

Multi-spectral monitoring of alpine plant communities after experimental warming (CamCom)

Billur Bektas



INTRO

Partner:

- **DIPEE & FreeAlpes:** LECA, LESSEM, SAJF
- Big additional support: Chairs of **MIAI** Grenoble Alpes (J. Chanusot, W. Thuiller)

QUESTIONS

Challenge: Follow the different facets of vegetation responses after experimental warming in a **standardised way over many years** and **many square meters**.

EXPERIMENT

Idea: «Develop a novel and innovative workflow based on **close-range imagery** combined with **AI-based solutions** to approximate plant community composition & functions»

First Steps

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CLIMATE CHANGE

- Global warming predictions for 2100: up to **3 – 7°C** (2014 and 1st updated models 2019)
- **High variability** in space and time

QUESTIONS

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CLIMATE CHANGE

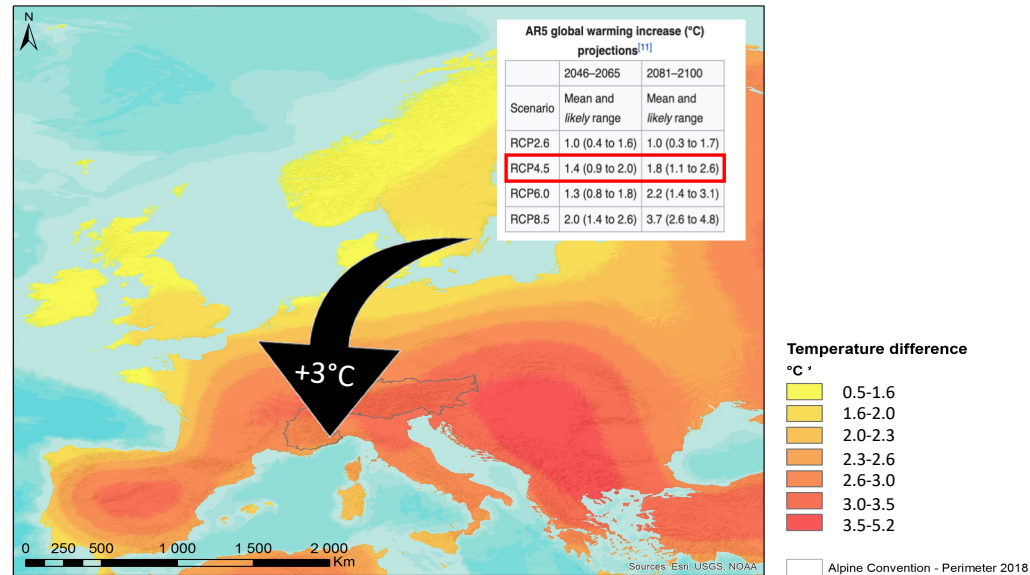
- Global warming predictions for 2100: up to **3 – 7°C** (2014 and 1st updated models 2019)
- **High variability** in space and time

QUESTIONS

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First Steps

Average temperature differences
(today vs. 2061-2080; rcp 4.5)



Julien Renaud & Maya Gueguen



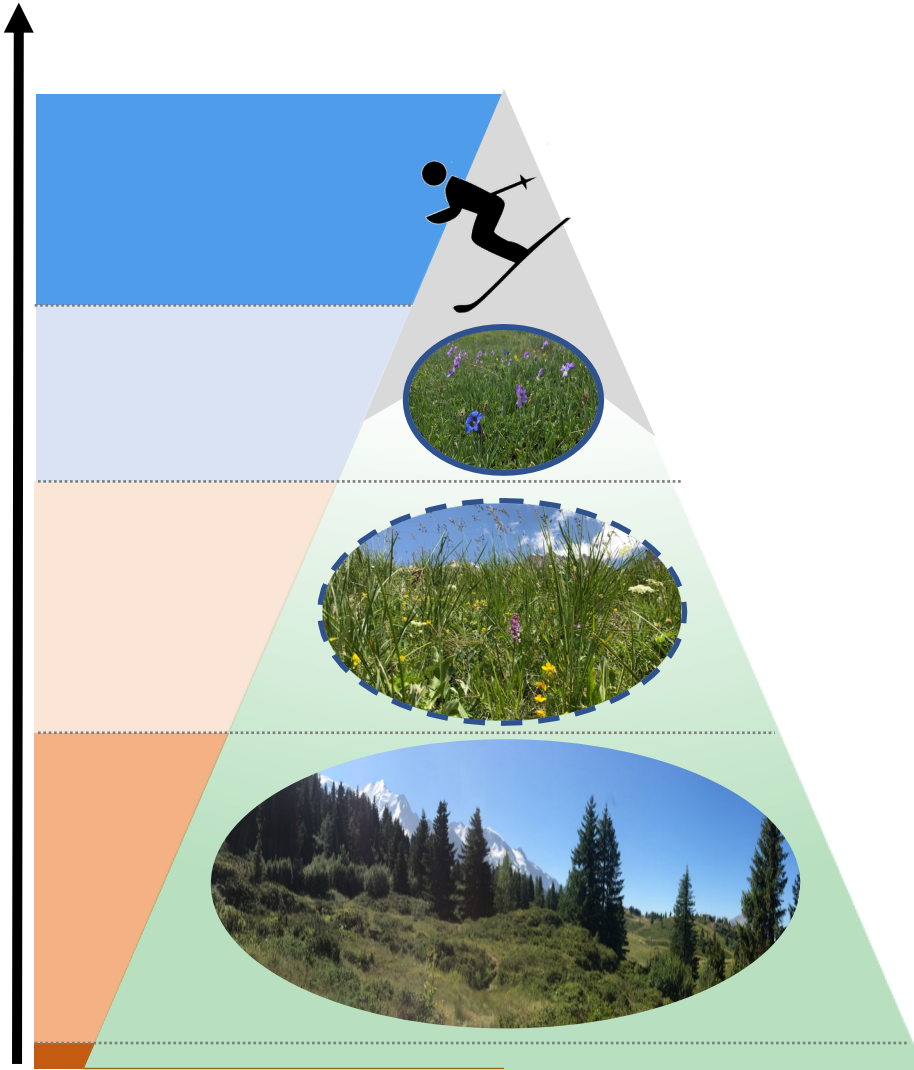
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CLIMATE CHANGE -> BIODIVERSITY & ECOSYSTEM FUNCTIONS



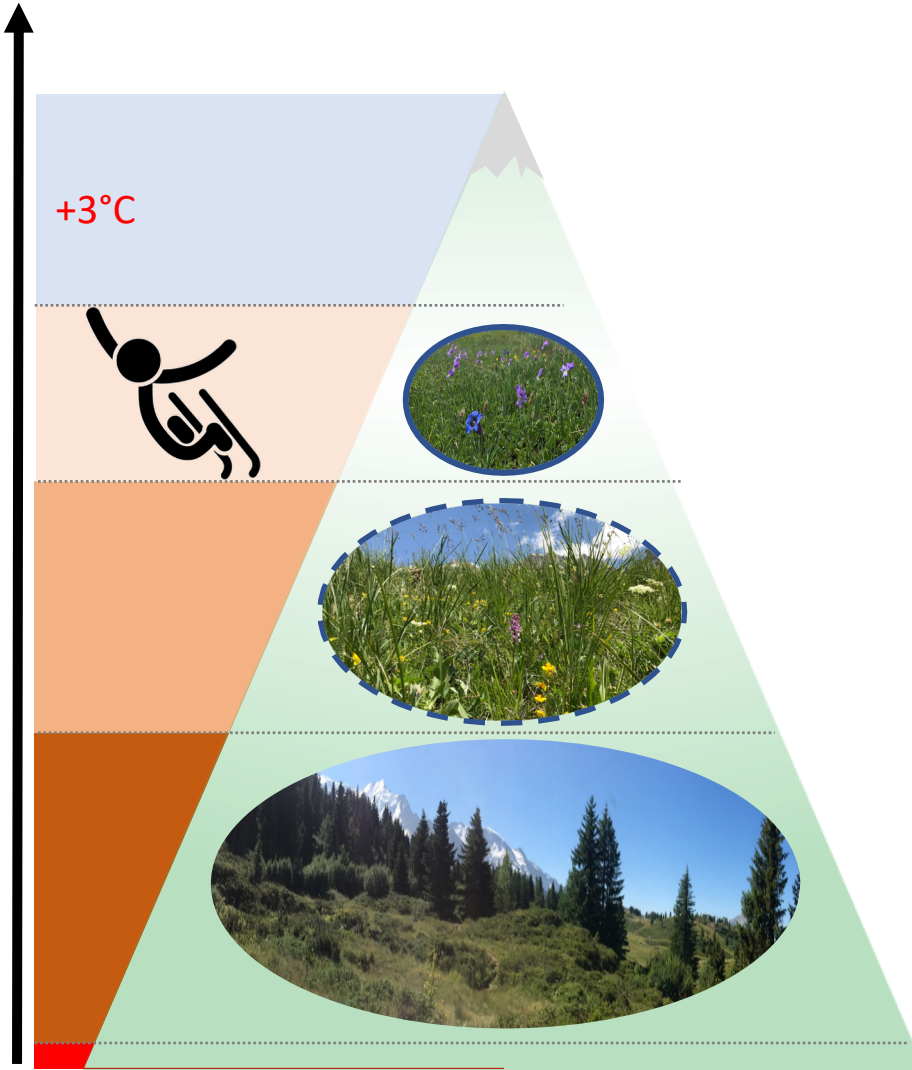
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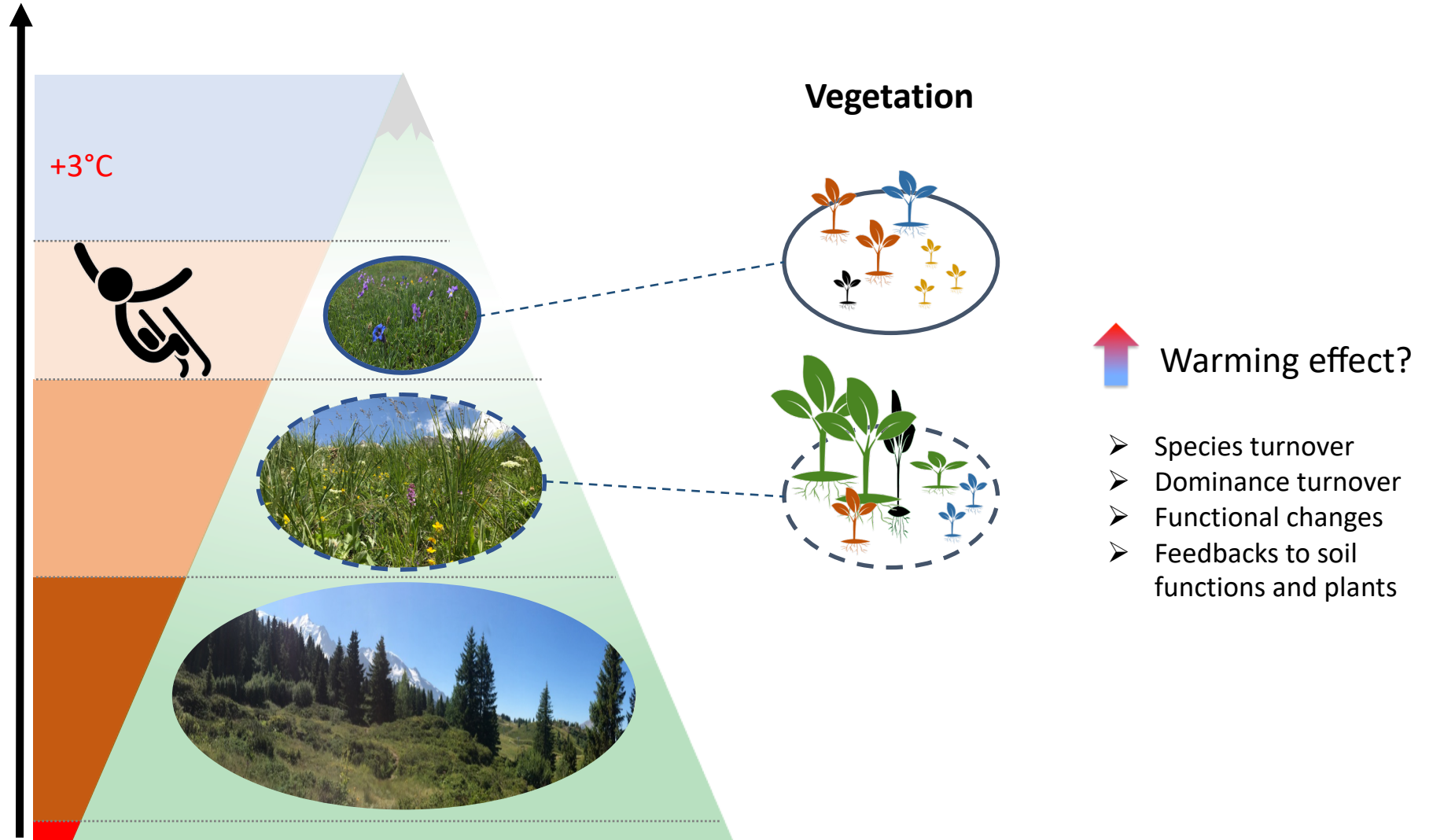
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CLIMATE CHANGE -> BIODIVERSITY & ECOSYSTEM FUNCTIONS



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RESEARCH QUESTIONS

1. Spatializing of productivity (NDVI) responses to warming: Will all warmed species be more productive and start their productivity later in the year ¹⁾?
2. How well will α - and β - species and trait diversity from field data correlate with spectral diversity? Will warming increase or decrease diversity?
3. Can AI-based solutions help identify plant species compositions? Or plant functional traits (including leaf surface and thickness, carbon, nitrogen, phosphorus content)?

¹⁾ Bektaş, B., Thuiller, W., Saillard, A., Choler, P., Renaud, J., Colace, M.-C., Della Vedova, R., **Münkemüller, T.** (2021). Lags in phenological acclimation of mountain grasslands after recent warming. *Journal of Ecology.*, 109(9), 3396-3410.



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Transplant experiment

Alpine site (2450m)



Sub-alpine site (1950m)

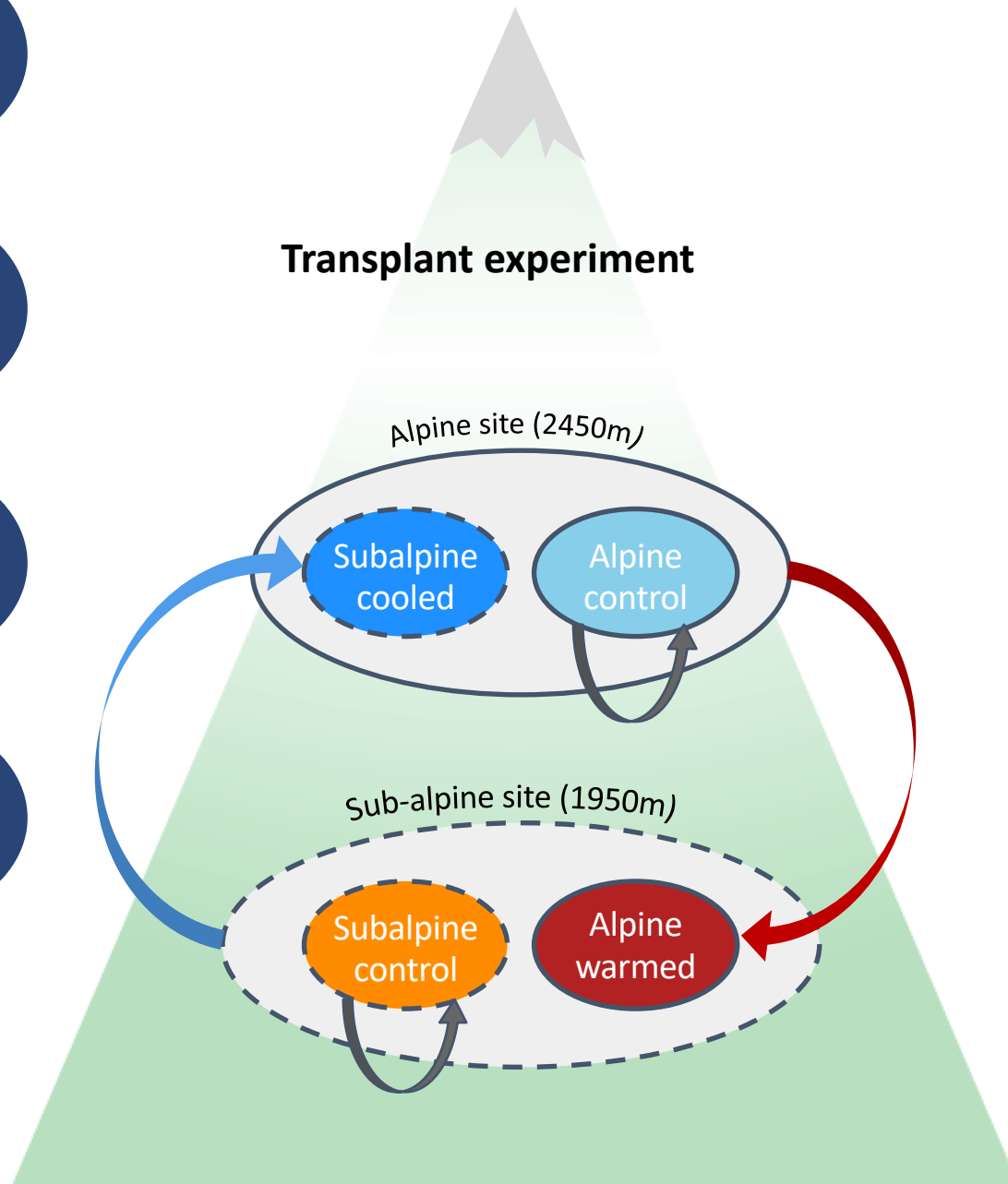


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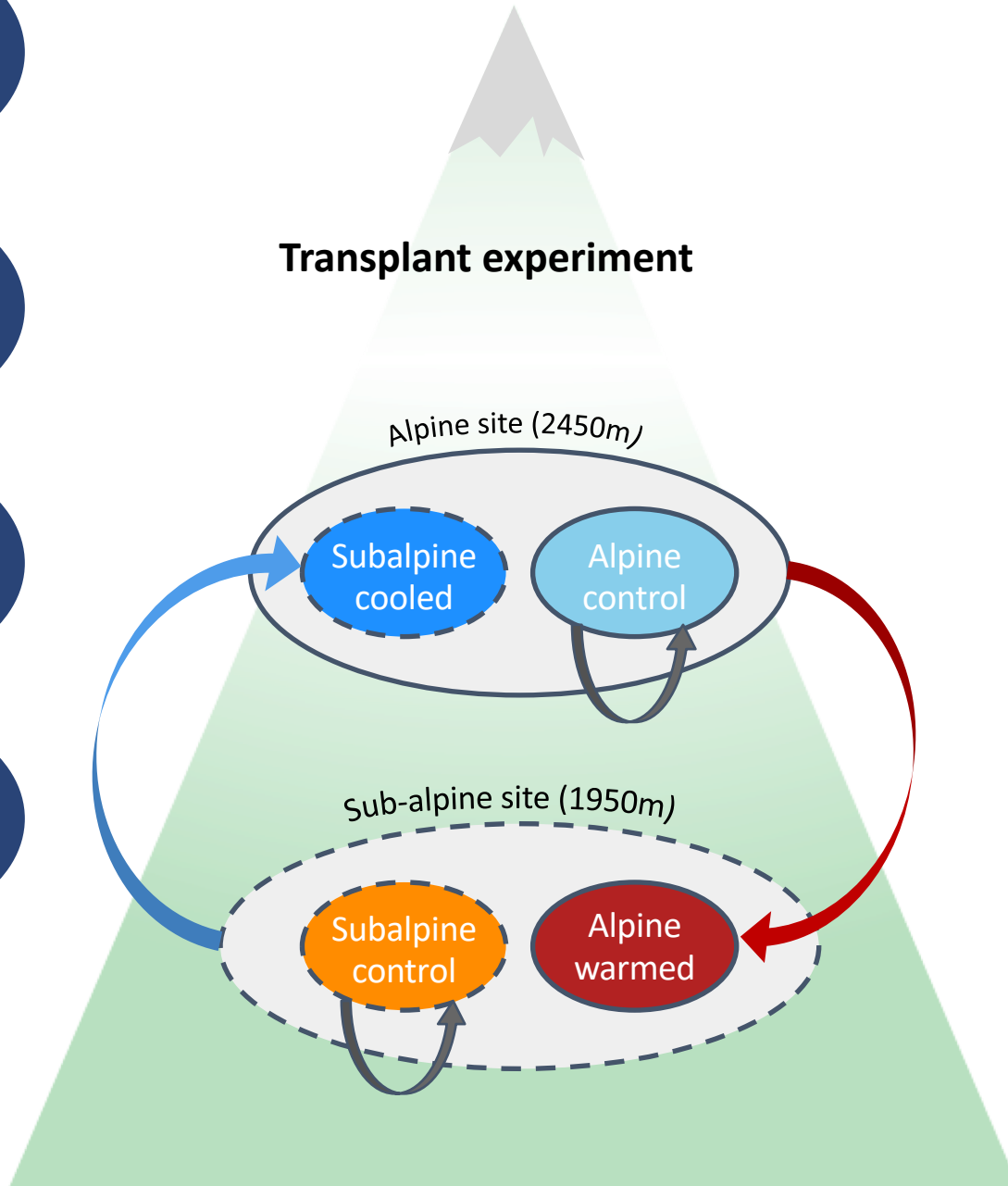
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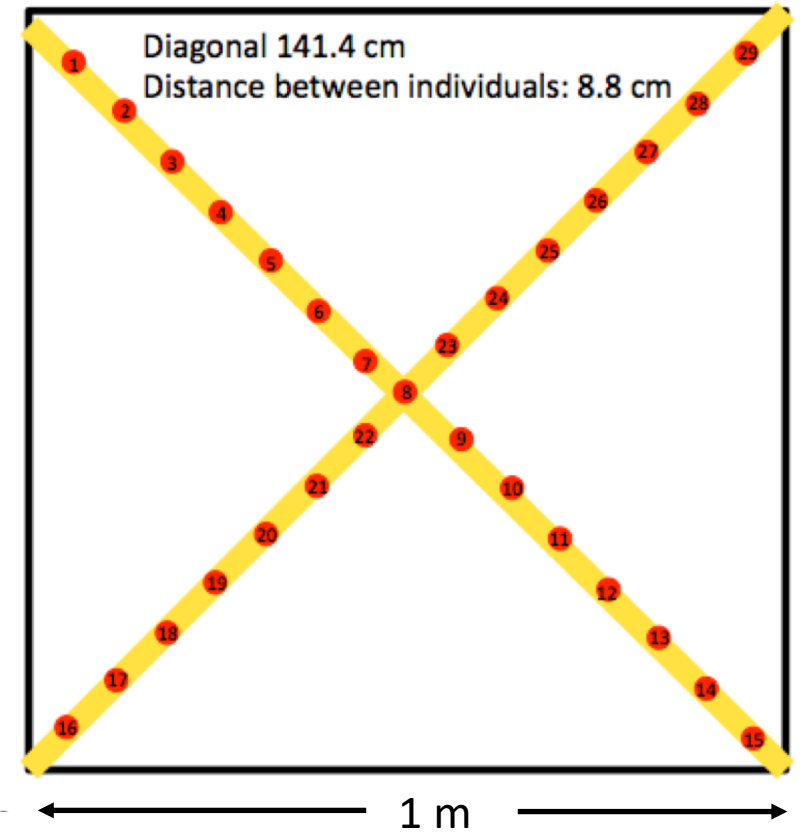
EXPERIMENT

First Steps

Transplant experiment



Ground Truthing: Traits



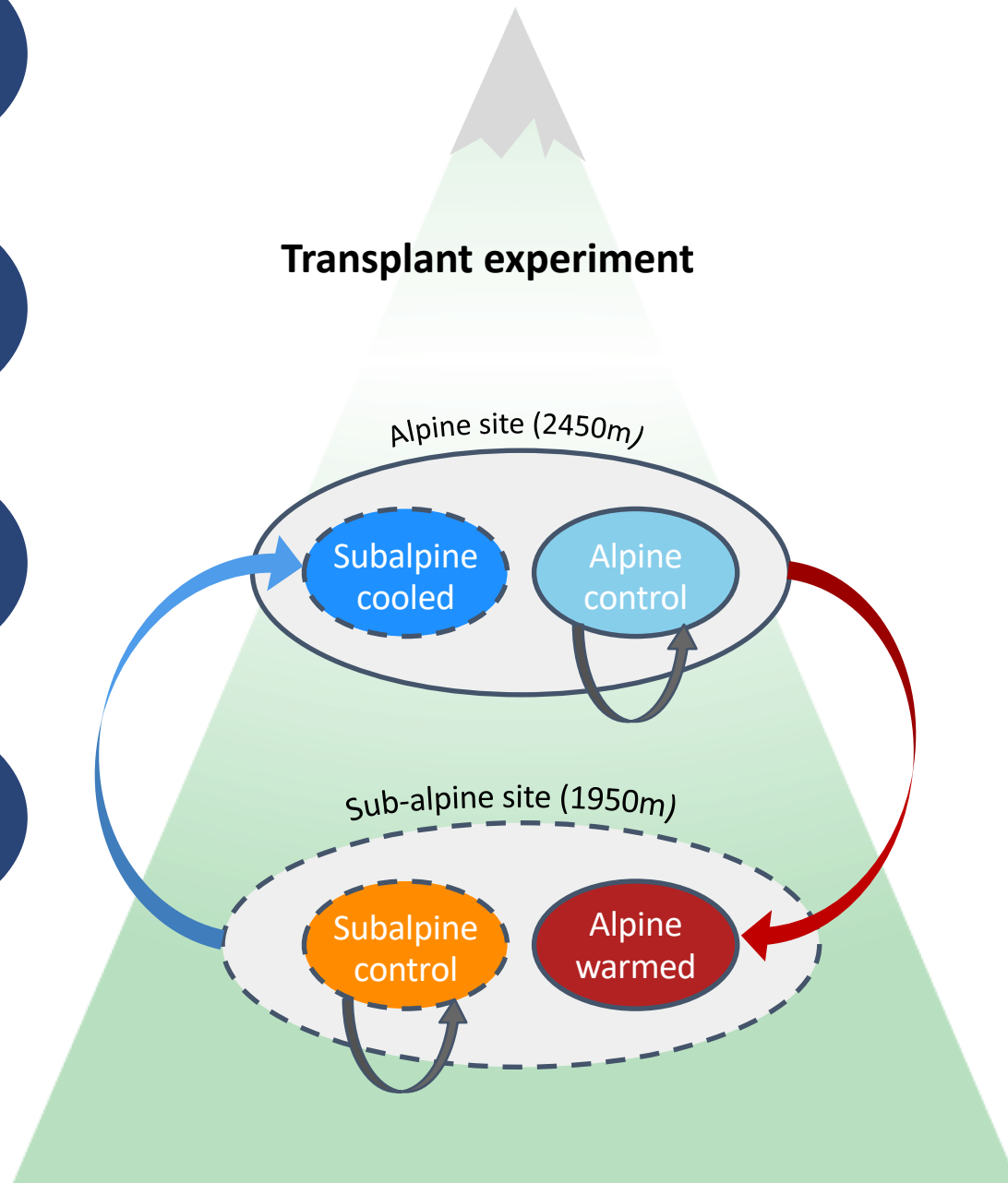
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Transplant experiment



Ground Truthing: Plant relevés



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Two camera systems

1. A (cheap) combination of RGB and NIR (original project)

-> high spatial resolution NDVI

2. Together with a private company construction of a novel (expensive)

combination of lower resolution, 16-channels multispectral subsystem and one high resolution RGB sensor (red-green-blue, 2592x1944 pixel)

-> high resolution, 16 channel images

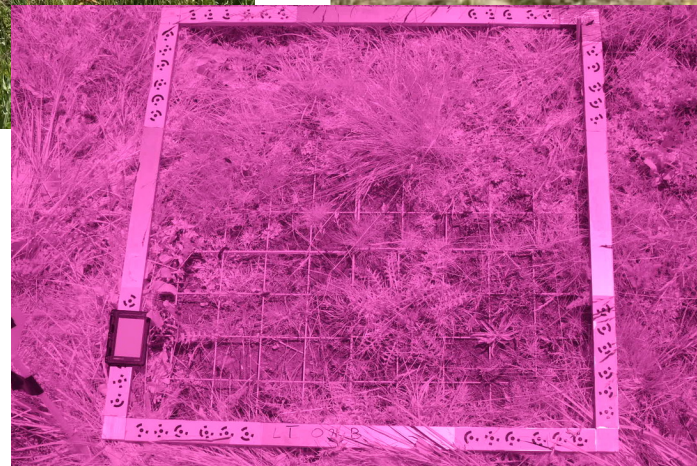
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2021: Fieldwork



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Next steps

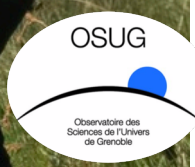
1. **Ortho-rectify images and combine images from different sensors**
2. **Pan-sharpening to upscale resolution of (low-resolution) multispectral images with the help of (high-resolution) RGB images**
3. **Confront final 16 band images with ground truthing data (AI based solutions)**

LECA

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Interns

Raphaël Della Vedova
Mélodie BOURREAU
Matthieu Fleuet
Nakita Rubuliak
Audrey Labonte
Chloé Mahieu
Loreley Mainguy
Léo Rocher
Margot Tessereau
Estelle Mesquida
Caroline Trochard
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