10 PhD positions available in the research training program "Alpine geo- and biodiversity during environmental changes (AlpsChange)"

We are looking for students who are interested in bridging disciplinary gaps between the geosciences and the biosciences and in establishing links to social sciences - skills that are essential to address the challenges caused by the ongoing climate and biodiversity crises. The students will be based in the FWF-funded doctoral program AlpsChange, which is integrated into the Doctoral School "Dynamic Mountain Environments and Society" at the Paris-Lodron University of Salzburg and offers an interdisciplinary research and training agenda.

The students will be part of an active and interdisciplinary consortium, conduct research at the interface between geo- and biosciences and apply state-of-the-art approaches and methods of both disciplines and of history (e.g. remote sensing, field and laboratory experiments and analyses, numerical and analogue modelling), benefiting from the wide range of expertise available in the AlpsChange consortium. Each student will be supervised by an interdisciplinary team of researchers.

Applications for one or more of the 10 projects (see below) are welcome. Please indicate your preference if you are applying for more than one of the projects. A successful applicant will be highly motivated, proficient in English language and scientific writing, and willing to work in an interdisciplinary context. A master-level degree or equivalent in a relevant discipline, preferably in the field of bio- or geosciences, is required.

Please send your application stating your project preference and including a letter of motivation, CV, certificates and contact details of two potential referees in electronic form as a single pdf file **latest by April 13th 2025** to AlpsChange@plus.ac.at. Please contact AlpsChange@plus.ac.at in case you have any questions. Start dates are flexible between October 2025 and January 2026. All projects will be fully funded for 3.5 years and students will receive a monthly salary based on currently € 2786 before tax.

Further information can be found at the AlpsChange Homepage.

Description of the projects:

Project 1: Edaphic properties as drivers of plant diversification with feedbacks on soil chemistry
This project tests for effects of bedrock type (siliceous vs. carbonate rocks) on floral diversification, which may subsequently drive plant speciation through differential pollinator attraction, and how nutrient availability and rock weathering/soil development change over time in response to plant presence. The insect-pollinated alpine cushion plant *Silene acaulis* with its vicarious subspecies (*S. a. longiscapa*, calcicolous; *S. a. exscapa*, silicicolous) will be the model. Field observations (e.g., pollinator community, flower phenotype) and common garden experiments, chemical ecological approaches and population genomics from the biosciences, and various field mapping and lab techniques for soil and rock characterization from the geosciences will be applied. Main supervisors: Stefan Dötterl, Andreas Lang.

Project 2: The impact of metallophyte vegetation on weathering rates and soil formation
Plants and microorganisms are important agents in weathering processes and soil formation, however, the underlying mechanisms are not understood in detail. In this project, we aim to investigate the reciprocal interplay between plants and their abiotic habitat by quantifying the direct and indirect impact of the local vegetation on soil chemistry. Using metallophytes exhibiting different metal uptake strategies at natural sites and in common garden settings as a model we will measure reciprocal element fluxes between soil and plants, quantify weathering rates of the parent bedrock, assess the composition of the local soil microbiome and identify chemical components involved in microbial enrichment and rock weathering. Main supervisors: Anja Hörger, Christoph von Hagke

Project 3: Hydrogeological patterns and alpine spring metacommunities
Specialist organisms such as aquatic insects occur in spring meta communities with very specific abiotic conditions and limited organismic dispersal between them. In two model sites in the Alps, we will use hydrogeological methods (mapping, conceptual flow models, physico-chemical field measurements, hydrochemical and isotope composition) and biological methods (sampling and identification of crustacean and aquatic insect species) to investigate the main determinants of spring community composition, test if organisms can be used as natural tracers to determine catchment areas of springs and predict how communities will change with rapid changes in water regimes under climate change. Main supervisors: Jana Petermann, Sylke Hilberg.

Project 4: Shelter under Shards – habitat changes quantify growth of dilatant rock fracture networks in mountain belts
Under a rapidly changing climate, mountains react with increased erosion rates, and consequently formation of open rock fractures. While on the one hand, such fractures may result in geohazards such as rock falls, they may on the other hand form local habitats and micro-climatic niches. While their geometry has been studied in detail, their time evolution is challenging to constrain. Particularly, it is unknown how rapidly these fracture networks evolve under changing climate. This knowledge is however vital for determining how such fractures develop into geohazards or into micro-habitats. on Indeed, micro-habitat evolution may be used to determine fracture growth rates. In turn, it is important to assess how ecosystems can adjust to different rates of fracture propagation and consequently evolving micro-habitats. We hypothesize that fracture growth in dynamically changing mountains forms local habitats in which different species can find niches sheltering them from large-scale landscape changes. They form local bio-diversity hotspots. In turn, the degree of soil formation, the diversity of inhabiting species as well as the type of species present provide information on the time evolution of fracture growth. Main supervisors: Christoph von Hagke, Anja Hörger

Project 5: Significance of cool scree slopes for biodiversity in a warming climate
Climate change in mountains alters ecological altitudinal regimes by shifting species distributions and disrupting ecosystem dynamics. Calcareous scree slopes serve as vital refuges for biodiversity providing cooler microhabitats that support species unable to thrive in warmer conditions. They harbour ecosystems of cold-adapted flora and fauna, which are increasingly vulnerable to climate change. We seek to quantify the regional occurrence and geomorphological characteristics of cool scree slopes and interlink abiotic conditions to plant and animal communities under a changing climate. The project applies remote-sensing analysis, field work in climatology, geomorphology and biology and modelling. Main supervisors: Jan-Christoph Otto, Andreas Tribsch

Project 6: Landscape response to a changing climate in the Eastern Alps: Analysing Big Data for past, present, and future conditions
This project aims to understand and predict Alpine landscape sensitivity to climate change. Using Google Earth Engine and HPC (high performance computing) combined with field data from key sites representative for the river and hillslope system, we'll analyze geospatial data to identify hidden correlations between climate, vegetation, and geomorphic processes. Tasks include: 1) computing spatio-temporal gradients of biotic and abiotic factors across the Alps, 2) determining changes in torrent erosional potential due to climate change, 3) detecting hillslope failure potential via deep learning, and 4) synthesizing these results to derive landscape sensitivity. Main supervisors: Jörg Robl, Andreas Tribsch

Project 7: Climate change effects on habitat distribution and plant-animal interactions

This research project examines the effects of rapid climate change on the butterfly *Cupido minimus* and its host plant *Anthyllis vulneraria*. It aims to understand their current and future distributions, considering geomorphological, climatic, and land-use conditions. Key questions include potential decoupling of the interacting species and how butterfly traits and floral characteristics vary and under different temperatures. The approach involves modeling distributions, conducting in-situ experiments by transplanting plants and butterflies to different altitudes, and performing ex-situ experiments in climate chambers. The study will analyze changes in floral scents, butterfly morphology, host selection behavior, and genetic expressions to assess potential climate change responses. Main supervisors: Jan C. Habel, Jan-Christoph Otto

Project 8: Effects of rapid climate and land-use change on species diversity across a mountain front

This project focuses on Alpine peatlands to analyse effects of rapid climate change and the anthropogenically induced impact of land-use on species diversity and species community composition across altitudes. Peatlands are particularly sensitive to record these changes and are important archives to determine climate and environmental variations over time periods often exceeding 10.000 years. In this project these effects and controlling factors will be integratively analysed in some of the most impressive East Alpine peat bogs. Field- and laboratory-based methods will involve, e.g., GIS-based analysis of historic and recent (e.g., aerial) data, geophysical surveying, drill-core analysis, as well as field mapping, focusing on variations in vegetation, arthropods, geology and hydrology. Main supervisors: Bernhard Salcher, Jan Habel, Andreas Tribsch

Project 9: Past and future warming induced community dynamics of Alpine vegetation

The Alps were almost fully glaciated during the Last Glacial Maximum (LGM) and alpine species have mainly survived in refugia at the Eastern and Southern Alpine margins. We can expect that the late Pleistocene and Early Holocene with the dynamic climate (e.g, the climatically cold and dry Younger Dryas period) also had great impact on high altitude ecosystems. Whereas the formation and changes of lowland ecosystems after the LGM is well understood we still lack knowledge how alpine LGM and late glacial plant communities were composed and geographically structured and how fast (sub-) alpine vegetation was able to re-establish after deglaciation. Ancient DNA analyses from lake sediments and other archives (sedaDNA) combined with environmental modelling techniques will be applied. Such a detailed understanding of historical vegetation dynamics will be essential for accurate prediction of future dynamics of bio- and geodiversity in the Alps. Main Supervisors: Andreas Tribsch, Andreas Lang, Bernhard Salcher

Project 10: The Return of the Trees – post disturbance landscape stabilisation due to a changing energy economy from wood to fossil fuels

Deeply dissected gully systems and badland morphologies are common features on slopes in today tree covered upland areas. The project will test if these fossilised dendritic gully systems result from erosion processes occurring during Late medieval and Early modern times. At that time and to provide wood fuel for salt production and ore processing hillslopes were clear-cut leaving them highly vulnerable to rainfall erosion. The situation changed with the introduction of fossil fuels and tree growth stabilised the deeply eroded landscapes. To quantify landscape dynamics during this period historical, geomorphological, geochronological, and dendrochronological approaches will be utilized to link economic transformation and environmental dynamics. Main supervisors: Andreas Lang, Martin Knoll