

EFFETTI DEI CAMBIAMENTI CLIMATICI SULLA VEGETAZIONE D'ALTA QUOTA: LE RICERCHE DI UNIPR NEL PARCO NAZIONALE DELLO STELVIO

Alessandro Petraglia, Michele Carbognani e Marcello Tomaselli



UNIVERSITA' DEGLI STUDI DI PARMA



OUTLINE

1) IL CONTESTO: CAMBIAMENTI CLIMATICI E TUNDRA ALPINA

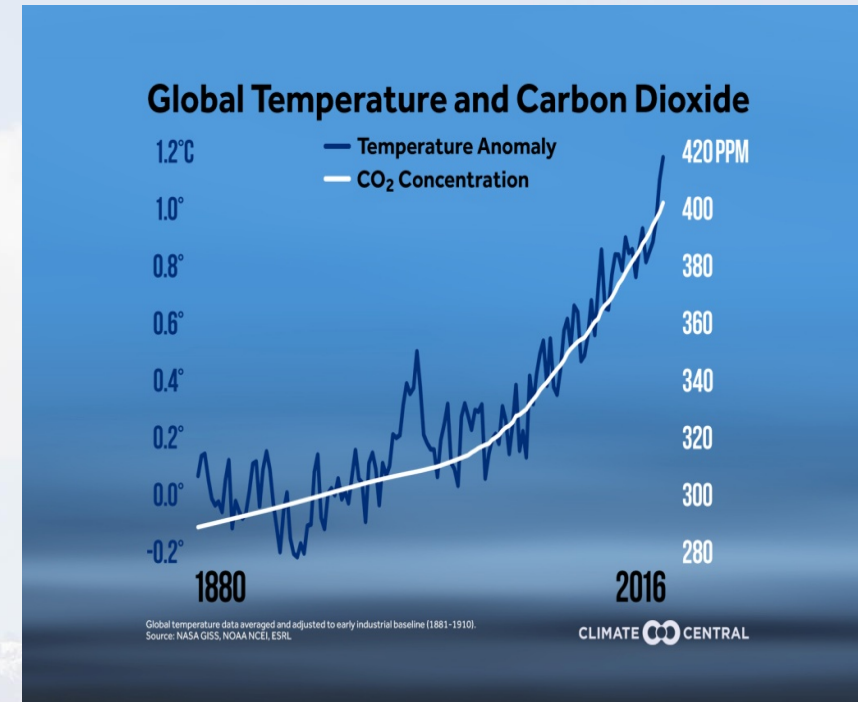
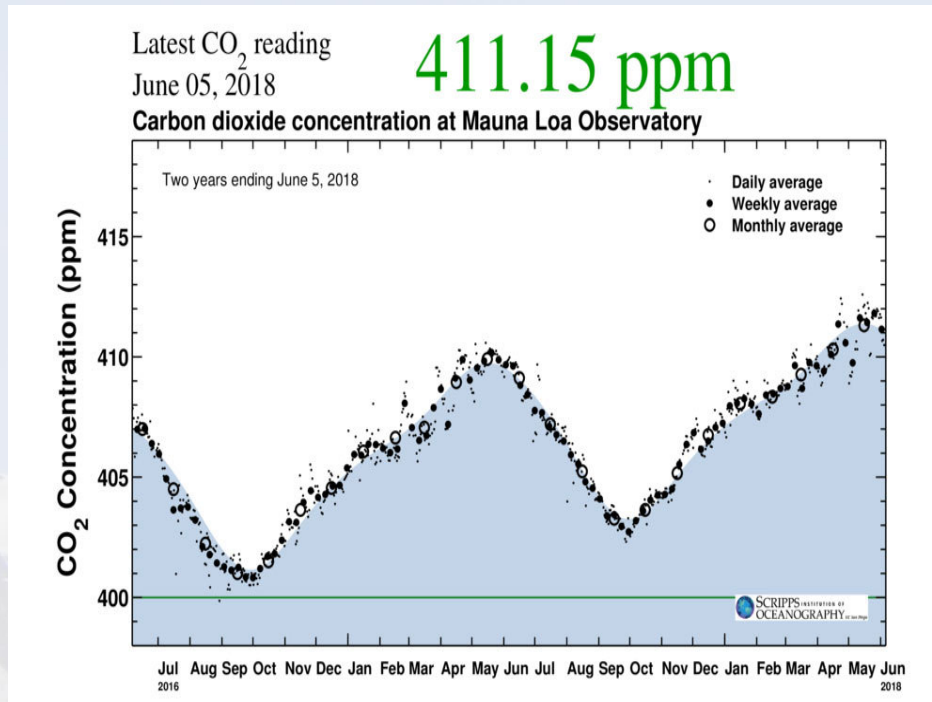
2) METODI SPERIMENTALI

3) RISULTATI

4) PROGETTI INTERNAZIONALI



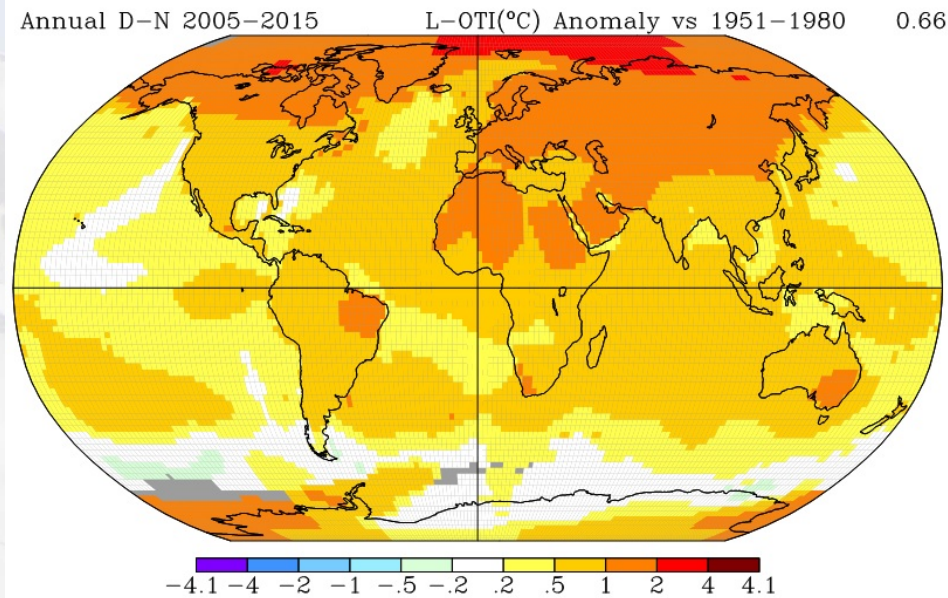
Riscaldamento Climatico



Nel corso degli ultimi 100 anni le temperature medie globali della superficie terrestre sono incrementate di circa 0.7 K a causa dell'aumento generale dei gas serra di origine antropica

Riscaldamento Climatico

Alcune regioni sono state maggiormente interessate dai cambiamenti climatici rispetto ad altre



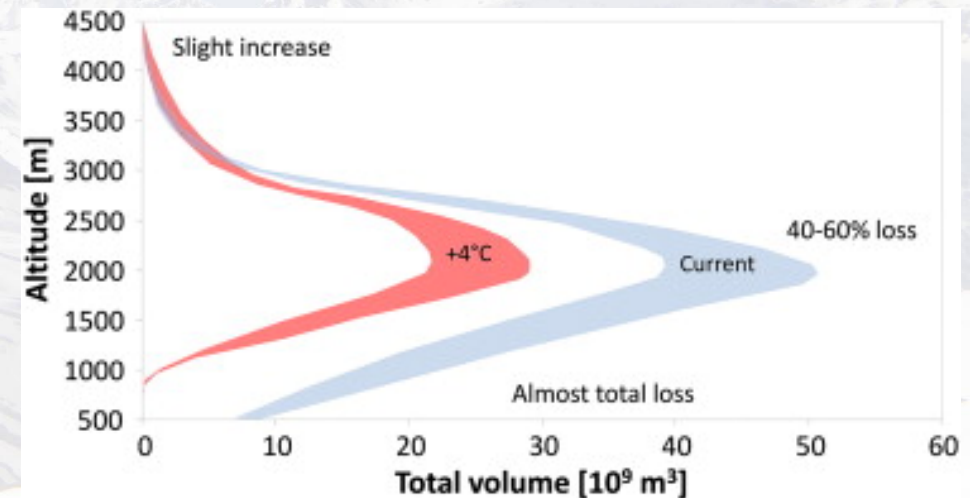
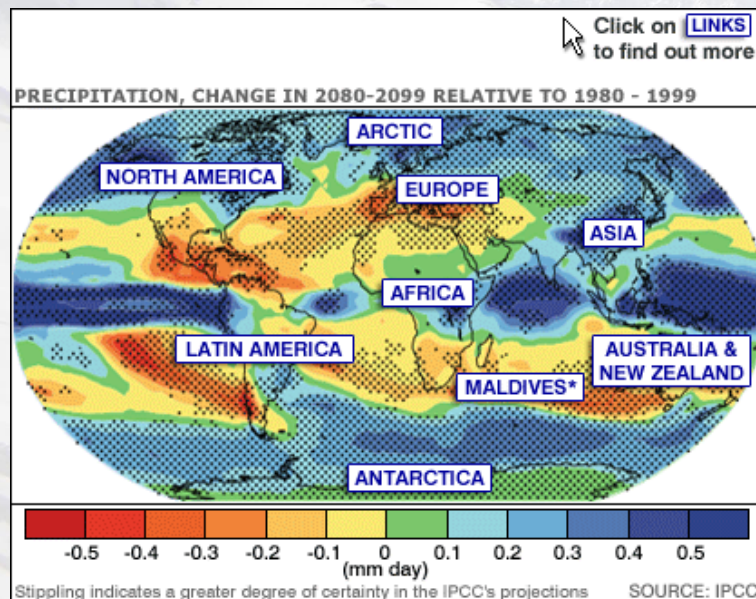
Le temperature minime sulle Alpi sono incrementate da 1.1 a 2 K durante il secolo scorso, con un aumento marcato nelle ultime decadi

Un riscaldamento più pronunciato è previsto negli ambienti artici e alpini dell'emisfero boreale

Cambiamenti Climatici nelle regioni montuose

I modelli di simulazione nelle **aree alpine** indicano per il prossimo secolo:

- incremento delle temperature medie di 2-4 K
- decremento delle precipitazioni estive tra il 4 e il 20%
- incremento delle precipitazioni invernali del 10% con aumento del rapporto pioggia/neve



COSA SUCCEDERA' AGLI ECOSISTEMI ALPINI?

Molti studi hanno già evidenziato come le comunità vegetali alpine si stiano già modificando



Perdita di biodiversità



Cambiamenti nella composizione e distribuzione delle comunità vegetali



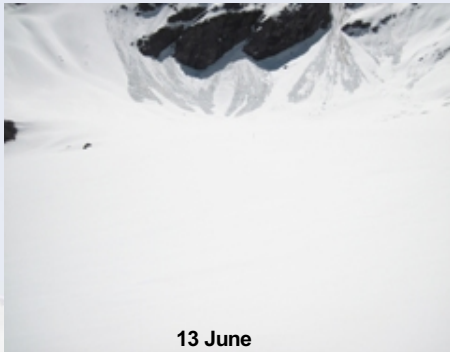
Alterazioni delle funzioni e dei servizi ecosistemici



Quantificare gli effetti dei cambiamenti climatici sulle piante è fondamentale per fornire scenari previsionali realistici sul futuro degli **ecosistemi alpini**

ECOSISTEMI DI TUNDRA ALPINA

Gli ecosistemi di tundra alpina sono caratterizzati da una **lunga permanenza del manto nevoso**, da **temperature relativamente basse**, dalla **scarsa disponibilità di nutrienti** e da una **disponibilità idrica eterogenea** su piccola scala



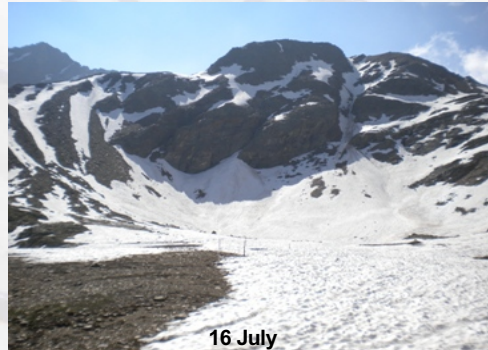
13 June



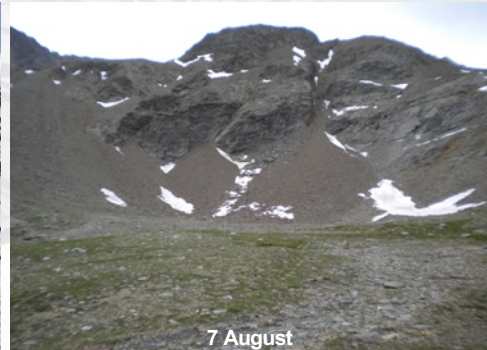
19 June



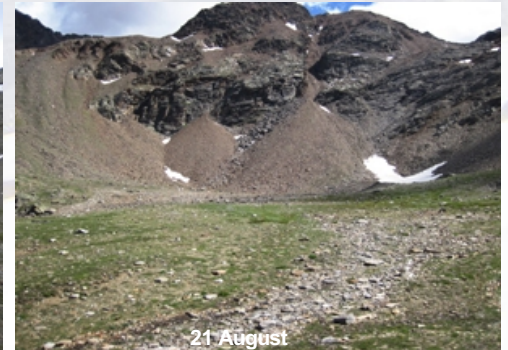
11 July



16 July



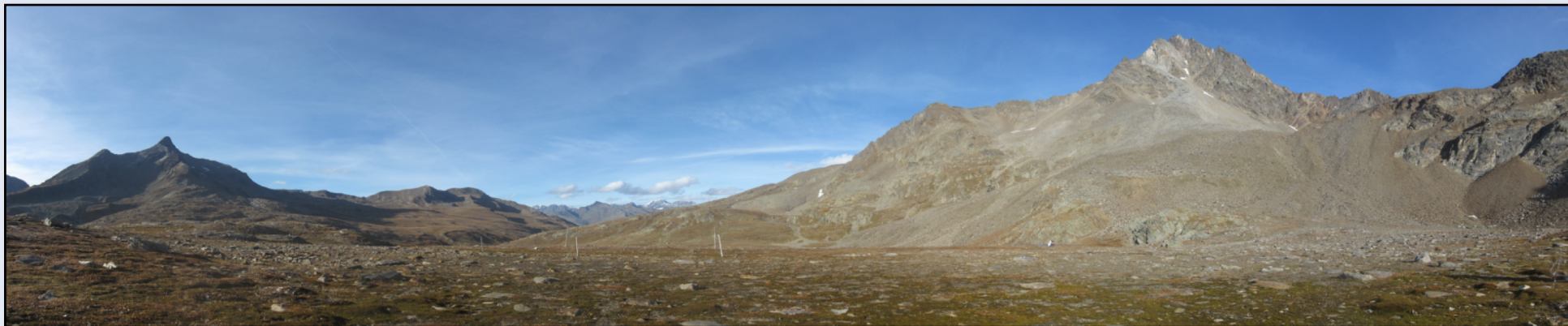
7 August



21 August

La presenza e la quantità di neve determinano l'inizio e la lunghezza della stagione vegetativa condizionando la presenza, la crescita e la riproduzione delle specie vegetali

La durata della copertura nevosa, la temperatura e la disponibilità idrica e di nutrienti controllano numerose caratteristiche dell'ecosistema tra le quali la biodiversità, la produzione primaria, la decomposizione e i cicli biogeochimici



Questi ecosistemi sono un **elemento unico della biodiversità del paesaggio alpino**, sia per le specie e le fitocenosi esclusive che ospitano sia per i servizi ecosistemici che possono offrire agli erbivori

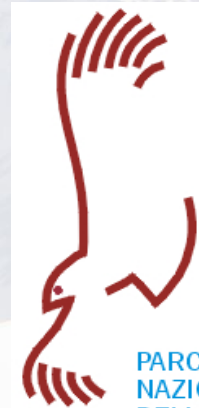


ESPERIMENTI E METODI: DOVE?



2700 m s.l.m.

**ALTA VALLE DEL GAVIA
Riserva Naturale Statale
"Tresero-Dosso del Vallon"**



**PARCO
NAZIONALE
DELLO
STELVIO**

**NATIONAL
PARK
STILFSEER
JOCH**

METODI SPERIMENTALI

MONITORAGGIO DELLA VEGETAZIONE LUNGO GRADIENTI AMBIENTALI

Monitoraggio di plot permanenti dislocati in numerose aree con vegetazione differente, a diverse quote e con diversa durata della copertura nevosa

Oltre 60 plot permanenti



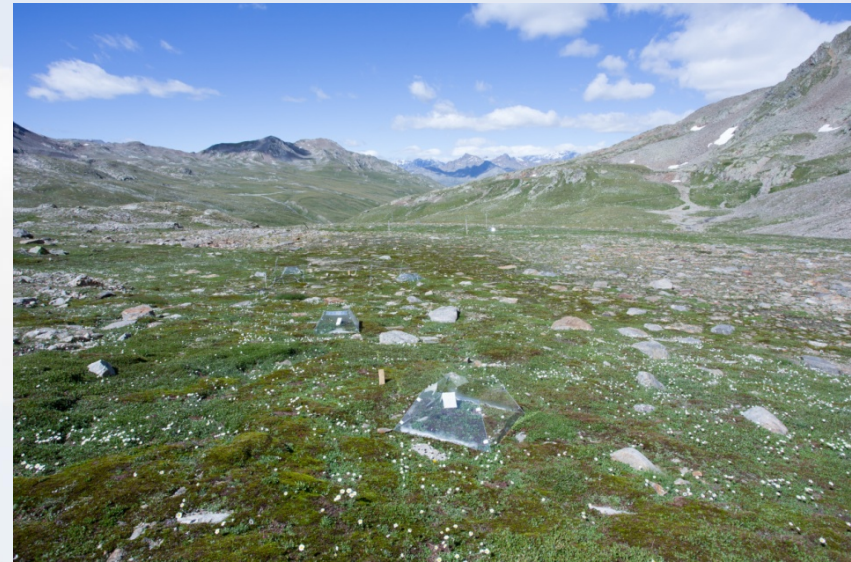
2009



2016

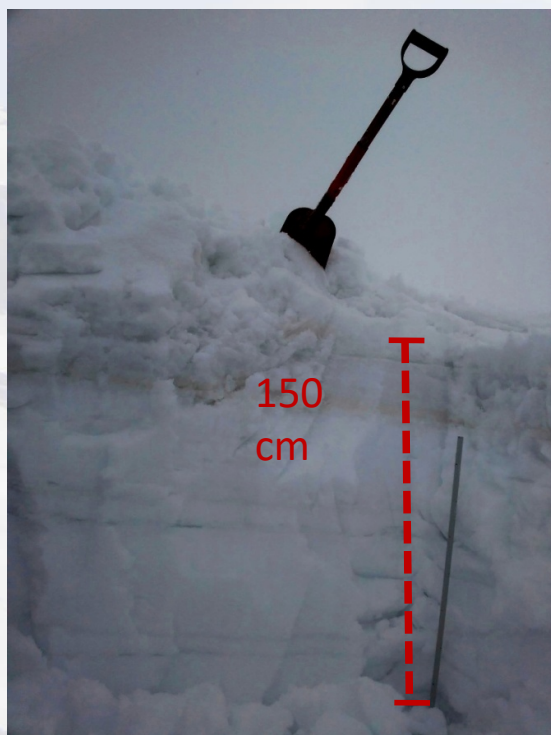
SIMULAZIONE DEGLI EFFETTI DEI CAMBIAMENTI CLIMATICI

Aumento delle temperature (OTC)



SIMULAZIONE DEGLI EFFETTI DEI CAMBIAMENTI CLIMATICI

Fusione anticipata della neve (rimozione manuale)



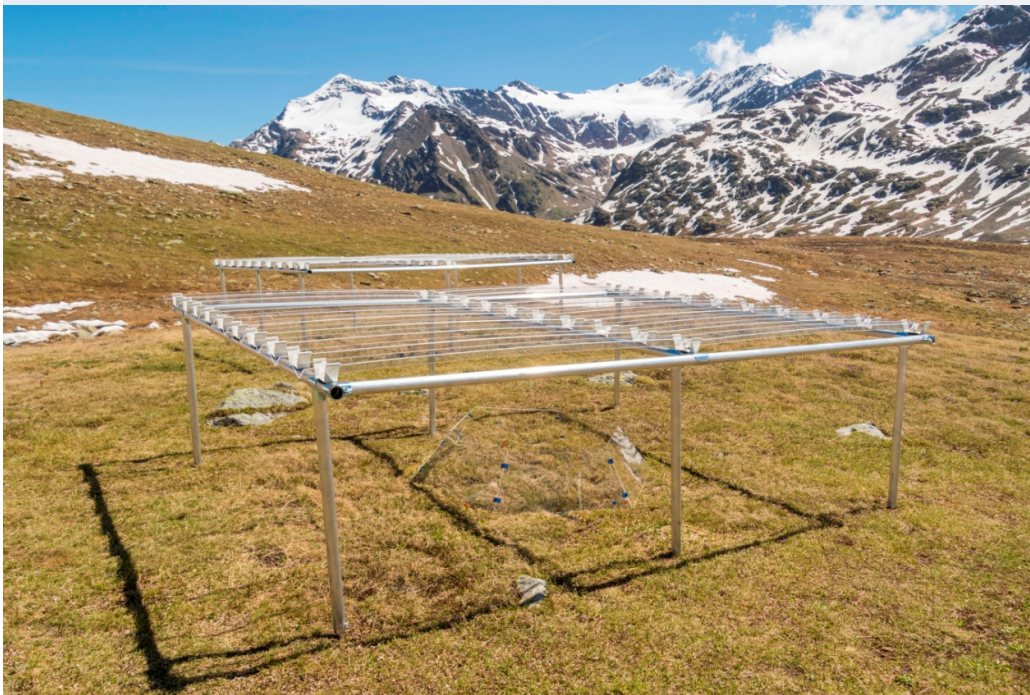
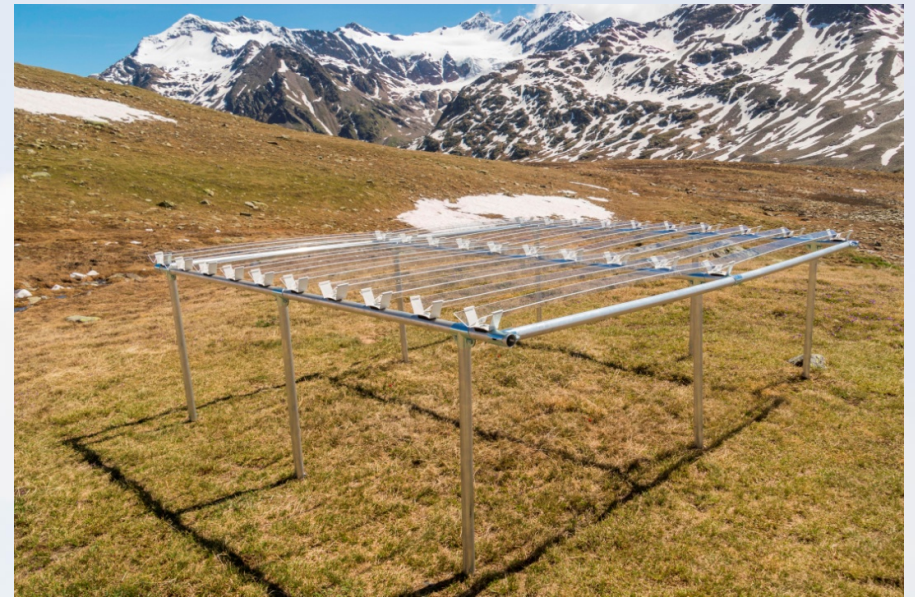
SIMULAZIONE DEGLI EFFETTI DEI CAMBIAMENTI CLIMATICI

Combinazione dell'incremento della temperatura (OTC) e della fusione anticipata della neve (rimozione manuale)

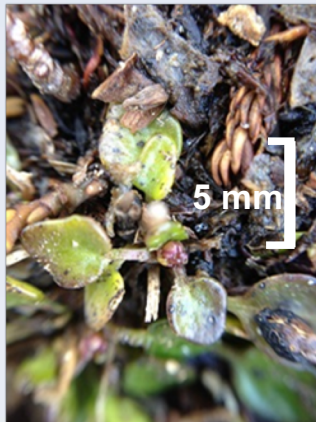


SIMULAZIONE DEGLI EFFETTI DEI CAMBIAMENTI CLIMATICI

Combinazione dell'incremento della temperatura (OTC) e della riduzione delle precipitazioni (RAIN-OUT SHELTERS)



OSSERVAZIONI, CONTEGGI, MISURE OVVERO: “COME RISPONDONO LE PIANTE E GLI ECOSISTEMI”?



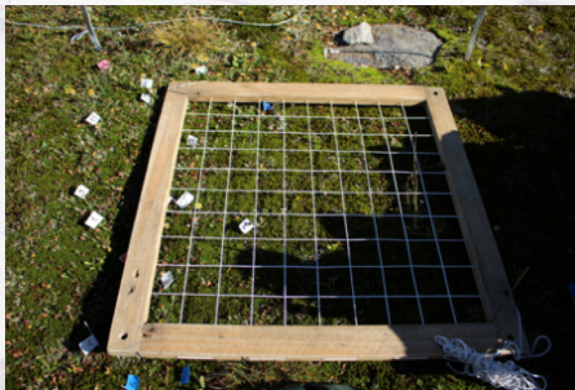
Gemme fiorali

Fioritura

Maturazione dei frutti

Dispersione dei semi

CONTEGGI



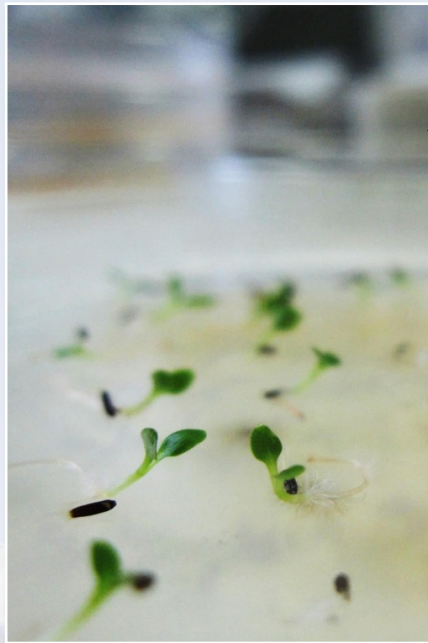
ALVEOLI PER LA SEMINA



MISURE DI CRESCITA



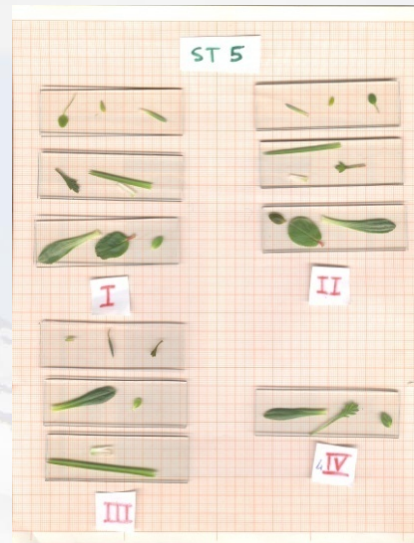
ESPERIMENTI E MISURE IN LABORATORIO



← GERMINAZIONE DEI SEMI



REIDRATAZIONE DI PIANTE →



← SCANSIONE DI FOGLIE PER SLA



← PESO DI SEMI, FOGLIE, RADICI ECC.

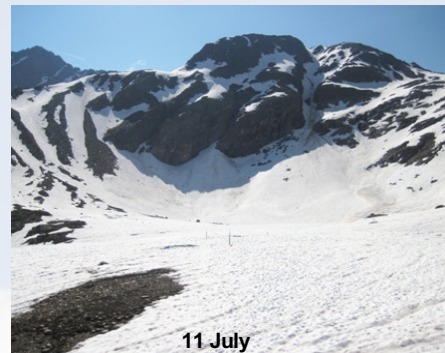
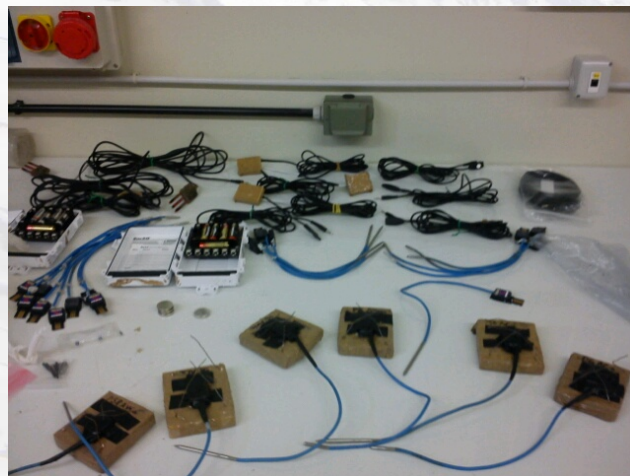


SOPRAVVIVENZA DELLE PLANTULE IN CELLA CLIMATICA →

MISURAZIONE DI DATI AMBIENTALI

Oltre 100 sensori

- Temperatura aria
- Temperatura suolo
- Umidità aria
- Umidità suolo
- Precipitazioni
- PAR
- Piranometro



11 July



16 July

Monitoraggio della data di scioglimento della neve



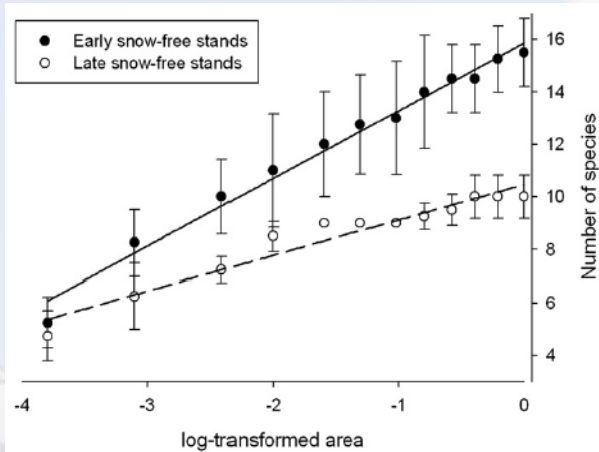
RISULTATI

**RICCHEZZA
BIODIVERSITA'**

**FENOLOGIA
RIPRODUZIONE**

**PRODUZIONE PRIMARIA
DECOMPOSIZIONE**

RICCHEZZA BIODIVERSITA'



Alp Botany (2014) 124:105–113
DOI 10.1007/s00035-014-0135-x

VEGETATION IN COLD ENVIRONMENTS UNDER CLIMATE CHANGE

Current vegetation changes in an alpine late snowbed community in the south-eastern Alps (N-Italy)

Michele Carbognani · Marcello Tomaselli ·
Alessandro Petraglia

Il rapporto tra specie tipiche di snowbeds e non tipiche di snowbeds sta diminuendo nel tempo → **la composizione in specie di questi ambienti sta cambiando**



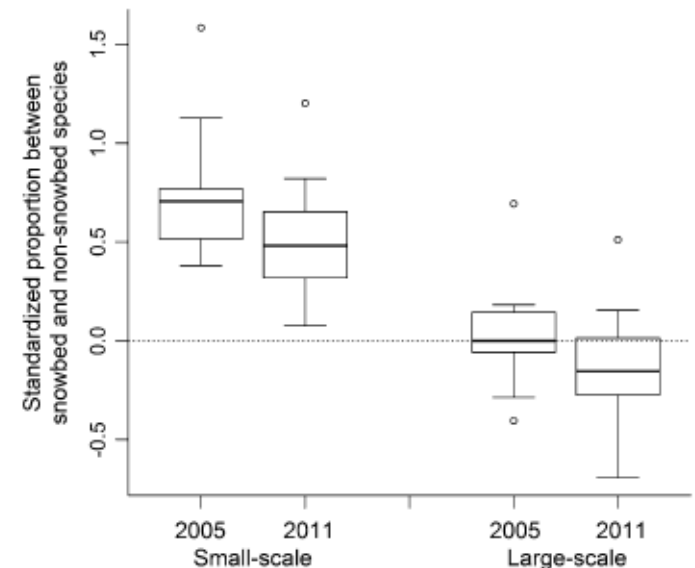
Original article

Influence of snowmelt time on species richness, density and production in a late snowbed community

Michele Carbognani, Alessandro Petraglia*, Marcello Tomaselli

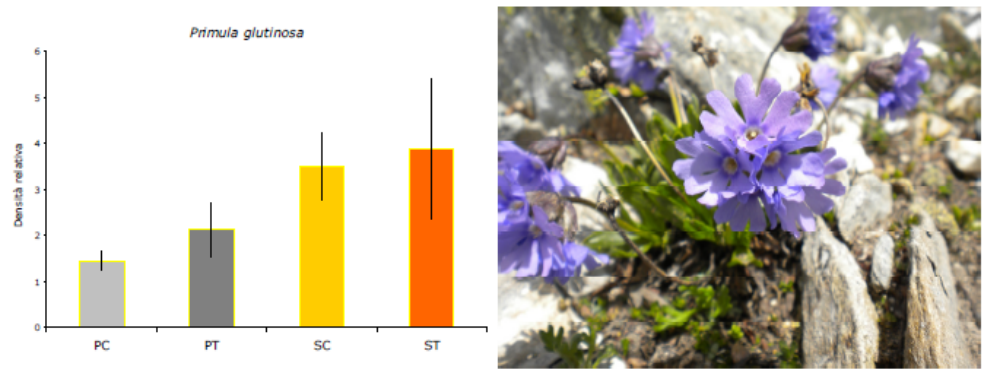
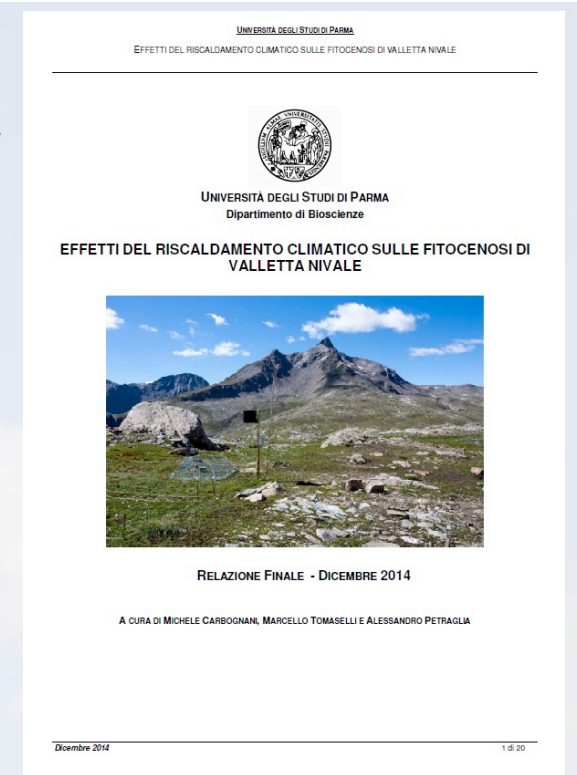
Department of Evolutionary and Functional Biology, University of Parma, Viale G.P. Usberti 11/A, I-43124 Parma, Italy

All'aumentare della lunghezza dell'innevamento il numero di specie e la biodiversità diminuiscono



RICCHEZZA BIODIVERSITA'

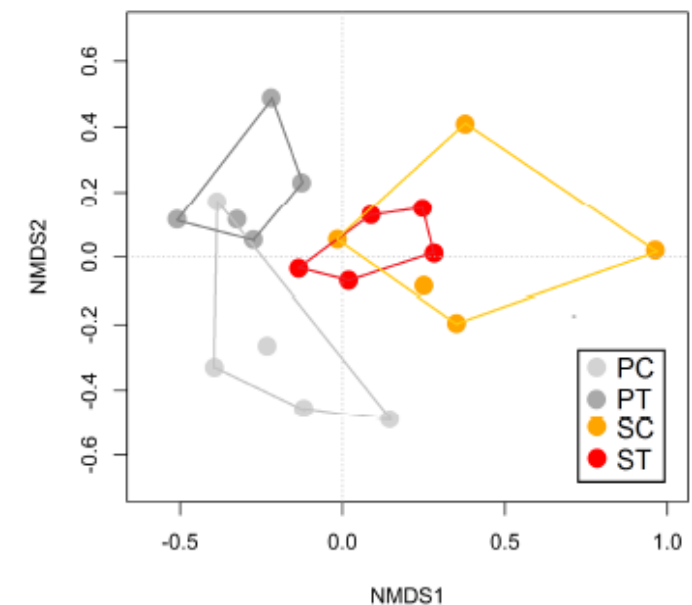
Dati disponibili nella relazione scientifica prodotta per il Parco Nazionale dello Stelvio nel 2014



EFFETTI DEL WARMING:

temperature più elevate determinano un aumento dell'abbondanza delle specie vascolari

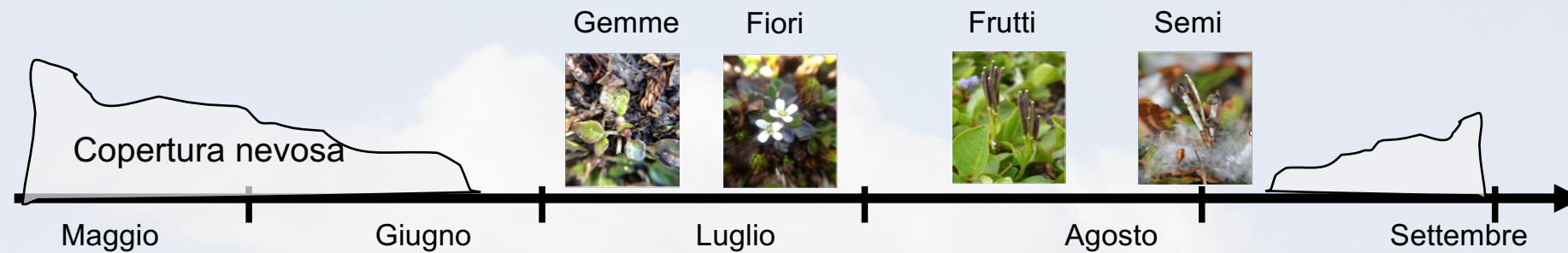
e una generale **omogeneizzazione floristica** della vegetazione



FENOLOGIA RIPRODUZIONE

EFFETTI DEL WARMING SULLA FIORITURA

Sviluppo delle strutture riproduttive



FENOLOGIA RIPRODUZIONE

EFFETTI DEL WARMING SULLA FIORITURA



Le **variazioni** nel periodo di fioritura indotte dal riscaldamento sono **specie-specifiche**

Le **specie non si affidano tutte alla stessa variabile microclimatica per fiorire** e gli effetti della neve e delle temperature variano fra gruppi di specie

Le **specie hanno differenti soglie termiche e utilizzano il calore in modo diverso nelle diverse fasi del loro ciclo riproduttivo**

Oecologia
DOI 10.1007/s00442-016-3669-3



GLOBAL CHANGE ECOLOGY – ORIGINAL RESEARCH

Micro-climatic controls and warming effects on flowering time in alpine snowbeds

Michele Carbognani¹ · Giulietta Bernareggi¹ · Francesco Perucco¹ ·
Marcello Tomaselli¹ · Alessandro Petraglia¹

OIKOS

SYNTHESISING ECOLOGY

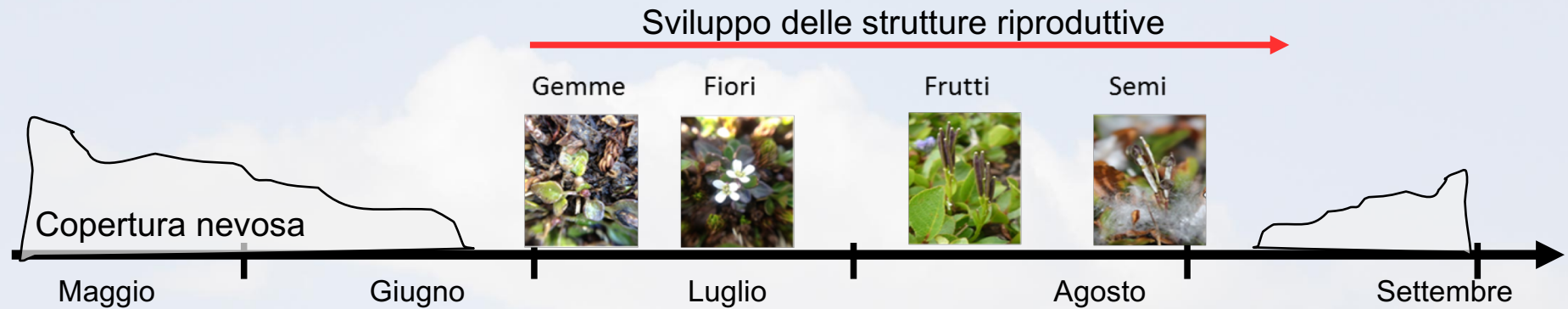
Research

Different temperature perception in high-elevation plants: new insight into phenological development and implications for climate change in the alpine tundra

Michele Carbognani ✉, Marcello Tomaselli, Alessandro Petraglia

FENOLOGIA RIPRODUZIONE

FUSIONE ANTICIPATA DELLA NEVE



Plant Ecol
DOI 10.1007/s11258-014-0368-1

Responses of flowering phenology of snowbed plants to an experimentally imposed extreme advanced snowmelt

Alessandro Petraglia · Marcello Tomaselli ·
Matteo Petit Bon · Nicola Delnevo ·
Giorgio Chiari · Michele Carbognani

Se la neve si scioglie in anticipo anche le piante anticiperanno il loro ciclo fenologico

FENOLOGIA RIPRODUZIONE

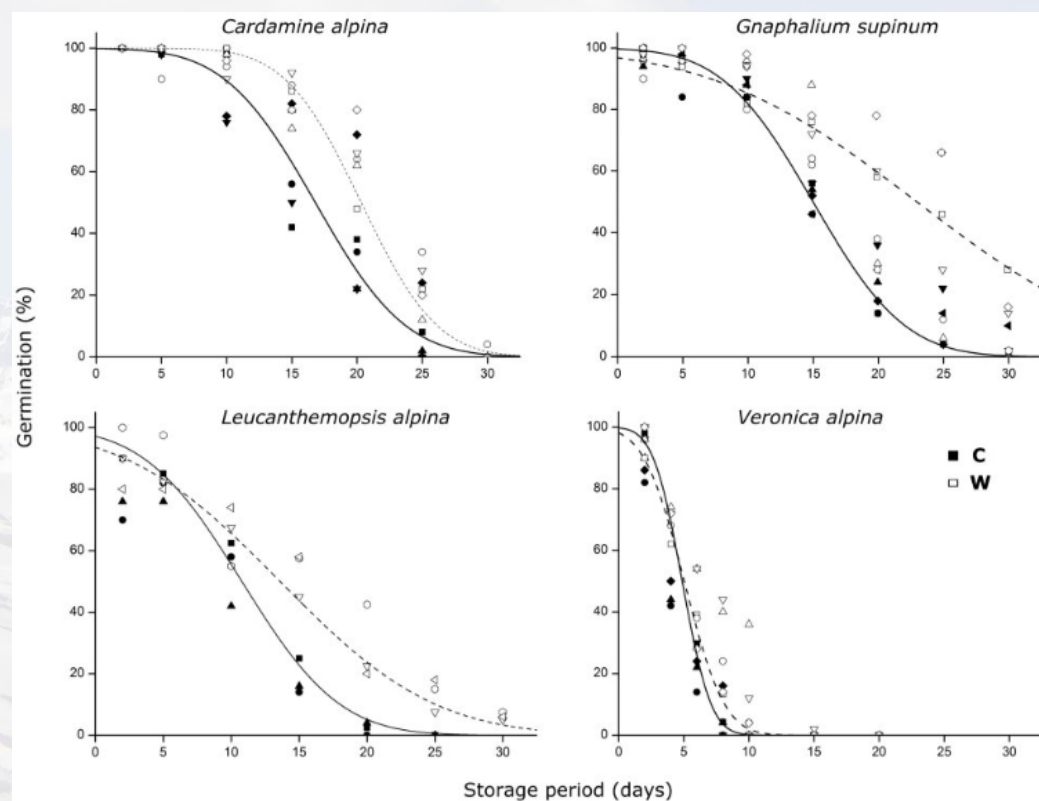
ORIGINAL ARTICLE

Climate warming could increase seed longevity of alpine snowbed plants

 Giuletta Bernareggi¹ · Michele Carbognani¹ · Alessandro Petraglia¹ · Andrea Mondoni²

Le specie testate sono in grado di produrre semi più longevi se sottoposte a temperature più calde durante il periodo di crescita

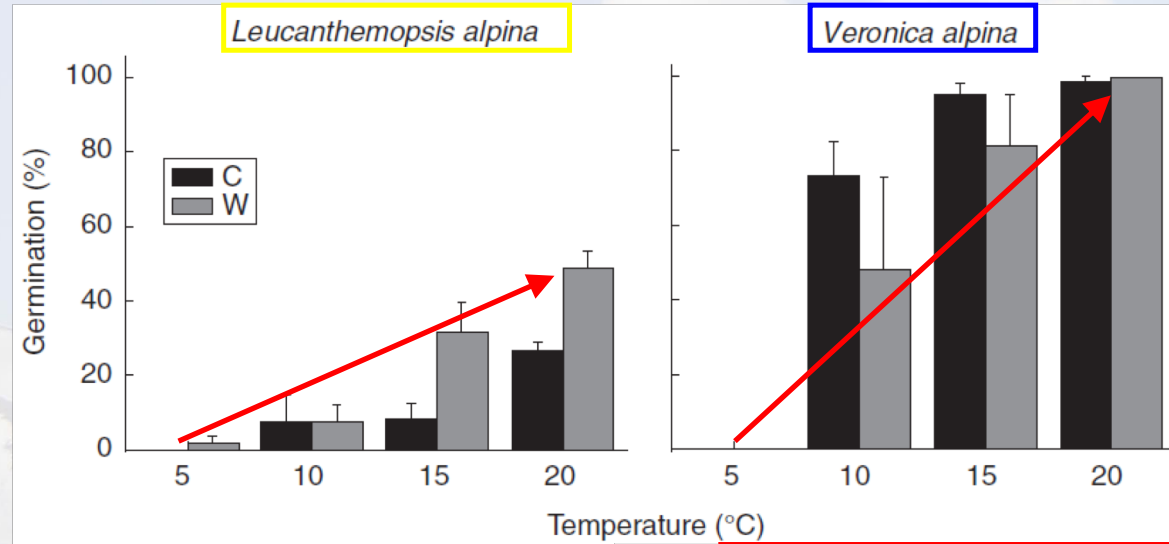
Potenziale incremento della longevità della seed-bank



FENOLOGIA RIPRODUZIONE

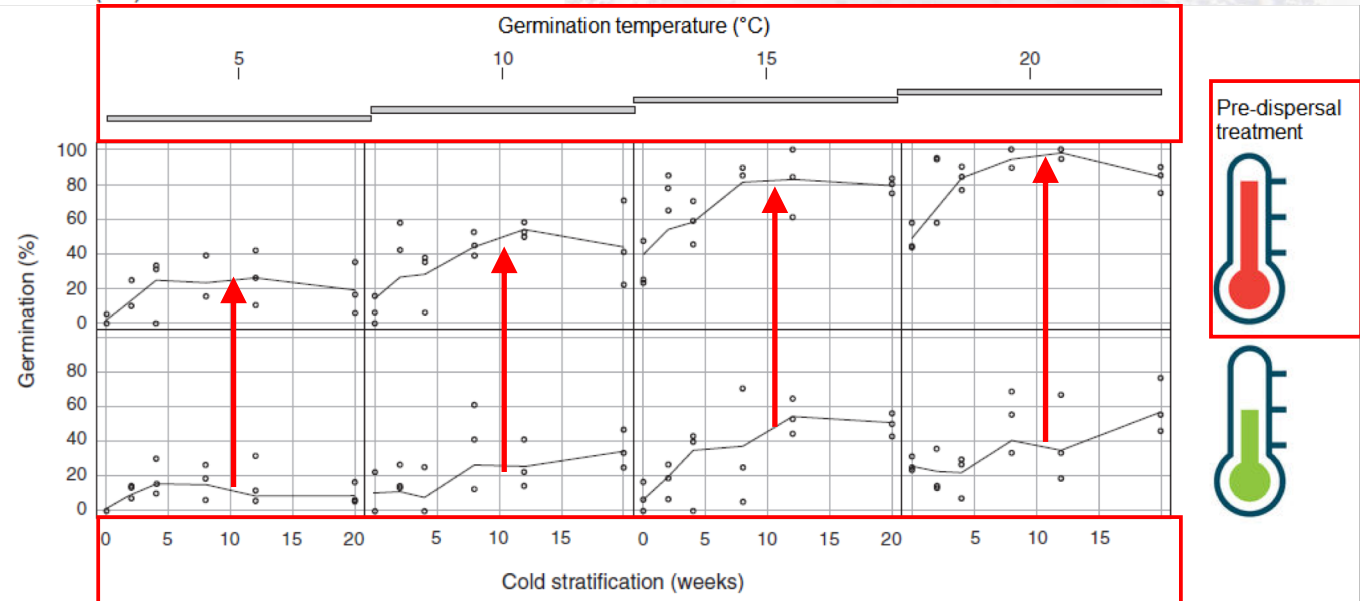
Seed dormancy and germination changes of snowbed species under climate warming: the role of pre- and post-dispersal temperatures

Giulietta Bernareggi^{1,†}, Michele Carbone^{1,†}, Andrea Mondoni^{2,*} and Alessandro Petraglia¹

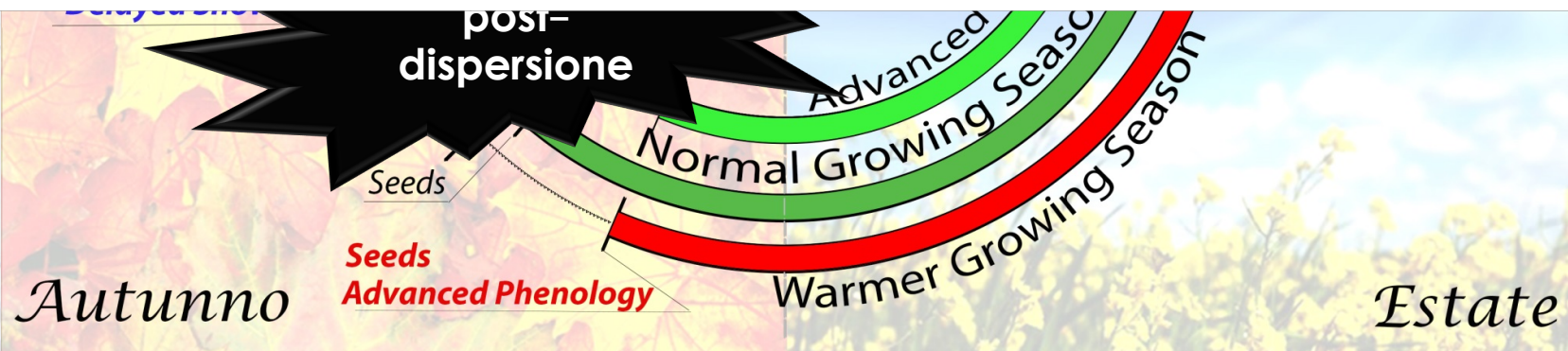
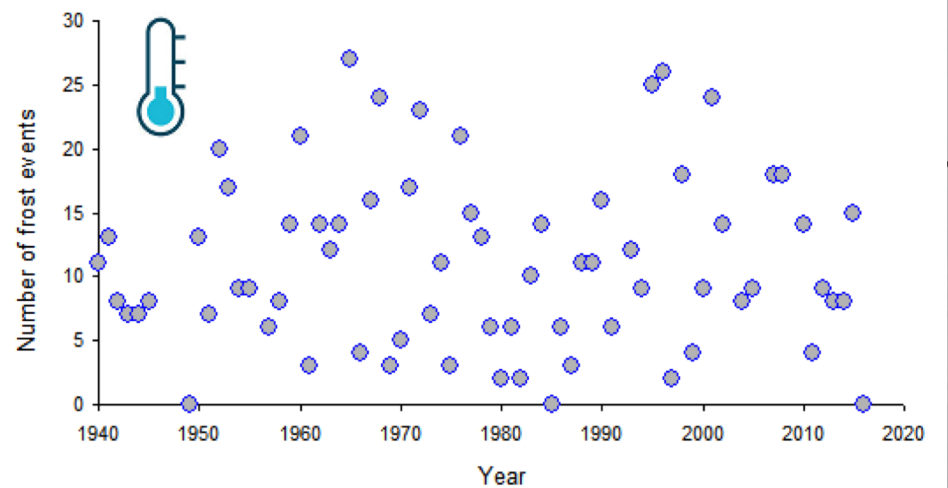
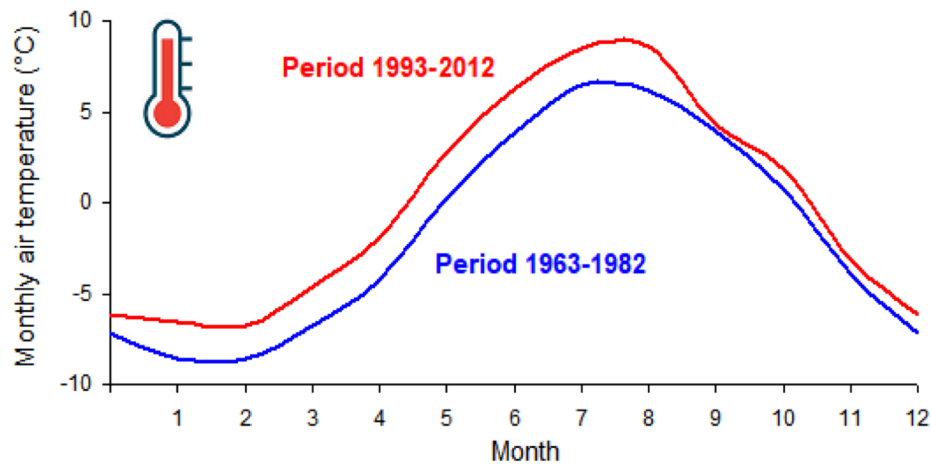


Temperature più elevate dopo la dispersione possono favorire la germinazione alla fine della stagione

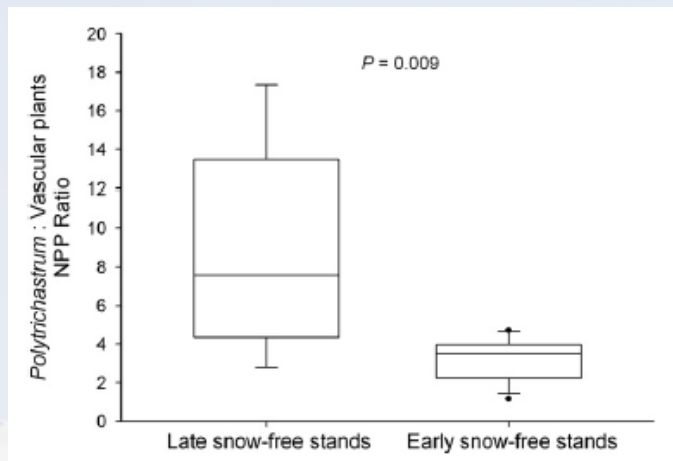
La dormienza e la germinazione dei semi sono influenzate dalla temperatura parentale



FENOLOGIA RIPRODUZIONE



PRODUZIONE PRIMARIA DECOMPOSIZIONE



Alp Botany (2014) 124:105–113
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Current vegetation changes in an alpine late snowbed community in the south-eastern Alps (N-Italy)

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Alessandro Petraglia

All'aumentare della produzione primaria aumenta la competizione fra specie



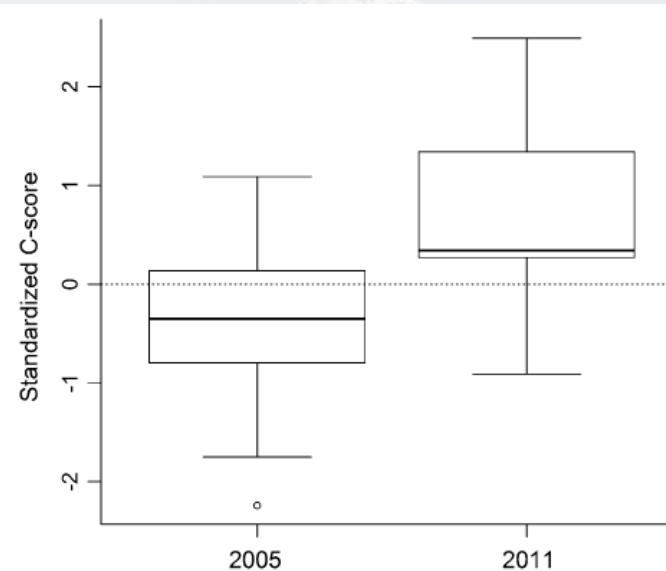
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Influence of snowmelt time on species richness, density and production in a late snowbed community

Michele Carbognani, Alessandro Petraglia*, Marcello Tomaselli

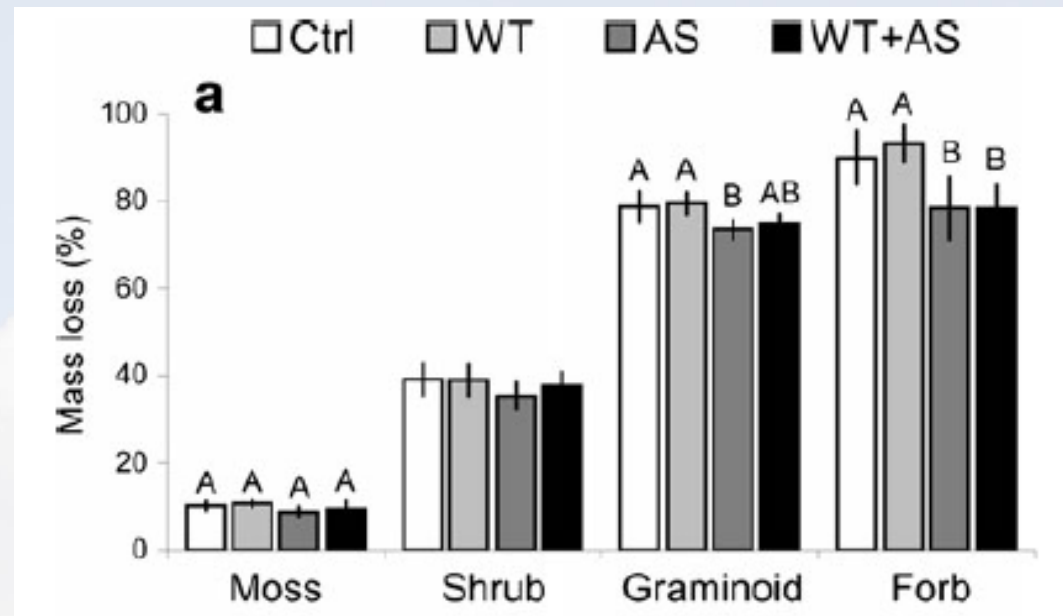
Department of Evolutionary and Functional Biology, University of Parma, Viale G.P. Usberti 11/A, I-43124 Parma, Italy

La produzione primaria è più elevata nelle snowbeds a minore innevamento ed è esclusivamente a carico delle piante vascolari



FACILITAZIONE
COMPETIZIONE

PRODUZIONE PRIMARIA DECOMPOSIZIONE



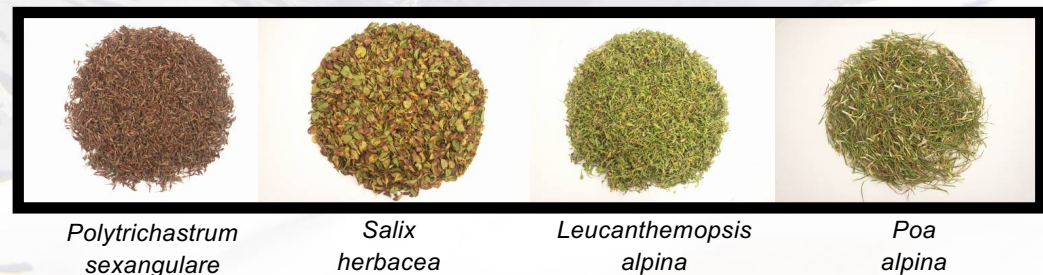
Plant Soil (2014) 376:277–290
DOI 10.1007/s11104-013-1982-8

REGULAR ARTICLE

Warming effects and plant trait control on the early-decomposition in alpine snowbeds

Michele Carbognani • Alessandro Petraglia •
Marcello Tomaselli

I fattori principali che controllano la decomposizione sono il tipo di necromassa che si decompone, la durata della copertura nevosa e la temperatura



*Polytrichastrum
sexangulare*

*Salix
herbacea*

*Leucanthemopsis
alpina*

*Poa
alpina*

RETI E PROGETTI DI RICERCA INTERNAZIONALI



International Tundra Experiment

sTundra Trait Update - 19 April 2016

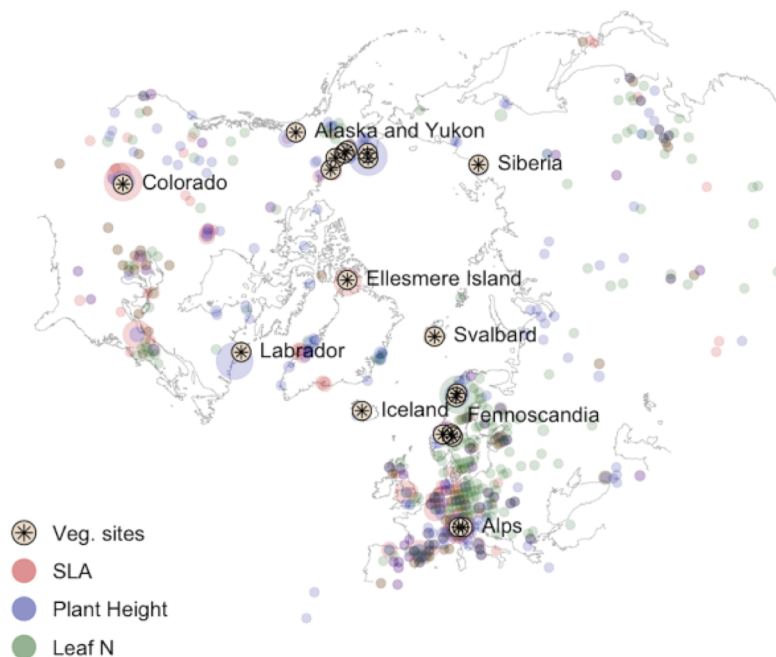


Figure 1. Map of sites with community composition data (black stars) and trait observations (colored circles; red = SLA, blue = plant height, green = leaf nitrogen).

Plant composition over time: We have also expanded the community composition data used in the previous ITEX synthesis. New sites include Kytalyk (Siberia), **Gavia Pass (Italian Alps)** and Fulufjället, Långfjället, and Ritsem, Sweden.

https://www.nature.com/articles/s41586-018-0563-7

CVSA s... SCIENZE DELLA NATU... Posta - alessandro.pet... 02/01/2018 14:40:45 +... Web of Science [v.5.27... Scopus - Docu...

A community from nature research

BEHAVIOURAL & SOCIAL SCIENCES

nature > articles > article

MENU

nature
International journal of science

Article | Published: 26 September 2018

Plant functional trait change across a warming tundra biome

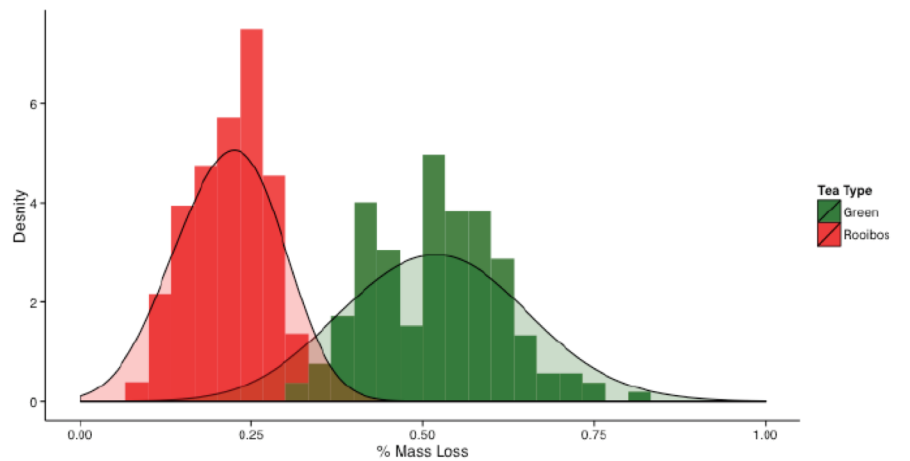
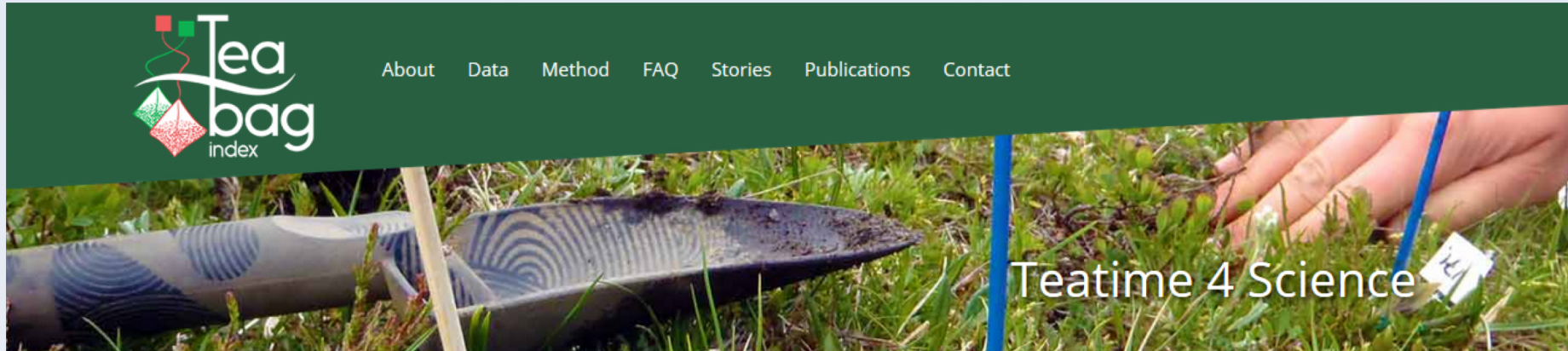
Anne D. Bjorkman, Isla H. Myers-Smith, [...] Evan Weiher

Nature 562, 57–62 (2018) | Download Citation

Abstract

The tundra is warming more rapidly than any other biome on Earth, and the potential ramifications are far-reaching because of global feedback effects between vegetation and climate. A better understanding of how environmental factors shape plant structure and function is crucial for predicting the consequences of environmental change for ecosystem functioning. Here we explore the biome-wide relationships between temperature, moisture and seven key plant functional traits both across space and over three decades of warming at 117 tundra locations. Spatial temperature–trait relationships were generally strong but soil moisture had a marked influence on the strength and direction of these relationships, highlighting the potentially important influence of changes in water availability on future trait shifts in tundra plant communities. Community height increased with warming across all

TEA TIME 4 SCIENCE



A simple and cheap method to measure decay rate of plant material by using tea



Early stage litter decomposition across biomes

Ika Djukic^{a,*}, Sebastian Kepfer-Rojas^b, Inger Kappel Schmidt^b, Klaus Steenberg Larsen^b, Claus Beier^b, Björn Berg^{c,d}, Kris Verheyen^e, TeaComposition:

Adriano Caliman¹, Alain Paquette², Alba Gutiérrez-Girón³, Alberto Humber^{2,24}, Alejandro Valdecantos⁴, Alessandro Petraglia⁵, Heather Alexander⁶, Algirdas Augustaitis⁷, Amélie Sailard^{8,22,5}.



DROUGHT-NET

Gli ecosistemi terrestri non rispondono in modo uniforme agli eventi siccitosi. I meccanismi che spiegano perché alcuni sistemi rispondano diversamente da altri ci sono ancora ignoti.

The screenshot shows the Drought-Net website homepage. The browser address bar displays <https://drought-net.colostate.edu>. The page features a blue navigation menu on the left with the following items: Blog, Activities (with sub-items: Enhancing Existing Experiments, International Drought Experiment, Guidelines for Participation, Protocols and Templates), Terrestrial Precipitation Analysis WebTools, Team, Tutorials/Help, Listserv, Publications, and Contact. Below the menu are logos for the Drought-Net project and the National Science Foundation (NSF). The main content area has a background image of a field with metal arches under a blue sky. A white text box on the right contains the following text:

Welcome to Drought-Net!

All ecosystems will be impacted to some extent by climate change, with forecasts for more frequent and severe drought likely to have the greatest impact on terrestrial ecosystems. Terrestrial ecosystems are known to vary dramatically in their responses to drought. However, the mechanistic basis underlying why some ecosystems respond more than others represents a critical knowledge gap, one that limits our ability to project drought impacts at regional and continental scales. To effectively forecast terrestrial ecosystem responses to drought, ecologists must determine the mechanisms underlying ecosystem sensitivity to drought across a range of different ecosystem types, and then improve existing modeling frameworks by incorporating such variation within the context of broader environmental gradients. Traditional site-based approaches cannot provide this knowledge because site-specific experiments are conducted in ways that makes comparisons among ecosystems difficult. Coordinated experimental networks, however, are ideally suited for comparative studies at regional to global scales. The Drought-Net Research Coordination Network (RCN) - funded by the US National Science Foundation - is coordinated experimental network aimed at advancing understanding of how and why terrestrial ecosystems across the globe may differ in their sensitivity to drought.

[VIEW PROJECTS](#)

At the bottom of the page, there is a blue button that says **Register to Participate**. The Windows taskbar at the bottom shows the search bar with the text "Scrivi qui per eseguire la ricerca" and the system tray with the date and time "18:20 16/10/2018".

droughtNET Login Register

Blog
Activities
Enhancing Existing Experiments
International Drought Experiment
Guidelines for Participation
Protocols and Templates
Terrestrial Precipitation Analysis WebTools
Team
Tutorials/Help
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Contact

International Drought Experiment (IDE)

IDE is a highly coordinated experimental network aimed at assessing differential sensitivity of terrestrial ecosystems to extreme drought. A key feature of IDE is that an extreme 4-year drought will be imposed based on the historical climate record for each participating site. [Tools](#) are available to enable participants to determine site-specific IDE drought treatments based on either existing climate data or global interpolated data. This will ensure that that same magnitude of drought is imposed at all sites across the network (see [IDE Protocols](#) for additional details). Drought treatments will be imposed using passive-reduction or through-fall displacement shelters. This approach of passively reducing each rainfall event by a set percentage has been shown to capture the key attributes of naturally-occurring extreme dry years ([Knapp et al. 2016](#)).

IDE will significantly expand the scope of past drought experiments by including a greater range of ecosystem types, insuring that these experiments are accessible to as many investigators as possible, and overcoming the limitations of past drought experiments (i.e., lack of coordination, differences in approaches and methodologies, etc.). IDE follows in the pioneering footsteps of the [Nutrient Network](#), in that 1) the experiment is designed with simplicity in mind to minimize fiscal and logistical constraints, and 2) an important feature of the network will be accessibility to all investigators that want to participate with a clear set of guidelines for data sharing, intellectual participation in network-level data analyses, and authorship of manuscripts.

Per prevedere efficacemente le risposte degli ecosistemi terrestri alla siccità gli ecologi devono studiare molti diversi tipi di ecosistemi e migliorare l'affidabilità dei modelli esistenti



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 - International Drought Experiment
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Terrestrial Precipitation
 Analysis WebTools

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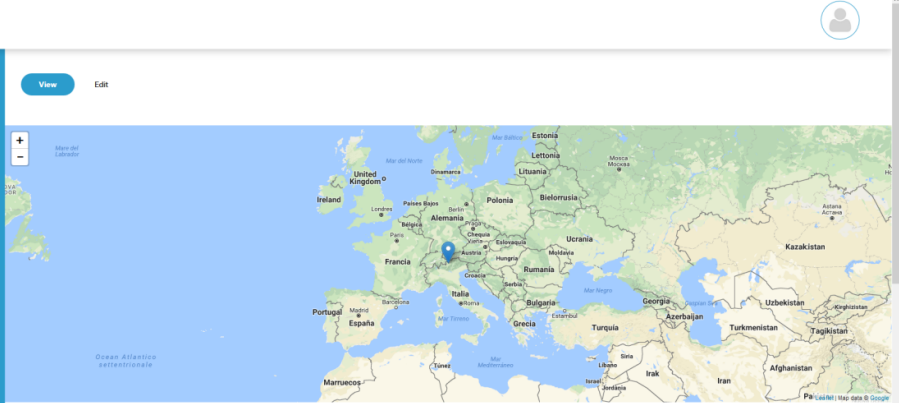
Passo Gavia IDE

Project Details

Drought Treatment Start Date:	Tuesday, June 12, 2018
Pre-Treatment Data:	Yes
Percent Reduction of Precipitation:	40%
Number of Replicates Per Drought Treatment:	5
Time of Manipulation:	June July August September
Ecosystem:	Grassland



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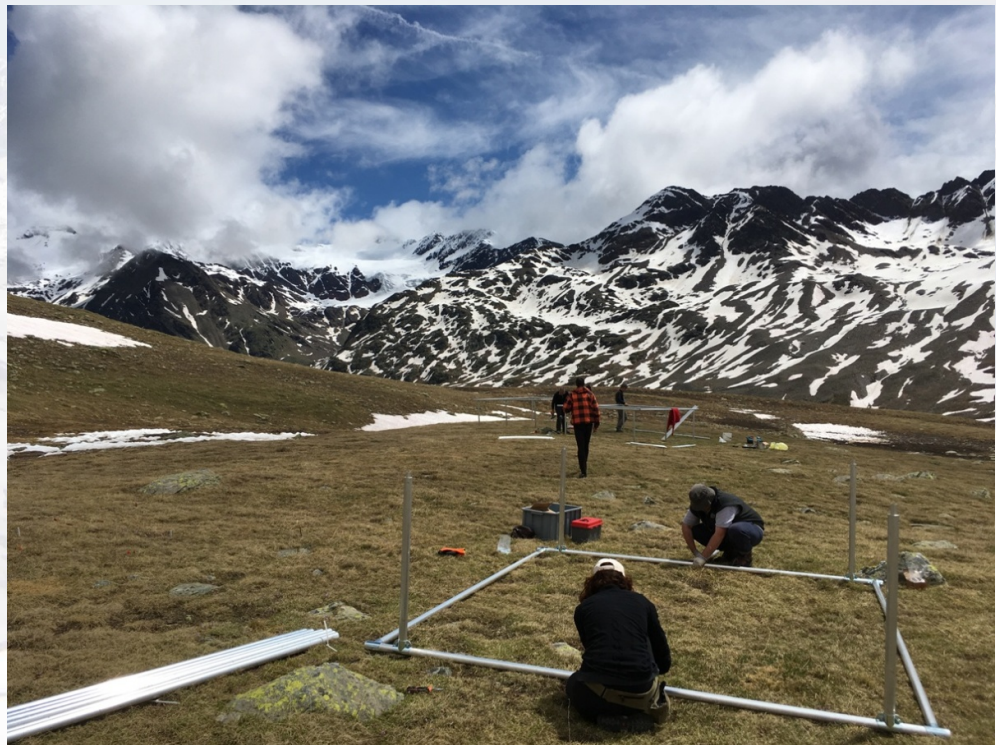
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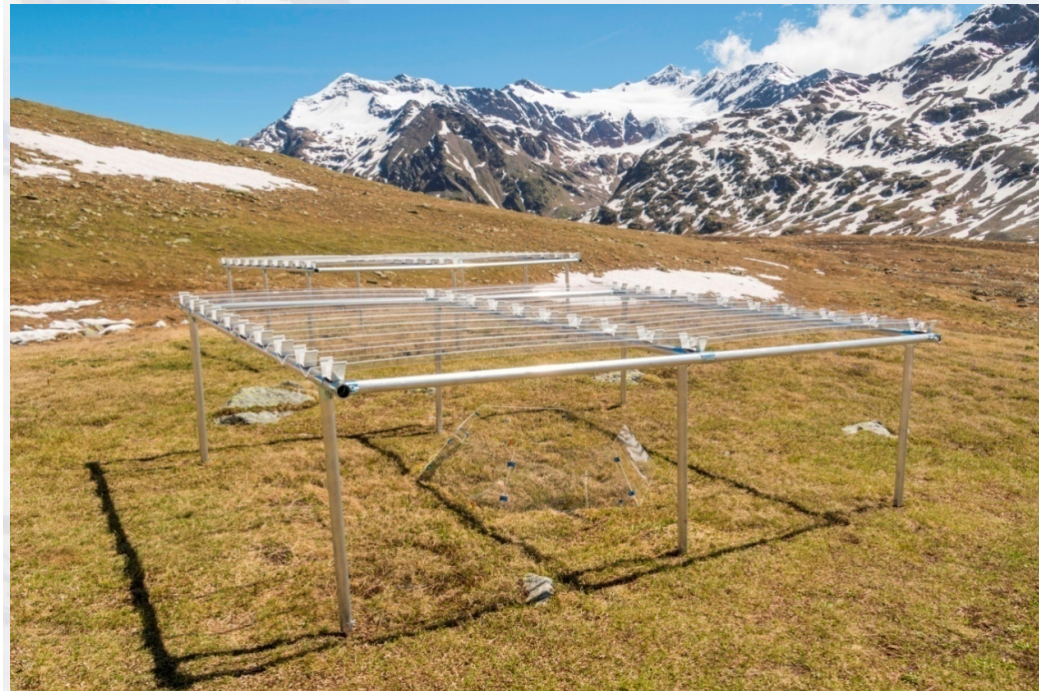
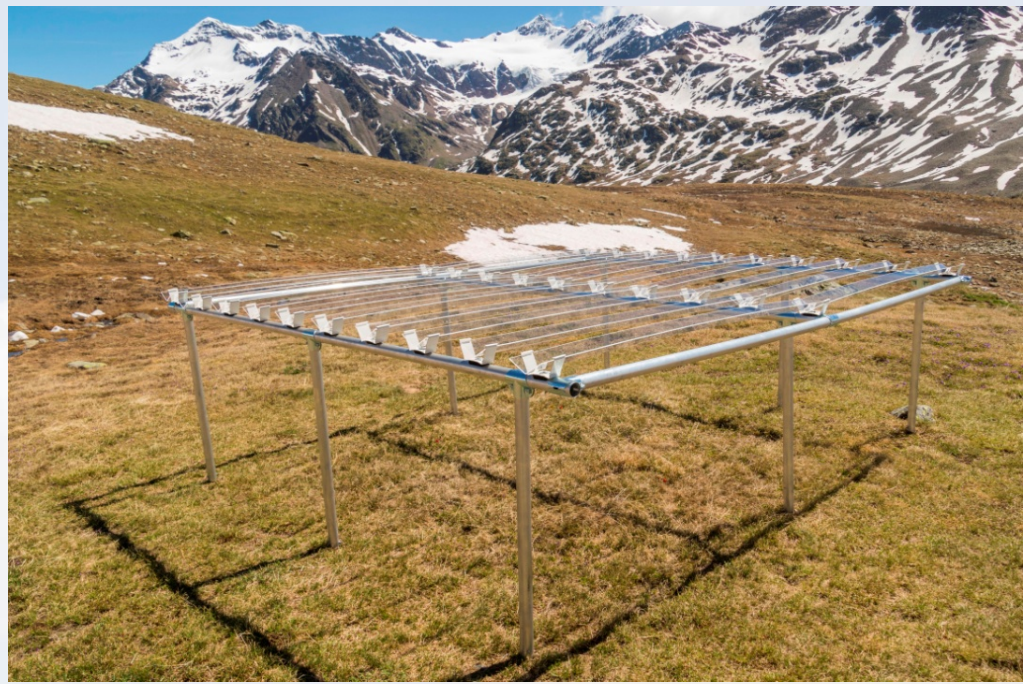
Project Journal:


THURSDAY, SEPTEMBER 27, 2018

Photos Gavia study site - summer 2018







A scenic mountain landscape. In the foreground, a lush green field is filled with numerous small, white, daisy-like flowers. The middle ground shows a grassy slope leading up to a range of rugged, brown mountains. Patches of snow are visible on the mountain slopes and in the crevices. The sky is a clear, bright blue.

GRAZIE PER L'ATTENZIONE