

The Future of Mountain Forests: Responses to a Drier Climate

PhD Position

A multiple constraints approach to gross primary productivity of a *Pinus sylvestris* stand

Background

Mountains play an essential role in global geo-chemical cycles, are extraordinary rich in biological and socio-cultural diversity and provide manifold ecosystem services. Climatic changes, which are especially pronounced in mountain regions, will particularly affect mountain forests due to the long life-span of trees, which does not allow for rapid adaptation. Drought stress may substantially limit mountain forest vitality, socio-economic and especially protective functions and interrelate with further risks, such as forest fires. The project “[The Future of Mountain Forests](#)” aims at analysing if and how drier conditions (i) influence carbon and water balances from tree to forest level, (ii) change plant stress responses and interactions with microbial communities, and (iii) affect ecosystem services. It will enable a better understanding of mountain forests and their complex processes under current and future conditions, and create knowledge highly relevant to future forest management strategies.

The project is funded in the frame of the [doc.funds](#) program of the Austrian Science Funds [FWF](#). It is based on eight PhD theses focusing on closely interlinked aspects at cellular, tree and forest level. The PhD students are supervised in teams and are embedded in the [Doctoral College “Alpine Biology and Global Change”](#) as well as the internationally recognised [Research Area “Mountain Regions”](#) of the University of Innsbruck. They profit from the interdisciplinary exchange with other PhD students and close cooperation with re-known international scientific partners, availability of highly-instrumented field sites, a comprehensive training program, a search tool for mountain literature, involvement in the [“International Mountain Conference”](#) and the associated [international summer school](#) as well as alumni programs. PhD students can expect promising career perspectives based on their methodical and organisational skills, embedment in the international scientific community and the expected excellent publication record.

PhD Project

The gross primary productivity (GPP) is the proximal driver of the current land carbon sink, which removes around one third of the anthropogenic emissions annually. Ecosystem-scale GPP, however, cannot be quantified directly, but must be inferred from related measurements through some sort of model. The resulting uncertainty severely limits our ability to project how GPP will respond to future climatic conditions, especially more frequent and severe periods of drought.

This project aims at reducing the uncertainty of GPP and its response to drought by separately quantifying the diffusional and biochemical limitations to GPP at ecosystem scale using three complementary experimental approaches, which will be synthesized within the frame of a process-based model. We hypothesize that (i) drought stress will induce diffusional and, at a later stage, biochemical limitations to GPP which can be separately picked up thanks to the complementary nature of the planned measurements and (ii) that the assimilation of these complementary experimental constraints into the model will reduce the uncertainty of the resulting GPP estimates.

GPP will be quantified *in situ* at a newly established [forest flux tower facility](#) in a *Pinus sylvestris* stand, which is regularly exposed to periods of drought, using a novel combination of three complementary approaches: eddy covariance carbonyl sulfide (COS) and carbon dioxide (CO₂) flux and active/passive chlorophyll fluorescence measurements. The resulting data will be used to inversely calibrate a process-based canopy radiative transfer and gas exchange model using a Bayesian framework, which will then be used to simulate GPP and its uncertainty.

Schedule

Year	2023	2024	2025	2026	2027
Organisation, Recruitment, Methodical training					
Active/passive chlorophyll fluorescence					
CO ₂ and COS flux measurements					
Inverse modelling					
Publication					
PhD position					

Supervision

Georg Wohlfahrt (georg.wohlfahrt@uibk.ac.at)

Co-Supervision: Michael Bahn, Walter Oberhuber, Thomas Karl, Ulrike Tappeiner

Cooperation

Mirco Migliavacca, European Commission, Joint Research Centre, Ispra, Italy

The PhD project will finance a research stay (ca. 1 month) at the partner institution.

Details Position

University of Innsbruck

FWF PhD-position 4 years (initial contract 3 months)

30h per week, gross salary € 2.464,80 per month (14x per year)

Start: July 2023 to September 2023

Requirements

Master in Ecology, Plant Sciences, Atmospheric Sciences, Remote Sensing or a related field

Keen interest in plant physiological processes, ecosystem-atmosphere exchange and model-data fusion

Demonstrated experience in at least one of the following fields: (i) eddy covariance flux measurements using laser absorption spectroscopy and data processing, (ii) active and/or passive chlorophyll fluorescence measurements and data processing, and (iii) running, calibrating and, when necessary, modifying process-based ecosystem-atmosphere exchange models

Interest in cooperation with international partner(s)

Ability to work independently

Application

Please send your application to MountainForests@uibk.ac.at until **2023-04-11**. We ask to indicate the PhD project applied for in the mail text. You can apply for up to 3 PhD projects with one application (in case mention preferred project). Please prepare and attach the following pdf documents (with chapters in the given order):

1. NAME_application.pdf

- 1. Motivation Letter: 1-2 pages; description of why you want to participate in “The Future of Mountain Forests” and the selected PhD project(s)
- 2. Research Outline: 1-2 pages; description of your research approaches and ideas for the PhD project(s)
- 3. CV: 1-2 pages; including publication list if available

2. NAME_documents.pdf

- 1. BSc-diploma and transcript (translated to English)
- 2. MSc-diploma and transcript (translated to English)
- 3. MSc-thesis abstract (in English)
- 4. Certificate of English skills (level B2 or higher; TOEFL: >87 points, IELTS: >6.5 points)

Further information

<https://www.uibk.ac.at/en/projects/mountainforests>

or contact MountainForests@uibk.ac.at