PhD programme in MOUNTAIN ENVIRONMENT AND AGRICULTURE

(Curriculum 2 – Ecology, environment and protection of mountain areas)

Research projects and supervisors		
Curriculum 2: Ecology, environment and protection of mountain areas		
Title	**Supervisor(s)**	**Curriculum**
9. Effect of climate change and abandonment on the subalpine and alpine vegetation of South Tyrol Description - Using existing fenced off exclosures such as avalanche protection areas, the PhD student will study the effects of abandonment and climate change on vegetation and other ecosystem properties in traditional south-Tyrolian subalpine and alpine pasture landscapes. Candidates should possess a basic knowledge in plant, community and ecosystem ecology. Quantitative skills (statistics in R), experience in vegetation ecology and willingness to do field work in a high mountain environment are beneficial.	Prof. Wellstein C., Prof. Hölzel N.	2
10. Dry forests of inneralpine valleys under current climate change- stability, biodiversity, ecosystem functions and management options Description – The PhD student will compare forest plantations of Pinus nigra on steep south facing slopes of an inner-alpine dry valley (Vinschgau) with more natural successional forests of native species in terms of forest structure, vitality, ground vegetation and other parameters of biodiversity and ecosystem stability that can be selected according to the skills of the candidate. Applicants should possess a basic knowledge in plant, community and ecosystem ecology. Quantitative skills (statistics in R) and experience in vegetation, soil or animal ecology are beneficial.	Prof. Wellstein C., Prof. Hölzel N.	2
11. Management strategies for control works in mountain basins subject to extreme weather events Description - The maintenance of erosion control structures along rivers and slopes in mountain basins is gaining global significance and awareness. The exponential increase in these structures built since the mid-20th century poses new technical, economic and theoretical challenges. This includes structural features like check-dams and sills as well as modern approaches to river restoration aiming at rebalancing geomorphological and vegetation aspects. Through the analysis of the past intervention evolution, and studying of aerial imagery, this project aims to develop conceptual management models to address the decay of erosion control structures and the changing dynamics of mountain rivers and catchments in terms of sediment and vegetation. These models will guide maintenance schedules and alternative management strategies, such as river restoration initiatives. The results will aid in evaluating various options, including the possibility of no-	Dr. Andreoli A., Prof. Mao L.	2

intervention, to inform cost-benefit analysis and future planning. The PhD student will conduct research on the interactions between erosion control structures and fluvial processes in mountain environments, adopting various interdisciplinary methodologies. Candidates should have a fundamental understanding of fluvial geomorphology, hydrology, erosion processes, and sediment transport dynamics in mountain environments. Proficiency in remote sensing and GIS is essential, while data analysis and statistical skills are advantageous.		
12. Facing the changes in sediment supply due to climate change Description - The loss of the Alpine cryosphere (glaciers, permafrost, etc.) and disturbances on forest covers (windstorms, snow, insect attacks, etc.) are causing a change on sediment supply and balance to the river network of Alpine Basins, with deterioration of water quality and an increasing flood risk at some locations. Analyzing long-term data on glacier extent, solid and liquid discharge, and water quality in streams affected by such disturbances will allow us to develop detailed best management strategies for handling significant changes in sediment supply due to both intense (post-disturbance) and extensive (large-scale, long-term) alterations. This is crucial for addressing extreme events and extensive degradation of alpine landscapes, particularly in terms of sediment management strategies at the provincial level. The Phd candidate should possess fundamental understanding of hydrological processes, including solid and liquid discharge dynamics, and how they are influenced by land use changes. Ability in data analysis and statistical skills is essential, along with a basic knowledge of remote sensing techniques and Geographic Information Systems (GIS).	Dr. Andreoli A., Prof. Mao L.	2
13. Chemical ecology and population dynamics of the European spruce bark beetle Description - This project focuses on the chemical ecology and population dynamics of the European spruce bark beetle, Ips typographus (Coleoptera: Curculionidae) aligning with the PNRR through contributions to environmental sustainability, economic resilience, and scientific innovation. Enhancing and protecting natural ecosystems is a core pillar of sustainable development. Spruce forests, crucial for biodiversity, can be devastated by bark beetle infestations, causing significant ecological imbalances. This project aims to decipher the role of pheromonal communication and host/non-host plant volatile interactions, to develop effective and sustainable pest management strategies. Headspace volatiles released by healthy and stressed host trees will be characterized using gas chromatography, electroantennography, and behavioral trials to determine their potential role as attractants or deterrents. Newly developed volatile blends will be tested in forests in collaboration with EcoResearch and the Forest Department of South Tyrol. Mitigating beetle infestations through a chemical ecology approach helps preserve spruce forests and their biodiversity. Better management of beetle populations maintain forest health and climate regulation, supporting the climate action objectives. Studying the population dynamics of I. typographus	Prof. Angeli S, Dr. Tomelleri E.	2 Co-funding institution: EcoResearch (M.D. 630/2024)

will enable outbreak predictions and preventative measures protecting timber resources and ensuring economic resilience. The ideal PhD candidate should possess expertise in entomology, forest sciences, advanced analytical techniques (such as gas chromatography, mass spectrometry, and electroantennography), ecological pest management, experimental design and data analysis.		
14. Extrapolating drought impacts on mountain forests from individual tree response to the landscape scale Description - The candidate will investigate the possibility of extrapolating drought impacts on mountain forests by monitoring carbon fixation and transpiration from individual trees to a regional scale. Physiological drought indices derived from a sound dataset of multiannual tree monitoring (xylogenesis, dendrometer, sap flow, wood anatomy) collected over two study areas in Lötschental (Valais, Switzerland) and Matsch/Mazia (province of Bolano/Bozen) will be compared to local scale meteorological and soil moisture drought indices to assess tree vulnerability to drought, seasonality, and lag effects. Spatially explicit drought indices derived from multiscale and multispectral satellite data will be compared with regional scale meteorological and soil moisture drought indices to assess their potential and limitations to identify and quantify drought impacts in carbon and water use. In addition to spectral indices, satellite-based estimates of GPP and evapotranspiration will also be investigated. Based on this, the candidate will evaluate the variability in responses concerning ground- and satellite-based indices, tree species, and temporal and spatial scales. The PhD will investigate the possibility of upscaling observed drought impacts on carbon and water from ground-based drought responses to a landscape scale. Applicants should demonstrate experience with satellite data for ecological applications and possess a basic understanding of plant and ecosystem ecology. Proficiency in R or Python for geospatial data processing and statistical analysis of timeseries is required.	Prof. Tognetti R., Dr. Castelli M.	2 Funding institution: Eurac Research