

UČNI NAČRT PREDMETA / COURSE SYLLABUS

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| Predmet: | PODNEBNE SPREMEMBE |
| Course title: | 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 | Modul: Okolje in človek | 1. in 2. | / |
| Environmental Protection and Eco-technologies, 2 nd level | Module: Environment and a human | 1 st and 2 nd | / |

Vrsta predmeta / Course type Modularni predmet / Modular course

Univerzitetna koda predmeta / University course code: PSM

| 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

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| Jeziki / | Predavanja / Lectures: | Slovenščina / Slovenian |
| Languages: | Vaje / Tutorial: | Slovenščina / Slovenian |

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| Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti: | Prerequisites: |
| Pogojev ni. Angleščina. | No formal prerequisites. English |

Vsebina:

Predmet obravnava podnebni sistem Zemlje, osnovne fizikalne zakonitosti sevanja in energijske bilance ter ključne procese, ki vplivajo na naravno in antropogeno pogojeno podnebno variabilnost. Poudarek je na razumevanju opazovanj podnebja, podnebnih modelov, scenarijev in negotovosti ter na vlogi znanstvenih sintez pri oblikovanju podnebnih politik. Predmet študente seznani tudi z osnovnimi koncepti climate proofing in načelom Do No Significant Harm (DNSH) v kontekstu znanstvenih spoznanj o podnebnih spremembah.

Poglavitne teme:

- **Podnebni sistem in fizikalne osnove**
 - Podnebni sistem Zemlje in časovno-prostorske skale
 - Osnovne fizikalne zakonitosti sevanja in energijska bilanca Zemlje
 - Učinek tople grede in vloga toplogrednih plinov

Content (Syllabus outline):

The course covers the Earth's climate system, the basic physical laws of radiation and energy balance, and the key processes that influence natural and anthropogenic climate variability. The emphasis is on understanding climate observations, climate models, scenarios and uncertainties, and on the role of scientific syntheses in climate policy-making. The course also introduces students to the basic concepts of climate proofing and the Do No Significant Harm (DNSH) principle in the context of scientific knowledge about climate change.

Main topics:

- Climate system and physical foundations
- Earth's climate system and time-space scales
- Basic physical laws of radiation and Earth's energy balance
- Greenhouse effect and the role of greenhouse gases

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| <p>Procesi in naravna variabilnost podnebja</p> <ul style="list-style-type: none"> • Biogeokemijski cikli in vloga oceanov ter kopnega • Povratne zanke v podnebnem sistemu • Naravna podnebna variabilnost in povezave z ekosistemi <p>Opazovanja, modeli in prihodnje podnebje</p> <ul style="list-style-type: none"> • Opazovanja podnebja in paleoklimatski zapisi • Podnebni modeli, scenariji in projekcije • Negotovosti in omejitve podnebnih ocen <p>Znanost, sinteze in podnebne politike</p> <ul style="list-style-type: none"> • Znanstvene sinteze in vloga IPCC • Povezava med znanostjo in podnebnimi politikami • Osnove climate proofing in načela Do No Significant Harm (DNSH) | <p>Processes and natural climate variability</p> <ul style="list-style-type: none"> • Biogeochemical cycles and the role of oceans and land • Feedback loops in the climate system • Natural climate variability and links with ecosystems <p>Observations, models and future climate</p> <ul style="list-style-type: none"> • Climate observations and paleoclimate records • Climate models, scenarios and projections • Uncertainties and limitations of climate assessments <p>Science, syntheses and climate policies</p> <ul style="list-style-type: none"> • Scientific syntheses and the role of the IPCC • The link between science and climate policies • Basics of climate proofing and the Do No Significant Harm (DNSH) principle |
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Temeljna literatura in viri / Textbooks:

Obvezna / Required:

Intergovernmental Panel on Climate Change (IPCC). (2021). *Climate change 2021: The physical science basis*. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press. <https://www.ipcc.ch/report/ar6/wg1/>

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/>

Intergovernmental Panel on Climate Change (IPCC). (2022). *Climate change 2022: Mitigation of climate change*. Contribution of Working Group III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press. <https://www.ipcc.ch/report/ar6/wg3/>

Intergovernmental Panel on Climate Change (IPCC). (2023). *Climate change 2023: Synthesis report*. Contribution of Working Groups I, II and III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change. IPCC. <https://www.ipcc.ch/report/ar6/syr/>

Ogrin, D., Repe, B., Štaut, L., Svetlin, D., & Ogrin, M. (2023). Podnebna tipizacija Slovenije po podatkih za obdobje 1991–2020. *Dela*, 59, 5–89. <https://doi.org/10.4312/dela.59.5-89>

Priporočena / Recommended:

Skok, G. (2020). *Uvod v meteorologijo*. Univerza v Ljubljani. <https://dlib.si/details/URN:NBN:SI:DOC-NDP582S4>

Thunberg, G. (Ed.). (2022). *The climate book*. Penguin Random House.
https://en.wikipedia.org/wiki/The_Climate_Book

Cilji in kompetence:

Cilji predmeta

Cilji predmeta so:

- razumevanje fizikalnih, kemijskih in biogeokemijskih procesov, ki določajo podnebni sistem Zemlje;
- razumevanje vzrokov in mehanizmov sodobnih podnebnih sprememb ter razlik med naravno variabilnostjo in antropogenimi vplivi;
- razumevanje opazovalnih podnebnih podatkov, trendov in negotovosti;
- razumevanje podnebnih scenarijev in projekcij prihodnjega podnebja ter njihove znanstvene osnove;
- razumevanje vloge znanstvenih ocen (npr. IPCC) pri oblikovanju podnebnih politik;
- razumevanje osnovnih načel climate proofing in Do No Significant Harm (DNSH) kot odziva politike na znanstvena spoznanja o podnebnih spremembah.

Predmetno-specifične kompetence

Predmet razvija naslednje predmetno-specifične kompetence:

- sposobnost analitične razlage delovanja podnebnega sistema in ključnih povratnih zank;
- sposobnost kritične presoje podnebnih trendov, projekcij in scenarijev;
- razumevanje negotovosti in omejitev podnebnih modelov;
- sposobnost interpretacije znanstvenih virov in poročil s področja podnebnih sprememb;
- sposobnost razločevanja znanstveno utemeljenih spoznanj od poenostavljenih ali zavajajočih interpretacij v javnosti in politiki;
- razumevanje povezave med znanstvenimi podnebnimi projekcijami ter koncepti, kot sta DNSH in climate proofing.

Splošne kompetence

Predmet prispeva k razvoju naslednjih splošnih kompetenc:

- kritično in sistemsko razmišljanje;

Objectives and competences:

Course objectives

The course objectives are:

- understanding the physical, chemical and biogeochemical processes that determine the Earth's climate system;
- understanding the causes and mechanisms of modern climate change and the differences between natural variability and anthropogenic impacts;
- understanding observational climate data, trends and uncertainties;
- understanding climate scenarios and projections of future climate and their scientific basis;
- understanding the role of scientific assessments (e.g. IPCC) in climate policy-making;
- understanding the basic principles of climate proofing and Do No Significant Harm (DNSH) as a policy response to scientific knowledge about climate change.

Subject-specific competences

The course develops the following subject-specific competences:

- ability to analytically explain the functioning of the climate system and key feedback loops;
- ability to critically assess climate trends, projections and scenarios;
- understanding uncertainties and limitations of climate models;
- ability to interpret scientific sources and reports in the field of climate change;
- the ability to distinguish scientifically based knowledge from simplified or misleading interpretations in the public and politics;
- understanding the connection between scientific climate projections and concepts such as DNSH and climate proofing.

General competences

The subject contributes to the development of the following general competences:

- critical and systemic thinking;
- ability to work with scientific literature and data;
- ability to reasoned professional debate;
- understanding the connection between science, politics and society;

- sposobnost dela z znanstveno literaturo in podatki;
- sposobnost argumentirane strokovne razprave;
- razumevanje povezave med znanostjo, politiko in družbo;
- sposobnost samostojnega strokovnega učenja in nadgrajevanja znanja.

- ability to learn independently and upgrade knowledge.

Predvideni študijski rezultati:

Znanje in razumevanje:

Študent bo ob zaključku predmeta sposoben:

- razložiti **zgradbo in delovanje podnebne sistema** ter vlogo ključnih fizikalnih, kemijskih in biogeokemijskih procesov;
- pojasniti **vzroke sodobnih podnebnih sprememb** ter razlikovati med naravno variabilnostjo in antropogenimi vplivi;
- interpretirati **opazovalne podnebne podatke** in dolgoročne trende glavnih podnebnih spremenljivk;
- razložiti osnovne **podnebne scenarije in projekcije prihodnjega podnebja** ter njihove znanstvene predpostavke;
- pojasniti **negotovosti, omejitve in predpostavke** podnebnih modelov in projekcij;
- razložiti vlogo **znanstvenih sintez (npr. IPCC)** pri oblikovanju podnebnih politik;
- pojasniti osnovna načela **climate proofing in Do No Significant Harm (DNSH)** ter njihovo povezavo z znanstvenimi spoznanji o podnebnih spremembah.

Prenosljive/ključne spretnosti in drugi atributi:

- **kritična analiza in vrednotenje znanstvene literature** s področja podnebnih sprememb;
- **interpretacija grafičnih, kartografskih in podatkovnih prikazov** podnebnih trendov in projekcij;
- **argumentirana strokovna razprava** o znanstvenih ugotovitvah, negotovostih in omejitvah;
- **jasna in strokovna komunikacija kompleksnih znanstvenih vsebin** različnim ciljnim skupinam;
- **prepoznavanje povezav med znanstvenimi spoznanji, podnebnimi politikami in družbenimi odzivi.**

Intended learning outcomes:

Knowledge and understanding:

Upon completion of the course, students will be able to:

- explain the structure and functioning of the climate system and the role of key physical, chemical, and biogeochemical processes;
- explain the causes of contemporary climate change and distinguish between natural variability and anthropogenic influences;
- interpret observational climate data and long-term trends in key climate variables;
- explain basic climate scenarios and projections of future climate and their scientific assumptions;
- explain the uncertainties, limitations, and assumptions of climate models and projections;
- explain the role of scientific syntheses (e.g., IPCC) in climate policy-making;
- explain the basic principles of climate proofing and Do No Significant Harm (DNSH) and their connection to scientific knowledge about climate change.

Transferable/key skills and other attributes:

- critical analysis and evaluation of scientific literature in the field of climate change;
- Interpretation of graphical, cartographic, and data representations of climate trends and projections;
- Informed professional discussion of scientific findings, uncertainties, and limitations;
- Clear and professional communication of complex scientific content to different target groups;
- Recognizing the links between scientific findings, climate policies, and societal responses.

Metode poučevanja in učenja:**Oblike dela:**

- predavanja,
- vaje,
- teren,
- krajša seminarska naloga.

Metode dela:

- razlaga in interpretacija temeljnih teoretičnih vsebin,
- prikaz analize podnebnih podatkov, grafov in rezultatov modelov,
- kritična obravnava znanstvene literature in poročil (npr. IPCC),
- problemsko in projektno učenje,
- vodena strokovna razprava,
- terensko delo.

Learning and teaching methods:**Forms of teaching:**

- lectures,
- exercises,
- fieldwork,
- short seminar assignment

Teaching methods:

- explanation and interpretation of fundamental theoretical content,
- presentation of climate data analysis, graphs, and model results,
- critical review of scientific literature and reports (e.g., IPCC),
- problem-based and project-based learning,
- guided expert discussion,
- fieldwork.

Načini ocenjevanja:

Delež (v %) /

Weight (in %)

Assessment:

Pogoj za pristop k izpitu:
udeležba na terenu

Končna ocena pri predmetu je sestavljena iz

- sodelovanje pri predavanjih 20%
- krajša seminarska 20%
- izpit 60%

Pogoj za pristop k izpitu oddana krajša seminarska naloga in udeležba na terenu.

Ocenjevalna lestvica:

- zadostno 6: 60–67 %
- dobro 7: 68–75 %
- prav dobro 8: 76–83 %
- prav dobro 9: 84–90 %
- odlično 10: 91–100 %

A prerequisite for access to the exam:
field participation

Final evaluation consists of

- participation in lectures 20%
- short seminar 20%
- exam 60%

Grading scale:

- 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,
- računalnik in ustrezen software,
- terenska oprema.

Material conditions for subject realization:

- multimedia equipment,
- internet,
- computer and appropriate software,
- field equipment.

Obveznosti študentov:**Student's commitments:**

- krajša seminarska naloga
- udeležba na terenu
- izpit

- 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 Cerkniškega polja — splošne značilnosti, trendi in pričakovana dinamika v prihodnosti. V: GABERŠČIK, Alenka (ur.). Presihajoče jezero : monografija o Cerkniškem 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 Cerkniškega polja — splošne značilnosti, trendi in pričakovana dinamika v prihodnosti. V: GABERŠČIK, Alenka (ur.). Presihajoče jezero : monografija o Cerkniškem 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 Cerkniško 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>