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Manipulation experiments in Alpine ecosystems: Exploring climate change impacts and carbon dynamics

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MICROPLANTALP

MICROorganism-**PLANT** Interactions in the Forefield of Glaciers: a Hotspot for Studying the Impact of Climate Change in **ALP**ine Habitats

Site: Courmayeur, Val Veny-Italy

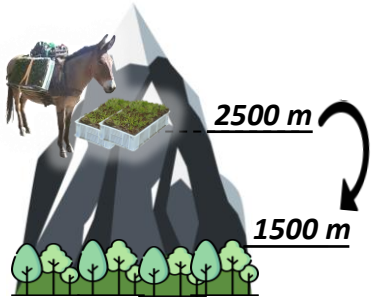
BACKGROUND

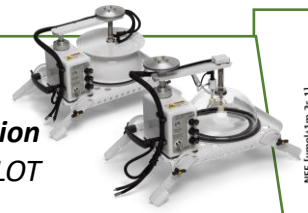
Alpine areas are warming faster than the global average, making them highly sensitive to climate change and potentially significant CO_2 sources. Climate change is expected to disrupt the balance between carbon assimilation, storage in vegetation and soils, and release through respiration.

OBJECTIVES

Analyze the state of alpine ecosystem under future climate conditions, by integrating the study of carbon fluxes, plants, and soil microorganisms with climate manipulation experiments.

TRANSPLANTATION EXPERIMENT



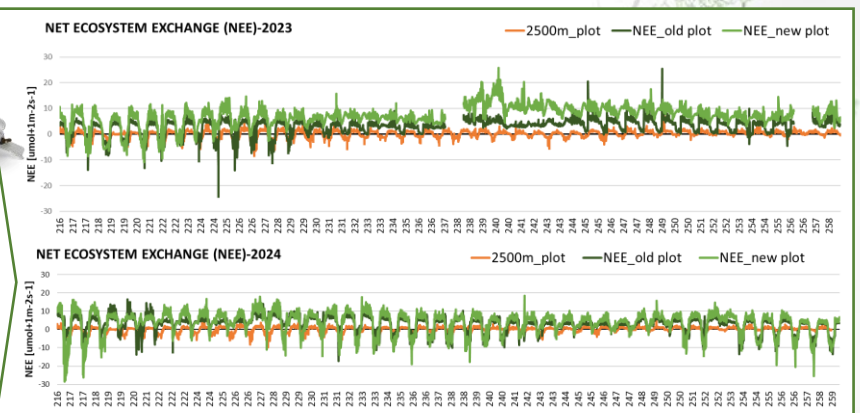


1° transplantation OLD PLOT — *2° transplantation* NEW PLOT

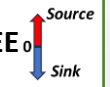
2022 — 2023 — 2024

Installation continuous C-fluxes chambers LI 8100

- Unraveling changes in the carbon balance (NEE) and its components (R_{eco}, GPP) in an alpine grassland subjected to climate manipulation.
- Assessment of the responses of carbon fluxes under different acclimation stages.



In 2023 both transplanted plots acted as carbon sources, with the new plots emitting more C. By 2024, the differences diminished, and the emissions declined, likely due to increased photosynthetic rates and reduced carbon loss through respiration, characteristic of the recovery phase following disturbance.



Warming reduced carbon uptake immediately after disturbance, with partial recovery after one year, but not to pre-disturbance levels

MICROCOSM EXPERIMENT

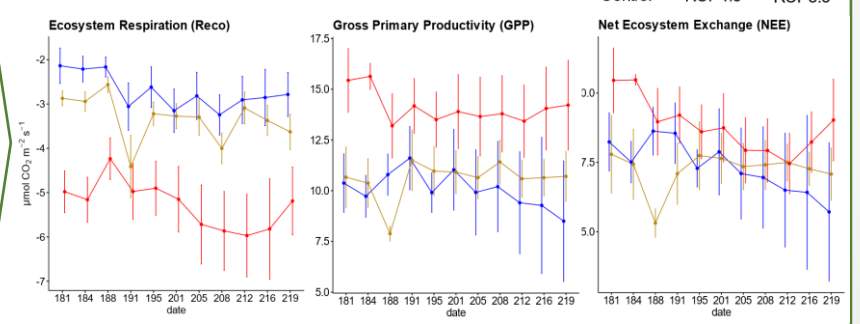
Montpellier European Ecotron (CNRS, France)

Three climate scenarios projected for 2070 in the IPCC 2022:

- **Control** (420 ppm CO_2)
- **RCP 4.5** (550 ppm CO_2)
- **RCP 8.5** (800 ppm CO_2)

- ✓ CO_2 flux measurement (IRGA - EGM5, PP-System)
- ✓ Vegetation cover assessment
- ✓ Microbiological sampling
- ✓ ^{13}C pulse labeling-chasing experiment

- Analyze the projected dynamics of soil-plant carbon fluxes under future climate conditions for the year 2070.



Under RCP 8.5, elevated CO_2, and temperatures stimulated canopy growth, preserving carbon sink functions despite higher respiration

Alpine ecosystems demonstrate short-term adaptability to warming conditions, but their long-term ability to sequester carbon is uncertain, highlighting the need for both field and experimental studies to understand future climate impacts.

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