

Department of Environmental Sciences

Outstanding Achievements 2021



Foreword

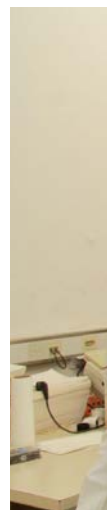


Prof. Dr. Milena Horvat
Head, Department
of Environmental Sciences

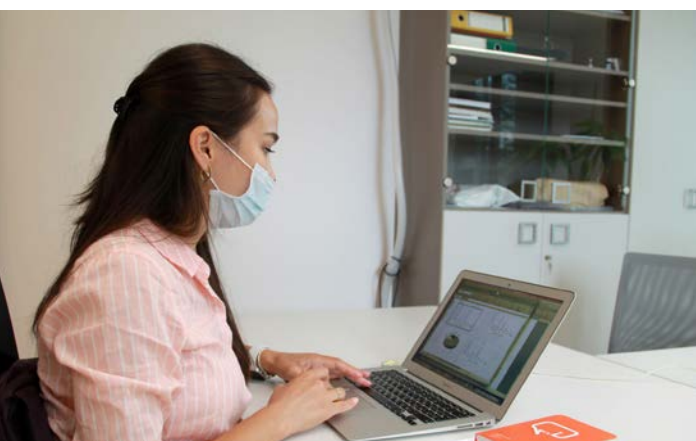
Environmental research is interdisciplinary in nature, as it involves the intertwining of natural processes and human activity in the broadest sense. Much of the Department of Environmental Sciences research is related to laboratory work, which requires excellent and demanding research equipment. However, the equipment alone cannot replace the engagement and commitment of researchers in the department, who discover new insights that create our environment with immense ingenuity and enthusiasm. The present brochure is the second in a series and reveals just a few of the high-profile achievements of 2021 popularly and understandably. The continuity of successful work is clearly evident.

In addition to the researched work, the Department of Environmental Sciences also carries out its mission with activities that are directly related to users in Slovenia and beyond. For these activities, it is necessary to meet high standards of quality and safety at work, which must also be formally recognized. Meeting these conditions requires commitment, but it also improves research work, connects collaborators and their responsibilities.

Work in 2021 was again marked by a global pandemic, which severely affected social life in the Department. Nonetheless, we can safely predict that the two-year legacy of the pandemic has brought experiences that we will use to our advantage in our future work.



About us

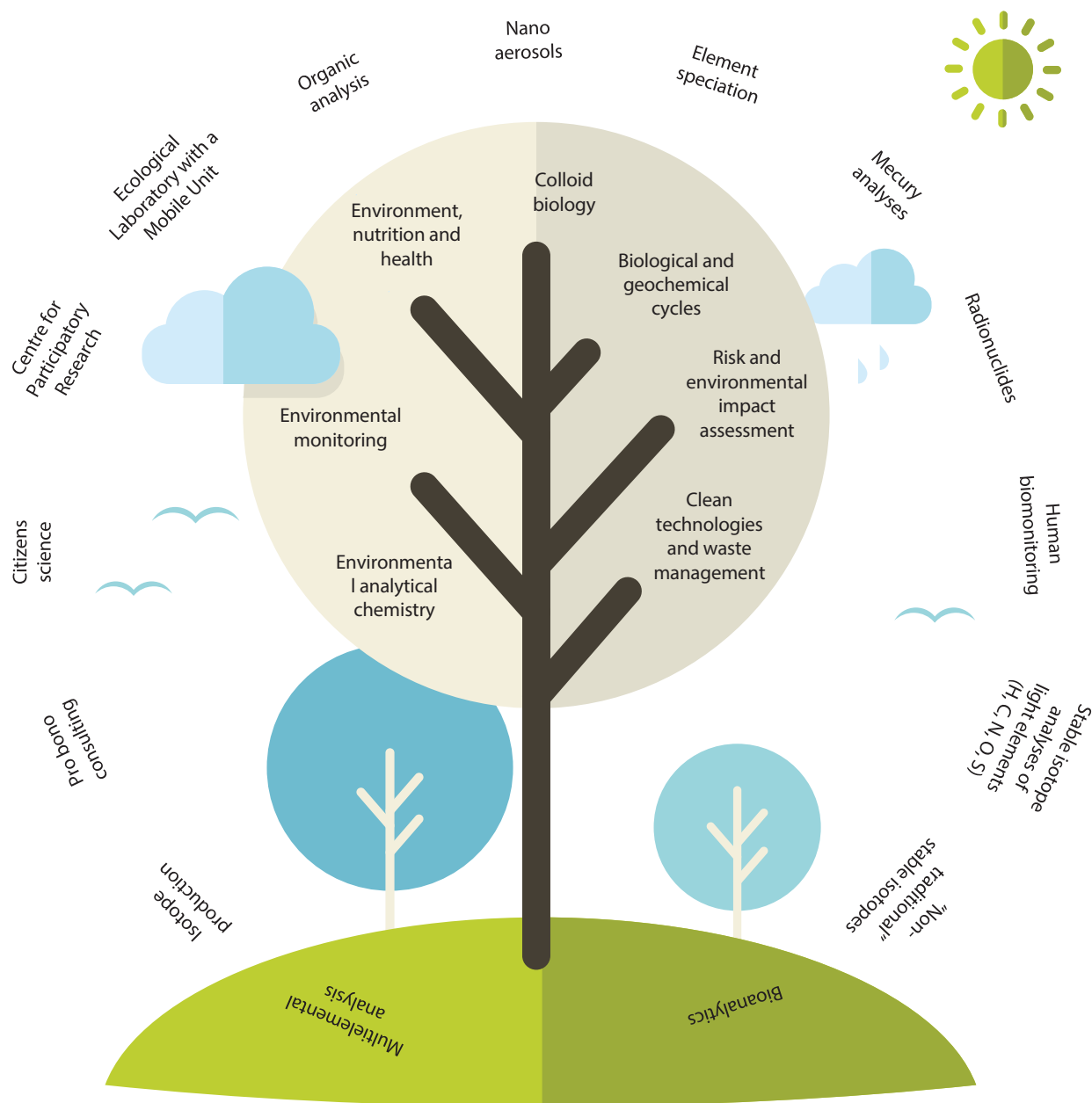


The Department of Environmental Sciences (O-2) focuses on interweaving the physical, chemical, and biological processes that shape our environment. The research we perform here at the Department of Environmental Sciences is interdisciplinary and multidisciplinary and covers several areas, such as environmental analytical chemistry, biogeochemical cycles, microbial ecology, environment and health, environmental technologies, risk and environmental assessment, and environmental monitoring. We also focus on the development of technical solutions for environmental problems and environmental management.

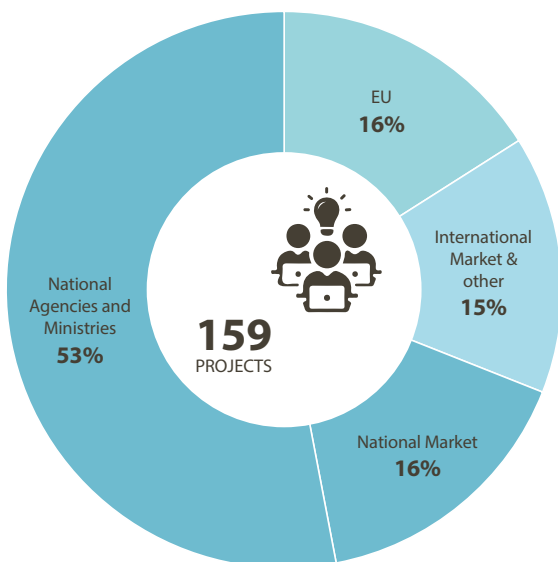
Currently, our Department hosts the “ISO-FOOD” ERA Chair for isotope techniques in food safety, quality, and traceability, the infrastructure Centre of Mass Spectrometry (CMS), the Mobile Ecological Laboratory Unit (ELMU), and the Center for Participatory Research. It coordinates the H2020 Marie Skłodowska-Curie Innovative Training Network FoodTraNet project and GMOS-Train project and the H2020 Twinning SurfBio project. It implements a National Human Biomonitoring Program (HBM) and participates in Metrofood, EMPIR, and many other EU, national, and international projects.

We also offer contract work for partners from industry, academia, public services and other customers and our laboratories are specialised in inorganic and organic analytical chemistry, radiochemistry and isotope ratio analysis. Besides analytical services, we also provide strategic environmental assessment, consulting and project assistance in environmental analysis, natural resource management, eco-technologies, food research and authentication, and public health.

O-2 at the glance



Highlights of 2021



The Department of Environmental Sciences has a long tradition of developing collaborative partnerships with industry. This collaboration helps deliver new products and services, which advances the Slovene economy, improves our quality of life, and brings real-world technologies and management issues into our research laboratories. Building international partnerships are recognised as a necessity for advancing technologies and solving global

In 2021 the Department was involved in **110** national and **49** international projects, **25** were within the EU framework projects.

Total number of projects:	159
EU:	16%
International Market & other:	15%
National Market:	16%
National Agencies and Ministries:	53%



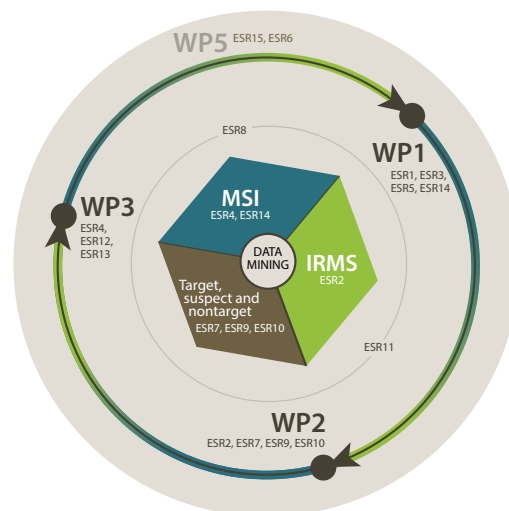
Shaping the next generation of food scientists



In 2020 we become the coordinator of the the Marie Skłodowska Curie Action Innovative Training Network (MSCA ITN) Advanced Research and Training Network in Food quality, safety and security (FoodTraNet).

The project involves 9 partners (7 academic, 2 ind.) from 7 countries and the support of EU industry partners from large industry (Barilla, CONCAST), 10 SMEs and world-renowned food organizations such as EFFoST and IUFoST.

The goal is to train and mobilize 15 early-stage researchers to develop advanced methods for maintaining food quality, authenticity, and traceability and create radical food production and safety solutions using advanced materials and technologies. Information is available at <https://www.foodtranet.org>.



- | | |
|--|--|
| ESR 1: Production type/Residue | ESR 8: Smart MIP & SAP material |
| ESR 2: Functional food | ESR 9: New alternative food |
| ESR 3: Production type/Metabolomics | ESR 10: Reuse of waste water/Risk assessment |
| ESR 4: Edible photonic barcodes | ESR 11: Sensors |
| ESR 5: Production type/Metabolomics | ESR 12: Biopolymer/Advanced packaging |
| ESR 6: Consumer and industrial confidence and protection | ESR 13: PET/PP/Advanced packaging |
| ESR 7: Microplastics/Risk assessment | ESR 14: Plastics/Proteomics |
| | ESR 15: Consumer perception |

FoodTraNet will involve stable isotope analysis, target, suspect, non-target mass spectrometric screening and imaging to identify markers and bioactive compounds to assure food safety, quality, authenticity and traceability. It will also characterize novel foods to support food security, develop and characterize new products based on the latest advances in nanotechnology: edible photonic barcodes for traceability, nano-sensors for food quality and safety, multi-functional polymer nanostructured materials for selective removal of bioactive compounds and compounds of emerging concern, and the development of intelligent packaging materials.

INPROFF Quality, Safety and Authenticity of Insect-Protein Based Food and Feed

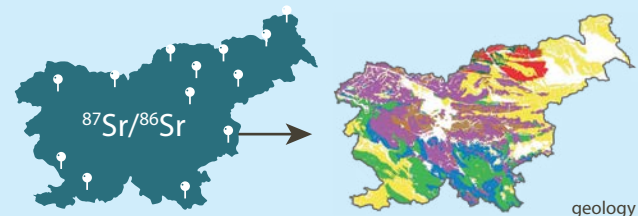
ISO-Food Era Chair

New alternative food sources¹⁻³



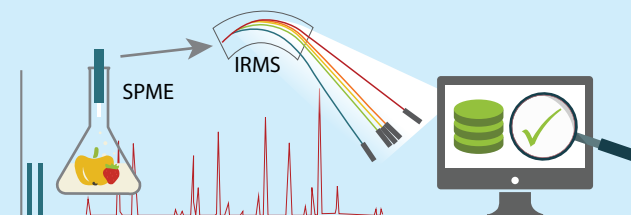
Geographical origin⁴

Slovenian milk



Natural vs. synthetic^{5,6}

IsoVos database



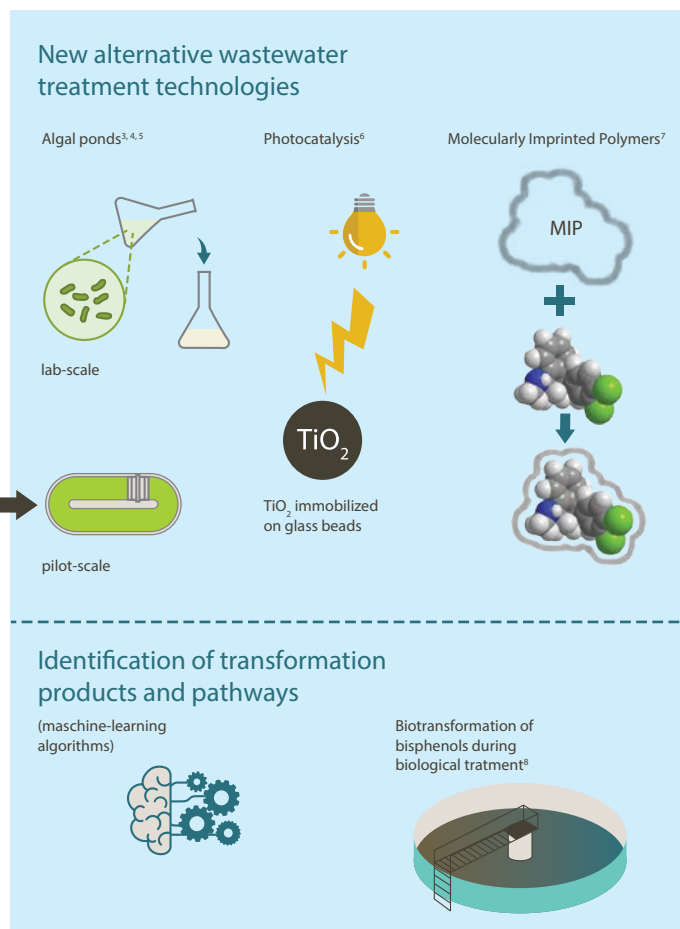
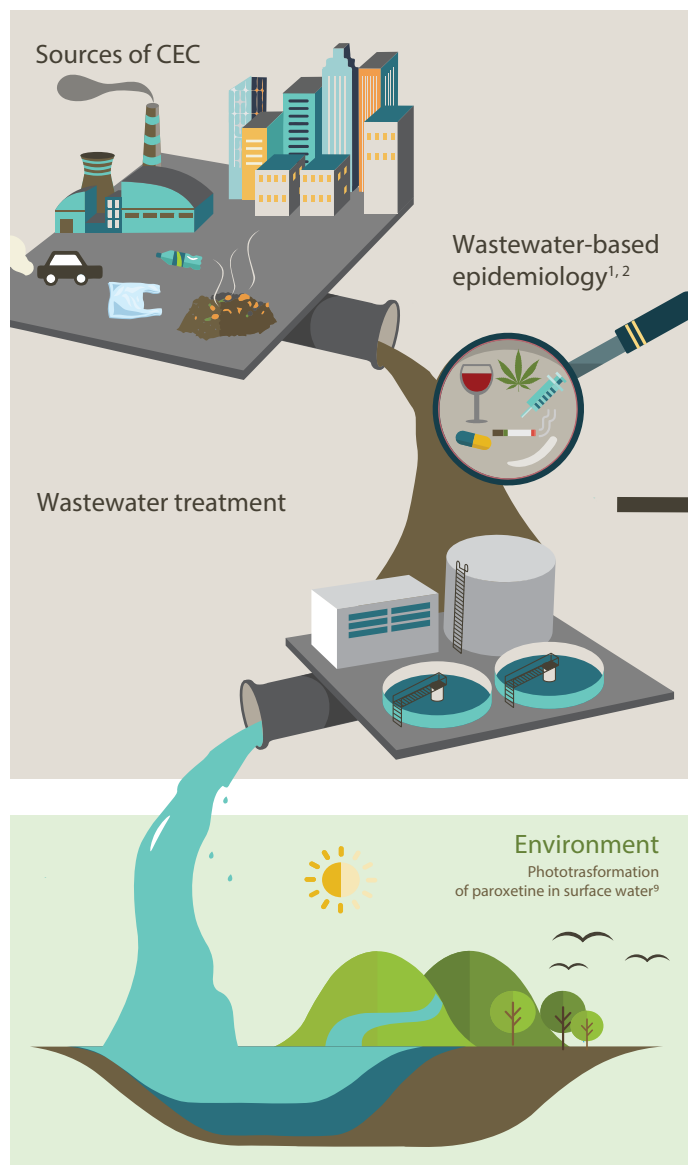
Organic vs. conventional⁷

Selected phytoestrogens and stable-isotope analysis



1. Masten Rutar et al. doi: [10.3390/antiox10091366](https://doi.org/10.3390/antiox10091366).
2. Kejžar et al. doi: [10.3389/fnut.2020.618503](https://doi.org/10.3389/fnut.2020.618503).
3. Zgonik et al. doi: [10.3390/microorganisms9112326](https://doi.org/10.3390/microorganisms9112326).
4. Hamzić Gregorčič et al. doi: [10.3390/foods10081729](https://doi.org/10.3390/foods10081729).
5. Šiškovič et al. doi: [10.1016/j.foodcont.2020.107698](https://doi.org/10.1016/j.foodcont.2020.107698).
6. Strojnik et al. doi: [10.3390/foods10071550](https://doi.org/10.3390/foods10071550).
7. Golubović et al. doi: [10.3390/foods10081839](https://doi.org/10.3390/foods10081839).

Occurrence, treatment, removal and transformation of contaminants of emerging concern (CEC)



1. Verovšek et al. doi: [10.1016/j.scitotenv.2021.150013](https://doi.org/10.1016/j.scitotenv.2021.150013).
2. Verovšek et al. doi: [10.1016/j.dib.2021.107614](https://doi.org/10.1016/j.dib.2021.107614).
3. Prosenc et al., doi: [10.1016/j.jhazmat.2021.126284](https://doi.org/10.1016/j.jhazmat.2021.126284).
4. Škufca et al., doi: [10.1016/j.scitotenv.2021.146949](https://doi.org/10.1016/j.scitotenv.2021.146949).
5. Škufca et al., doi: [10.1016/j.chemosphere.2021.129786](https://doi.org/10.1016/j.chemosphere.2021.129786).
6. Žener et al. doi: [10.1016/j.jece.2021.106814](https://doi.org/10.1016/j.jece.2021.106814).
7. Gorniket et al., doi: [10.3390/polym13010120](https://doi.org/10.3390/polym13010120).
8. Kovačič et al., doi: [10.1016/j.jhazmat.2020.124079](https://doi.org/10.1016/j.jhazmat.2020.124079).
9. Gornik et al., doi: [10.1016/j.scitotenv.2021.145380](https://doi.org/10.1016/j.scitotenv.2021.145380).

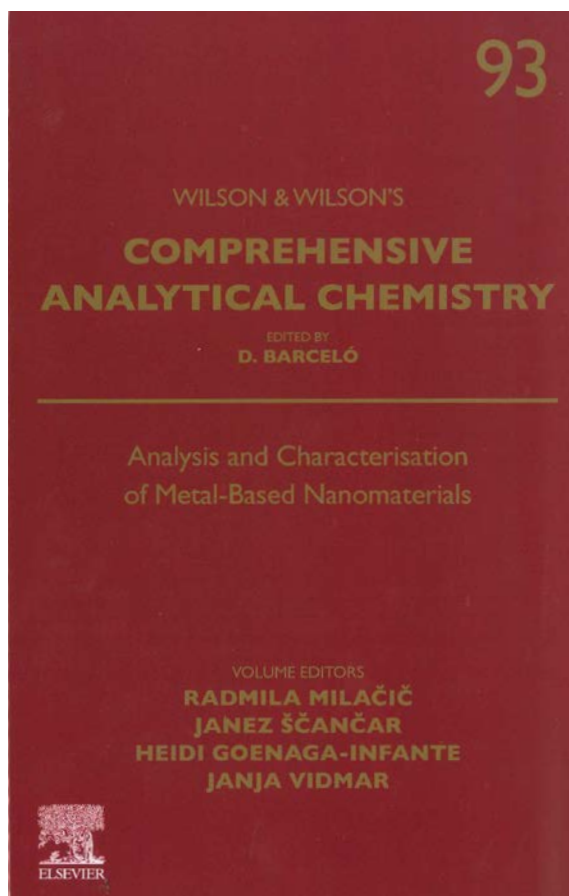
Analysis and Characterization of Metal-Based Nanomaterials

The book summarizes recent progress in analytical methodologies for detection, characterization and quantification of metal-based NMs, and their applications to a variety of complex samples.

Within the Comprehensive Analytical Chemistry series, volume 93, the Elsevier issued the book [Analysis and Characterization of Metal-Based Nanomaterials](#), edited by Radmila Milačič, Janez Ščančar, Heidi Goenaga-Infante and Janja Vidmar.

The book contains 11 chapters and summarizes recent progress in analytical methodologies for detection, characterization and quantification of metal-based NMs, and their applications to a variety of complex samples. Single-particle inductively coupled plasma mass spectrometry (SP-ICP-MS) is highlighted as a powerful analytical tool for the determination of NPs number-based concentration and size distribution. Further, the potential of liquid chromatography and field flow fractionation techniques hyphenated to ICP-MS in analysis of metal-based NPs is emphasized. The book also describes imaging of metal-based NPs by hyphenation of laser ablation to ICP-MS and the use of different microscopic techniques for the detection and characterization of metal-based NPs as contrast agents for magnetic resonance imaging.

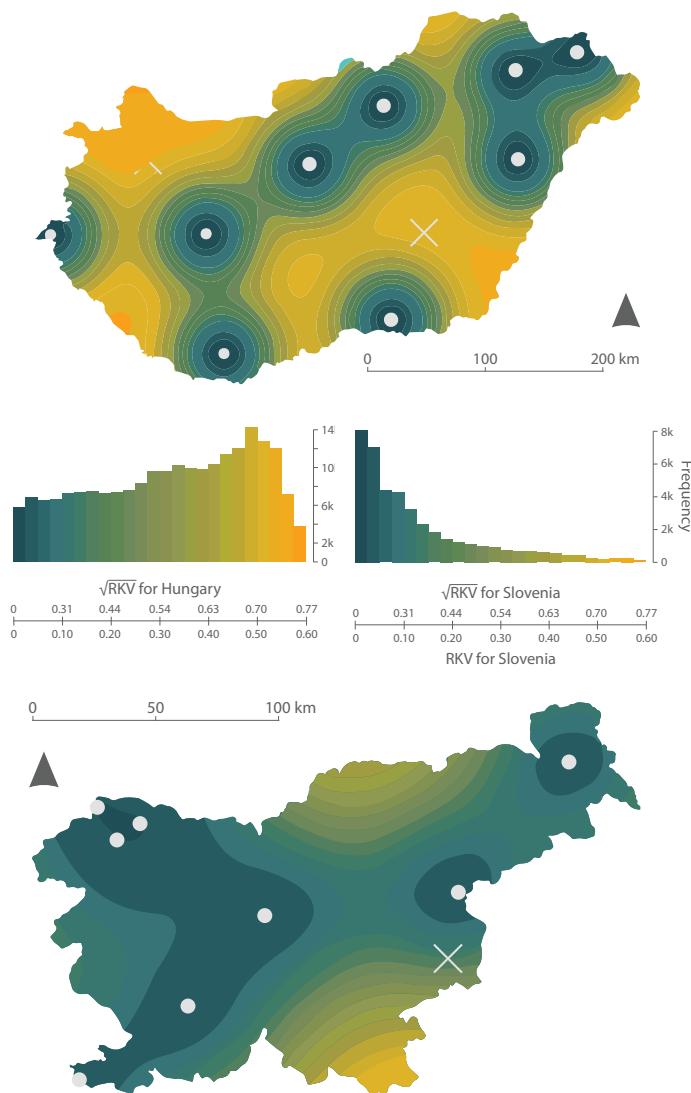
It is worth mentioning that key established world researchers have been attracted to write the chapters, while the chapters were also written by promising young researchers. Among them researchers from Jožef Stefan Institute Janez Zavašnik, Andreja Šestan, and Vasyl Shvalya contributed a chapter on microscopic techniques for the characterisation of metal-based nanoparticles, Nina Kostevšek and Igor Serša a chapter on characterization of metal-based nanoparticles as contrast agents for magnetic resonance imaging and Janja Vidmar a chapter on detection and characterization of metal-based NPs in environmental, biological and food samples by SP-ICP-MS.



Isotopes in water management

Optimisation of monitoring networks of O and H isotopes in precipitation in Slovenia and Hungary

Knowing the long-term stable isotope signatures of precipitation is essential for many fields of research and applications, e.g. water resources management, determination of geographical origin of foods, regional palaeoclimate analysis and future climate projections. Detailed geostatistical assessment of spatial representativity of the two precipitation monitoring networks identified both over- and under-represented areas and emphasised the importance of data exchange between neighbouring countries. The map shows the variance of the krigging-prediction error of isotopic composition of precipitation, while the white crosses mark the best suited locations of additional stations needed to assure the full coverage of both countries with high-quality data. The locations were identified with assumption of full data exchange with existing isotope monitoring networks of neighbouring countries (Austria, Italy, Croatia). This study – resulting from the bilateral scientific collaboration between Hungary and Slovenia – may be termed pioneering in the matter of the detailed geostatistical assessment of spatial representativity of a precipitation stable isotope monitoring network, and as such, can serve as an example of the spatial optimization of other regional precipitation monitoring networks.



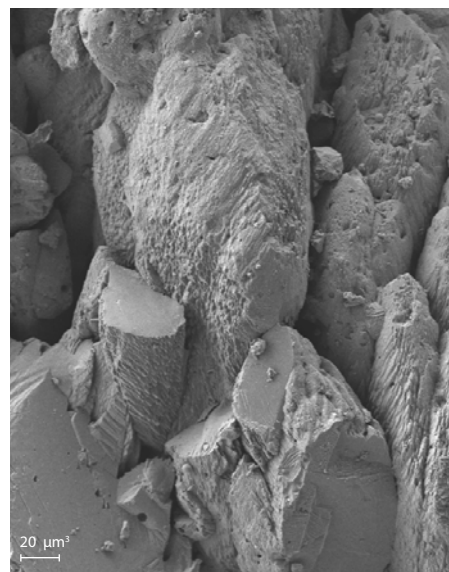
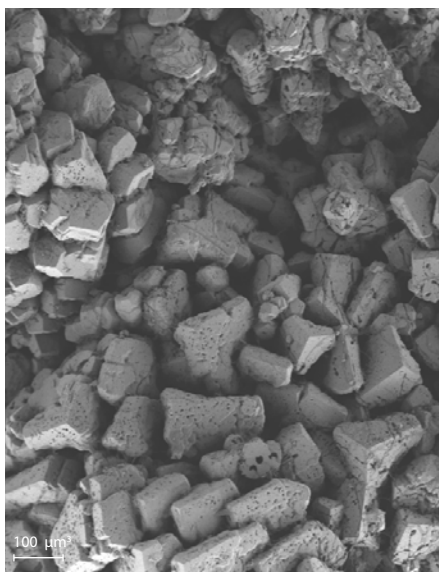
Uranium isotopes may help to elucidate terrestrial CO₂ sinks

Uranium is a trace element that is omnipresent in nature. In carbonaceous karst aquifers, U is mobilised from bedrock in contact with groundwater, where the dissolved U gets enriched in light ^{234}U isotope due to the so-called alpha recoil effect. Increased $^{234}\text{U}/^{238}\text{U}$ ratio is not only a tracer of groundwater with short retention time; the isotopic signal is directly translated into the secondary carbonate that precipitates from karst groundwater during so-called prior calcite precipitation within the aquifer and during authigenic carbonate precipitation in the river, for instance, in carbonate shells of microbiota or in tufa coatings and barriers at rapids and waterfalls. With detailed analysis of $^{234}\text{U}/^{238}\text{U}$ isotope ratios in water,

bedrock, soil and tufa in a karst aquifer, we were able to separate different sources of carbonate in tufa barriers (detrital vs. authigenic) and to estimate the actual rate of CO₂ fixation fluvial precipitates. This is an important step forward in quantification of terrestrial CO₂ sinks, which are not yet adequately explored.

Figure: microcrystalline authigenic calcite aggregates (middle) and columnar authigenic calcite in laminated tufa coating of artificial substrate at Skradinski Buk (Krka River, Croatia) with distinct $^{234}\text{U}/^{238}\text{U}$ ratios (right). SEM, photo dr. Srečo D. Škapin, Advanced Materials Department.

Rovan et al., doi: [10.1016/j.scitotenv.2021.149103](https://doi.org/10.1016/j.scitotenv.2021.149103).



HUMAN BIOMONITORING in the context of environmental and human health interactions

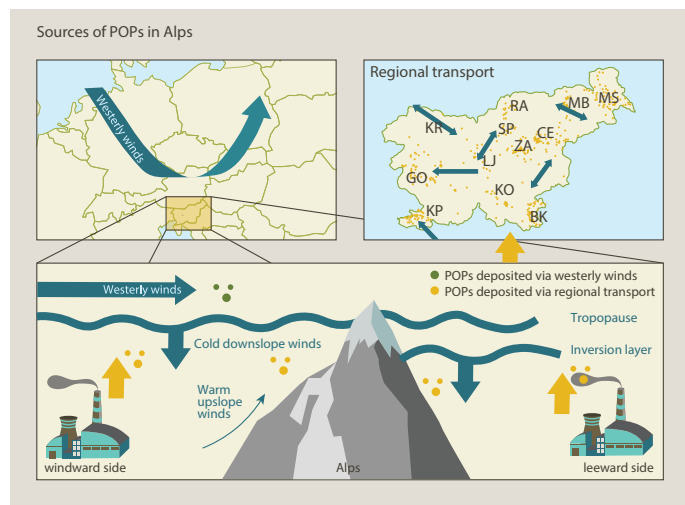
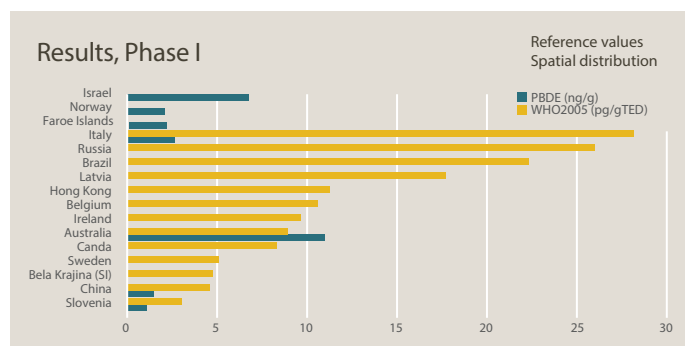
The exposure of children and adolescents in Slovenia to a wide range of different endocrine disrupting chemicals were demonstrated for the first time, connecting exposure patterns and exposure sources. The study is to the authors' knowledge the first that investigates direct connection between levels of urinary endocrine disrupting chemical biomarkers and genetic polymorphism in UGT2B15. First estimation of GLY and AMPA exposure in a Slovenian study population showed much lower levels when compared to levels reported in similar studies worldwide. Some results might be explained by more intensive use of GBH in spring, but in general we were unable to distinguish between exposure from the diet or use of GBH in residential environments.

Tkalec et al., doi: [10.1016/j.envint.2020.106172](https://doi.org/10.1016/j.envint.2020.106172).



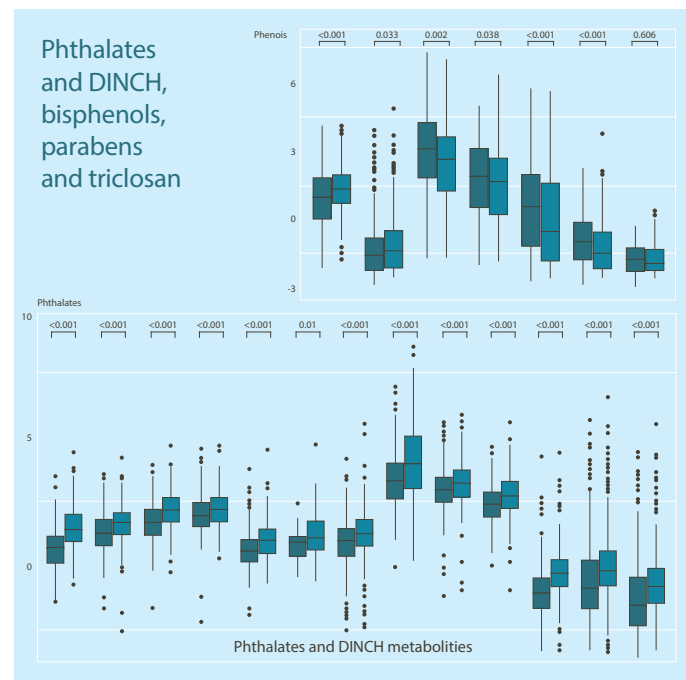
The study findings suggest low exposure of men and lactating women to legacy pollutants in Slovenia, which gave rise to the hypothesis that Slovenia's geographical location might provide shelter from the long-range transport of POPs via Westerly winds. This hypothesis remains to be confirmed within future studies.

Runkel et al., doi: [10.1016/j.envres.2021.111224](https://doi.org/10.1016/j.envres.2021.111224).



The most significant determinant of exposure was the area of residence and the year of sampling (2008–2014) that mirrors trends in the market. Participants from urban or industrialized sampling locations had higher levels of almost all monitored analytes compared to rural locations.

Based on the hazard quotient (HQ) values, individual analytes do not seem to pose a risk to the studied population at current exposure levels, whereas the HQ value of the chemical mixture is near the threshold of 1 which would indicate a higher risk.

Runkel et al., doi: [10.1016/j.chemosphere.2021.131858](https://doi.org/10.1016/j.chemosphere.2021.131858).

Involvement of citizens in research activities brings new opportunities but also challenges

Combining traditional and novel approaches based on citizen science (CS) principles is an ongoing practice in the Environmental Informatics research group to better understand human exposure to stressors in urban systems.

Traffic and biomass burning were revealed as the major control-demanding sources of particulate matter (PM) at a city level, with a traditional approach of studying chemical composition of PM in air in combination with source apportionment modelling and health risk assessment^{1,2}. The main research results, stemming from the involvement of citizens by using novel sensing technologies, focused on providing citizens with holistic insights into their immediate surroundings and their personal exposure to urban stressors, while some unique challenges were recognized in the implementation of CS projects. More specifically:

- Data fusion and harmonization scripts were developed for automatic visualization of data and generation of individualised reports for participants in multi-sensor personal air pollution exposure monitoring campaigns.³
- Using a combination of human-centred design, hu-

man-information interaction and design thinking approaches, participants were iteratively included in the framing and design of the final report.⁴

- New elements were suggested to be included as part of the ethical approval procedures stemming from the new role of citizens, who are not merely research subjects but provide an active contribution to the research endeavour.⁵
- Volunteer motivations in citizen science and best practices for motivation of volunteers in CS projects and their retention through implementation of functional features in respective tools were reviewed.⁶
- Challenges and opportunities specific to the implementation of co-created CS projects in environmental epidemiology were identified.⁷

1. Saraga et al., doi: [10.1016/j.scitotenv.2020.141855](https://doi.org/10.1016/j.scitotenv.2020.141855).
2. Degrendele et al., doi: [10.1016/j.scitotenv.2021.148528](https://doi.org/10.1016/j.scitotenv.2021.148528).
3. Novak et al., doi: [10.3390/ijerph182111614](https://doi.org/10.3390/ijerph182111614).
4. Robinson et al., doi: [10.3390/ijerph182312544](https://doi.org/10.3390/ijerph182312544).
5. Ficorilli et al., doi: doi.org/10.22323/2.20060204.
6. Robinson et al. doi: [10.1080/09640568.2020.1853507](https://doi.org/10.1080/09640568.2020.1853507).
7. Froelinger et al., doi: [10.1016/j.envint.2021.106470](https://doi.org/10.1016/j.envint.2021.106470).



Optimal ventilation regime in educational buildings in terms of controlling radon level

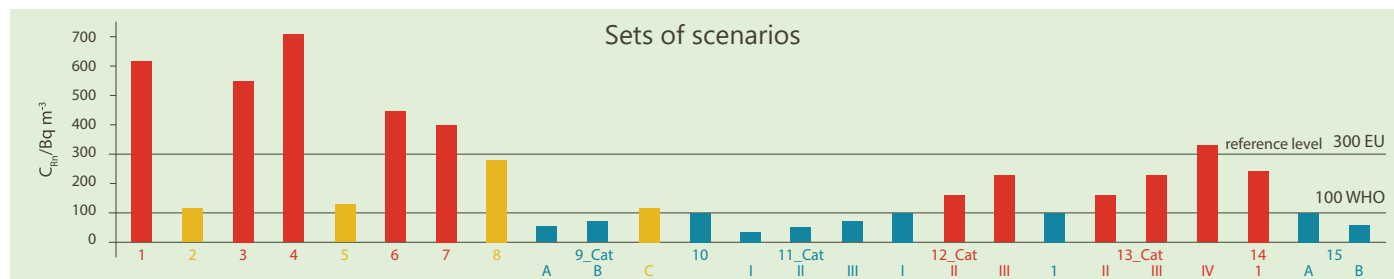
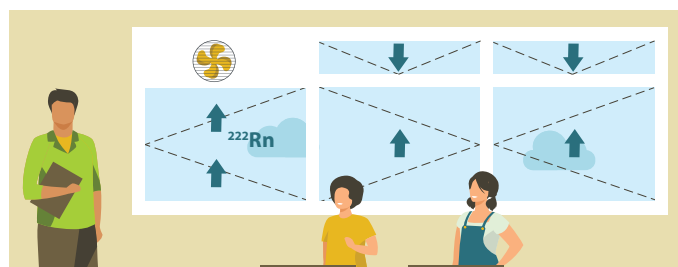
Radon entry in the building

Natural radioactive gas radon (^{222}Rn) enters buildings mainly from the ground through joints and fissures.



Ventilation regimes

When the indoor radon concentration only slightly exceeds the national and EU (300 Bq m^{-3}) or WHO (100 Bq m^{-3}) reference level, ventilation (natural, mechanical, hybrid) is an efficient measure to control the indoor air quality.



Simulated radon concentrations in the classroom within fifteen scenarios

In a renovated school in our study, the average radon concentration ranges from 200 to 1000 Bq m^{-3} . According to the legislative requirements and recommendations, radon concentration was simulated by varying the designed ventilation rates (DVRs) within fifteen scenarios (twenty-five cases).¹

The DVRs were insufficient in six (24%) cases of the EU and

fourteen (56%) cases of the WHO guidelines. However, ventilation is an immediate measure to reduce radon concentration and it needs to be performed in line with other holistic measures to control radon as a health risk factor.

Particularly new and renovated energy-efficient buildings are characterized by minimized ventilation and increased building airtightness, leading to poor indoor air quality.

1. Dovjak et al., doi: [10.1016/j.ijheh.2021.113742](https://doi.org/10.1016/j.ijheh.2021.113742).

The application of laser ablation – inductively coupled plasma mass spectrometry in multimodal bio-imaging for diagnosis and therapies of cancer

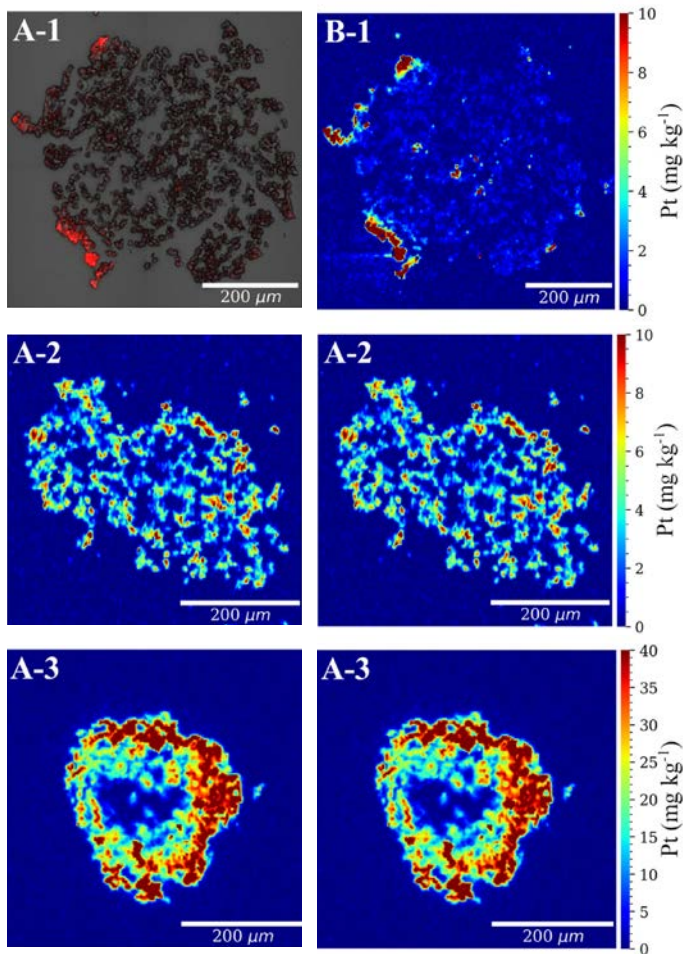


Fig. 1 High spatial resolution imaging of cisplatin and Texas Red cisplatin in tumour spheroids using laser ablation isotope dilution inductively coupled plasma mass spectrometry and confocal fluorescence microscopy.

Traditionally, mammograms, breast ultrasound, magnetic resonance imaging and histopathological image analysis of surgical biopsy of tissue or cells samples taken directly from a tumour are used in oncology to visualize cancer.

Here, we reported advanced quantitative imaging of platinum in tumour 3 dimensional models (spheroids) treated with Pt-based chemotherapeutics, cisplatin or cisplatin marked with the fluorophore dye Texas Red. For this purpose we applied laser ablation inductively coupled plasma mass spectrometry and confocal fluorescence microscopy.

3D quantitative images of Pt spatial distribution in spheroids treated with cisplatin or Texas Red cisplatin were also created.

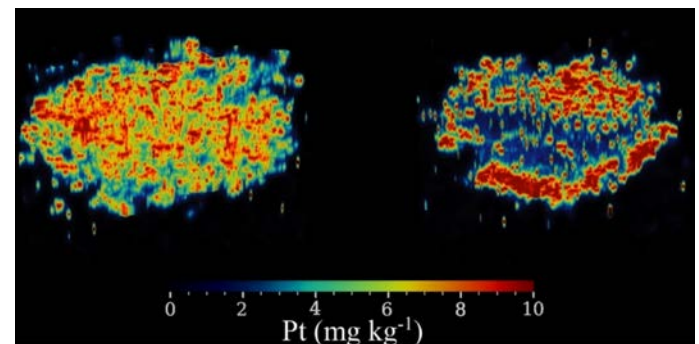
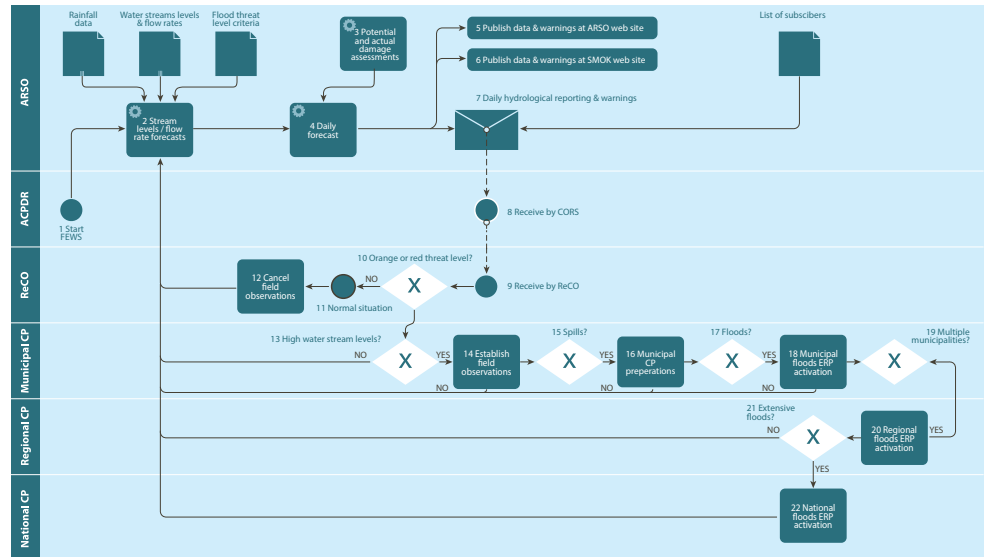


Fig. 2 3D quantitative images of Pt distribution in spheroids treated with CDDP or TR-CDDP.

Environmental management, environmental impact assessment and risk assessment

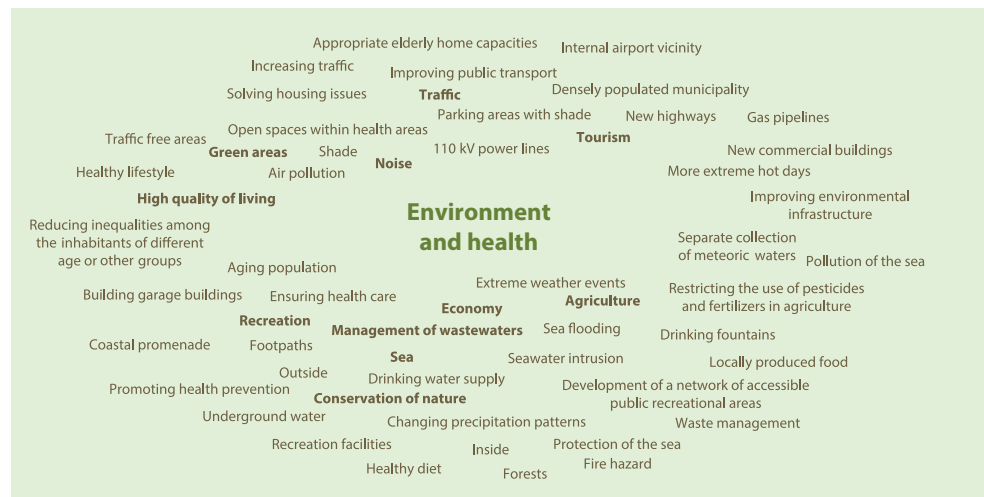
To increase uniformity, homogeneity and effectiveness of early warning systems for floods and forest fires, the new early warning platform has been developed to help improve the detection of risks and related emergency response.

Figure: Analysis of the early warning system for floods



In the framework HRA and HIA based research, the main issues in informing public health decisions within the HIA process have been identified and addressed; the inclusion of environmental health related topics and related opportunities for improvement of public health must be emphasised in process of strategic spatial plan development.

Figure: Selected environmental and health topics of the strategic spatial development planning process



Colloidal biology: aggregation and immobilization of bacterial cells for novel applicative solutions

In the group for colloid biology we have advanced our aggregation and immobilization approaches to construct bacterial consortia that are able to perform specific metabolic transformation, an achievement suitable for numerous applicative solutions in biotechnology, medicine, agronomy, ecoremediation and other environmental technologies.

Lignin revalorization - new added value compounds

Project Applause was successfully completed by isolation of lignin degrading bacteria that were shown to not only degrade lignin but also produce industrially relevant chemicals and products, such as vanillic acid used in food and cosmetic industry and acetovanillone, used in pharmaceutical industry. Furthermore, degradation ability of lignin degrading isolate was also tested on paper industry wastewater, rich in lignin, and again, degradation activity was detected.

Targeted isolation of beneficial bacterial consortia

Diesel degrading bacterial consortia was isolated by bacterial confinement in alginate beads using microfluidic approach. Beads of up to 30 μm were produced and measured using flow cytometry, while the selection was based on bacterial activity of indicator decolourization.



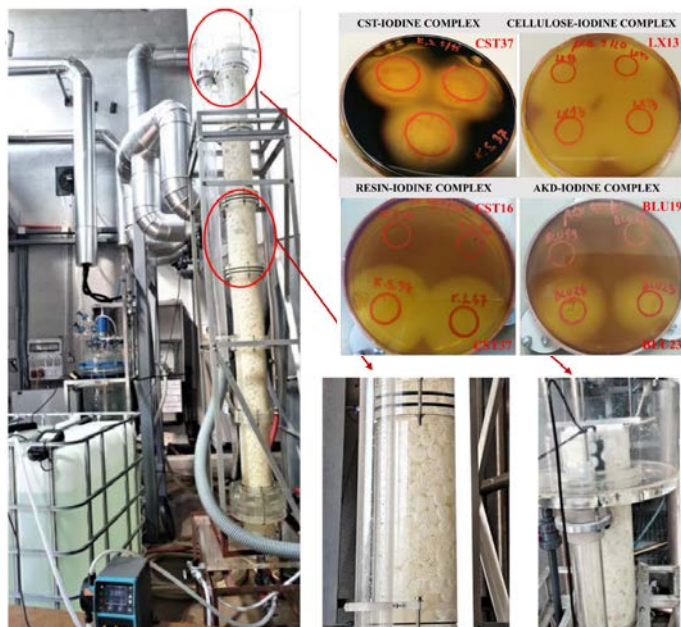
Figure 1: Control sample on the left, without decolourization and bacterial sample on the right where bacterial activity degraded lignin and decolourized the indicator in visible green color.



Figure 2: Alginate beads, produced by microfluidic set-up, are collected for further selection and analysis. Blue indicator is added to monitor bacterial activity of diesel degradation.

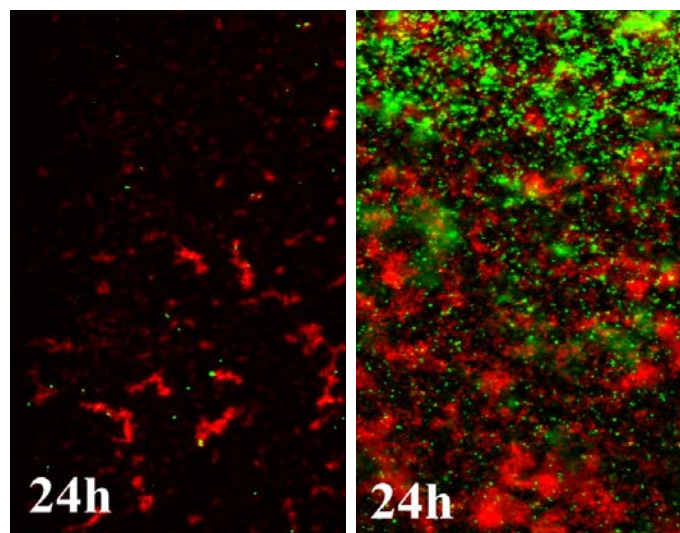
Wastewater remediation approaches

We applied the colloid biology bioaugmentation approach to immobilize on carriers a synthetic bacterial consortium that was collectively able to degrade a set of recalcitrant compounds that are used in the paper making process and end up in the wastewater produced by paper mills. On site pilot studies showed the filters, columns filled up with these carriers were able to reduce the COD up to 88% where azo dyes were almost completely mineralized (up to 98%), a step towards building advanced microbiology based remediation solutions.



Artificial biofilms on material surfaces

We have developed a method that forces bacteria to attach to surfaces and form biofilms despite their initial ability to do so. This is particularly important for biotechnologically relevant strains, since they lose the ability of biofilm formation due to the extensive cultivation in laboratory conditions. As a proof of concept, we showed that an artificial biofilm consisting of (A) probiotic cells (red) can exclude the sedimentation of potentially pathogenic *E. coli*. (B) In the control, the same pathogenic strain (green) can grow on the artificial biofilm of a non-probiotic strain (red).



Uptake and Fate of CeO_2 NPs in shrimps

The risk assessment of nanomaterial release into the environment and consequences for organisms depends on the accurate measurement of doses and knowledge of environmental transformations along transfer pathways.

This is especially important for slowly dissolving particles, such as CeO_2 . We developed an innovative dual-radiolabelling strategy for CeO_2 nanoparticles using neutron activation and in-diffusion labelling to radiolabel CeO_2 nanoparticles with both Ce-141 and Ce-139. The different distribution of the radiolabels in the particles does not only allow easy dose determination in uptake studies but also enables us to track the uptake pathways of the anthropogenic cerium as shown on example of freshwater shrimp. The results suggest a dissolution-based translocation of cerium over the gut wall and a consequent exposure of the internal organs of the crustaceans to potentially toxic, dissolved cerium species. This has further implications for the fate of anthropogenic cerium in the environment and its potential accumulation in the food chain.

Analysis of complex environmental processes via cross-institute, cross WP complementary facility use

 IJS

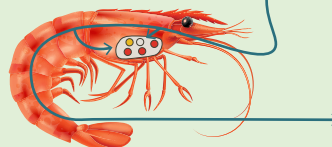
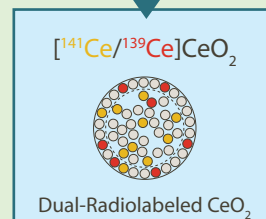
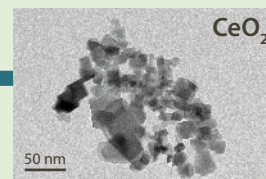


^{141}Ce
 $t_{1/2} = 32.511 \text{ d}$ $E_\gamma = 145.44 \text{ keV}$

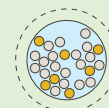
 HZDR



^{139}Ce
 $t_{1/2} = 137.64 \text{ d}$ $E_\gamma = 168.86 \text{ keV}$



Dissolution-based uptake and accumulation in the shrimp hepatopancreas





DESIGNATED INSTITUTE

for the Amount of substance/Chemical trace Elements/in the organic and inorganic materials

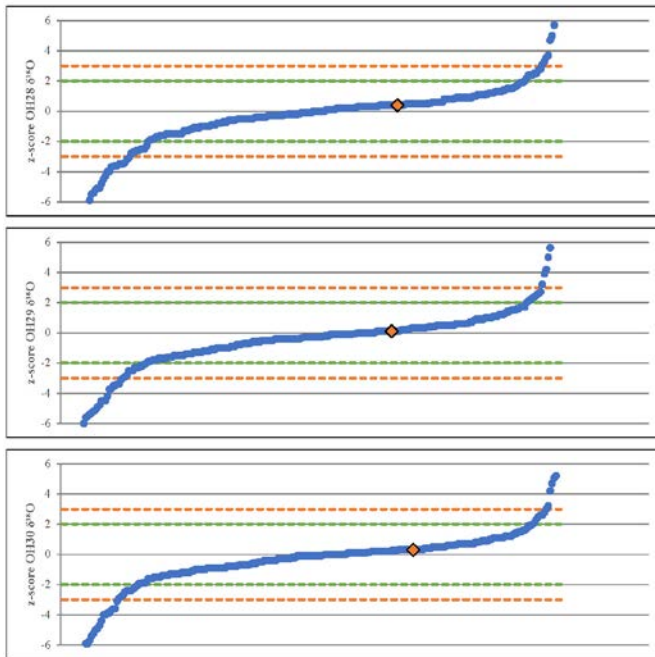
The Department has been the holder of the national etalon for trace element content in organic and inorganic materials since 2010. In the framework of the international metrology systems, the Department is a [Designated Institute](#) and demonstrates Calibration and Measurement Capability (CMC) through Key Intercomparisons, which resulted in 17 CMCs in the BIPM Key Comparison Database ([KCDB](#)).

CMC mark in the KCDB	El.	Mass fraction mg/kg	Expanded uncertainty in % (k=2)	Method	Category	Approved
O-2k0-INAAa	As	0.1 – 60	7 – 10	k_0 -INAA	10	28.06.2016
O-2k0-INAAb	Ca	3000 – 100000	7 – 10	k_0 -INAA	10	28.06.2016
O-2k0-INAAc	Zn	10 – 100	7 – 10	k_0 -INAA	10	28.06.2016
O-2ICP-MSa	Cd	0.1 – 10	4 – 15	ICP-MS	10	28.06.2016
O-2ICP-MSb	Pb	0.1 – 10	7 – 10	ICP-MS	10	28.06.2016
O-2ICP-MSc	As	1 – 60	4 – 8	ICP-MS	11	08.07.2015
O-2ICP-MSd	Zn	10 – 100	4 – 8	ICP-MS	11	08.07.2015
O-2ICP-MSe	Fe	160 – 500	4 – 8	ICP-MS	11	08.07.2015
O-2k0-INAAAd	Total As	0.1 – 60	7 – 10	k_0 -INAA	11	08.07.2015
O-2CVAASHga	Hg	0.01 – 1	7 – 10	CV AAS	11	11.04.2021
O-2ICP-MSi	Ni	0.5 – 5	8 – 12	ICP-MS	11	21.06.2021
O-2ICP-MSf	As	5 – 100	6 – 8	ICP-MS	13	28.06.2018
O-2ICP-MSg	Cd	0.1 – 600	5 – 8	ICP-MS	13	28.06.2018
O-2k0-INAAf	Fe	10000 – 50000	6 – 8	k_0 -INAA	13	28.06.2018
O-2ICP-MSh	Mn	500 – 1500	6 – 8	ICP-MS	13	28.06.2018
O-2k0-INAAe	As	0.1 – 60	7 – 10	k_0 -INAA	14	08.07.2015
O-2CVAASHg	Hg	0.05 – 10	7 – 8	CV AAS	14	08.07.2015

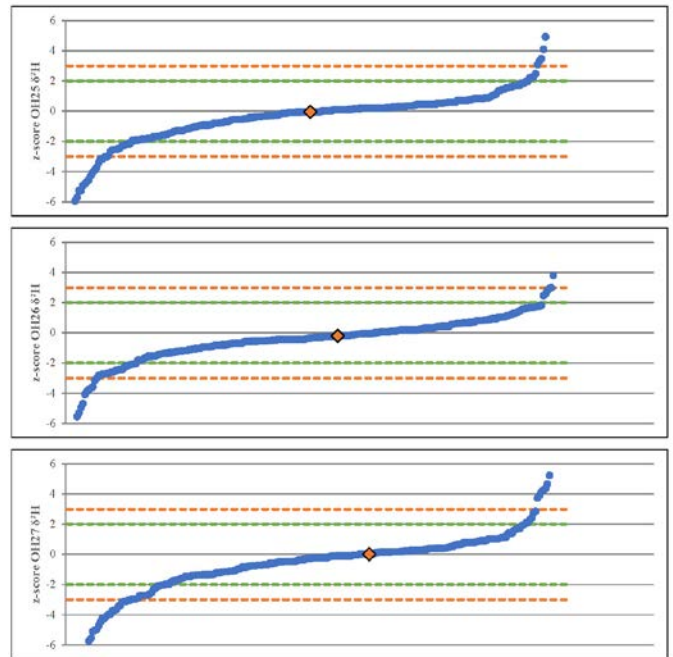
Interlaboratory comparisons

O2 achieved excellent results for the analysis of stable isotope composition of hydrogen ($\delta^2\text{H}$) and oxygen ($\delta^{18}\text{O}$) in six different environmental water samples at the latest Water Isotope Inter-laboratory Comparison (WICO 2020) organized by the International Atomic Energy Agency and with more than 220 participating laboratories worldwide.

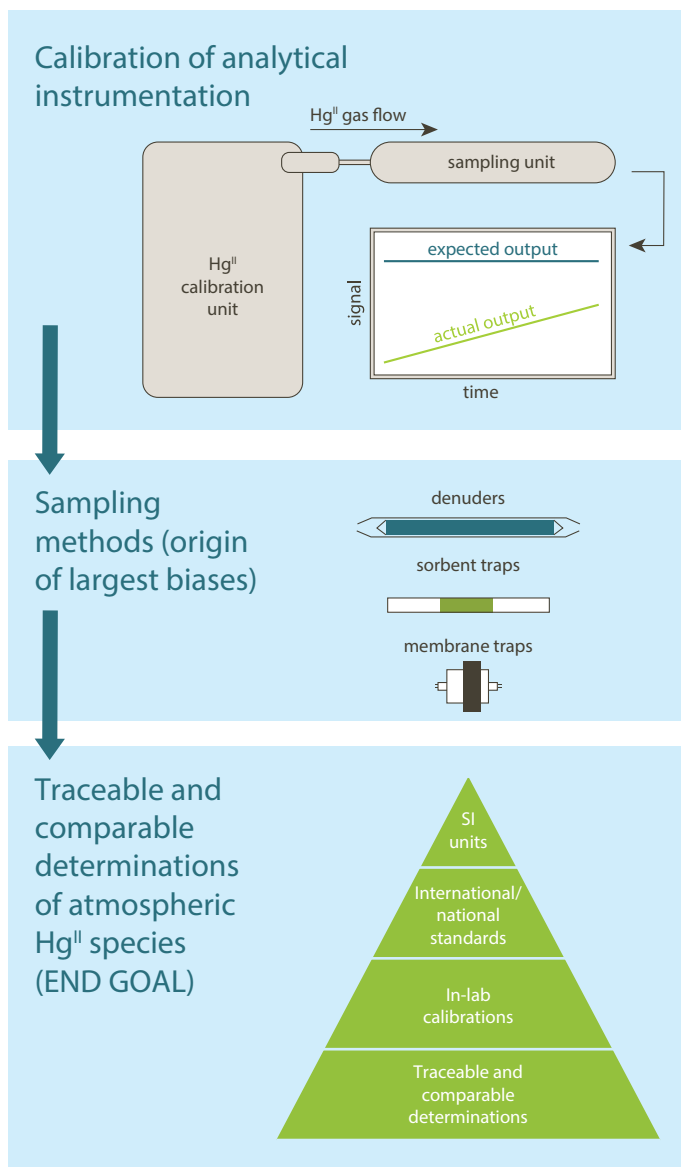
s-Plots $\delta^{18}\text{O}$, OH28-30



s-Plots $\delta^2\text{H}$, OH25-27



Improving the metrology of atmospheric Hg^{II} species



- Evaluation of performance for existing calibration methods
- Existing calibration unit proven inappropriate for calibration at low ambient Hg^{II} conc.
- Development of a new in-house calibration approach for Hg^{II} species
- Evaluation and development of the calibration methods were facilitated by the use of highly sensitive and specific ¹⁹⁷Hg radiotracer
- Evaluation of performance under different simulated sampling conditions
- Determination of losses and consequential biases that occur during sampling
- Again, ¹⁹⁷Hg radiotracer enabled experiments at ambient concentration levels

1. Gačnik et al., doi: [10.5194/amt-14-6619-2021](https://doi.org/10.5194/amt-14-6619-2021).
2. Gačnik et al., doi: [10.3390/s21072501](https://doi.org/10.3390/s21072501).

Prestigious Awards

Award for one the most excellent achievements of UL

- ☆ Commission for Research and Development of the University of Ljubljana has awarded research 'Modern organic pollutants - how can we control them with algae?' as one of the most excellent research achievements of the University of Ljubljana in 2021. Sincere congratulations to Prof Dr Ester Heath, Dr David Škufca and their associates!

Krka Awards

- ☆ Helena Plešnik's MSc thesis entitled "Determination of bacterial lignin degradation products by liquid chromatography coupled to mass spectrometry" which she worked on as part of the Applause project, was chosen to be awarded the Krka Award for research work at 51st Krka Awards call for best research projects.

European Public Sector Awards

- ☆ The EPSA Award is given by the European Institute of Public Administration (EIPA), which promotes the efforts of organizations to promote innovative, digital and green public sector. The European project APPLAUSE – the transformation of invasive non-native plants into useful products and input raw materials for industry, won 3rd place in the category of Green Public Sector. The APPLAUSE project, which ended at the end of 2020, addressed unresolved issues regarding the management of invasive non-native plants after the waste-free approach and according to the principles of the circular economy. As part of the project, we studied the possibilities of processing into wood products, raw materials for future industries, food sources, dyes and hybrid coatings, and extracts/powders for plant pest control. We have developed as many as 65 ways to process the biomass of invasive alien plants into something useful. We involved more than 3,200 citizens in the process of identifying, removing and processing invasive non-native plants.

Among other things, we produced 339 wood products, more than 6 tons of paper from Japanese knotweed, Robinia and Canadian goldenrod, obtained 30,000 data for 121 plant species in 20,000 sites. We connected 92 researchers and 375 undergraduate and postgraduate students, developed 8 new materials, 33 new recipes, 5 new methods and 2 new processes. We have already obtained 1 patent (Russia) for the work performed, 4 are still in the process of verification, and we have established 5 separate, independent circular business models.





Bronze medal: 19. Mednarodni razstavi inovacij ARCA 2021, Zagreb

- ☆ Za tehnologijo "A method for making spatially defined aggregates by precisely positioning cells based on electrostatic interaction" sta izumitelja Aleš Lapanje in Tomaž Rijavec prejela Bronasto medaljo.

Pupils awarded at the 34th meeting of young researchers

- ☆ As part of the CiteS-Health project, the students of the Spodnja Šiška primary school presented a research paper entitled Sound environment - how we perceive it and how it affects us. Their project and its presentation at the 34th meeting of young researchers and their mentors in Ljubljana called Let's trust in our own creativity was rewarded with a participation in the national meeting, which will take place at the end of June in Murska Sobota.



Best case study presentation award

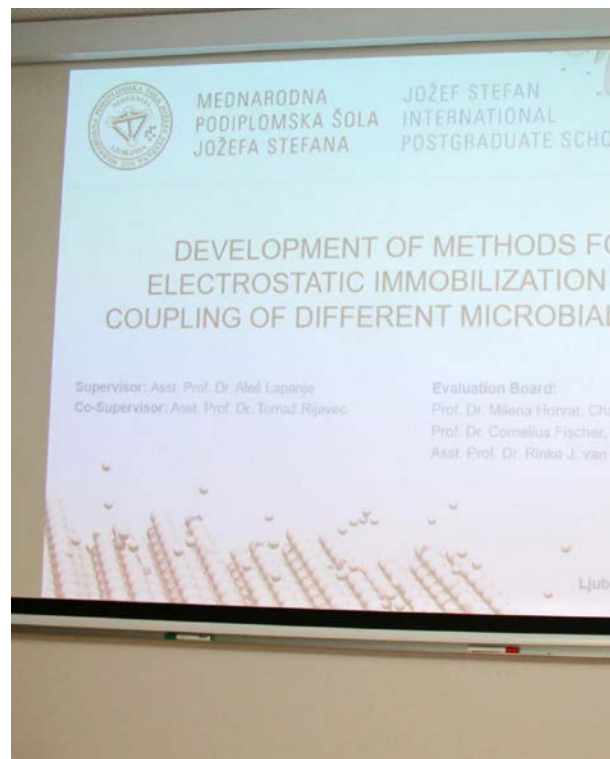
- ☆ Johanna Robinson, a young researcher was awarded for the best case study presentation titled "When technology fails: a case study of a premature CS tool" at a Citizen Science with Application to Nuclear, Seismic and Air Quality Monitoring: APPLICATIONS in Air Quality Monitoring Workshop held online 15 - 19 Mar 2021 by The Abdus Salam International Centre for Theoretical Physics (ICTP). For her PhD she is studying the user experience and motivation of volunteers who have participated in air quality related Citizen Science projects and environmental health studies which are based on low-cost air quality sensor technologies.



Theses and Mentoring

Doctoral Dissertations

- ☆ KOVAČIČ, Ana. *Bisphenol residues in the aqueous environment : occurrence and fate*, doctoral dissertation. Ljubljana, 2021.
- ☆ RYBKIN, Iaroslav. *Development of methods for electrostatic immobilization and coupling different microbial cells*, doctoral dissertation. Ljubljana, 2021.
- ☆ ROVAN, Leja. *Method for the determination of uranium isotope ratios and its application as a novel geochemical tracer*, doctoral dissertation. Ljubljana, 2021
- ☆ ŠKUFC, David. *Removal of contaminants of emerging concern using algal photobioreactors*, doctoral dissertation. Ljubljana, 2021
- ☆ TULASI, Delali. *Speciation of mercury in environmental samples from gold mining communities in Southwestern Ghana*, doctoral dissertation. Ljubljana, Slovenia; Accra, Ghana, 2021.



Master Thesis

- ☆ MAAIRE GYENGNE, Francis. *Gaseous elemental mercury (GEM) in air of the former mercury mine and the vicinity of the cement production facility*, master thesis, 2021
- ☆ BIRIKORANG, Bright. *Natural recovery of the environment polluted by past mercury mining by studying the fractionation of mercury in river water*, master thesis, Ljubljana, 2021.
- ☆ BONCIANI, Neri. *Use of geochemical markers to identify the geographic origin of the extra virgin olive oil*, master thesis. Firenze, 2021.
- ☆ GORNIK, Nadja. *Authenticity of juniper brandies and berries on the Slovenian market*, master thesis. Ljubljana, 2021.
- ☆ LAMOVŠEK, Lea. *Synthesis and evaluation of molecularly imprinted polymers for the extraction of bupivacaine : uniform master's study programme pharmacy*, master thesis. Ljubljana, 2021.
- ☆ VEHAR, Anja. *Spremljanje učinkovitosti odstranjevanja bisfenolov iz odpadne vode v komunalni čistilni napravi*, magistrsko delo. Ljubljana, 2021.
- ☆ JAMIL, Qasim. *The evaluation of stable isotopes of carbon and strontium as tracers for estimation of CO₂ storage in recent tufa in River Krka*, master thesis. Ljubljana, 2021



You are invited to become part of our team!

How would you like to perform research in an international environment
alongside excellent researchers?

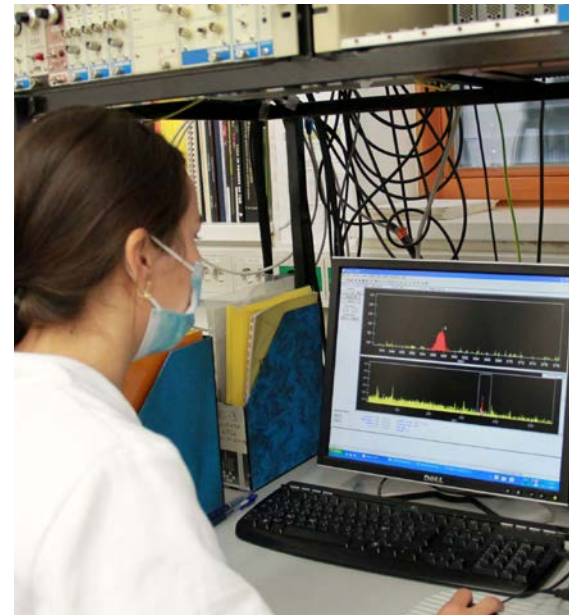
Are you interested in working with state-of-the-art research equipment?

Would you like to upgrade your knowledge of advanced scientific methods?

The Department for Environmental Sciences unites students and employees
with the desire and ambition to develop professionally and personally in an
innovative research environment.

We are currently offering graduates interested in conducting a master's degree
in the Environmental Sciences the opportunity to be supervised by top
researchers in the field and to become a member of a dynamic, productive and
highly efficient team.

For more information, visit www.environment.si.



Bring cutting edge research in real life!

We aim to understand better the relationship between natural processes and human activities and the influence that these activities have on human health and the environment. Our research groups cooperate with leading research institutions and universities worldwide. Our goal is to provide our students with the highest quality post-graduate studies at the master and doctoral level through joint research and education within a dynamic research and development environment and contribute to the strengthening of science and technology to better society. We cooperate closely with the Jožef Stefan International Postgraduate School (IPS), an independent higher education institution, that is strongly supported by industry (including Gorenje, Kolektor, and Saloni) and an international network of cooperating universities and research institutions from the European Union, the USA, and Japan.



11
SCHOLARSHIP
HOLDERS
in 2021/22



7
MAGISTRANDS
in 2021



5
DOCTORANDS
in 2021



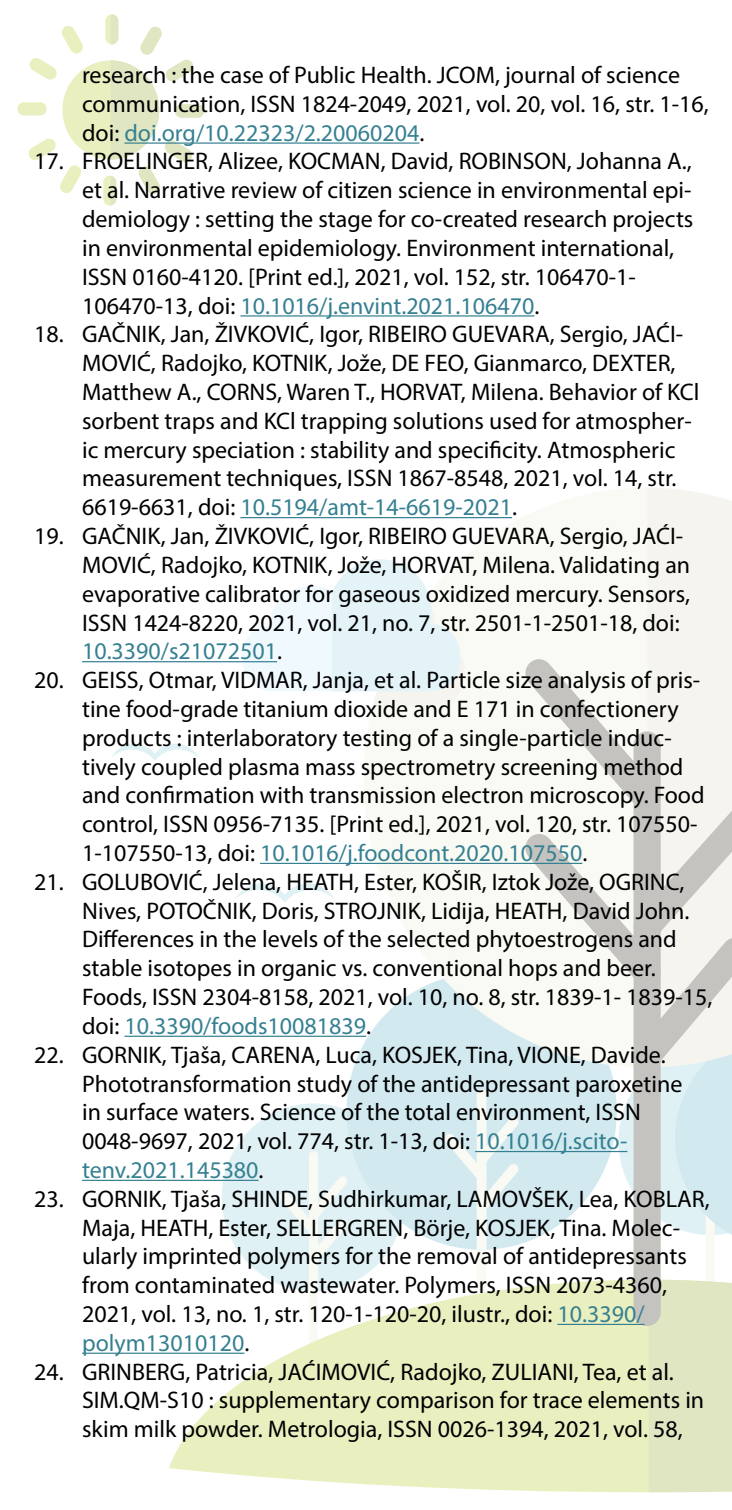
75
RESEARCH
ARTICLES



Publications Published in 2021

Original articles

1. BENEDIK, Ljudmila, PILAR, Anja Marija, PROSEN, Helena, JAČIMOVIĆ, Radojko, POVINEC, P. Pavel. Determination of ultra-trace levels of uranium and thorium in electrolytic copper using radiochemical neutron activation analysis. *Applied Radiation and Isotopes*, ISSN 0969-8043. [Print ed.], 2021, vol. 175, str. 109801-1-109801-6, doi: [10.1016/j.apradiso.2021.109801](https://doi.org/10.1016/j.apradiso.2021.109801).
2. BOITO, Marta, IACUMIN, Paola, ROSSI, Mattia, OGRINC, Nives, VENTURELLI, Giampiero. Isotope partitioning between cow milk and farm water : a tool for verification of milk provenance. *Rapid communications in mass spectrometry*, ISSN 0951-4198, [in press] 2021, doi: [10.1002/rcm.9160](https://doi.org/10.1002/rcm.9160).
3. BOZAU, Elke, BAUER, Georg, LICHA, Tobias, LOJEN, Sonja. Hydrochemical response of spring and mine waters in the Upper Harz Mountains (Germany) after dry periods and heavy rain events. *Zeitschrift der Deutschen Gesellschaft für Geowissenschaften*, ISSN 1860-1804, 2021, vol. 172, no. 1, str. 73-82, doi: [10.1127/zdgg/2021/0259](https://doi.org/10.1127/zdgg/2021/0259).
4. BOZAU, Elke, LOJEN, Sonja, ZUPANČIČ, Nina. The peat bog at Zinnwald-Georgenfeld revisited after 25 years : geochemical investigation of water, Sphagnum moss and peat cores. *Chemie der Erde*, ISSN 0009-2819, 2021, str. 1-39, doi: [10.1016/j.chemer.2021.125823](https://doi.org/10.1016/j.chemer.2021.125823). [COBISS.SI-ID 77941763], [JCR, SNIP]
5. ŠKUFGA, David, KOVAČIČ, Ana, GRIESSLER BULC, Tjaša, HEATH, Ester. Determination of 18 bisphenols in aqueous and biomass phase of high rate algal ponds : development, validation and application. *Chemosphere*, ISSN 0045-6535. [Print ed.], [in press] 2021, 33 str., doi: [10.1016/j.chemosphere.2021.129786](https://doi.org/10.1016/j.chemosphere.2021.129786).
6. CASTIGLIONI, Sara Michela, HEATH, Ester, et al. New psychoactive substances in several European populations assessed by wastewater-based epidemiology. *Water research*, ISSN 0043-1354, [in press] 2021, 35 str., doi: [10.1016/j.watres.2021.116983](https://doi.org/10.1016/j.watres.2021.116983)
7. ČERNE, Marko, JAČIMOVIĆ, Radojko, BENEDIK, Ljudmila, HEATH, David John, et al. Effect of sewage sludge derived compost or biochar amendment on the phytoaccumulation of potentially toxic elements and radionuclides by Chinese cabbage. *Journal of environmental management*, ISSN 0301-4797, 2021, vol. 293, str. 112955-1-112955-12, doi: [10.1016/j.jenvman.2021.112955](https://doi.org/10.1016/j.jenvman.2021.112955).
8. CHOUHAN, Raghuraj S., HORVAT, Milena, JAHANGEER, Ahmed, ALHOKBANY, Norah, ALSHEHRI, Saad M., GANDHI, Sonu. Magnetic nanoparticles : a multifunctional potential agent for diagnosis and therapy. *Cancers*, ISSN 2072-6694, 2021, vol. 13, no. 9, str. 2213-1- 2213-16, doi: [10.3390/cancers13092213](https://doi.org/10.3390/cancers13092213).
9. CONCINA, Federica, MAZEJ, Darja, SNOJ TRATNIK, Janja, HORVAT, Milena, et al. Nutrient intake during pregnancy and adherence to dietary recommendations : the Mediterranean PHIME cohort. *Nutrients*, ISSN 2072-6643, 2021, vol. 13, no. 5, str. 1434-1-1434-17, doi: [10.3390/nu13051434](https://doi.org/10.3390/nu13051434).
10. DEEV, D., RYBKIN, Iaroslav, RIJAVEC, Tomaž, LAPANJE, Aleš. When beneficial biofilms on materials is needed : electrostatic attachment of living bacterial cells induces biofilm formation. *Frontiers in materials*, ISSN 2296-8016, [in press] 2021, 5 str., doi: [10.3389/fmats.2021.624631](https://doi.org/10.3389/fmats.2021.624631)
11. DEGRENGELE, Céline, KANDUČ, Tjaša, KOČMAN, David, HORVAT, Milena, et al. NPAHs and OPAHs in the atmosphere of two central European cities : seasonality, urban-to-background gradients, cancer risks and gas-to-particle partitioning. *Science of the total environment*, ISSN 0048-9697, 2021, vol. 793, str. 148528-1-14852812, doi: [10.1016/j.scitotenv.2021.148528](https://doi.org/10.1016/j.scitotenv.2021.148528).
12. DOVJAK, Mateja, VIRANT, Barbara, KRAINER, Aleš, ŠIJANEČ-ZAVRL, Marjana, VAUPOTIČ, Janja. Determination of optimal ventilation rates in educational environment in terms of radon dosimetry. *International journal of hygiene and environmental health*, ISSN 1438-4639, maj 2021, vol. 234, 113742, str. 1-11 + [13], ilustr., doi: [10.1016/j.ijheh.2021.113742](https://doi.org/10.1016/j.ijheh.2021.113742).
13. ĐURIĆ, Marija, OPRČKAL, Primož, ZALAR SERJUN, Vesna, MAUKO PRANJIČ, Alenka, ŠČANČAR, Janez, MILAČIČ, Radmila, MLADENIČ, Ana. Environmental impacts and immobilization mechanisms of cadmium, lead and zinc in geotechnical composites made from contaminated soil and paper-ash. *Applied sciences*, ISSN 2076-3417, 2021, vol. 11, iss. 24, str. 1-15, ilustr., doi: [10.3390/app112411822](https://doi.org/10.3390/app112411822).
14. ELERŠEK, Tina, NOTERSBERG, Tilen, KOVAČIČ, Ana, HEATH, Ester, FILIPIČ, Metka. The effects of bisphenol A, F and their mixture on algal and cyanobacterial growth : from additivity to antagonism. *Environmental science and pollution research international*, ISSN 0944-1344. [Print ed.], 2021, vol. 28, str. 3445-3454, ilustr., doi: [10.1007/s11356-020-10329-7](https://doi.org/10.1007/s11356-020-10329-7).
15. FAGANELI, Jadran, OGRINC, Nives, TAMŠE, Samo, KRANJC, Bor, TURK, Valentina, MALEJ, Alenka, KOVAČ, Nives. "Kisanje" severnega Jadrana. *Acta chimica slovenica*, ISSN 1580-3155. [Spletna izd.], 2021, vol. 68, no. 3, str. [587]-593, ilustr., doi: [10.17344/acs.2021.7002](https://doi.org/10.17344/acs.2021.7002).
16. FICORILLI, Antonella, KANDUČ, Tjaša, KOČMAN, David, et al. Investigating the process of ethical approval in citizen science



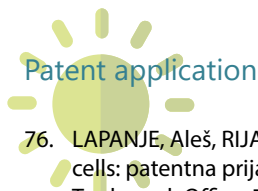
research : the case of Public Health. JCOM, journal of science communication, ISSN 1824-2049, 2021, vol. 20, vol. 16, str. 1-16, doi: doi.org/10.22323/2.20060204.

17. FROELINGER, Alizee, KOCMAN, David, ROBINSON, Johanna A., et al. Narrative review of citizen science in environmental epidemiology : setting the stage for co-created research projects in environmental epidemiology. Environment international, ISSN 0160-4120. [Print ed.], 2021, vol. 152, str. 106470-1-106470-13, doi: [10.1016/j.envint.2021.106470](https://doi.org/10.1016/j.envint.2021.106470).
18. GAČNIK, Jan, ŽIVKOVIĆ, Igor, RIBEIRO GUEVARA, Sergio, JAČIMOVIĆ, Radojko, KOTNIK, Jože, DE FEO, Gianmarco, DEXTER, Matthew A., CORNS, Warren T., HORVAT, Milena. Behavior of KCl sorbent traps and KCl trapping solutions used for atmospheric mercury speciation : stability and specificity. Atmospheric measurement techniques, ISSN 1867-8548, 2021, vol. 14, str. 6619-6631, doi: [10.5194/amt-14-6619-2021](https://doi.org/10.5194/amt-14-6619-2021).
19. GAČNIK, Jan, ŽIVKOVIĆ, Igor, RIBEIRO GUEVARA, Sergio, JAČIMOVIĆ, Radojko, KOTNIK, Jože, HORVAT, Milena. Validating an evaporative calibrator for gaseous oxidized mercury. Sensors, ISSN 1424-8220, 2021, vol. 21, no. 7, str. 2501-1-2501-18, doi: [10.3390/s21072501](https://doi.org/10.3390/s21072501).
20. GEISS, Otmar, VIDMAR, Janja, et al. Particle size analysis of pristine food-grade titanium dioxide and E 171 in confectionery products : interlaboratory testing of a single-particle inductively coupled plasma mass spectrometry screening method and confirmation with transmission electron microscopy. Food control, ISSN 0956-7135. [Print ed.], 2021, vol. 120, str. 107550-1-107550-13, doi: [10.1016/j.foodcont.2020.107550](https://doi.org/10.1016/j.foodcont.2020.107550).
21. GOLUBOVIĆ, Jelena, HEATH, Ester, KOŠIR, Iztok Jože, OGRINC, Nives, POTOČNIK, Doris, STROJNIK, Lidija, HEATH, David John. Differences in the levels of the selected phytoestrogens and stable isotopes in organic vs. conventional hops and beer. Foods, ISSN 2304-8158, 2021, vol. 10, no. 8, str. 1839-1-1839-15, doi: [10.3390/foods10081839](https://doi.org/10.3390/foods10081839).
22. GORNIK, Tjaša, CARENA, Luca, KOSJEK, Tina, VIONE, Davide. Phototransformation study of the antidepressant paroxetine in surface waters. Science of the total environment, ISSN 0048-9697, 2021, vol. 774, str. 1-13, doi: [10.1016/j.scitotenv.2021.145380](https://doi.org/10.1016/j.scitotenv.2021.145380).
23. GORNIK, Tjaša, SHINDE, Sudhirkumar, LAMOVŠEK, Lea, KOBLAR, Maja, HEATH, Ester, SELLERGREN, Börje, KOSJEK, Tina. Molecularly imprinted polymers for the removal of antidepressants from contaminated wastewater. Polymers, ISSN 2073-4360, 2021, vol. 13, no. 1, str. 120-1-120-20, ilustr., doi: [10.3390/polym13010120](https://doi.org/10.3390/polym13010120).
24. GRINBERG, Patricia, JAČIMOVIĆ, Radojko, ZULIANI, Tea, et al. SIM.QM-S10 : supplementary comparison for trace elements in skim milk powder. Metrologia, ISSN 0026-1394, 2021, vol. 58, no. 1A, str. 1-58, doi: [10.1088/0026-1394/58/1A/08008](https://doi.org/10.1088/0026-1394/58/1A/08008).
25. GROŠELJ, Aleš, BOŠNJAK, Maša, KRŽAN, Mojca, KOSJEK, Tina, BOTTYÁN, Krisztina, PLEŠNIK, Helena, JAMŠEK, Črt, ČEMAŽAR, Maja, KIS, Erika, SERŠA, Gregor. Bleomycin concentration in patients' plasma and tumors after electrochemotherapy : a study from InspECT Group. Pharmaceuticals, ISSN 1999-4923. [Online ed.], 2021, vol. 13, no. 9, str. 1324-1-1324-7, doi: [10.3390/pharmaceutics13091324](https://doi.org/10.3390/pharmaceutics13091324).
26. HAMZIĆ GREGORČIČ, Staša, OGRINC, Nives, FREW, Russell, NEČEMER, Marijan, STROJNIK, Lidija, ZULIANI, Tea. The provenance of Slovenian milk using 87Sr/86Sr87Sr/86Sr isotope ratios. Foods, ISSN 2304-8158, 2021, vol. 10, no. 8, str. 1729-1-1729-15, doi: [10.3390/foods10081729](https://doi.org/10.3390/foods10081729).
27. HATVANI, István Gábor, SZATMÁRI, Gábor, KERN, Zoltán, ERDÉLYI, Dániel, VREČA, Polona, KANDUČ, Tjaša, CZUPPON, György, LOJEN, Sonja, KOHÁN, Balázs. Geostatistical evaluation of the design of the precipitation stable isotope monitoring network for Slovenia and Hungary. Environment international, ISSN 0160-4120. [Print ed.], 2021, vol. 146, str. 106263-1-106263-14, doi: [10.1016/j.envint.2020.106263](https://doi.org/10.1016/j.envint.2020.106263).
28. HOJNIK, Nataša, MODIČ, Martina, WALSH, James L., ŽIGON, Dušan, JAVORNIK, Uroš, PLAVEC, Janez, ŽEGURA, Bojana, FILIPIČ, Metka, CVELBAR, Uroš. Unravelling the pathways of air plasma induced aflatoxin B1B1 degradation and detoxification. Journal of hazardous materials, ISSN 0304-3894. [Print ed.], Sep. 2021, vol. 403, str. 1-29, ilustr., doi: [10.1016/j.jhazmat.2020.123593](https://doi.org/10.1016/j.jhazmat.2020.123593).
29. HORACEK, Micha, OGRINC, Nives, MAGDAS, Dana Alina, WUNDERLIND, Daniel, ŠUČUR RADONJIČ, Sanja, MARAŠ, Vesna, MISUROVIC, Ana, EDER, Reinhard, ČUŠ, Franc, WYHLIDAL, Stefan, PAPESCH, Wolfgang. Isotope analysis (1313C, 1818O) of wine from Central and Eastern Europe and Argentina, 2008 and 2009 vintages : differentiation of origin, environmental indications and variations within countries. Frontiers in sustainable food systems, ISSN 2571-581X, May 2021, vol. 5, article 638941, str. 1-10, ilustr., doi: [10.3389/fsufs.2021.638941](https://doi.org/10.3389/fsufs.2021.638941).
30. KANDUČ, Tjaša, SEDLAR, Jerneja, NOVAK, Rok, ZADNIK, Ivo, JAMNIKAR, Sergej, VERBOVŠEK, Timotej, GRASSA, Fausto, ROŠER, Janez. Exploring the 2013-2018 degassing mechanism from the Pesje and Preloge excavation fields in the Velenje Coal basin, Slovenia : insights from molecular composition and stable isotopes. Isotopes in environmental and health studies, ISSN 1477-2639, [in press] 2021, 25 str., doi: [10.1080/10256016.2021.1981309](https://doi.org/10.1080/10256016.2021.1981309).
31. KEJŽAR, Jan, JAGODIČ HUDOBIVNIK, Marta, NEČEMER, Marijan, OGRINC, Nives, MASTEN, Jasmina, POKLAR ULRIH, Nataša. Characterization of algae dietary supplements using antioxidative potential, elemental composition and stable isotopes

- approach. *Frontiers in nutrition*, ISSN 2296-861X, Jan. 2021, vol. 7, article 618503, str. 1-10, doi: [10.3389/fnut.2020.618503](https://doi.org/10.3389/fnut.2020.618503).
32. KÖCK SCHULMEYER, Marianne, MILAČIČ, Radmila, et al. Priority and emerging organic microcontaminants in three Mediterranean river basins : Occurrence, spatial distribution, and identification of river basin specific pollutants. *Science of the total environment*, ISSN 0048-9697, 2021, vol. 754, str. 142344-1-142344-15, doi: [10.1016/j.scitotenv.2020.142344](https://doi.org/10.1016/j.scitotenv.2020.142344).
 33. LUČIČ, Mavro, MIKAC, Nevenka, VDOVIČ, Neda, BAČIČ, Nikola, NAVA, Veronica, VIDMAR, Janja, MILAČIČ, Radmila. Spatial and temporal variability and sources of dissolved trace elements in the Sava River (Slovenia, Croatia). *Environmental science and pollution research international*, ISSN 0944-1344. [Print ed.], [in press] 2021, 19 str., doi: [10.1007/s11356-021-17769-9](https://doi.org/10.1007/s11356-021-17769-9).
 34. MA, Guanglong, KOSTEVŠEK, Nina, MARKELC, Boštjan, HUDOKLIN, Samo, ERDANI-KREFT, Mateja, SERŠA, Igor, ČEMAŽAR, Maja, MARKOVIČ, Katarina, ŠČANČAR, Janez, et al. PD1 blockade potentiates the therapeutic efficacy of photothermally-activated and MRI-guided low temperature-sensitive magnetoliposomes. *Journal of controlled release*, ISSN 0168-3659. [Print ed.], 2021, vol. 332, 45 str., str. 419-433, doi: [10.1016/j.jconrel.2021.03.002](https://doi.org/10.1016/j.jconrel.2021.03.002).
 35. MARKOVIČ, Stefan, URŠIČ, Katja, ČEMAŽAR, Maja, SERŠA, Gregor, STAREŠINIČ, Barbara, MILAČIČ, Radmila, ŠČANČAR, Janez. High spatial resolution imaging of cisplatin and Texas Red cisplatin in tumour spheroids using laser ablation isotope dilution inductively coupled plasma mass spectrometry and confocal fluorescence microscopy. *Analytica chimica acta*, ISSN 0003-2670. [Print ed.], 2021, vol. 1162, str. 338424-1-338424-12, doi: [10.1016/j.aca.2021.338424](https://doi.org/10.1016/j.aca.2021.338424).
 36. MASTEN, Jasmina, CILLERO-PASTOR, Berta, MOHREN, Ronny, POKLAR ULRIH, Nataša, OGRINC, Nives, JAMNIK, Polona. Insight into the antioxidant effect of fermented and non-fermented *Spirulina* water and ethanol extracts at the proteome level using a yeast cell model. *Antioxidants*, ISSN 2076-3921, 2021, vol. 10, no. 9, str. 1366-1-1366-15, ilustr., doi: [10.3390/antiox10091366](https://doi.org/10.3390/antiox10091366).
 37. MATJAŠIČ, Tjaša, SIMČIČ, Tatjana, KANDUČ, Tjaša, SAMARDŽIJA, Zoran, MORI, Nataša. Presence of polyethylene terephthalate (PET) fibers in hyporheic zone alters colonization patterns and seasonal dynamics of biofilm metabolic functioning. *Water Research*, ISSN 1879-2448. [Online ed.], Sep. 2021, vol. 203, str. 1-13, ilustr. <https://www.sciencedirect.com/science/article/pii/S0043135421006539>.
 38. MURI, Gregor, HORVAT, Milena, KOTNIK, Jože, MURI, Boštjan, VREČA, Polona, JACIMOVIČ, Radojko. Recent changes in major and trace elements in sediments from a remote mountain lake (6th Triglav Lake) in the Julian Alps, NW Slovenia. *Journal of paleolimnology*, ISSN 0921-2728, 2021, vol. 65, no. 1, str. 69-83, doi: [10.1007/s10933-020-00149-7](https://doi.org/10.1007/s10933-020-00149-7).
 39. NAGODE, Klara, KANDUČ, Tjaša, ZULIANI, Tea, BRAČIČ-ŽELEZNIK, Branka, JAMNIK, Brigita, VREČA, Polona. Daily fluctuations in the isotope and elemental composition of tap water in Ljubljana, Slovenia. *Water*, ISSN 2073-4441, 2021, vol. 13, no. 11, str. 1451-1-1451-16, doi: [10.3390/w13111451](https://doi.org/10.3390/w13111451).
 40. NOČ, Luka, LIČEN, Matjaž, DREVENŠEK OLENIK, Irena, CHOUHAN, Raghuraj S., KOVAČ, Janez, MANDLER, Daniel, JERMAN, Ivan. Polyhedral oligomeric silsesquioxanes as protective monolayer coatings against the high-temperature corrosion of concentrating solar power absorber surfaces. *Solar energy materials and solar cells*, ISSN 0927-0248. [Print ed.], 2021, vol. 223, str. 110984-1-110984-12, doi: [10.1016/j.solmat.2021.110984](https://doi.org/10.1016/j.solmat.2021.110984).
 41. NOIREAUX, Johanna, LOPÉZ-SANZ, Sara, VIDMAR, Janja, CORREIA, Manuel, DEVOILLE, Laurent, FISICARO, Paola, LOESCHNER, Katrin. Titanium dioxide nanoparticles in food: comparison of detection by triple-quadrupole and high-resolution ICP-MS in single-particle mode. *Journal of nanoparticle research*, ISSN 1388-0764, 2021, vol. 23, no. 4, str. 102-1-102-14, doi: [10.1007/s11051-021-05198-1](https://doi.org/10.1007/s11051-021-05198-1).
 42. NOVAK, Rok, KOCMAN, David, KANDUČ, Tjaša, et al. Harmonization and visualization of data from a transnational multi-sensor personal exposure campaign. *International journal of environmental research and public health*, ISSN 1660-4601. [Online ed.], 2021, vol. 18, no. 21, str. 11614-1-11614-18, doi: [10.3390/ijerph182111614](https://doi.org/10.3390/ijerph182111614).
 43. NÜBLER, Stefanie, MARKOVIČ, Stefan, MARKOVIČ, Katarina, et al. Interlaboratory Comparison Investigations (ICIs) for human biomonitoring of chromium as part of the quality assurance programme under HBM4EU. *Journal of trace elements in medicine and biology*, ISSN 0946-672X, [in press] 2021, 15 str., doi: [10.1016/j.jtemb.2021.126912](https://doi.org/10.1016/j.jtemb.2021.126912).
 44. OGRINC, Nives, MILAVEC, Mojca, BOGOŽALEC KOŠIR, Alexandra, et al. Support for a European metrology network on food safety food-MetNet. *Measurement, Sensors*, ISSN 2665-9174, 2021, vol. 18, str. 100285-1-100285-4, doi: [10.1016/j.measen.2021.100285](https://doi.org/10.1016/j.measen.2021.100285).
 45. OGRIZEK, Monika, JACIMOVIČ, Radojko, ŠALA, Martin, KROFLIČ, Ana. No more waste at the elemental analysis of airborne particulate matter on quartz fibre filters. *Talanta*, ISSN 0039-9140. [Print ed.], 1 May 2021, vol. 226, str. 122110-1-122110-10, doi: [10.1016/j.talanta.2021.122110](https://doi.org/10.1016/j.talanta.2021.122110).
 46. ORLANDO-BONACA, Martina, PITACCO, Valentina, BAJT, Oliver, FALNOGA, Ingrid, JAGODIC HUDOBIVNIK, Marta, MAZEJ, Darja, ŠLEJKOVEC, Zdenka, BONANNO, Giuseppe. Spatial and temporal distribution of trace elements in Padina pavonica from the northern Adriatic Sea. *Marine pollution bulletin*, ISSN 0025-326X, 2021, vol. 172, str. 112874-1-112874-12, doi: [10.1016/j.marpolbul.2021.112874](https://doi.org/10.1016/j.marpolbul.2021.112874).

47. PAPAIOANNOU, Nafsika, HORVAT, Milena, et al. Multi-omics analysis reveals that co-exposure to phthalates and metals disturbs urea cycle and choline metabolism. Environmental research : multidisciplinary journal of environmental sciences, ecology, and public health, ISSN 0013-9351, 2021, vol. 192, str. 110041-1- 110041-11, doi: [10.1016/j.envres.2020.110041](https://doi.org/10.1016/j.envres.2020.110041).
48. PLESTENJAK, Gregor, ELER, Klemen, MIHELIC, Rok, FERLAN, Mitja, OGRINC, Nives, KRAJNC, Bor, VODNIK, Dominik. Can additional air supply enhance decomposition processes in sludge treatment reed beds?. Journal of environmental management, ISSN 0301-4797, 2021, vol. 277, art no.111511, 1-8, doi: [10.1016/j.jenvman.2020.111511](https://doi.org/10.1016/j.jenvman.2020.111511).
49. POTOČNIK, Doris, JAGODIC HUDOBIVNIK, Marta, MAZEJ, Darja, OGRINC, Nives. Optimization of the sample preparation method for determination of multi-elemental composition in fruit samples by ICP-MS analysis. Measurement, Sensors., ISSN 2665-9174, 2021, vol. 18, str. 100292-1-10292-4, doi: [10.1016/j.measen.2021.100292](https://doi.org/10.1016/j.measen.2021.100292).
50. PROSENC, Franja, PIECHOCKA, Justyna, ŠKUFCA, David, HEATH, Ester, GRIESSLER BULC, Tjaša, ISTENIČ, Darja, BUTTIGLIERI, Gianluigi. Microalgae-based removal of contaminants of emerging concern : mechanisms in Chlorella vulgaris and mixed algal-bacterial cultures. Journal of hazardous materials, ISSN 0304-3894. [Print ed.], 2021, vol. 418, str. 126284-1-126284-11, doi: [10.1016/j.jhazmat.2021.126284](https://doi.org/10.1016/j.jhazmat.2021.126284).
51. ROBINSON, Johanna A., KOCMAN, David, SPEYER, Orestis, GERASOPOULOS, Evangelos. Meeting volunteer expectations : a review of volunteer motivations in citizen science and best practices for their retention through implementation of functional features in CS tools. Journal of environmental planning and management, ISSN 1360-0559, [in press] 2021, 26 str., doi: [10.1080/09640568.2020.1853507](https://doi.org/10.1080/09640568.2020.1853507).
52. ROBINSON, Johanna A., NOVAK, Rok, KANDUČ, Tjaša, KOCMAN, David, et al. User-centred design of a final results report for participants in multi-sensor personal air pollution exposure monitoring campaigns. International journal of environmental research and public health, ISSN 1660-4601. [Online ed.], 2021, vol. 18, str. 12544-1-12544-18, doi: [10.3390/ijerph182312544](https://doi.org/10.3390/ijerph182312544).
53. ROVAN, Leja, ZULIANI, Tea, HORVAT, Barbara, KANDUČ, Tjaša, VREČA, Polona, JAMIL, Qasim, ČERMELJ, Branko, BURANA-KIČ, Elvira, CUKROV, Neven, ŠTOK, Marko, LOJEN, Sonja. Uranium isotopes as a possible tracer of terrestrial authigenic carbonate. Science of the total environment, ISSN 0048-9697, 2021, vol. 797, str. 149103-1- 149103-12, doi: [10.1016/j.scitotenv.2021.149103](https://doi.org/10.1016/j.scitotenv.2021.149103).
54. RUNKEL, Agneta Annika, KRIŽANEC, Boštjan, LIPIČAR, Eva, BASKAR, Mojca, HRŽENJAK, Vesna, CENCIČ-KODBA, Zdenka, KONONENKO, Lijana, KANDUČ, Tjaša, MAZEJ, Darja, SNOJ TRATNIK, Janja, HORVAT, Milena. Organohalogen : a persisting burden in Slovenia?. Environmental research : multidisciplinary journal of environmental sciences, ecology, and public health, ISSN 0013-9351, 2021, vol. 198, str. 111224-1-111224-15, doi: [10.1016/j.envres.2021.111224](https://doi.org/10.1016/j.envres.2021.111224).
55. RUNKEL, Agneta Annika, MAZEJ, Darja, SNOJ TRATNIK, Janja, TKALEC, Žiga, KOSJEK, Tina, HORVAT, Milena. Exposure of men and lactating women to environmental phenols, phthalates, and DINCH. Chemosphere, ISSN 0045-6535. [Print ed.], 2021, vol. 286, part 3, str. 131858-1-131858-13, doi: [10.1016/j.chemosphere.2021.131858](https://doi.org/10.1016/j.chemosphere.2021.131858).
56. SARAGA, D., HORVAT, Milena, KOCMAN, David, KANDUČ, Tjaša, et al. Multi-city comparative PM_{2.5} source apportionment for fifteen sites in Europe : the ICARUS project. Science of the total environment, ISSN 0048-9697, 2021, vol. 751, str. 141855-1-141855-15, doi: [10.1016/j.scitotenv.2020.141855](https://doi.org/10.1016/j.scitotenv.2020.141855).
57. Savič Zdravković, Dimitrija, MILOŠEVIČ, Djuradj, CONIČ, Jelena, MARKOVIČ, Katarina, ŠČANČAR, Janez, MILIŠA, Marko, JOVANOVIČ, Boris. Revealing the effects of cerium dioxide nanoparticles through the analysis of morphological changes in Chironomus riparius. Science of the total environment, ISSN 0048-9697, 2021, vol. 786, str. 147439-1-147439-14, doi: [10.1016/j.scitotenv.2021.147439](https://doi.org/10.1016/j.scitotenv.2021.147439).
58. ŠCHYMURA, Stefan, DREV, Sandra, PODLIPEC, Rok, RIJAVEC, Tomaž, LAPANJE, Aleš, ŠTOK, Marko, et al. Dissolution-based uptake of CeO₂ nanoparticles by freshwater shrimp : a dual-radiolabelling study of the fate of anthropogenic cerium in water organisms. Environmental science, Nano, ISSN 2051-8161, 11 str., doi: [10.1039/d1en00264c](https://doi.org/10.1039/d1en00264c).
59. SERIANZ, Luka, CERAR, Sonja, VREČA, Polona. Using stable isotopes and major ions to identify recharge characteristics of the Alpine groundwater-flow dominated Triglavsko Bistrica River = Uporaba stabilnih izotopov in glavnih ionov za oceno napajalnih značilnosti alpskega rečnega toka Triglavsko Bistrice pod vplivom podzemne vode. Geologija, ISSN 0016-7789. [Tiskana izd.], 2021, vol. 64, no .2, str. 205-220, doi: [10.5474/geologija.2021.012](https://doi.org/10.5474/geologija.2021.012).
60. SILVA, B. C., CURY, L. A., LEAL, A. S., MENEZES, Maria-Angela, NAGORNY, S., NISI, St., SAIKI, Mitiko, JAČIMOVIČ, Radjko, KRAMBROCK, K. Neutron-induced point defects and luminescence properties of enriched Zn₈₂SeZn₈₂Se crystals. Journal of applied physics, ISSN 1089-7550. [Online ed.], 2021, vol. 130, no. 5, str. 054502 -1-054502 -11, doi: [10.1063/5.0052503](https://doi.org/10.1063/5.0052503).
61. ŠIŠKOVIČ, Nina, STROJNIK, Lidija, GREBENC, Tine, VIDRIH, Rajko, OGRINC, Nives. Differentiation between species and regional origin of fresh and freeze-dried truffles according to their volatile profiles. Food control, ISSN 0956-7135. [Print ed.], 2021, vol.

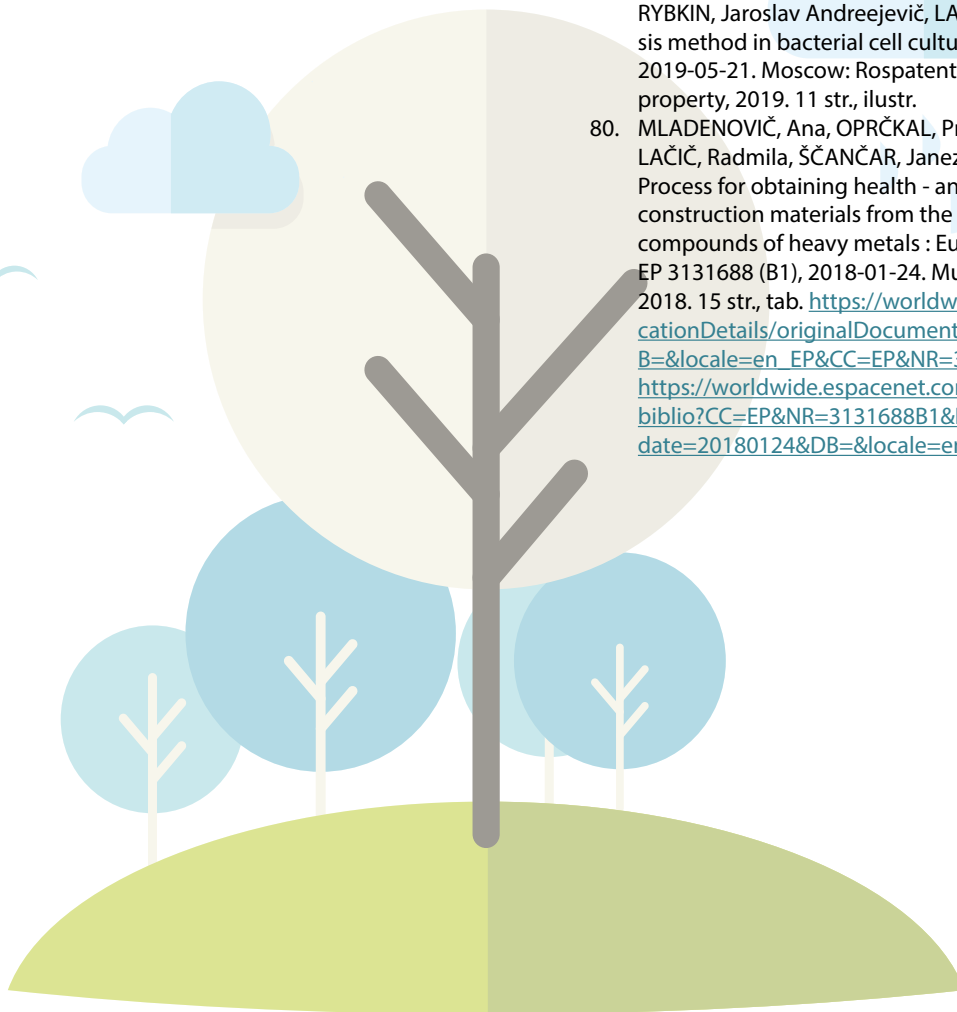
- 123, str. 1-10, doi: [10.1016/j.foodcont.2020.107698](https://doi.org/10.1016/j.foodcont.2020.107698)
62. ŠKUFGA, David, KOVAČIČ, Ana, PROSENC, Franja, GRIESSLER BULC, Tjaša, HEATH, David John, HEATH, Ester. Phycoremediation of municipal wastewater : removal of nutrients and contaminants of emerging concern. Science of the total environment, ISSN 0048-9697, Aug. 2021, vol. 782, str. 1-6, ilustr., doi: [10.1016/j.scitotenv.2021.146949](https://doi.org/10.1016/j.scitotenv.2021.146949).
63. ŠLEJKOVEC, Zdenka, GORŠE, Leon, GROBLER, Ana, JAGODIĆ HUDOBIVNIK, Marta, FALNOGA, Ingrid. Arsenic speciation and elemental composition of rice samples from the Slovenian market. Food chemistry, ISSN 0308-8146. [Print ed.], 2021, vol. 342, art. 128348, doi: [10.1016/j.foodchem.2020.128348](https://doi.org/10.1016/j.foodchem.2020.128348).
64. STROJNIK, Lidija, HLADNIK, Jože, CVELBAR WEBER, Nika, KORON, Darinka, STOPAR, Matej, ZLATIČ, Emil, KOKALJ, Doris, STROJNIK, Martin, OGRINC, Nives. Construction of IsoVoc database for the authentication of natural flavours. Foods, ISSN 2304-8158, 2021, vol. 10, iss. 7, str. 1550-1-1550-18, doi: [10.3390/foods10071550](https://doi.org/10.3390/foods10071550).
65. ŠTOK, Marko, SVETEK, Barbara. Optimization and validation of a procedure for the determination of tritium in gaseous effluents from nuclear power plants. Radiochimica Acta, ISSN 0033-8230, [in press] 2021, 7 str., doi: [10.1515/ract-2021-1037](https://doi.org/10.1515/ract-2021-1037).
66. TKALEC, Žiga, KOSJEK, Tina, SNOJ TRATNIK, Janja, STAJNKO, Anja, RUNKEL, Agneta Annika, SYKIOTOU, Marianthi, MAZEJ, Darja, HORVAT, Milena. Exposure of Slovenian children and adolescents to bisphenols, parabens and triclosan : urinary levels, exposure patterns, determinants of exposure and susceptibility. Environment international, ISSN 0160-4120. [Print ed.], 2021, vol. 146, str. 106172-1-106172-11, doi: [10.1016/j.envint.2020.106172](https://doi.org/10.1016/j.envint.2020.106172).
67. TKALEC, Žiga, NEGREIRA, Noelia, LOPEZ DE ALDA, Miren, BARCELÓ, Damià, KOSJEK, Tina. A novel workflow utilizing open-source software tools in the environmental fate studies : the example of imatinib biotransformation. Science of the total environment, ISSN 0048-9697, 2021, vol. 797, str. 149063-1-149063-10, doi: [10.1016/j.scitotenv.2021.149063](https://doi.org/10.1016/j.scitotenv.2021.149063)
68. TULASI, Delali, FAJON, Vesna, KOTNIK, Jože, SHLYAPNIKOV, Yaroslav, ADOLEY, Dennis, SERFOR-ARMAH, Yaw, HORVAT, Milena. Mercury methylation in cyanide influenced river sediments : a comparative study in Southwestern Ghana. Environmental monitoring and assessment, ISSN 0167-6369, 2021, vol.193, no. 4, str. 180-1-180-18, doi: [10.1007/s10661-021-08920-7](https://doi.org/10.1007/s10661-021-08920-7)
69. VERDEL, Nada, RIJAVEC, Tomaž, RYBKIN, Iaroslav, ERZIN, Anja, VELIŠČEK, Žiga, PINTAR, Albin, LAPANJE, Aleš. Isolation, identification, and selection of bacteria with proof-of-concept for bioaugmentation of whitewater from wood-free paper mills. Frontiers in microbiology, ISSN 1664-302X, Oct. 2021, vol. 12, [article no.] 758702, str. 1-15, ilustr., doi: [10.3389/fmicb.2021.758702](https://doi.org/10.3389/fmicb.2021.758702).
70. VEROVŠEK, Taja, KRIZMAN MATASIĆ, Ivona, HEATH, David John, HEATH, Ester. Data in brief : drug use data for slovenian educational institutions using wastewater analysis. Data in brief, ISSN 2352-3409, vol. 39, 2021, str. 107614-1-107614-15, doi: [10.1016/j.dib.2021.107614](https://doi.org/10.1016/j.dib.2021.107614)
71. VEROVŠEK, Taja, KRIZMAN MATASIĆ, Ivona, HEATH, David John, HEATH, Ester. Investigation of drugs of abuse in educational institutions using wastewater analysis. Science of the total environment, ISSN 0048-9697, [in press] 2021, 10 str., doi: [10.1016/j.scitotenv.2021.150013](https://doi.org/10.1016/j.scitotenv.2021.150013).
72. VIDMAR, Janja, HÄSSMANN, Luisa, LOESCHNER, Katrin. Single-particle ICP-MS as a screening technique for the presence of potential inorganic nanoparticles in food. Journal of agricultural and food chemistry, ISSN 0021-8561, [in press] 2021, 12 str., doi: [10.1021/acs.jafc.0c07363](https://doi.org/10.1021/acs.jafc.0c07363).
73. VIŽINTIN, Angelika, MARKOVIČ, Stefan, ŠČANČAR, Janez, MIKLAVČIČ, Damijan. Electroporation with nanosecond pulses and bleomycin or cisplatin results in efficient cell kill and low metal release from electrodes. Bioelectrochemistry, ISSN 1567-5394. [Print ed.], Aug. 2021, vol. 140, 107798, str. 1-12, ilustr., doi: [10.1016/j.bioelechem.2021.107798](https://doi.org/10.1016/j.bioelechem.2021.107798).
74. ŽENER, Boštjan, MATOH, Lev, RODIČ, Peter, ŠKUFGA, David, HEATH, Ester, LAVRENIČ ŠTANGAR, Urška. Removal of 18 bisphenols co-present in aqueous media by effectively immobilized titania photocatalyst. Journal of environmental chemical engineering, ISSN 2213-3437. [Online ed.], Dec. 2021, vol. 9, iss. 6, str. 1-9, ilustr., doi: [10.1016/j.jece.2021.106814](https://doi.org/10.1016/j.jece.2021.106814).
75. ZGONIK, Vera, MULEC, Janez, ELERŠEK, Tina, OGRINC, Nives, JAMNIK, Polona, POKLAR ULRIH, Nataša. Extremophilic microorganisms in Central Europe. Microorganisms, ISSN 2076-2607, 2021, vol. 9, no. 11, str. 1-24., doi: [10.3390/microorganisms9112326](https://doi.org/10.3390/microorganisms9112326).



76. LAPANJE, Aleš, RIJAVEC, Tomaž. Controlled aggregation of cells: patentna prijava US 2021198622 A1. [S. l.]: US Patent and Trademark Office, 7. 1. 2021.
77. LAPANJE, Aleš, RIJAVEC, Tomaž. A method for making spatially defined aggregates by precisely positioning cells based on electrostatic interaction : patentna prijava EP 3845633A1. München: European Patent Office, 7. 7. 2021.

Patents

78. MLADENVIČ, Ana, OPRČKAL, Primož, MILAČIČ, Radmila, ŠČANČAR, Janez, VIDMAR, Janja, SEVER ŠKAPIN, Andrijana, NADRAH, Peter, MAUKO PRANJIC, Alenka, ŠPRINZER, Mirko. Method for the potabilization of effluents from biological WWTPS = Verfahren zur trinkbarmachung von Abwasser aus biologischen WWTPS = Procédé rendant potables des effluents de WWTPS biologiques : European patent specification EP 3 562 788 B1, 2020-09-16. Munich: European Patent Office, 2020. 20 str., ilustr. <https://worldwide.espacenet.com/patent/search/family/061132882/publication/EP3562788B1?q=pn%3DE-P3562788B1>.
79. SERGEJEV, Gleb Borisovič, ALEKSANDROVIČ, Gorin Dmitrij, RYBKIN, Jaroslav Andreejevič, LAPANJE, Aleš. Protein synthesis method in bacterial cell culture : patent RU 2 688383 C2, 2019-05-21. Moscow: Rospatent Federal service for intellectual property, 2019. 11 str., ilustr.
80. MLADENVIČ, Ana, OPRČKAL, Primož, KRŽIŠNIK, Nina, MILAČIČ, Radmila, ŠČANČAR, Janez, SEVER ŠKAPIN, Andrijana. Process for obtaining health - and environment acceptable construction materials from the soil containing water soluble compounds of heavy metals : European patent specification EP 3131688 (B1), 2018-01-24. Munich: European Patent Office, 2018. 15 str., tab. <https://worldwide.espacenet.com/publicationDetails/originalDocument?FT=D&date=20180124&D-B=&locale=en EP&CC=EP&NR=3131688B1&KC=B1&ND=1#>, <https://worldwide.espacenet.com/publicationDetails/biblio?CC=EP&NR=3131688B1&KC=B1&FT=D&ND=1&date=20180124&DB=&locale=en EP#>.





Department of Environmental Sciences is located at two locations:
Location Jamova and Location Reactor Centre Podgorica

Contact:

Department of Environmental Sciences (O-2)

Jamova cesta 39

1000 Ljubljana

T: +386 (0)1 588 53 55

E: environment@ijs.si

W: www.environment.si



Jožef Stefan Institute, Ljubljana, Slovenia

