering concepts, and solutions. The morning session was reserved for lectures of Prof. Petar Milanović, who presented lecture “*Problems related to construction of dams, reservoirs and other structures in karst; Investigation, design, corrective measures*”. Furthermore, promotion of the book “*Karst istočne Hercegovine i dubrovačkog priobalja*” (*Karst of Eastern Herzegovina and Dubrovnik Littoral*) by Petar Milanović was held after short coffee break, and all attendance had the opportunity to get a book signed by author.



Lecture of Prof. Peter Milanović and promotion of his book

The afternoon session was reserved for half day field trip. During the excursion, the students, together with the lecturers, visited Grančarevo dam and intake for water supply of Trebinje (spring “Oko”). The first stop was Grančarevo dam, where Prof. Milanović delivered a presentation about hydrogeology and geophysical survey, dam design, constructive and monitoring elements as well as remedial works for leakage prevention. The second stop was



International Course and Field Seminar  
**Characterization and Engineering of Karst Aquifers**  
Trebinje, Bosnia & Herzegovina

at the Oko Spring, situated several meters above the riverbed of the Trebišnjica River, upstream of the town of Trebinje, where prof. Petar Milanović gave a presentation about this spring used for city water supply, his removal and new tapping structure built after initial site was submerged by new reservoir (Gorica).

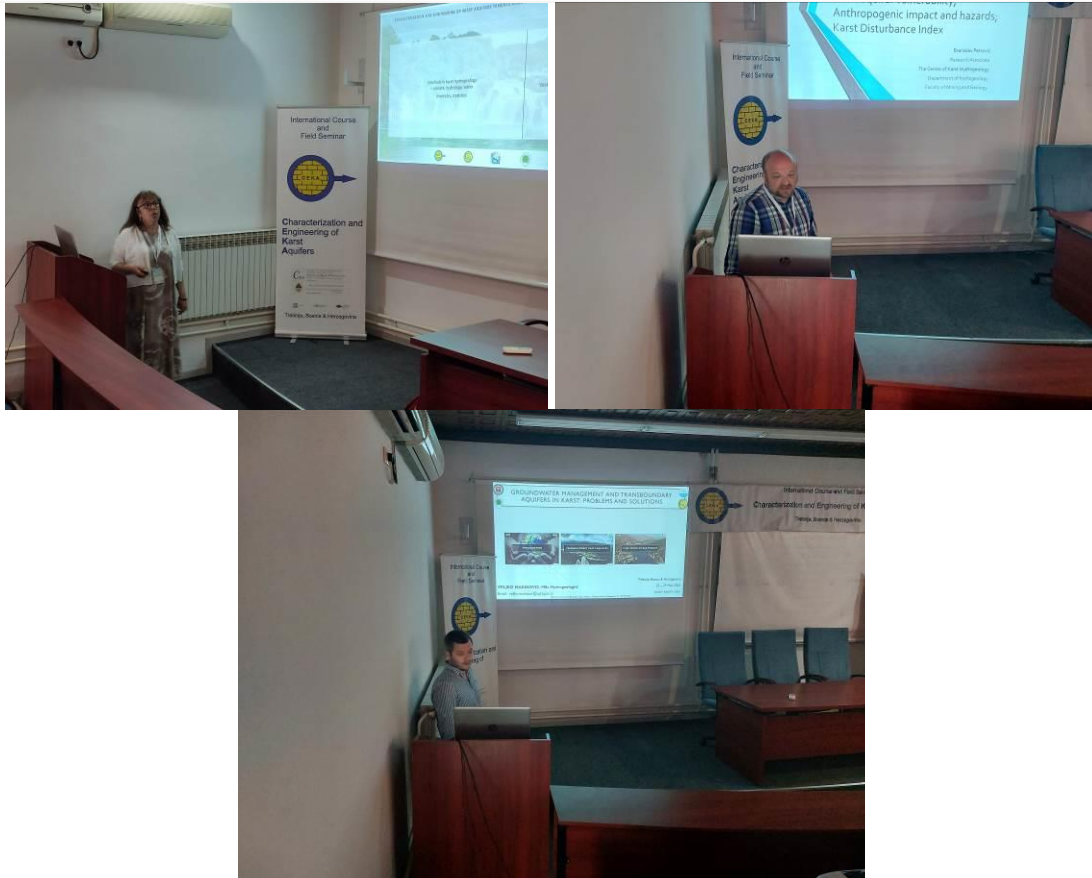


Half-day field trip to Grančarevo Dam and the Oko Spring

Morning session on the third day of course was reserved for presentations of Prof. Vesna Ristić Vakanjac, Dr Branislav Petrović and Veljko Marinović, who provided lectures titled: “*Methods in karst hydrogeology – climate, hydrology, statistics (exercise)*” by Ristić Vakanjac, “*Karst and epikarst; Karst aquifer vulnerability (overview/examples: EPIK; PI; COP; TDM...)*”; *Anthropogenic impact and hazards; Karst Disturbance Index*” by Dr Petrović, and “*Groundwater management and transboundary aquifers in karst: problems and solutions*” by Marinović, research assistant.



International Course and Field Seminar  
**Characterization and Engineering of Karst Aquifers**  
Trebinje, Bosnia & Herzegovina



Lectures of Prof. Vesna Ristić Vakanjac, Dr Branislav Petrović and Veljko Marinović, assistant researcher

After presentations, students together with professors, had field work on the Lušac Spring, located in Trebinje city, guided by Branislav Petrović, Veljko Marinović and Petar Vojnović. They showed to students directly on the spring how to make an inventory of the spring and how to properly measure basic physico-chemical parameters with field portable laboratory equipment. Also, participants had opportunity to see different colour of tracers used for tracer tests in karst systems.



Field work on the Lušac Spring

Fourth and the last day of course was reserved for all-day field trip. The field trip was guided by Prof. Petar Milanović, who provided explanations at every observation point. The trip started in Popovo Polje, one of the world's largest karst poljes. The first stop was at the



International Course and Field Seminar  
**Characterization and Engineering of Karst Aquifers**  
Trebinje, Bosnia & Herzegovina

Trebišnjica River in Popovo Polje, the largest sinking stream in entire Europe which is today completely regulated. The students had an opportunity to see riverbed which nowadays is covered with concrete blanket, and ponors that were previously utilized by local villagers as water mills. After this stop, the excursion continued to 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. After cave, participants visited nearby located Bio-speleological museum.



Popovo polje and Trebišnjica River



Vjetrenica cave

After the cave tour, course participants visited the Buna Spring near Blagaj (Mostar) which, with its discharges in range of 3-300 m<sup>3</sup>/s, is listed among the thirty world’s largest springs. Further on, the students were able to see Dabarsko and Fatničko polje with spring Vrijeka and Susica and estavelle Obod. On the way to Trebinje Prof. Milanović showed to participants from bus where is the Trebišnjica River spring (Dejanova cave), which is submerged and flooded by the Bilečko Lake (Reservoir). The last stop was at the exit of another tunnel that connecting Fatnica polje and the Bilečko Lake.



## International Course and Field Seminar Characterization and Engineering of Karst Aquifers

Trebinje, Bosnia & Herzegovina



Vrelo Bune Spring



Stops at Dabarsko and Fatničko polje; tunnel connecting Fatnica polje and the Bilećko Lake

After whole day excursion, good atmosphere from bus has transferred to a local ethnic restaurant “Studenac” on farewell party, where also closing ceremony was held. Attendants who completed the course received a Certificate of Attendance, and an additional Certificate which included final grade and credits (6 ESTC) issued by the University of Belgrade – FMG and all lecturers received Certificate of Appreciation for participation in the course. After this ceremony, participants and lecturers were enjoyed local food and wines. They also enjoyed music and dance, which continued till late hours.





International Course and Field Seminar  
**Characterization and Engineering of Karst Aquifers**

Trebinje, Bosnia & Herzegovina



Closing ceremony and Farewell party

Reported by

Dr Ljiljana Vasić, assistant prof.



International Course and Field Seminar  
**Characterization and Engineering of Karst Aquifers**  
Trebinje, Bosnia & Herzegovina



CEKA Team of the year 2022 !