

**UČNI NAČRT PREDMETA / COURSE SYLLABUS**

<b>Predmet:</b>	EKOHIĐROLOŠKI PROCESI IN PRITISKI NA KRASU
<b>Course title:</b>	ECOHYDROLOGICAL PROCESSES AND PRESSURES IN KARST

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Vede o Zemlji in okolju, magistrski študij 2. stopnje	Krasoslovje	2	1
Earth and Environmental Sciences, Master study 2nd level	Karstology	2	1

**Vrsta predmeta / Course type** Izbirni/Elective

**Univerzitetna koda predmeta / University course code:** MIK01

Predavanja Lectures	Seminar Seminar	Sem. vaje Tutorial	Lab. vaje Laboratory work	Teren. vaje Field work	Samost. delo Individ. work	ECTS
25	20			25	80	6

**Nosilec predmeta / Lecturer:** Nataša Ravbar

<b>Jeziki / Languages:</b>	<b>Predavanja / Lectures:</b>	angleščina/English/slovenščina/Slovenian
	<b>Vaje / Tutorial:</b>	angleščina/English/slovenščina/Slovenian

**Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:**

Končan študijski program 1. stopnje ali dodiplomski študijski program za pridobitev univerzitetne izobrazbe, sprejet pred 11. 6. 2004 s področja naravoslovja.

**Prerequisites:**

First-cycle Bologna degree or a university degree in the natural sciences.

**Vsebina:**

Kraški vodonosniki so pomembni viri pitne vode in bogati z edinstvenimi (podzemni) ekosistemi. Zaradi njim lastnimi v primerjavi z drugimi manj prepustnimi sistemi zelo dinamičnimi hidrološkimi procesi so še posebej izpostavljeni spremembam v okolju in človeškim dejavnostim. Pomemben pogoj za razumevanje omejitev ustreznega upravljanja s kraškimi naravnimi viri je poznavanje pokrajinskih procesov in posebnih značilnosti pretakanja vode v krasu. Ta predmet zato

**Content (Syllabus outline):**

Karst aquifers hold important water resources and are rich in unique (underground) ecosystems. Due to highly dynamic hydrological processes compared to other less permeable systems, they are particularly vulnerable to environmental changes and human activities. An important prerequisite for understanding the limitations of appropriate management of karst natural resources is knowledge of landscape processes and the specific characteristics of water flow in karst. This

vključuje kraške študije v splošni ekološki, geomorfološki, speleološki in hidrološki kontekst ter poudarja uporabo kraških specifičnih raziskovalnih metod. Posebna pozornost je namenjena ekohidrološkim funkcijam kraškega podzemlja, časovni hidrološki spremenljivosti, medsebojnim vplivom med površinsko in podzemno vodo ter težavam z onesnaževanjem. Predstavljene bodo najboljše prakse in rešitve varovanja ter primerne upravljanja s kraškimi naravnimi viri.

course therefore integrates karst studies into a general ecological, geomorphological, speleological and hydrological context and emphasises the application of karst-specific research methods. Special attention is paid to the ecohydrological functions of karst underground, the temporal hydrological variability, surface- groundwater interaction and contamination problems. Best practices for protection and management solutions will be presented.

#### Temeljni literatura in viri / Readings:

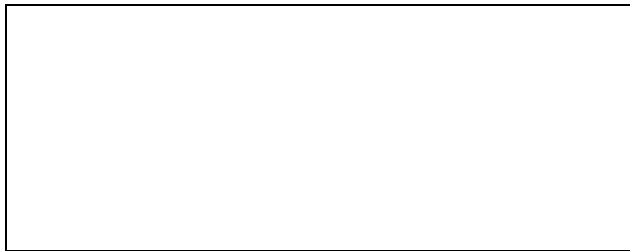
- BONACCI, O., PIPAN, T., CULVER, D. C., 2009: A framework for karst ecohydrology. *Environmental Geology*, 56/5: 891-900.
- GOLDSCHIEDER, N., 2012: A holistic approach to groundwater protection and ecosystem services in karst terrains. *Aqua Mundi*, 3: 117-124. doi: 10.4409/Am-046-12-0047.
- GUTIÉRREZ, F., PARISE, M., De WAELE, J., JOURDE, H., 2014: A review on natural and human-induced geohazards and impacts in karst. *Earth-Science Reviews*, 138: 61-88.
- HARTMANN, A., GOLDSCHIEDER, N., WAGENER, T., LANGE, J., WEILER, M., 2014: Karst water resources in a changing world: Review of hydrological modeling approaches. *Reviews of Geophysics*, 52/3: 218-242.
- KLØVE, B., ALA-AHO, P., BERTRAND, G., BOUKALOVA, Z., ERTÜRK, A., ... WIDERLUND, A., 2011: Groundwater dependent ecosystems. Part I: Hydroecological status and trends. *Environmental Science & Policy*, 14/7: 770-781. doi: 10.1016/j.envsci.2011.04.002.
- KOVAČIČ, G., RAVBAR, N., 2010: Extreme hydrological events in karst areas of Slovenia, the case of the Unica River basin. *Geodinamica Acta*, 23/1-3: 89-100.
- RAVBAR, N., 2007: The protection of karst waters: a comprehensive Slovene approach to vulnerability and contamination risk mapping. Inštitut za raziskovanje krasa ZRC SAZU, Postojna. (poglavja/chapters: 4-8).

#### Cilji in kompetence:

- Slušatelji spoznajo pomen kraških naravnih virov in druge posebnosti kraškega okolja,
- spoznajo posebnosti pretakanja voda v krasu in hidrološko variabilnost ter razumejo zakaj so kraški naravni viri zelo ranljivi,
- spoznajo se z osnovnimi metodami in tehnikami za raziskovanje kraških procesov,
- razumejo, kakšno znanje je potrebno za učinkovito varovanje kraških naravnih virov in kateri ukrepi so za smiselno načrtovanje dejavnosti na krasu najbolj učinkoviti.

#### Objectives and competences:

- Students learn about the importance of karst natural resources and other peculiarities of the karst environment;
- They learn about the specifics of water flow in karst and hydrological variability and they understand why karst natural resources are highly vulnerable;
- They get acquainted with the basic methods and techniques for researching karst processes;
- Understand what knowledge is needed for the effective protection of karst natural resources and what measures are most



effective for meaningful planning of activities on karst.

**Predvideni študijski rezultati:**

- Poznavanje pojmov hidrološka spremenljivost, interakcija med površinsko in podzemno vodo, ekosistemi, ki so odvisni od podzemne vode itd.,
- sposobnost navajanja posebnosti pretakanja voda v krasu, pomena kraških naravnih virov ipd.,
- poznajo raziskovalne metode, ki so specifične za raziskovanje krasa,
- sposobnost kritičnega vrednotenja, kateri so primerni načini varovanja in upravljanja izrabe kraških naravnih virov, poznavanja primerov dobrih praks,
- sposobnost samostojnega ocenjevanja literature in virov.

**Intended learning outcomes:**

- Introduction to terms hydrological variability, surface-groundwater interaction, groundwater dependant ecosystems, etc.;
- Ability to list the specifics of water flow in karst, the importance of karst natural resources, etc.;
- Know research methods that are specific to karst research;
- Ability to critically evaluate what are the appropriate ways to protect and manage the use of karst natural resources, knowledge of examples of good practice;
- Ability to independently evaluate literature and sources.

**Metode poučevanja in učenja:**

Vsebina predmeta je predstavljena na predavanjih, popestrenih s sodobnimi didaktičnimi prijemi. Seminarji potekajo vzporedno s predavanji in se navezujejo na posamezne tematske sklope predavanj. Študenti sami predstavijo problematiko povezano z njihovo raziskovalno temo, ki jo obiskovalci seminarja skupno analiziramo.

**Learning and teaching methods:**

The content of the course is presented at lectures, diversified with modern didactic grips. Seminars take place at the same time with lectures and they are being related to individual thematic assemblies of lectures. Students individually present problems connected with their research theme, that are being analysed commonly by their classmates.

Načini ocenjevanja:	Delež (v %) / Weight (in %)	Assessment
• Ustni izpit,	<b>60</b>	• Oral exam;
• seminarska naloga.	<b>40</b>	• Written paper.

**Reference nosilca / Lecturer's references:**

- PETRIČ, M., RAVBAR, N., GOSTINČAR, P., KRŠNIK, P., GACIN, M., 2020: GIS database of groundwater flow characteristics in carbonate aquifers : tracer test inventory from Slovenian karst. Applied geography, 118: 8 str. doi: 10.1016/j.apgeog.2020.102191.
- OLARINOYE, T., GLEESON, T., MARX, V., SEEGER, S., ADINEHVAND, R., ALLOCCA, V., ANDREO, B., APAÉSTEGUI, J., APOLIT, C., ARFIB, B., BLATNIK, M., RAVBAR, N., et al., 2020: Global karst springs hydrograph dataset for research and management of the world's fastest-flowing groundwater. Scientific data, 7, article no. 59. doi: 10.1038/s41597-019-0346-5.

- MAYAUD, C., GABROVŠEK, F., BLATNIK, M., KOGOVSĚK, B., PETRIĀ, M., **RAVBAR, N.**, 2019: Understanding flooding in poljes : a modelling perspective. *Journal of Hydrology*, 575: 874-889. doi: 10.1016/j.jhydrol.2019.04.092.
- PETRIĀ, M., KOGOVSĚK, J., **RAVBAR, N.**, 2018: Effects of the vadose zone on groundwater flow and solute transport characteristics in mountainous karst aquifers : the case of the Javorniki-SneŹnik massif (SW Slovenia). *Acta carsologica*, 47/1: 35-51. doi: 10.3986/ac.v47i1.5144.
- **RAVBAR, N.**, KOVAĀIĀ, G., PETRIĀ, M., KOGOVSĚK, J., BRUN, C., KOŹELJ, A., 2018: Climatological trends and anticipated karst spring quantity and quality : case study of the Slovene Istria. V: PARISE, M. (ur.), et al. *Advances in karst research : theory, fieldwork and applications*, (Special publication - Geological Society of London, no. 466). Geological Society, London: 295-305. doi: 10.1144/SP466.19.
- PARISE, M., GABROVŠEK, F., KAUFMANN, G., **RAVBAR, N.**, 2018: Recent advances in karst research : from theory to fieldwork and applications. V: PARISE, M. (ur.), et al. *Advances in karst research : theory, fieldwork and applications*, (Special publication - Geological Society of London, no. 466). Geological Society, London: 1-24.
- VIŹINTIN, G., **RAVBAR, N.**, JANEŹ, J., KOREN, E., JANEŹ, N., ZINI, L., TREU, F., PETRIĀ, M., 2018: Integration of models of various types of aquifers for water quality management in the transboundary area of the Soĉa/Isonzo river basin (Slovenia/Italy). *Science of the total environment*, 619/620: 1214-1225. doi: 10.1016/j.scitotenv.2017.11.017.
- TURPAUD, P., ZINI, L., **RAVBAR, N.**, CUCCHI, F., PETRIĀ, M., URBANC, J., 2018: Development of a protocol for the karst water source protection zoning: application to the Classical Karst Region (NE Italy and SW Slovenia). *Water resources management*, 32: 1953-1968. doi: 10.1007/s11269-017-1882-4.
- KOIT, O., **RAVBAR, N.**, MARANDI, A., TERASMAA, J., 2017: Threshold-controlled three-stage hydraulic behaviour of a mantled shallow carbonate aquifer (Tuhala karst area, North Estonia). *Acta carsologica*, 46/(2/3): 265-282. doi: 10.3986/ac.v46i2-3.4951.
- **RAVBAR, N.**, KOVAĀIĀ, G., 2015: Vulnerability and protection aspects of some Dinaric karst aquifers : a synthesis. *Environmental earth sciences*, 74/1: 129-141. doi: 10.1007/s12665-014-3945-7.
- **RAVBAR, N.**, ŹEBELA, S., 2015: The effectiveness of protection policies and legislative framework with special regard to karst landscapes : insights from Slovenia. *Environmental science & policy*, 51: 106-116. doi: 10.1016/j.envsci.2015.02.013.
- TURK, J., MALARD, A., JEANNIN, P.-Y., PETRIĀ, M., GABROVŠEK, F., **RAVBAR, N.**, VOUILLAMOZ, J., SLABE, T., SORDET, V., 2015: Hydrogeological characterization of groundwater storage and drainage in an alpine karst aquifer (the Kanin massif, Julian Alps). *Hydrological processes*, 29/8: 1986-1998. doi: 10.1002/hyp.10313.
- **RAVBAR, N.**, 2015: Advanced strategies in managing and sustaining karst water quality. V: STEVANOVIĀ, Z. (ur.). *Karst aquifers : characterization and engineering. Professional practice in earth sciences*. Springer, Cham: 614-624. doi: 10.1007/978-3-319-12850-4.
- **RAVBAR, N.**, KOGOVSĚK, J., PIPAN, T., 2015: Environmental value and vulnerability of karst resources. V: ZUPAN HAJNA, N. (ur.), et al. *Life and water on Karst : monitoring of transboundary water resources of Northern Istria*. ZaloŹba ZRC, Ljubljana: 23-34.
- **RAVBAR, N.**, PETRIĀ, M., RUBINIĀ, J., DIKOVIĀ, S., KOŹELJ, A., PIPAN, T., KOGOVSĚK, J., 2015: Monitoring the quantitative status and quality of karst water sources. V: ZUPAN HAJNA, N. (ur.), et al. *Life and water on Karst : monitoring of transboundary water resources of Northern Istria*. ZaloŹba ZRC, Ljubljana: 143-150.