

# Investigating shrub-encroached mountain grassland using high precision lysimeters

Georg LEITINGER <sup>a</sup>, Bello MOUHAMADOU <sup>b</sup>, Ulrike TAPPEINER <sup>a,c</sup>, Ursula PEINTNER <sup>d</sup>, Sandra LAVOREL <sup>b</sup>

<sup>a</sup> University of Innsbruck, Department of Ecology, Sternwartestr. 15, 6020 Innsbruck, Austria; <sup>b</sup> Laboratoire d'écologie alpine (LECA), 38058 Grenoble Cedex 9, France; <sup>c</sup> Eurac Research, Institute for Alpine Environment, Drususallee 1, 39100 Bolzano/Bozen, Italy; <sup>d</sup> University of Innsbruck, Department of Microbiology, Technikerstr. 25d, 6020 Innsbruck, Austria

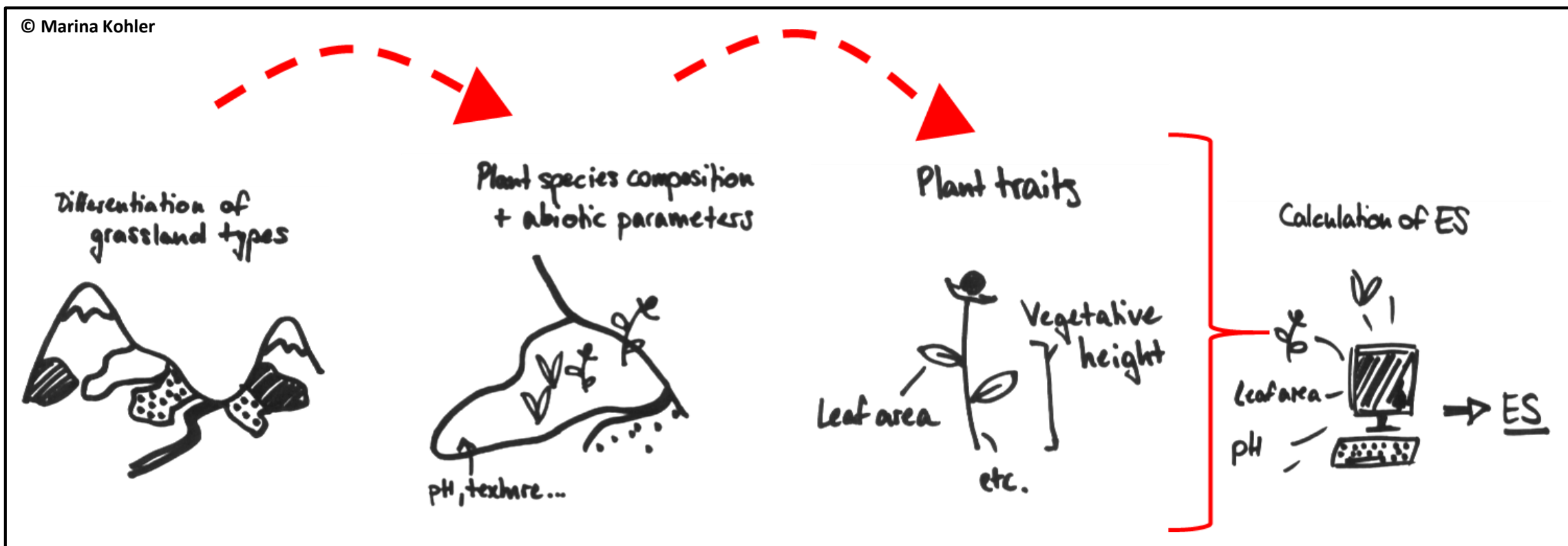


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Projektnummer [I 4969-B] and by ANR for the French partner

ANR

## Calculation of ecosystem services based on plant and soil (functional) traits:

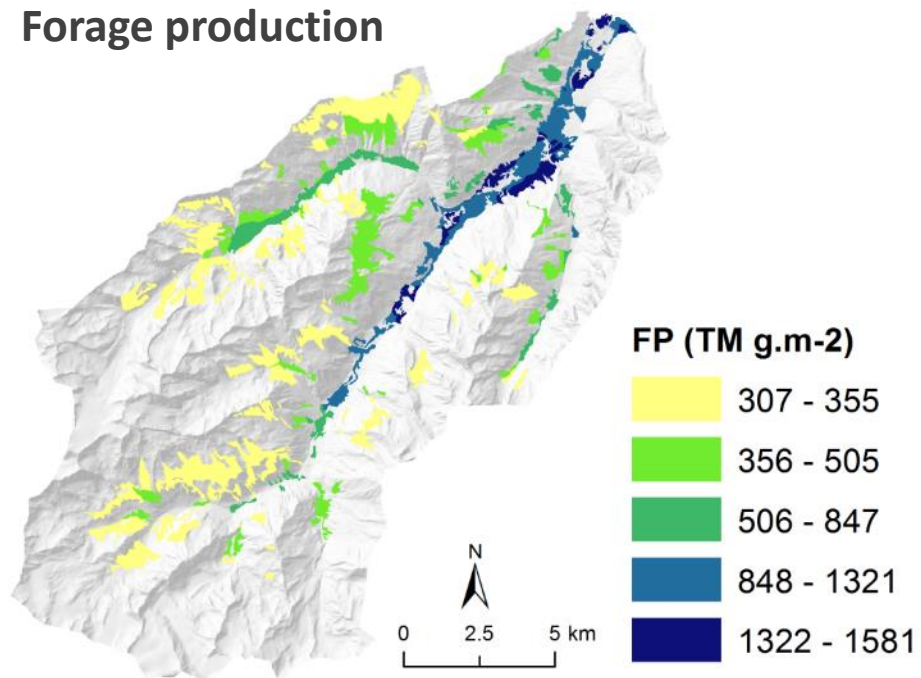
Lavorel et al. 2011; Lavorel & Grigulis 2012; Kohler et al. 2017a,b; Lavorel et al. 2017; Schirpke et al. 2017; Schirpke, Leitinger et al. 2020



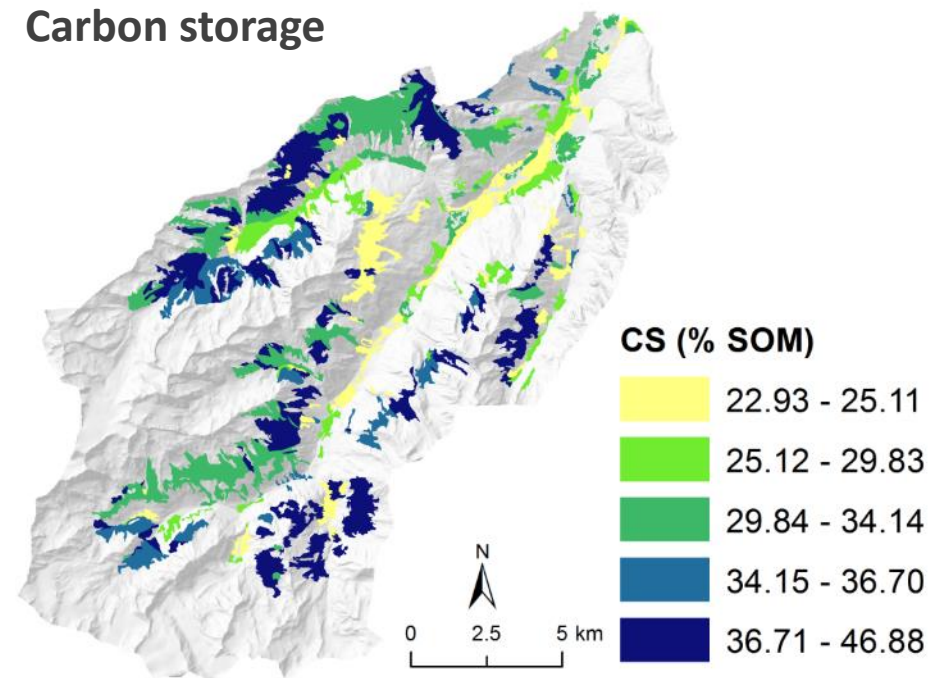
# Ecosystem service provision

B  
A  
C  
K  
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O  
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N  
D

Forage production



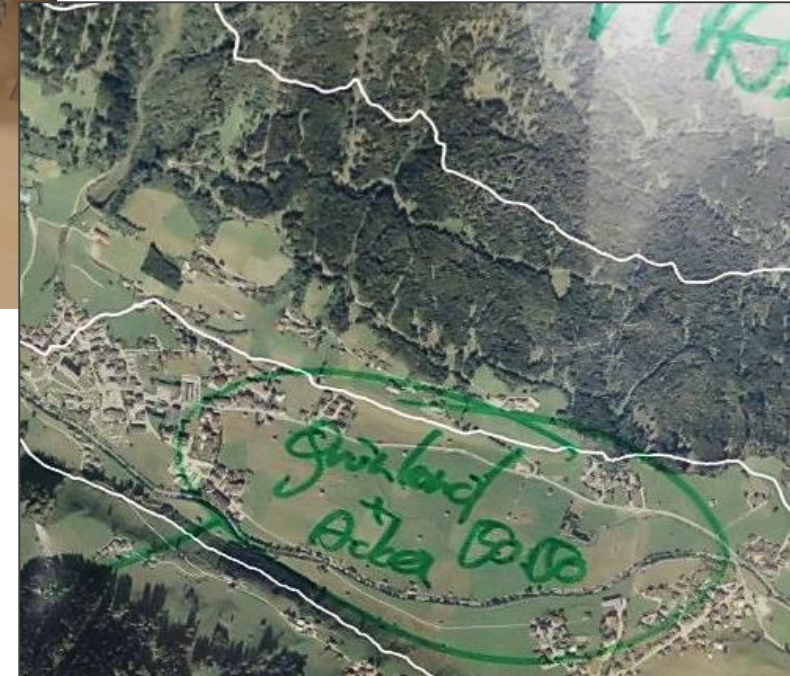
Carbon storage



*Kohler et al. 2017a; Schirpke et al. 2017*

# Stakeholder workshop and land use change mapping

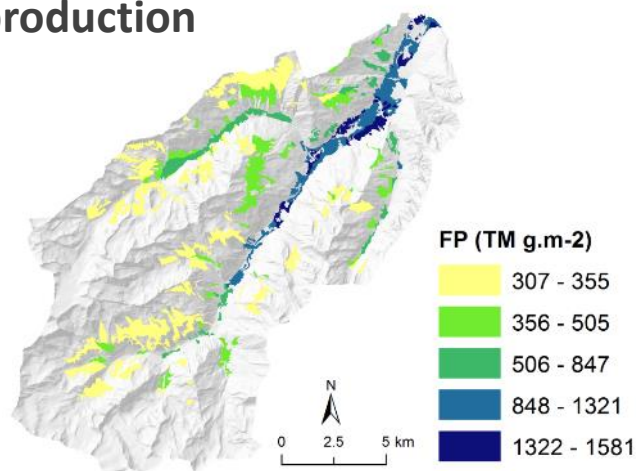
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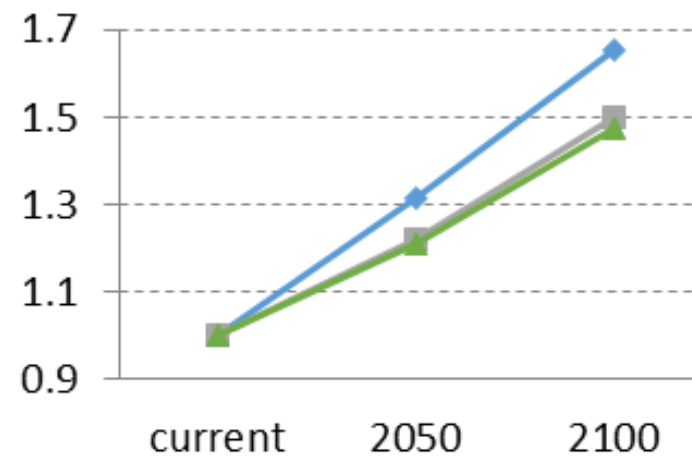
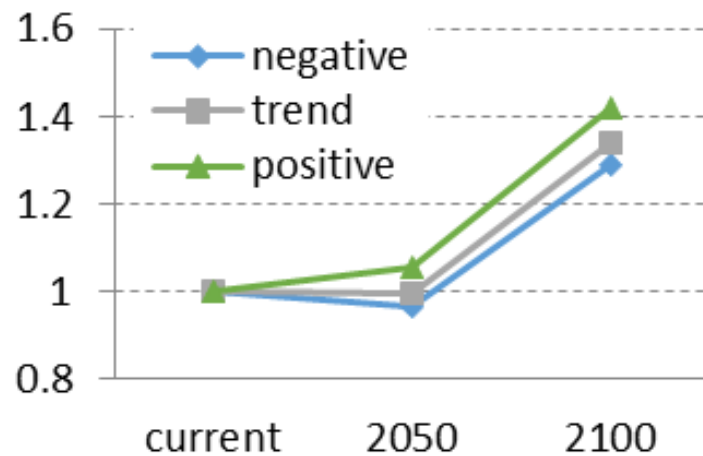
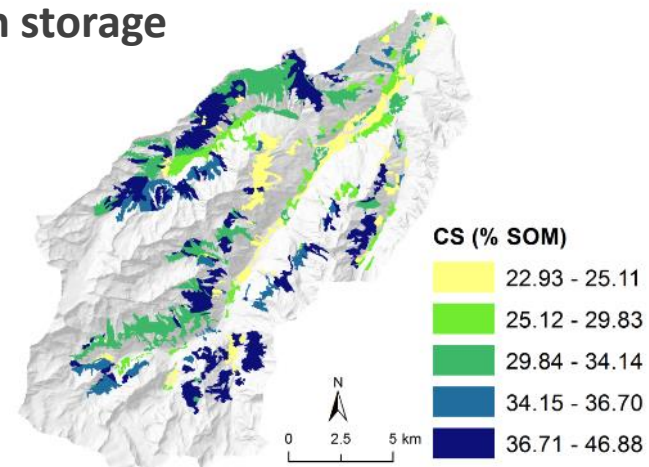
*Kohler et al. 2017b*

# Impact on ecosystem service provision

Forage production



Carbon storage



*Lavorel et al. 2017; Schirpke et al. 2017*

B  
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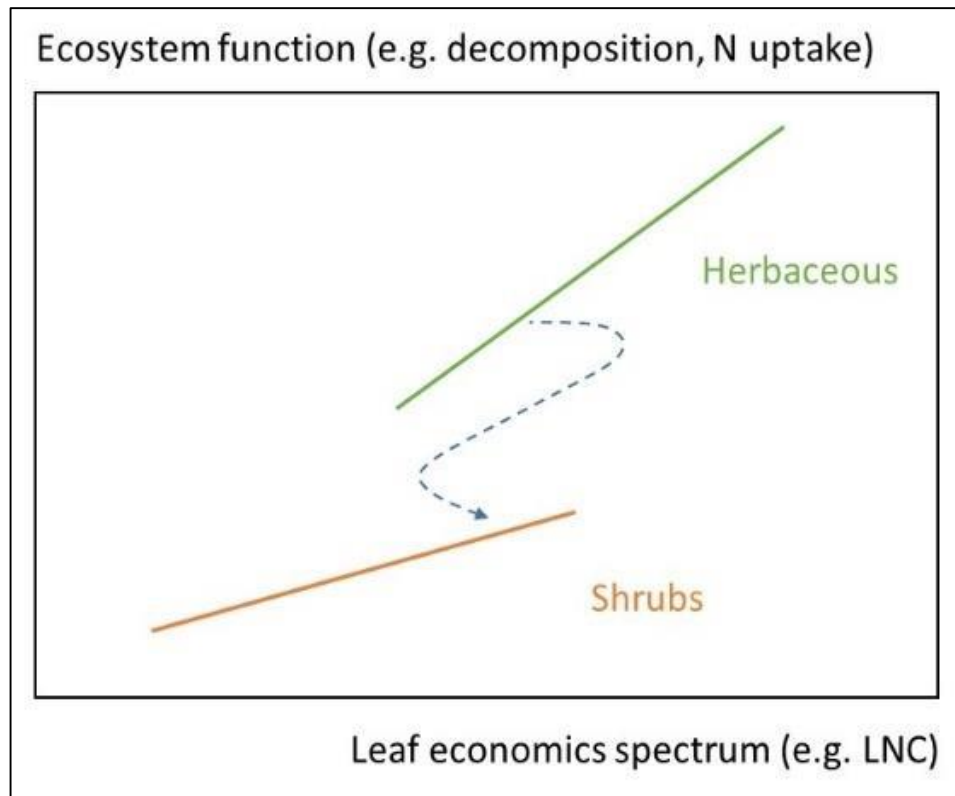
# What about shrubs?

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D



→ Joint international research project (FWF-ANR): 2021-2025

## *Forecasting impacts of land-use and climate change on ecosystem services from shrub-encroached mountain grassland (LUCSES)*

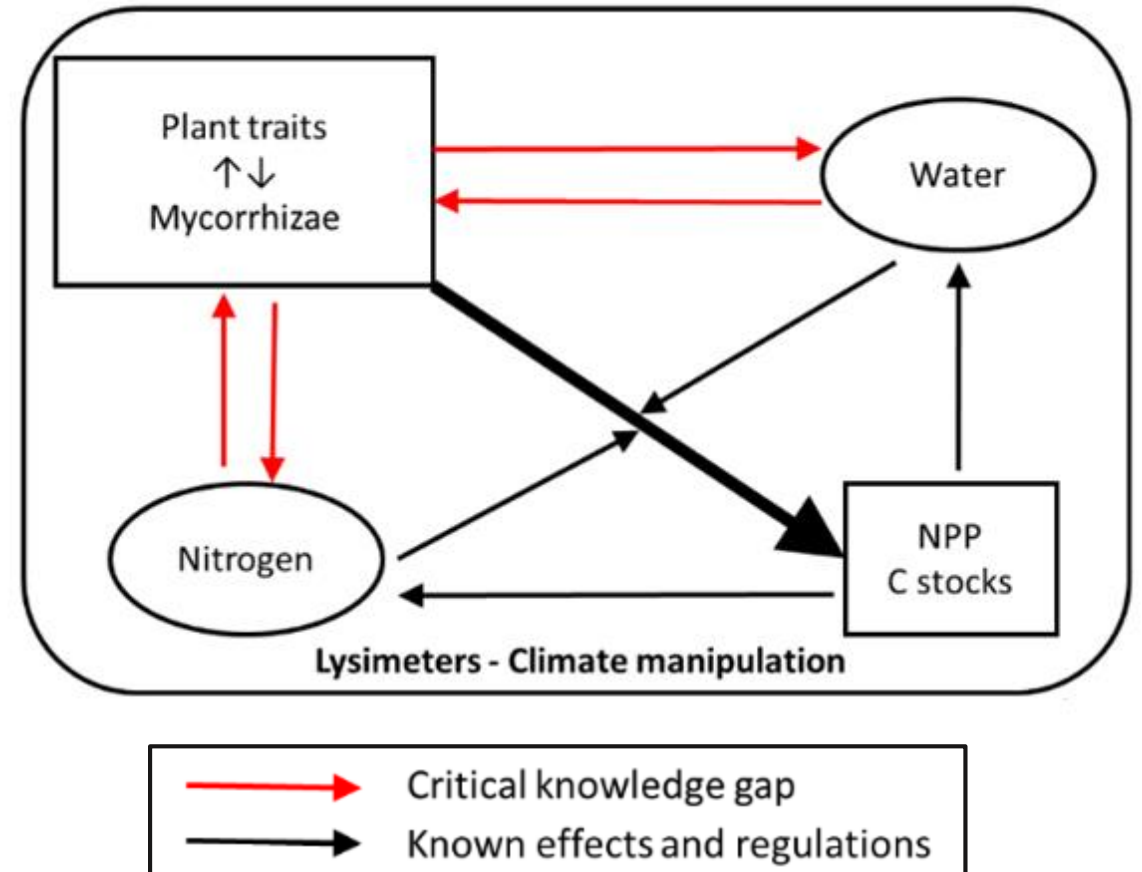


**The core hypothesis of LUCSES is that shrub colonization results in a tipping point** in relationships between traits associated with the plant economics spectrum and processes of nitrogen and water cycling ...

→ Joint international research project (FWF-ANR): 2021-2025

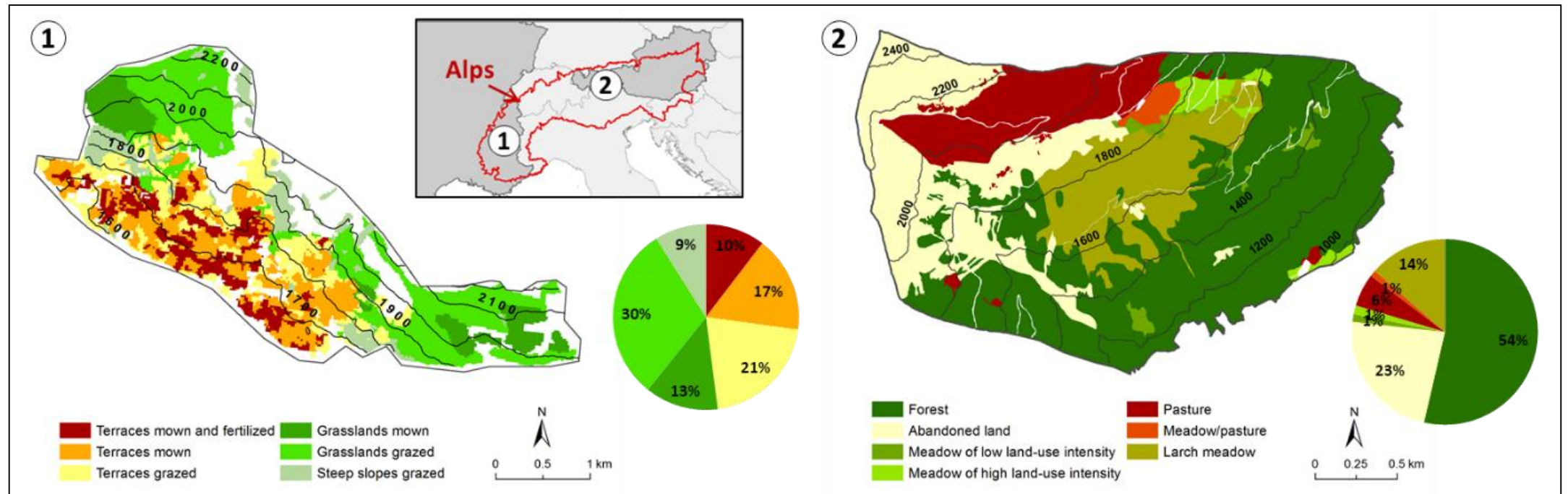
## Forecasting impacts of land-use and climate change on ecosystem services from shrub-encroached mountain grassland (**LUCSES**)

... and that this qualitative, hysteretic **change can be related to** characteristic structural (*e.g. stem density*) and biochemical (*e.g. lignin : nitrogen content, tannins*) **plant traits and to mycorrhizal functions.**



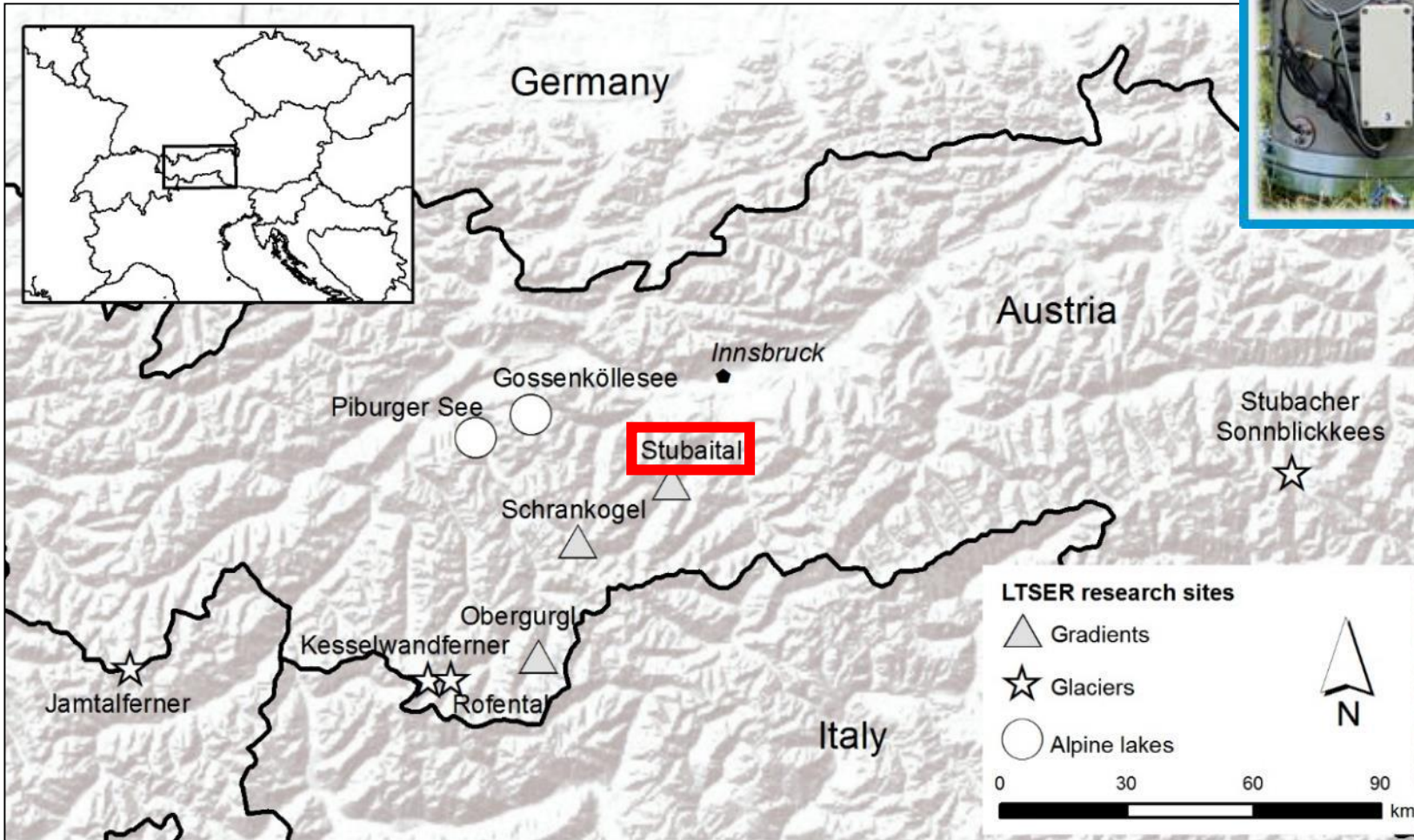


## Investigating shrub-encroached mountain grassland using high precision lysimeters



Study sites '*Lautaret*' in the Upper Romanche Valley, FRA (1); '*Stubai Valley*' in the Tyrol, AUT (2)

# ,Meadow Neustift', Stubai Valley Lysimeter monitoring



## Site Stubai (Meadow Neustift)

970 m a.s.l.

Water balance and grassland management

Further information and data available at:

<https://deims.org/324f92a3-5940-4790-9738-5aa21992511c>



*‘...LUCSES aims to develop understanding of nitrogen and water cycling processes in shrub-encroached mountain grasslands to facilitate reliable, robust and realistic trait-based models for predicting global change effects on mountain ecosystem services...’*

**With the help of high precision lysimeters, this study is going to analyse...**

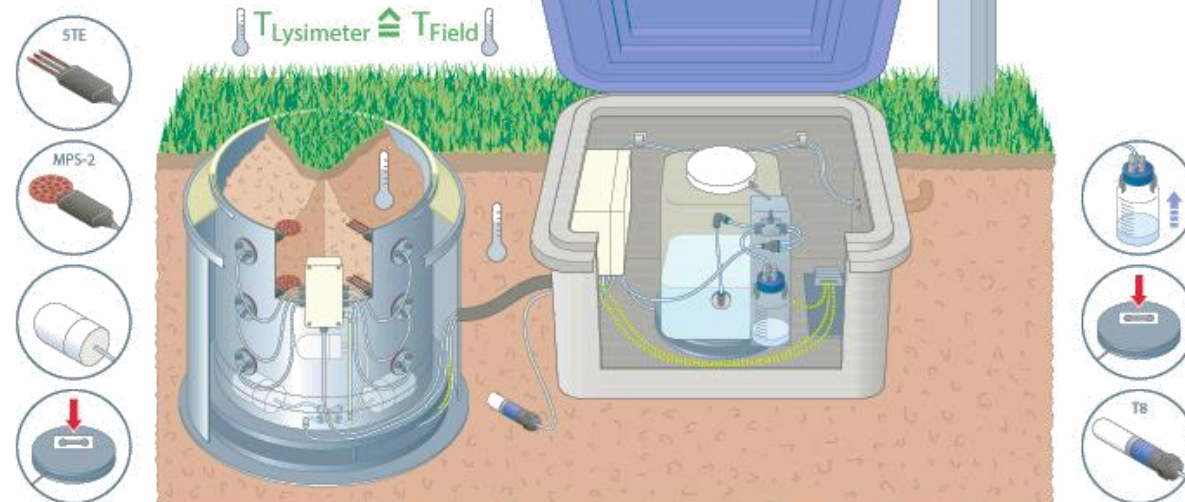
- Combined effects of increased shrub density and drought
- Combined effects of increased shrub density and early snowmelt

# Smart-Field-Lysimeter

## Small High Precision Lysimeter:

- Stainless steel Lysimeter ( $\emptyset$  + depth = 30 cm) on platform scale
- SWC / Temp & SWT at 5, 15, 25cm
- ‘Virtual Tensiometer’ at the bottom to collect seepage water and regulate lower boundary condition (in combination with a bi-directional pumping system)
- Platform Scale to measure and 10 l sampling bottles to collect seepage

DESIGN



Microclimate Station 

Control 

Treatment 

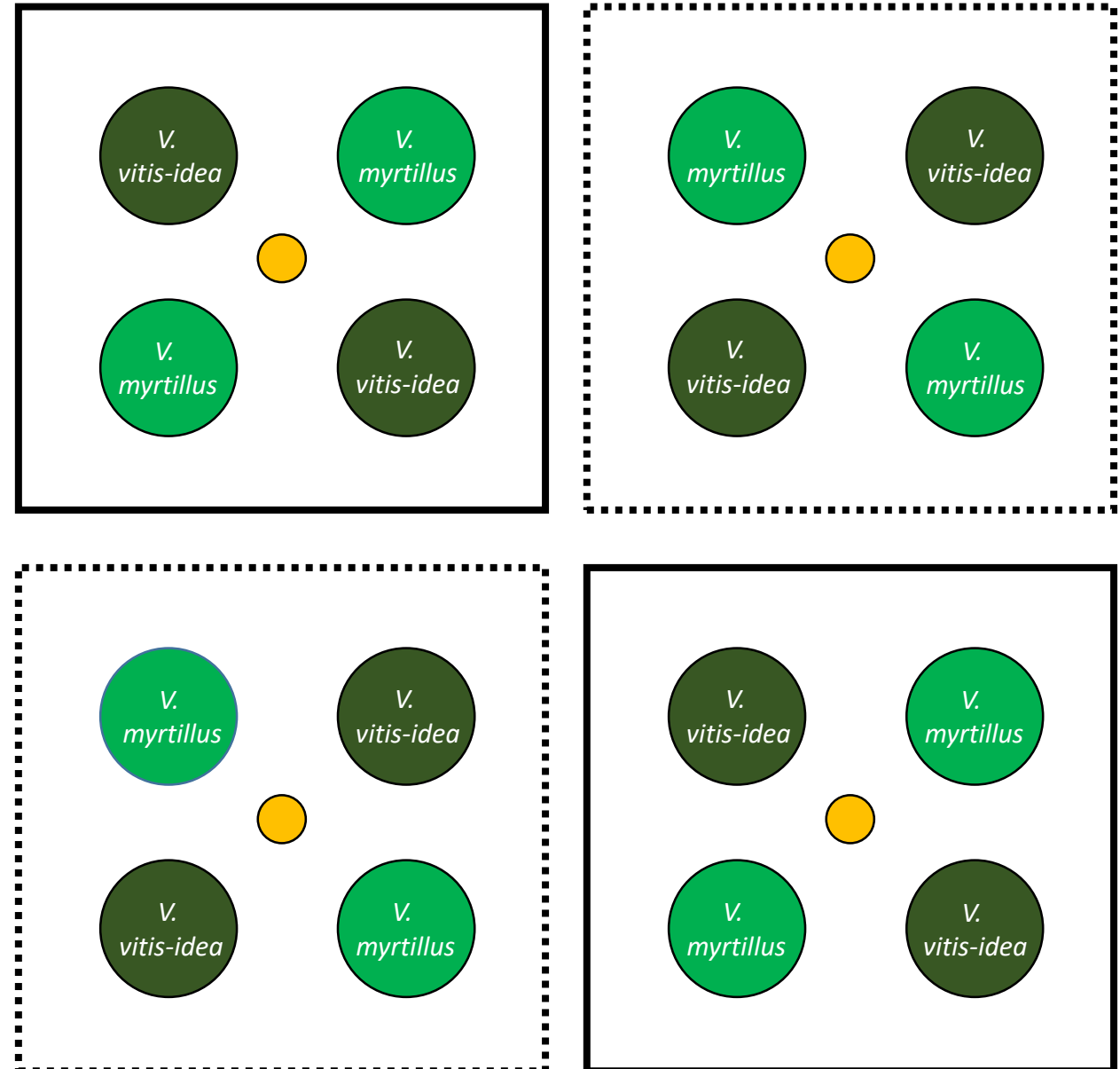
**2022:** Control vs. Snow removal

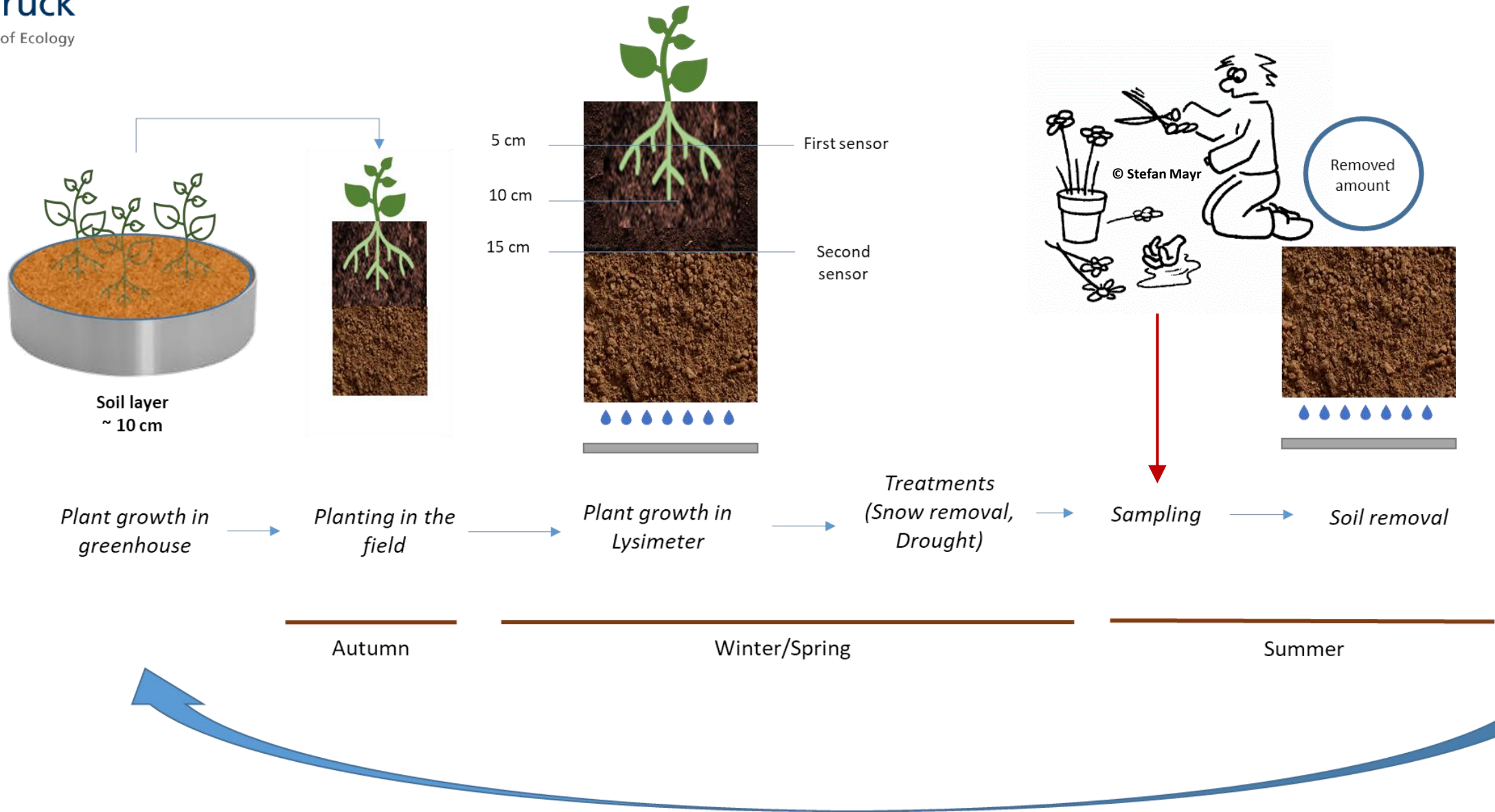
**2023:** Control vs. Snow removal &  
summer drought

- two congeneric shrubs
- a deciduous (*Vaccinium myrtillus*) and evergreen (*V. vitis-idea*) habit
- lysimeters filled with in situ sieved (5mm) and homogenized soil from original sites

“...Native soil and 2-3 fairly small individuals in per lysimeter...”

# 16 Smart-Field-Lysimeter





# HYPOTHESES

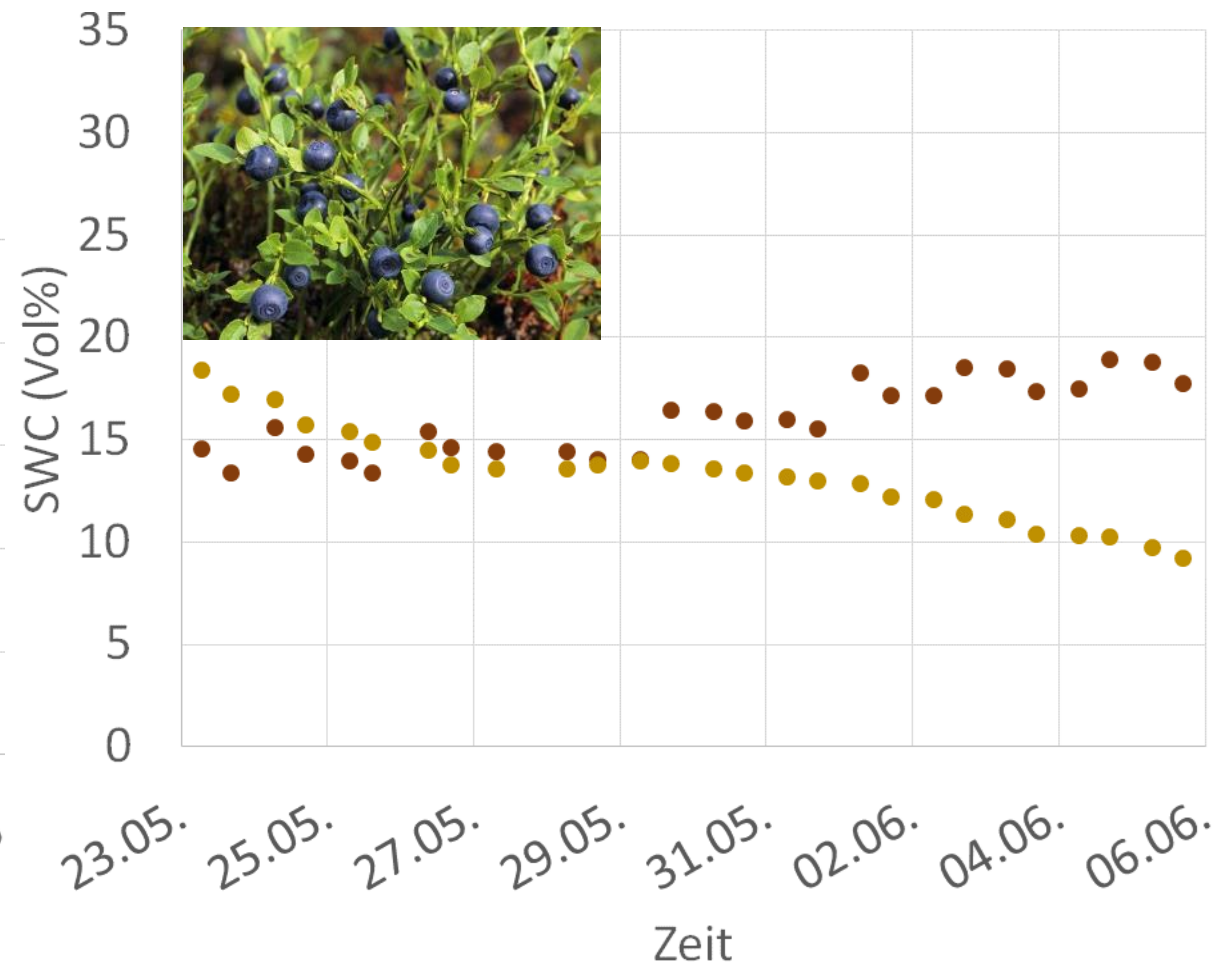
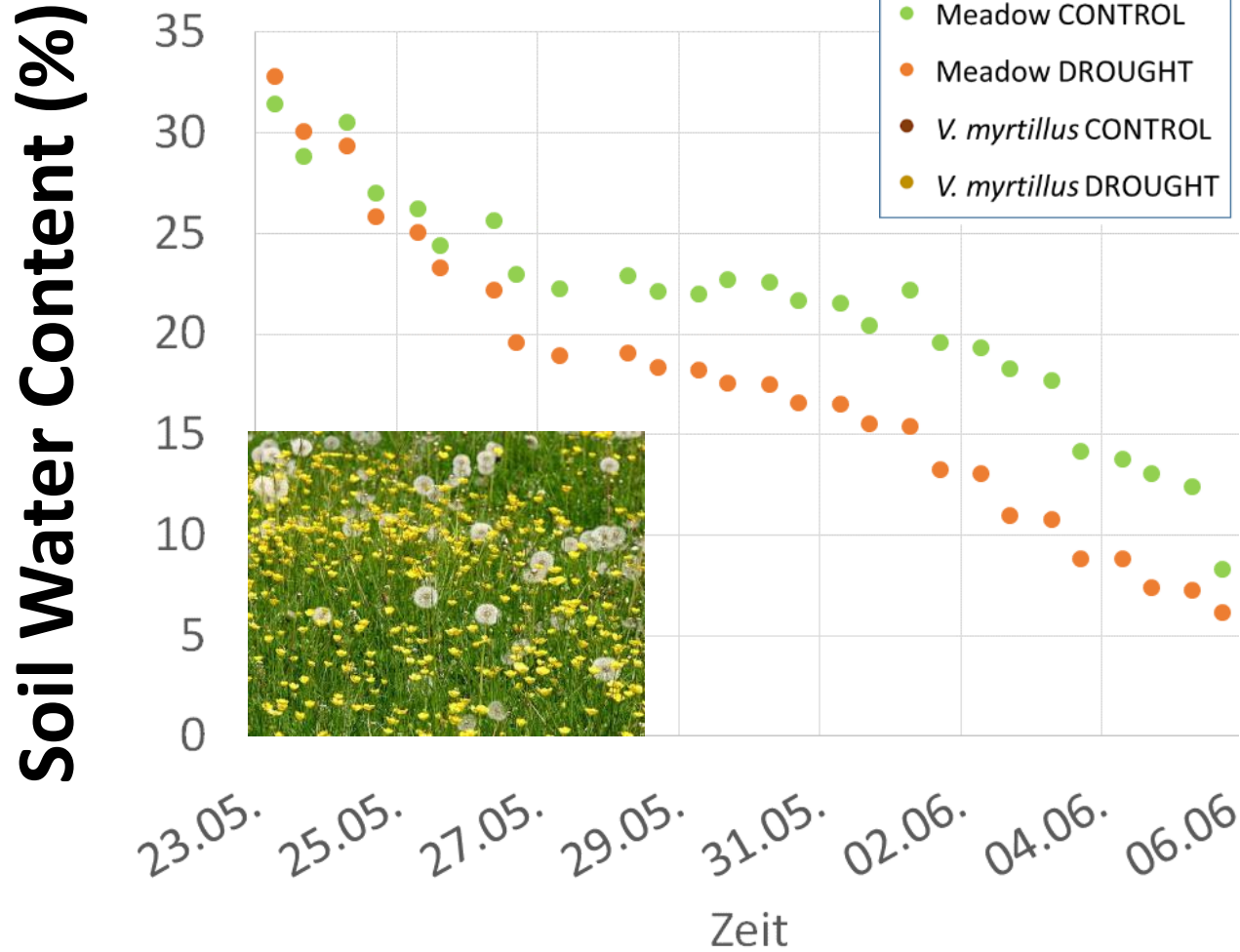
***We hypothesize that** shrub colonisation shifts fungal communities towards ecto- and ericoid mycorrhizae due to phylogenetic effects (Ericaceae family) and more humid conditions promoting mycorrhizal recruitment.*

***We further hypothesise that** changes in leaf area index (LAI) and specific root length (SRL) between congeneric shrubs with deciduous vs. evergreen habit profoundly modify water availability in interaction with mycorrhization and N uptake.*

## **Specifically we test the following:**

- Increased LAI and decreased SRL of shrub species decrease hydraulic conductance potential of soil water (i.e. ET) and increase soil moisture, with thus less impacts for deciduous than for evergreen shrub species
- Increased prevalence of ECM and ERC over AMF decreases plant water uptake and thus increases soil moisture

## Drought Experiment 2019: Grassland & *Vaccinium myrtillus*

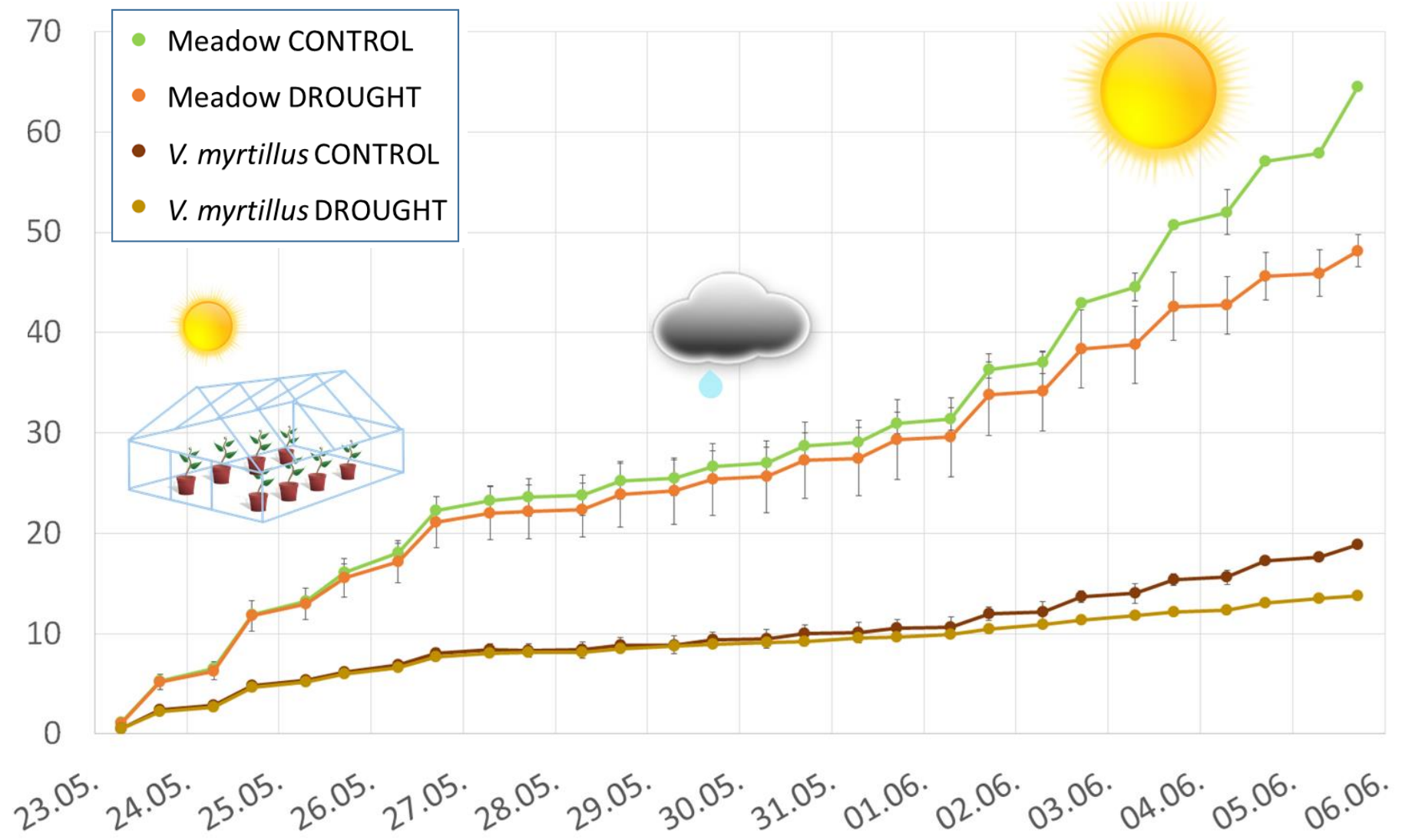




# PRELIMINARY / FEASIBILITY STUDIES

Evapotranspiration (mm)

accumulated



## Effects of 3 weeks drought: (37mm precipitation *versus* 0mm precipitation)

- ↪ SWC is lower in shrub communities,  
    ↪ *(!!) need to standardize soil (!!)*
- ↪ Drought affects SWC of grassland more
- ↪ ET is clearly lower for shrubs (deciduous, *V. myrtillus*)
- ↪ Strong increase of ET in grassland under drought

# CONCLUSION

*“ ... For a better understanding of the water fluxes underlying grassland productivity, further studies should also consider the importance of the belowground biomass and mycorrhizal associations on productivity, water fluxes and plant adaptation ... ”*

**Tello-García E. et al. 2020**

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The research project LUCSES will answer and further target towards the full spectrum of alpine grasslands including the most abundant dwarf shrubs

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