

UČNI NAČRT PREDMETA / COURSE SYLLABUS

Predmet: VODNA ODPORNOST IN PODNEBNE SPREMEMBE
Course title: WATER RESILIENCE AND CLIMATE CHANGE

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Varstvo okolja in ekotehnologije, 2. stopnja	/	2.	/
Environmental Protection and Eco-technologies, 2 nd level	/	2 nd	/

Vrsta predmeta / Course type

Izbirni predmet / Optional course

Univerzitetna koda predmeta / University course code:

VOCC

Predavanja Lectures	Sem. vaje Tutorial	Lab. vaje Laboratory work	Teren. vaje Field work	Samost. delo Individ. work	ECTS
20	10	/	10	80	4

Nosilec predmeta / Lecturer:

doc. dr. Peter Frantar

Jeziki /

Predavanja / Lectures: Slovenščina / Slovenian

Languages:

Vaje / Tutorial: Slovenščina / Slovenian

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

Pogojev ni.

Prerequisites:

No formal prerequisites.

Vsebina:

Predmet obravnava vodni krog in vplive podnebnih sprememb nanj ter posledice za morje, površinske in podzemne vode, vključno s poplavami, sušami in pomanjkanjem vode. Poudarek je na razumevanju ranljivosti in odpornosti vodnih sistemov ter na pristopih k prilagajanju v vodnem sektorju. Predmet povezuje znanstvene podnebne in hidrološke projekcije z upravljanjem voda, prostorskim načrtovanjem in strateškimi dokumenti, vključno s strategijami vodne odpornosti ter uporabo konceptov climate proofing in načela Do No Significant Harm (DNSH).

Poglavitne teme:

- vplivi podnebnih sprememb na vodni krog in hidrološke procese;
- spremembe padavinskih režimov, odtoka, poplav in suš;
- ranljivost, odpornost in prilagoditvena sposobnost vodnih sistemov;

Content (Syllabus outline):

The course covers the water cycle and the effects of climate change on it, as well as the consequences for the sea, surface and groundwater, including floods, droughts, and water shortages. The emphasis is on understanding the vulnerability and resilience of water systems and approaches to adaptation in the water sector. The course links scientific climate and hydrological projections with water management, spatial planning, and strategic documents, including water resilience strategies and the application of climate proofing concepts and the Do No Significant Harm (DNSH) principle.

Main topics:

- impacts of climate change on the water cycle and hydrological processes;
- changes in precipitation patterns, runoff, floods, and droughts;
- vulnerability, resilience, and adaptive capacity of water systems;

- prilagoditveni ukrepi v vodnem sektorju (strukturni, nestrukturni, sonaravni);
- upravljanje površinskih in podzemnih voda v pogojih podnebnih sprememb;
- strategija vodne odpornosti na lokalni, nacionalni in evropski ravni;
- vloga prostorskega načrtovanja, politik in zakonodajnih okvirov;
- uporaba konceptov climate proofing in načela Do No Significant Harm (DNSH) v vodnem sektorju.

- adaptation measures in the water sector (structural, non-structural, nature-based);
- management of surface and groundwater in the context of climate change;
- water resilience strategy at local, national, and European level;
- role of spatial planning, policies, and legislative frameworks;
- application of climate proofing concepts and the Do No Significant Harm (DNSH) principle in the water sector.

Temeljna literatura in viri / Textbooks:

Obvezna / Required:

1. **Evropska strategija za vodno odpornost (strateški okvir EU za water resilience):**
European Commission. (2025). *European Water Resilience Strategy*. European Commission.
https://environment.ec.europa.eu/publications/european-water-resilience-strategy_en
2. **Strategija Evropske unije za prilagajanje na podnebne spremembe (okvir za climate proofing):**
European Commission. (2021). *Forging a climate-resilient Europe – the new EU Strategy on Adaptation to Climate Change* (COM(2021) 82 final). European Commission.
<https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52021DC0082>
3. **Direktiva EU o obvladovanju poplavne ogroženosti (Floods Directive):**
European Union. (2007). *Directive 2007/60/EC on the assessment and management of flood risks*. Official Journal of the European Union.
<https://eur-lex.europa.eu/eli/dir/2007/60/oj>
4. **Znanstvena podlaga za vplive, ranljivost in prilagajanje v vodnem sektorju:**
Intergovernmental Panel on Climate Change (IPCC). (2022). *Climate Change 2022: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change*. Cambridge University Press.
<https://www.ipcc.ch/report/ar6/wg2/>
5. **Metodološki okvir za vključevanje podnebnih tveganj v odločanje v vodnem sektorju:**
UNESCO. (2018). *Climate Risk Informed Decision Analysis (CRIDA): A framework for robust decision-making under climate uncertainty*. UNESCO.
<https://www.unesco.org/en/crida>
6. **Evropski okvir za obvladovanje suš in pomanjkanja vode (EU drought & water scarcity policy):**
European Commission. (2022). *Drought management in the EU – Policy framework and best practices*. European Commission.
https://environment.ec.europa.eu/topics/water/water-scarcity-and-droughts_en
7. **Znanstvena podlaga o sušah, vplivih in prilagajanju (IPCC – voda in suša):**
Intergovernmental Panel on Climate Change. (2022). *Climate Change 2022: Impacts, Adaptation and Vulnerability – izbrana poglavja (Water, Extremes)*. Cambridge University Press.
<https://www.ipcc.ch/report/ar6/wg2/>

Priporočena / Recommended:

1. IUCN. (2020). *Guidance for using the IUCN Global Standard for Nature-based Solutions*. International Union for Conservation of Nature.
<https://portals.iucn.org/library/sites/library/files/documents/2020-021-En.pdf>

2. World Bank. (2017). Implementing nature-based flood protection: Principles and implementation guidance. World Bank Group.
<https://documents1.worldbank.org/curated/en/739421509427698706/pdf/Implementing-nature-based-flood-protection-principles-and-implementation-guidance.pdf>
3. UNESCO World Water Assessment Programme (WWAP). (2020). The United Nations World Water Development Report 2020: Water and Climate Change. UNESCO.
<https://www.unesco.org/en/wwap/wwdr/2020>
4. European Commission Joint Research Centre. (2023). European Drought Observatory (EDO). JRC, European Commission.
<https://edo.jrc.ec.europa.eu>
5. European Environment Agency (EEA). (2024). Drought impact on ecosystems in Europe (Indicator, 8th Environment Action Programme). EEA.
<https://www.eea.europa.eu/en/analysis/publications/european-union-8th-environment-action-programme-1/indicators/04-drought-impact-on-ecosystems-in-europe/@@download/file>
6. European Union. (2000). Directive 2000/60/EC establishing a framework for Community action in the field of water policy (Water Framework Directive). Official Journal of the European Communities.
<https://eur-lex.europa.eu/eli/dir/2000/60/oj>
7. Joint Research Centre (JRC), European Commission. Drought impacts and water scarcity in Europe.
<https://publications.jrc.ec.europa.eu/repository/handle/JRC135215>

Cilji in kompetence:

Cilji predmeta so:

- razumevanje vplivov podnebnih sprememb na vodni krog ter na površinske in podzemne vode;
- razumevanje konceptov vodne ranljivosti, odpornosti in prilagajanja v kontekstu podnebnih sprememb;
- razumevanje povezav med podnebnimi projekcijami in spremembami hidroloških procesov;
- razumevanje pristopov k prilagajanju vodnih sistemov na spremenjene podnebne razmere;
- razumevanje vloge upravljanja voda, prostorskega načrtovanja in politik pri povečevanju vodne odpornosti;
- razumevanje uporabe konceptov climate proofing in Do No Significant Harm (DNSH) v vodnem sektorju.

Predmetno specifični cilji in kompetence:

- sposobnost analize vplivov podnebnih sprememb na hidrološke procese (odtok, poplave, suše, podzemne vode);
- sposobnost presoje ranljivosti in odpornosti vodnih sistemov na podnebne spremembe;
- sposobnost povezovanja znanstvenih projekcij s konkretnimi ukrepi prilagajanja v vodnem sektorju;

Objectives and competences:

The objectives of the course are:

- to understand the impacts of climate change on the water cycle and on surface and groundwater;
- to understand the concepts of water vulnerability, resilience, and adaptation in the context of climate change;
- to understand the links between climate projections and changes in hydrological processes;
- to understand approaches to adapting water systems to changing climatic conditions;
- to understand the role of water management, spatial planning, and policies in increasing water resilience;
- understanding the application of climate proofing and Do No Significant Harm (DNSH) concepts in the water sector.

Subject-specific objectives and competences:

- ability to analyze the impacts of climate change on hydrological processes (runoff, floods, droughts, groundwater);
- ability to assess the vulnerability and resilience of water systems to climate change;
- ability to link scientific projections with concrete adaptation measures in the water sector;
- ability to critically assess adaptation measures and water management strategies;
- ability to interpret professional and scientific sources in the field of climate change adaptation;

<ul style="list-style-type: none"> • sposobnost kritične presoje prilagoditvenih ukrepov in strategij upravljanja voda; • sposobnost interpretacije strokovnih in znanstvenih virov s področja prilagajanja na podnebne spremembe; • razumevanje uporabe konceptov climate proofing in DNSH pri načrtovanju in izvajanju ukrepov v vodnem sektorju. <p>Splošne kompetence:</p> <ul style="list-style-type: none"> • sistemsko in problemsko razmišljanje; • sposobnost analize kompleksnih okoljskih problemov; • sposobnost dela z znanstveno in strokovno literaturo; • sposobnost argumentirane strokovne presoje in razprave; • sposobnost povezovanja znanstvenih spoznanj z odločitvenimi in upravljavskimi procesi. 	<ul style="list-style-type: none"> • understanding of the application of climate proofing and DNSH concepts in the planning and implementation of measures in the water sector. <p>General competencies:</p> <ul style="list-style-type: none"> • systemic and problem-oriented thinking; • ability to analyze complex environmental problems; • ability to work with scientific and professional literature; • ability to make reasoned professional judgments and engage in debate; • ability to link scientific knowledge with decision-making and management processes.
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Predvideni študijski rezultati:

<p>Znanje in razumevanje: Študent bo ob zaključku predmeta sposoben:</p> <ul style="list-style-type: none"> • pojasniti vplive podnebnih sprememb na vodni krog ter na površinske in podzemne vode; • razložiti spremembe hidroloških procesov (odtok, poplave, suše, napajanje podzemne vode) v pogojih spreminjajočega se podnebja; • interpretirati hidrološke in podnebne projekcije v kontekstu vodnih sistemov; • razložiti koncepte vodne ranljivosti, odpornosti in prilagajanja; • pojasniti vlogo upravljanja voda in prostorskega načrtovanja pri prilagajanju na podnebne spremembe; • razložiti uporabo konceptov climate proofing in Do No Significant Harm (DNSH) v vodnem sektorju. <p>Prenosljive/ključne spretnosti in drugi atributi:</p> <ul style="list-style-type: none"> • analiza ranljivosti vodnih sistemov na podnebne spremembe; • presoja odpornosti in prilagoditvenih sposobnosti vodnih sistemov; • vrednotenje učinkovitosti prilagoditvenih ukrepov v vodnem sektorju; • povezovanje znanstvenih projekcij s strateškim in operativnim načrtovanjem;
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Intended learning outcomes:

<p>Knowledge and understanding: At the end of the subject, student will be able:</p> <ul style="list-style-type: none"> • explain the effects of climate change on the water cycle and on surface and groundwater; • explain changes in hydrological processes (runoff, floods, droughts, groundwater recharge) under changing climate conditions; • interpret hydrological and climate projections in the context of water systems; • explain the concepts of water vulnerability, resilience, and adaptation; • explain the role of water management and spatial planning in climate change adaptation; • explain the application of climate proofing and Do No Significant Harm (DNSH) concepts in the water sector. <p>Transferable/key skills and other attributes:</p> <ul style="list-style-type: none"> • analysis of the vulnerability of water systems to climate change; • assessment of the resilience and adaptive capacity of water systems; • evaluation of the effectiveness of adaptation measures in the water sector; • Linking scientific projections with strategic and operational planning; • Critical analysis of professional and scientific literature in the field of water resilience; • Reasoned professional assessment and presentation of solutions for adaptation to climate change.

<ul style="list-style-type: none"> • kritična analiza strokovne in znanstvene literature s področja vodne odpornosti; • argumentirana strokovna presoja in predstavitev rešitev za prilagajanje na podnebne spremembe. 	
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Metode poučevanja in učenja:

Oblike dela:

- predavanja,
- vaje,
- teren,
- krajša seminarska ali projekt

Metode dela:

- razlaga in interpretacija temeljnih konceptov vodne odpornosti in prilagajanja;
- analiza primerov vplivov podnebnih sprememb na vodne sisteme;
- projektno in problemsko učenje, usmerjeno v pripravo rešitev za povečanje vodne odpornosti;
- delo z znanstveno in strokovno literaturo ter strateškimi dokumenti;
- vodena strokovna razprava in predstavitev projektnih rezultatov.
- teren.

Learning and teaching methods:

Forms of work:

- lectures,
- exercises,
- fieldwork,
- short seminar or project

Working methods:

- explanation and interpretation of basic concepts of water resilience and adaptation;
- analysis of examples of the impact of climate change on water systems;
- project-based and problem-based learning focused on developing solutions to increase water resilience;
- working with scientific and professional literature and strategic documents;
- guided professional discussion and presentation of project results.
- fieldwork.

Načini ocenjevanja:	Delež (v %) / Weight (in %)	Assessment:
<p>Pogoj za pristop k izpitu: udeležba na terenu</p> <p>Končna ocena pri predmetu je sestavljena iz</p> <ul style="list-style-type: none"> • seminarska ,projektna naloga 30% • izpit 70% <p>Ocenjevalna lestvica:</p> <ul style="list-style-type: none"> ▪ zadostno 6: 60–67 % ▪ dobro 7: 68–75 % ▪ prav dobro 8: 76–83 % ▪ prav dobro 9: 84–90 % ▪ odlično 10: 91–100 % 		<p>A prerequisite for access to the exam: ...</p> <p>Final evaluation consists of</p> <ul style="list-style-type: none"> • project, seminar 30% • exam 70% <p>Grading scale:</p> <ul style="list-style-type: none"> ▪ Sufficient D (6): 60–67% ▪ Good C (7): 68–75% ▪ Very good B (8): 76–83% ▪ Very good B+ (9): 84–90% ▪ Excellent A (10): 91–100%

Materialni pogoji za izvedbo predmeta :

- predavalnica z multimedijско opremo,
- internet,

Material conditions for subject realization:

- multimedia equipment,
- internet,

- računalnik in ustrezen software,
- terenska oprema.

- computer and appropriate software,
- field equipment.

Obveznosti študentov:

- krajša seminarska naloga
- udeležba na terenu
- izpit

Student's commitments:

- short seminar paper
- fieldwork participation
- exam

Reference nosilca predmeta:

Pedagoško delo:

- docent na Fakulteti za varstvo okolja
- predavatelj na višji šoli Biotehniškega centra Naklo
- več predavanj na NTF, FF Geografija na UNI LJ

Znanstveno-raziskovalno delo:

- raziskovalna skupina ARSO

Strokovno delo in izbrane strokovne publikacije:

- BLATNIK, Matej, RAVBAR, Nataša, GABROVŠEK, Franci, FRANTAR, Peter, ANDJELOV, Mišo, ULAGA, Florjana. Podnebje v zaledju Cerknškega polja — splošne značilnosti, trendi in pričakovana dinamika v prihodnosti. V: GABERŠČIK, Alenka (ur.). Presihajoče jezero : monografija o Cerknškem jezeru = avtorji fotografij Matej Blatnik ... et al.]. 1. izd. Ljubljana: Založba Univerze, 2025. Str. 23-40, ilustr. ISBN 978-961-297-717-7.
- FRANTAR, Peter (avtor, kartograf). Temperaturni režimi rek v Sloveniji v obdobju 1976-1990 in spremembe režimov v obdobju 1991-2005. Geografski vestnik : časopis za geografijo in sorodne vede. [Tiskana izd.]. 2012, 84, [št.] 2, str. 11-28, ilustr. ISSN 0350-3895. http://zgs.zrc-sazu.si/Portals/8/Geografski_vestnik/gv_84-2_frantar.pdf

Priznanja in nagrade:

- Bronasto priznanje Zveze geografov Slovenije 2025
- Priznanje MNVP 2025

Lecturer's references:

Pedagogic activities:

- Assistant professor at the Faculty of Environmental Protection
- Lecturer at the Naklo Biotechnical Center College
- Several lectures at NTF, FF Geography at UNI LJ

Scientific and research work:

research group ARSO

Professional work and selected professional publications:

- BLATNIK, Matej, RAVBAR, Nataša, GABROVŠEK, Franci, FRANTAR, Peter, ANDJELOV, Mišo, ULAGA, Florjana. Podnebje v zaledju Cerknškega polja — splošne značilnosti, trendi in pričakovana dinamika v prihodnosti. V: GABERŠČIK, Alenka (ur.). Presihajoče jezero : monografija o Cerknškem jezeru = avtorji fotografij Matej Blatnik ... et al.]. 1. izd. Ljubljana: Založba Univerze, 2025. Str. 23-40, ilustr. ISBN 978-961-297-717-7.
- FRANTAR, Peter (avtor, kartograf). Temperaturni režimi rek v Sloveniji v obdobju 1976-1990 in spremembe režimov v obdobju 1991-2005. Geografski vestnik : časopis za geografijo in sorodne vede. [Tiskana izd.]. 2012, 84, [št.] 2, str. 11-28, ilustr. ISSN 0350-3895. http://zgs.zrc-sazu.si/Portals/8/Geografski_vestnik/gv_84-2_frantar.pdf

Awards:

- Bronze award from the Association of Geographers of Slovenia 2025
- Ministry of Natural Resources and Planning award 2025

Izbrani znanstveni članki / Selected scientific papers:

- Frantar, P., & Draksler, A. (2022). Vpliv podnebnih sprememb na temperaturo vode v Sloveniji v 21. stoletju. *Geografski vestnik*, 94(2), 45–79. <https://doi.org/10.3986/GV94203>
- Blatnik, M., Gabrovšek, F., Ravbar, N., Frantar, P., & Gill, L. (2024). Assessment of climatic and anthropogenic effects on flood dynamics in the Cerknško Polje (SW Slovenia) based on a 70-year observation dataset. *Journal of Hydrology: Regional Studies*, 51, 101609. <https://doi.org/10.1016/j.ejrh.2023.101609>
- Jemec Auflič, M., Bezak, N., Šegina, E., Frantar, P., Gariano, S. L., Medved, A., & Peternel, T. (2023). Climate change increases the number of landslides at the juncture of the Alpine, Pannonian and Mediterranean regions. *Scientific Reports*, 13, 50314. <https://doi.org/10.1038/s41598-023-50314-x>
- Souvent, P., Pavlič, U., Andjelov, M., Rman, N., & Frantar, P. (2023). Groundwater quantitative status assessment for River Basin Management Plan 2022–2027 (RBMP III). *Geologija*, 66(2), 257–273. <https://doi.org/10.5474/geologija.2023.012>
- Bogataj, N., & Frantar, P. (2025). Groundwater recharge as a basis for the assessment of ecosystem services on commonland: The case of the Primorska region in Slovenia. *Acta Geographica Slovenica*, 65(3), 38–53. <https://doi.org/10.3986/AGS.14319>