Charles University

MSCA PF/GF 2025: LIST OF TOPICS DESCRIPTIONS AND SUPERVISORS (NATURAL SCIENCES)

FACULTY	INSTITUTE/DEPARTMENT	RESEARCH TOPIC (PROJECT)	DESCRIPTION OF RESEARCH TOPIC (approx. 60 words)	SUPERVISOR (+ e-mail)	CONTACT PERSON (+e-mail)
Faculty of Science	Institute of hydrogeology, engineering geology and applied geophysics	**1) Landslides in a changing climate 2) Chemo-mechanics of clay landslides and engineered clay barriers**	1) I would like to support candidates who wish to explore the role of climate change on landslides (and, more broadly, natural hazards) in study areas of their choice (where data are available to them) by means of either physically-based modelling or physics-informed data-driven approaches at various scales: from individual slopes to catchments and entire orogens. The candidate should bring a fresh, original perspective rather than proposing applications or incremental refinements of existing methodologies. My interest lies in thermal effects, but I would welcome ideas for accounting for diverse coupled processes into the picture (hydro-mechanical, thermo-hydro-mechanical, chemo-mechanical processes, etc.). Also, I would welcome multidisciplinary studies where societal aspects are also considered so as to quantify risk (not only susceptibility and hazard) and proposee risk reduction strategies. 2) I would be happy to discuss ideas with candidates who are planning experimental campaigns and constitutive modelling of clay soils accounting for chemo-hydro-mechanical coupling. I am especially interested in how the exposure of clays to salt solutions, acids and bases, and organic compounds can temporarily or permanently alter the hydraulic and mechanical behaviours of clay soils, with possible applications in slope stability/landslide stabilisation and/or engineered clay barriers. The candidate should propose their own original experimentation or a novel modelling strategy. It is not a must, but I would be especially happy if the candidate has the skills to explore the full thermo-chemo-hydro-mechanically coupled response of soils.	Gianvito Scaringi (gianvito.scaringi@natur.cuni.cz)	Ludmila Součková (ludmila.souckova@natur.cuni.cz)
Faculty of Science	Botany	**1)°Plant adaptations to changing climatic conditions., 2) The effects of changing climatic conditions on plant-herbivore and plant-pollinator interactions., 3) Drivers of plant trait variation at inter- and well as intra-specific level. 4) Plant-soil interactions and their role in plant climate responses, plant invasions and species coexistence.**	I will be happy to supervise projects dealing with one of the topics below or its parts, possibly also including a combination of several of the below described topics or their parts. Our group is primarily working with herbs in various field gradient studies and manipulative experiments, but working with trees and other settings is also possible. 1)Plant adaptations to changing climatic conditions. This work is expected to provide novel insights into the ability of plants to adapt to changing climatic conditions by exploring changes in plant performance (including germination), physiology and metabolome composition and the role of phenotypic plasticity, genetic adaptations and epigenetics in these responses. 2)The effects of changing climatic conditions on plant-herbivore and plant-pollinator interactions. This work is expected to explore the climate effects on these interactions including detailed understanding of plant traits mediating these interactions. 3)Drivers of plant trait variation at inter- and well as intra-specific level. This may involve studies getting deeper insights into the environmental effects on plant flower traits and the whole flower economics spectra and comparing the flower trait variation with variation in leaf and root traits. May also involve deeper studies on plant metabolome and root exudates. 4)Plant-soil interactions and their role in plant climate responses, plant invasions and species coexistence. This work in expected to explore interactions of plants with soil biotic and abiotic components using manipulative experiments and detailed studied of soil microbial communities and soil physical structure and chemistry. It may also involve exploring the plant trait variation driving these interactions under different conditions.	Zuzana Münzbergová (zuzmun@natur.cuni.cz)	Ludmila Součková (ludmila.souckova@natur.cuni.cz)
Faculty of Science	Department of Biochemistry	**Analysis of Candida albicans essential genes**	Set of genes deemed essential in the pathogenic yeast *Candida albicans* contains a subset of genes whose function is unclear. The project will be focused on elucidating the role of these genes.	Olga Heidingsfeld (olga.heidingsfeld@natur.cuni.cz)	Ludmila Součková (ludmila.souckova@natur.cuni.cz)
Faculty of Science	Department of Botany	**Biogeography, niche shifts, and trait evolution across orobiomes in Caltha sect. Psychrophila plant lineage**	Evolutionary drivers responsible for species diversification in orobiomes of the Southern Hemisphere, the world's biodiversity hotspots, remain poorly understood, mostly due to lack of resolved phylogenies and inadequate taxon sampling on population level. In South America, Australia, and New Zealand, genus *Caltha* (Ranunculaceae) forms a monophyletic lineage, section *Psychrophila* , which in the Andes is distributed from temperate lowlands to the alpine tropics. Its Gondwanan distribution along with occurrence across four orobiomes and distinct morphological traits makes *Caltha* an exceptional study system. High-resolution genomic approaches (HybSeq, RADSeq) will be applied at populations sampled thoroughly across the whole distributional range and combined with morphometry and climatic niche characterization to provide a robust and integrative biogeographical view of the species and trait evolution in the group. Using this complex analytical framework, the study will provide unprecedented insight into the evolutionary mechanisms of the Southern Hemisphere alpine floras.	Supervisor: Petr Sklenář (petr.sklenar@natur.cuni.cz), Co-supervisor: Patrik Mráz (mrazpat@natur.cuni.cz)	Ludmila Součková (ludmila.souckova@natur.cuni.cz)
Faculty of Science	Chemistry - Department of Physical and Macromolecular Chemistry	**Development of 2D Zeolite-Based Catalysts for Efficient Dry Reforming of Methane**	This project develops lab-scale catalysts for dry reforming of methane (DRM), focusing on stabilizing metal nanoparticles on zeolite layers, using non-noble metals, and optimizing reaction conditions. Two-dimensional (2D) zeolites, including colloidal monolayers, offer strong metal–zeolite interactions and tunable silanol chemistry. Their unique structure overcomes diffusion limitations, enabling precise control of catalytic properties for enhanced DRM performance.	Michal Mazur (michal.mazur@natur.cuni.cz)	Ludmila Součková (ludmila.souckova@natur.cuni.cz)

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Faculty of Science	Zoology	**Does convergent evolution of molecular phenotypes shape immune responses in birds?**	Emerging diseases represent an important threat to human health. Many birds (similar to bats) are key vectors of zoonotic infections. Evolutionary research in molecular convergence (sharing of molecular adaptations) could aid in showing zoonotic potentials in different hosts. In silico detection of positive selection and convergence can predict functionally relevant sites diversifying immune genes across species. But there is currently no functional proof of this concept. Our objective is to identify convergent adaptations modulating inflammatory responses to different pathogens in birds. In evolutionary immunology, we will be first to test the functional effects of selected convergent variants on immune responsiveness (in vitro / in vivo). By exploring their links to avian microbiota, we will allow prediction of host-symbiont associations. The project will take the advantage of a cutting-edge multidisciplinary approach linking biodiversity-based evolutionary analysis with structural modelling, searching for predictive tools for understanding host variation in disease susceptibility.	Michal Vinkler (michal.vinkler@natur.cuni.cz)	Michal Vinkler (michal.vinkler@natur.cuni.cz)
Faculty of Science	Department of Experimental Plant Biology	**Elucidating the regulation and evolutionary constraints of transcription for rational engineering of plant organellar genomes**	Plant organelles (chloroplasts and mitochondria) evolved from bacterial endosymbionts that, over billions of years of evolution within eukaryotic hosts, have substantially reshaped their genomes and gene expression mechanisms while still retaining many prokaryotic-like features. Our lab takes an interdisciplinary approach to understanding the evolution and expression of organellar genomes, with a particular emphasis on transcription and RNA polymerase complexes as a foundation for the rational engineering of organellar genomes for biotechnological applications. We welcome research projects that bridge fundamental scientific questions with practical biotechnological applications, integrating both dry and wet lab work.	dr. Vanessa Loiacono (vanessa.loiacono@gmail.com)	Ludmila Součková (ludmila.souckova@natur.cuni.cz)
Faculty of Science	Physiology	**Epitranscriptomic regulation of brain mitochondrial function in health and neurodegeneration**	Our laboratory studies the role of the m6A-epitranscriptome in mitochondrial dynamics and renewal in neuronal and glial cells. We seek a post-doctoral fellow to investigate how the m6A modification regulates mitochondrial function and dynamics, and the neuroprotective effects of novel m6A-epidrugs in in vitro and in vivo Alzheimer's disease models. Applicants must have a strong publication record and expertise in molecular/cellular biology or animal physiology.	Jiří Novotný (jiri.novotny@natur.cuni.cz)	Ludmila Součková (ludmila.souckova@natur.cuni.cz)
Faculty of Science	Department of Cell Biology, https://www.maseklab.org	**Gallbladder signaling in development and disease.**	The gallbladder is an organ with a flexible size and a crucial role in cholestatic liver disease. While tightly linked to heavily studied hepatobiliary development, only little is known about the signaling pathways involved in its development, function, and pathology. We use unique mouse strains carrying human disease-mimicking mutations in the Jagged1 gene, together with advanced transcriptomic techniques and light sheet microscopy to elucidate the requirement of Notch-dependent and Notch-independent Jagged1 signaling in gallbladder development and disease.	Jan Masek, PhD (jan.masek@natur.cuni.cz)	Jan Masek, PhD (jan.masek@natur.cuni.cz)