Podiplomskašola ZRCSAZU
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UČNI NAČRT PREDMETA / COURSE SYLLABUS

Predmet:	Upravljanje z zemeljskimi plazovi
Course title:	Landslide Management

Študijski program in stopnja Study programme and level	Študijska smer Study field	Letnik Academic year	Semester Semester
Okoljske in regionalne študije, doktorski študij 3. stopnje	4D Zemlja	/	/
Environmental and Regional Studies, doctoral study 3rd cycle	4D Earth	/	/

Vrsta predmeta / Course type	Izbirni/Elective
Univerzitetna koda predmeta / University course code:	DIZ05

Predavanja Lectures	Seminar Seminar	Vaje Tutorial	Klinične vaje work	Druge oblike študija	Samost. delo Individ. work	ECTS
15	5	10			150	6

Nosilec predmeta / Lecturer:	doc. dr. Mateja Jemec Auflič (ostali izvajalci: dr. Adrijan Košir, dr. Jernej Jež, dr. Polona Kralj, dr. Mitja Janža, dr. Tina Peternel)

Jeziki / Languages:	**Predavanja / Lectures:**	slovenščina, angleščina / Slovene, English
	Vaje / Tutorial:	slovenščina, angleščina / Slovene, English

Pogoji za vključitev v delo oz. za opravljanje študijskih obveznosti:	**Prerequisits**
Končana druga bolonjska stopnja ustrezne smeri ali univerzitetni študij VII stopnje	Second-cycle Bologna degree in the relevant track or a university (level VII) degree.

Vsebina:	**Content (Syllabus outline):**
• Osnovni koncepti: delitev, nastanek, vzroki pojavljanja, pripravljalni in sprožitveni dejavniki • Plazovi v Sloveniji: zgodovinski pregled večjih dogodkov • Paleoplazovi: stratigrafski in geomorfološki zapis prazgodovinskih masnih premikanj • Mehanske in petrofizikalne lastnosti kamnin, njihova zaporedja ter dovzetnost in vpliv na nastanek zemeljskih plazov • Priprava in zajem podatkov na terenu in izris v GIS okolju	• Basic terms: classification, occurrence, causes, preparatory and triggering factors • Landslides in Slovenia: historical overview of the most important events • Palaeolandslides: stratigraphical and geomorphological record of prehistoric mass movements • Mechanical and petrophysical properties of rocks, their sequence and their susceptibility to and influence on landslides • Preparation and collection of data in the field and its visualization in a GIS environment • Processing, analysis and modelling of spatial landslide data

- Obdelava, analize in modeliranje prostorskih podatkov o zemeljskih plazovih
- Geološki podatki za ocene nevarnosti: zasnova, vhodni podatki, modeli, validacija, uporaba
- Zgodnje opozarjanje pred nastankom: zasnova, vhodni podatki, modeli, validacija, uporaba
- Raziskave in monitoring tehnike: kartiranje, geotehnične, hidrološke, geofizikalne, geodetske, daljinsko zaznavanje
- Upravljanje: preventiva, sanacijski ukrepi, register zemeljskih plazov
- Vplivi na okolje: infrastruktura, gozd, kmetijska zemljišča, urbana zemljišča
- Vpliv podzemne vode na nastanek in dinamiko zemeljskih plazov: terenske hidrogeološke meritve in interpretacija meritev
- Prenos onesnaževal pod površjem: koncept prenosa onesnaževal v nezasičini in zasičeni coni vodonosnika, orodja za modeliranje prenosa onesnaževal
- Poplave podzemne vode: vloga podzemne vode pri poplavah, opazovanje in interpretacija hidrogeoloških podatkov

- Geological data for hazard assessment: conception, input data, models, validation, applicability
- Landslide early warning: Conceptualization, input data, models, validation, applicability
- Research and monitoring techniques: mapping, geotechnics, hydrology, geophysics, geodesy, remote sensing
- Management: prevention, remediation measures, landslide register
- Environmental impact: Infrastructure, forests, agricultural land, urban areas
- Impact of groundwater on the occurrence and dynamics of landslides: hydrogeological field measurements and interpretation of measurements
- Underground transport of contaminants: Concept of contaminant transport in the unsaturated and saturated zones of aquifers, tools for modelling contaminant transport
- Groundwater flooding: the role of groundwater in flooding, observation and interpretation of hydrogeological data

Temeljni literatura in viri / Readings:

Izbrana poglavja iz knjig ter članki/Selected chapters from books and papers:

- Bobrowsky PT, Marker B (eds) (2018) Encyclopedia of Engineering Geology. Springer, Cham, pp 978–284
- Clague, J. J. and Stead, D. 2012: Landslides. Types, Mechanisms and Modeling. Cambridge University Press, 436 p.
- Glade, Thomas, Malcolm Anderson, and Michael J. Crozier. 2005. Landslide Hazard and Risk. Wiley&Sons, book, p. 810
- Highland, L. M., & Bobrowsky, P. (2008). The landslide Handbook - A guide to understanding landslides. US Geological Survey Circular, (1325), 1–147.
- Hungr, O., Leroueil, S. & Picarelli, L. (2014) The Varnes classification of landslide types, an update. Landslides 11, 167–194. https://doi.org/10.1007/s10346-013-0436-y
- Janža M., Serianz L., Šram D., Klasinc M. (2018). Hydrogeological investigation of landslides Urbas and Čikla above the settlement of Koroška Bela (NW Slovenia). Geologija; 61: 191-203. DOI: 10.5474/geologija.2018.013
- Jemec Auflič, M.., Herrera, G., Mateos, R.M., Peternel, T. et al. Landslide monitoring techniques in the Geological Surveys of Europe. Landslides 20, 951–965 (2023). https://doi.org/10.1007/s10346-022-02007-1

- Skaberne, D. (2001). Proposal of the Slovene terminology on slope movements - slope transport. Geologija, 44(1), 89–100. https://doi.org/10.5474/geologija.2001.006.

Cilji in kompetence:

- Prepoznavanje zemeljskih plazov na terenu, razumevanje vzrokov, dinamike in posledic
- Inženirsko-geološki pregled plazu in izris v GIS okolju
- Vrednotenje rezultatov in ocena stopnje nevarnosti
- Poznavanje virov podatkov in metod za ocene nevarnosti zemeljskih plazov
- Sposobnost prepoznavanja različnih vrst zemeljskih plazov na danem območju in ocena potencialnih geoloških nevarnosti

Objectives and competences:

- Recognition of landslides in the field, understanding of their causes, dynamics and consequences
- Engineering geological investigation of landslides and visualisation in a GIS environment
- Evaluation of the results and hazard assessment
- Knowledge of data sources and methods for landslide hazard assessment
- Ability to identify the different types of landslides in a given area and assess potential geological hazards

Predvideni študijski rezultati:

- Osvojena strokovna terminologija
- Sposobnost uporabe pridobljenega znanja na praktičnem primeru
- Analiza izbranega območja
- Samostojnost pri kabinetnem in terenskem delu
- Seminarska naloga

Intended learning outcomes:

- Acquired specialist terminology
- Ability to apply the acquired knowledge in a practical example
- Analysis of a selected area
- Independent work in class and in practise
- Seminar paper

Metode poučevanja in učenja:

☒ Predavanja
☒ Laboratorijske vaje
☒ Terensko delo
☒ Seminar
☒ Individualne naloge
☒ Konzultacije
- ☒ e-izobraževanje

Learning and teaching methods:

☒ Lectures
☒ Lab work/tutorials
☒ Field work
☒ Seminar
☒ Independent work assignments
☒ Consultations
- ☒ e-Learning

Načini ocenjevanja:	Delež (v %) / Weight (in %)	Assessment:
Seminarska naloga z zagovorom	100	Written seminar paper and defence

Reference nosilca / Lecturer's references:

1. **Jemec Auflič M**, Oštir K, Grabrijan T, Ivačič M, **Peternel T** and Šegina E (2024) Towards the development of a landslide activity map in Slovenia. Front. Earth Sci. 12:1368405. doi: 10.3389/feart.2024.1368405
2. **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. Sci Rep 13, 23085 (2023). https://doi.org/10.1038/s41598-023-50314-x
3. Šegina, E., **Jemec Auflič, M.**, Zupan, M., Jež, J., & **Peternel,** T. (2022). Composite landslide in the dynamic alpine conditions: a case study of Urbas landslide. Geologija, 65(2), 161–175. https://doi.org/10.5474/geologija.2022.010

4. **Peternel**, **Tina**, **Janža**, **Mitja**, Šegina, Ela, Bezak, Nejc, Maček, Matej. 2022. Recognition of landslide triggering mechanisms and dynamics using GNSS, UAV photogrammetry and in situ monitoring data. Remote sensing 14/ 14. DOI: 10.3390/rs14143277.
5. **Peternel**, **Tina**, Šegina, Ela, **Jež**, Jernej, **Jemec Auflič**, Mateja, **Janža**, **Mitja**, Logar, Janko, Mikoš, Matjaž, Bavec, Miloš. 2022. Review of the research and evolution of landslides in the hinterland of Koroška Bela settlement (NW Slovenia) = Pregled raziskav in nastanek plazov v zaledju naselja Koroška Bela (SZ Slovenija). Geologija 65/2: 131 – 149. DOI: 10.5474/geologija.2022.008.
6. Bezak, Nejc, Sodnik, Jošt, Maček, Matej, Jurček, Timotej, **Jež**, **Jernej, Peternel, Tina**, Mikoš, Matjaž. 2021. Investigation of potential debris flows above the Koroška Bela settlement, NW Slovenia, from hydro-technical and conceptual design perspectives. Landslides : 18/12: 16. DOI: 10.1007/s10346-021-01774-7.
7. **Janža Mitja** (2022). Optimization of well field management to mitigate groundwater contamination using a simulation model and evolutionary algorithm. Science of The Total Environment; 807: 150811. DOI: 10.1016/j.scitotenv.2021.150811
8. **Kralj Polona** (2016). Hydrothermal zeolitisation controlled by host-rock lithofacies in the Periadriatic (Oligocene) Smrekovec submarine composite stratovolcano, Slovenia. J Volcanol Geoth Res 317, pp. 53-65. http://dx.doi.org/10.1016/j.jvolgeores.2016.02.009.
9. Verbovšek T, **Košir A**, Teran M, Zajc M, Popit T (2017) Volume determination of the Selo landslide complex (SW Slovenia): integrating field mapping, ground penetrating radar and GIS approaches. Landslides 14: 1265–1274. https://doi.org/10.1007/s10346-017-0815-x