

***Climate, gradients, experiments,  
traits***

***& how the Peru course fits in***

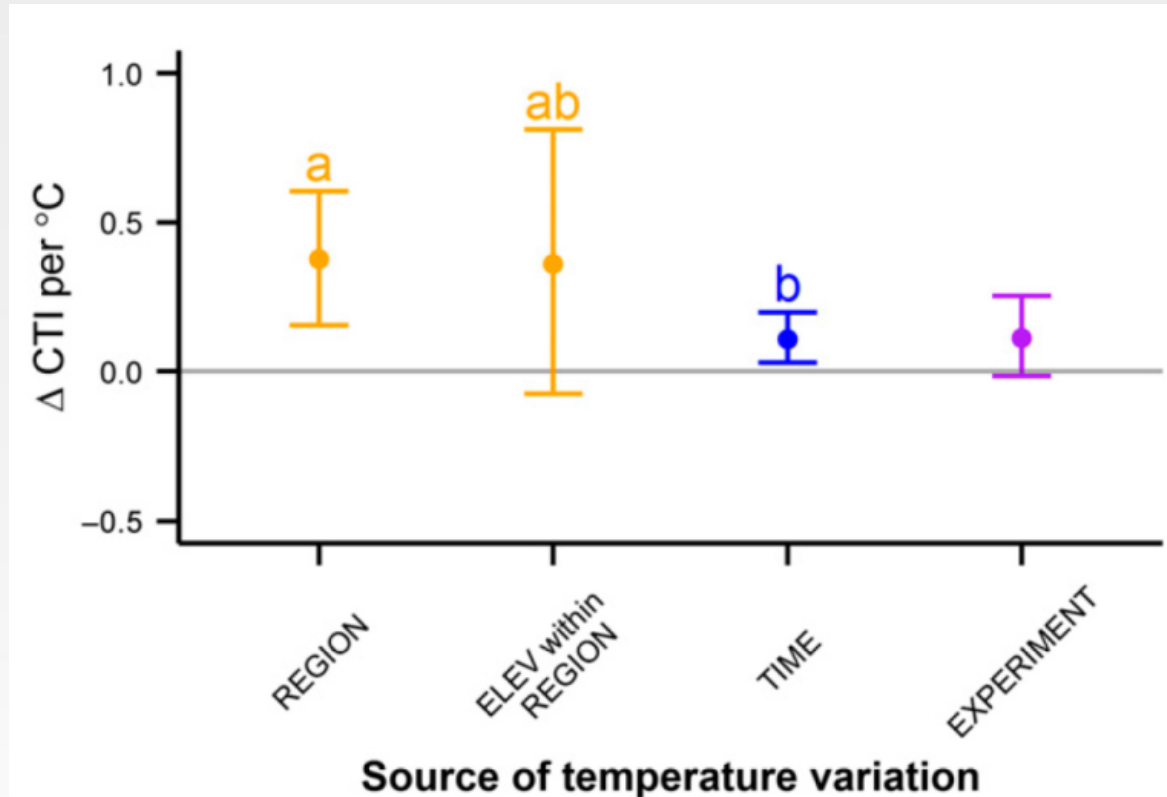
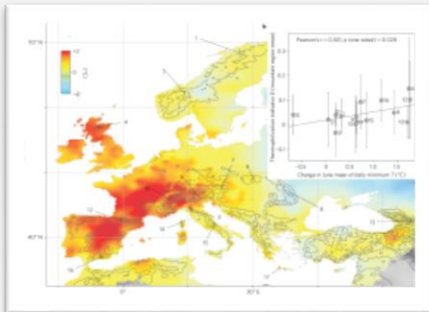
Vigdis Vandvik  
@vvandvik

# Climate change impacts on plants: different approaches; different answers

- **EXPERIMENTS**



- **RE-SAMPLING**



- **OBSERVATIONS ALONG GRADIENTS IN TIME/SPACE**
- **MODELS (ESM, SDM,...)**

# Models, observations and experiments *ask different questions*



	Models	Observations	Experiments
TIME-SCALE	100 – 1000+	10 – 100 – (1000)	0 – 10
FOCUS	Long-term 'equilibrium'	Equilibrium, change	Transient dynamics, change, timelags
RESPONSES	Ecosystem & biodiversity state & trends	Species ranges, pools, ecosystem state	Extant community, ecosystem response
QUESTIONS	Ecosystem processes; state, flux, feedbacks, species' ranges	Evolutionary outcomes; Local adaptations, traits, species' losses, gains	Ecological processes; Direct / indirect effects, species' interactions, physiology, life-history..



**Summer  
temperature  
(4 – 15°C)**

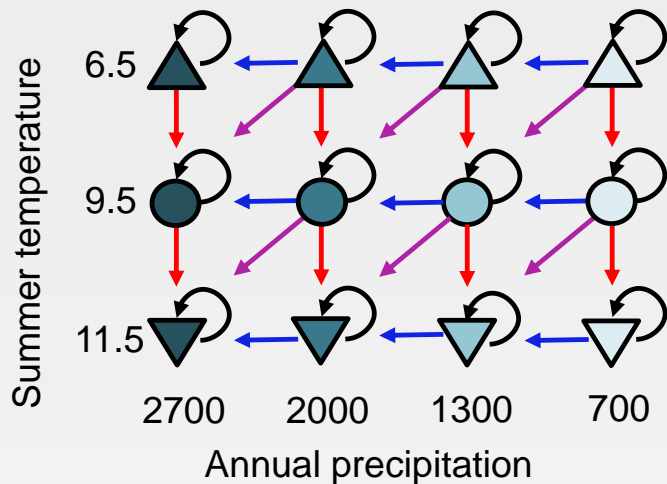
**Annual  
precipitation  
(500 – 3500mm)**

**1100 m ~ 6°C**

**Sognefjorden, western Norway.**

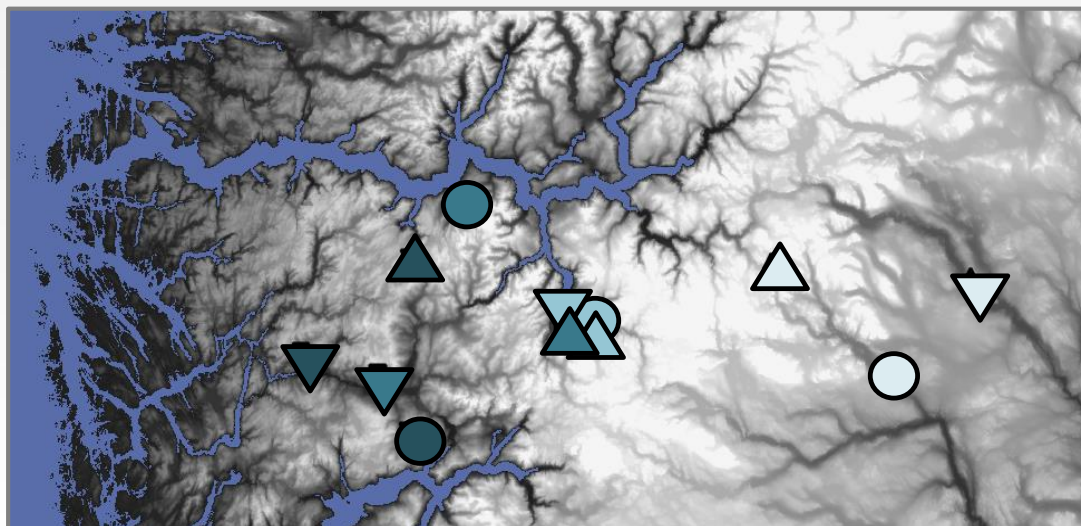


# The SEEDCLIM climate grid



**Summer  
temperature  
(4 – 15°C)**

**Annual  
precipitation  
(500 – 3500mm)**



(various RCN projects 2009- )





500 m.a.s.l.



## study system

Widely distributed

Small statured

Fine-grained

Reasonable timescales

High diversity

Climate responses

Processes, interactions

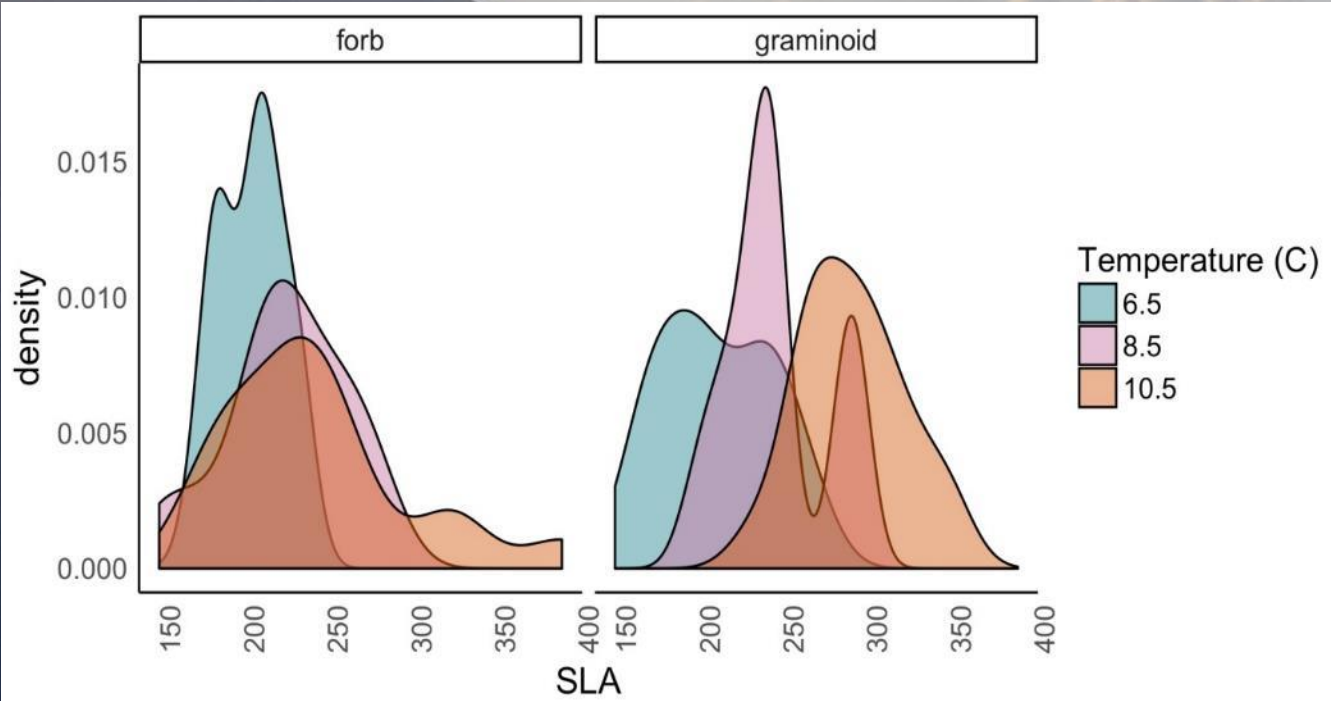
Ecological functions

Ecosystem services

1200 m.a.s.l.



# Leaf traits *change* along climate gradients..



Francesca Jaroszynska  
Ragnhild Gya

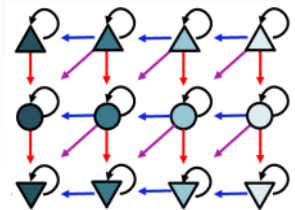


Aurland, Sogn, Norway

# Experiments allow digging into the underlying ecological mechanisms



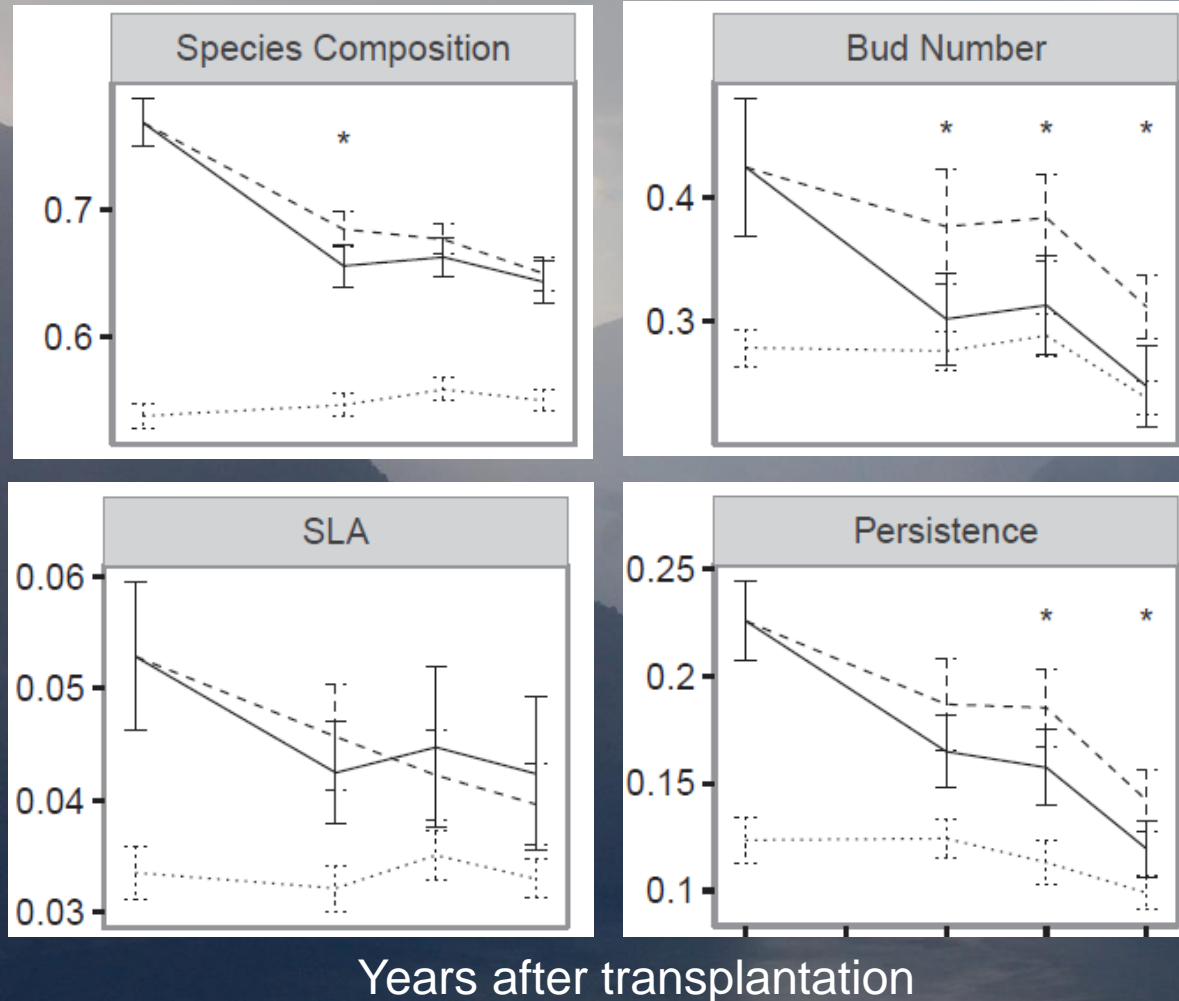
*We followed 7.452 Violas and Veronicas over seven years, counted and measured 72.093 leaves and 64.981 seedlings, & registered 194.784 plant occurrences ..... and counting.....*





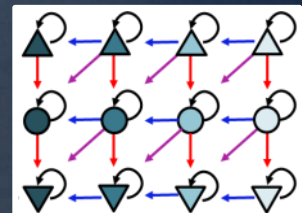
# Leaf traits *change*, but clonal traits *drive* those responses

Difference from 'destination' controls



(Guittar et al. 2017)

Aurland, Sogn, Norway



# Experiment to understand process 💧❤️🟢



## SEEDCLIM

*Transplants*

**Net CC effects on plants, communities, ecosystems**



## FUNCAB

*Graminoid x forb x bryophyte removal*

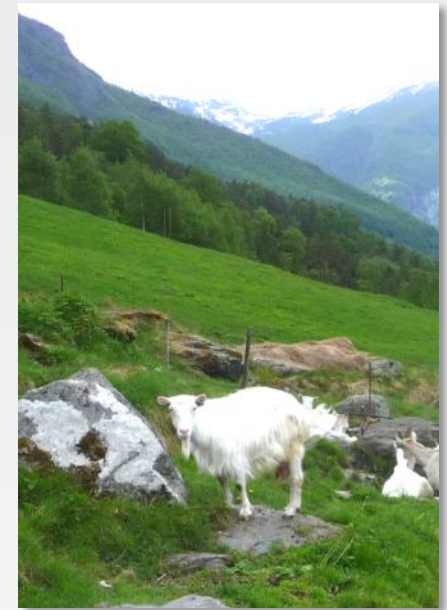
**Indirect effects of changed interactions**



## INCLINE

*Transplants & OTCs*

**Disentangling direct and indirect CC effects**



## THREE-D

*Transplants x grazing x nitrogen*

**Interactive effects of global change drivers**



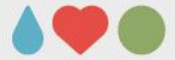
(Guittar et al. Ecology 2016)

(Olsen et al. GCB 2016)

(Althuizen et al. GCB 2018)



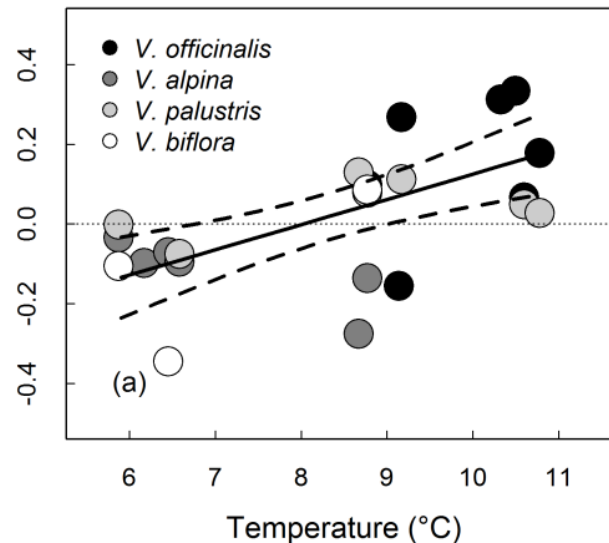
# Climate context-dependencies:



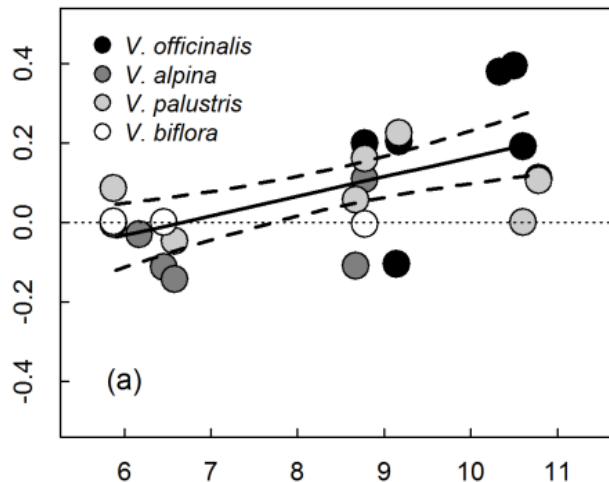
## Competition at warm sites; facilitation in cold



$\Delta$  population  
growth rate ( $\lambda$ )



Contribution  
from survival



Siri Lie Olsen<sup>b</sup>

(Olsen et al GCB 2016)

# A climate change condendum: responses are context-dependent



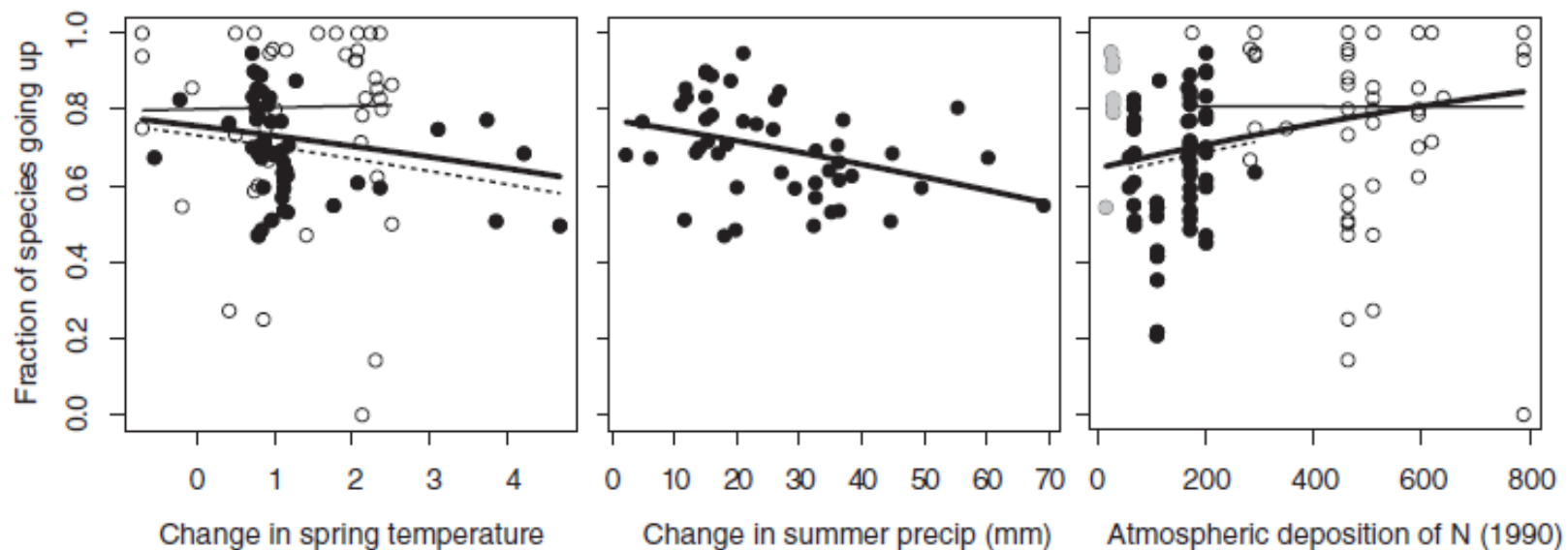
*Global Ecology and Biogeography, (Global Ecol. Biogeogr.) (2014) 23, 876–884*

RESEARCH  
PAPER



## Identifying the driving factors behind observed elevational range shifts on European mountains

John-Arvid Grytnes<sup>1\*</sup>, Jutta Kapfer<sup>1,2</sup>, Gerald Jurasinski<sup>3</sup>, Hilary H. Birks<sup>1</sup>, Hanne Henriksen<sup>4</sup>, Kari Klanderud<sup>4</sup>, Arvid Odland<sup>5</sup>, Mikael Ohlson<sup>4</sup>, Sonja Wipf<sup>6</sup> and H. John B. Birks<sup>1,7,8</sup>





# To understand this variability: Replicate TransPlant exp's!



TransPlant Network Sites



RECITE RCN INTPART 2018-2022  
INCLINE RCN FRIMEDBIO 2018-2022  
ERC Jake Alexander, ETH Zürich



Jake  
Alexander



Chelsea  
Chisholm



Thomas  
Walker



Aud  
Halbritter

ETH Zürich



Vigdis  
Vandvik



Joachim  
Töpper



Dagmar  
Egelkraut



Richard  
Telford





**Mt Gongga, China**

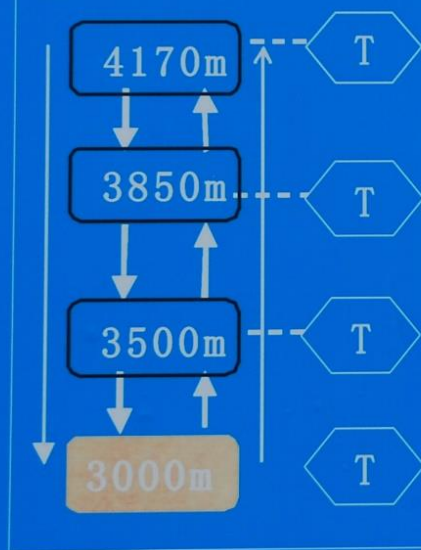


# 中挪国际合作试验基地

Modulating Experimental Sites between China

Norway

Altitude (m)



3000梯度位移试验样地

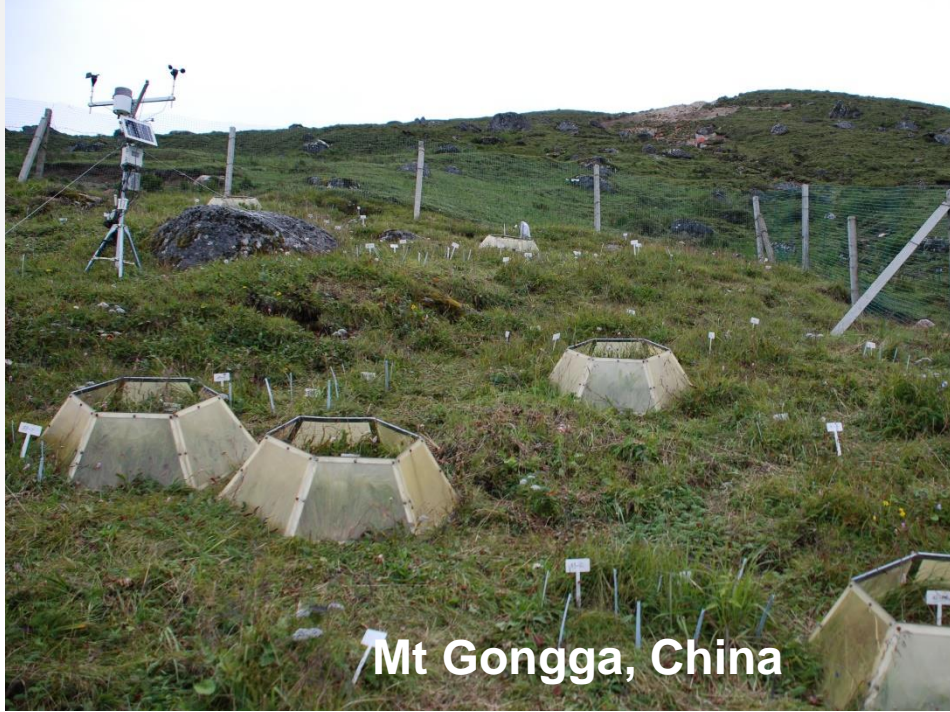
测定指标：空气温湿度、  
土壤温湿度、  
植物和土壤群落动态

试验样地示意图

Schematic presentation for the  
“Transplant and Warming(T)  
Experiment

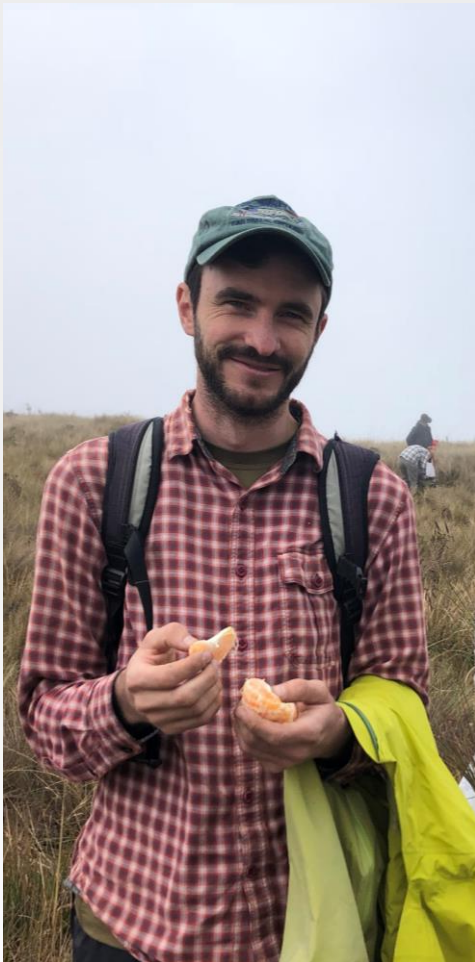
责任人：王根绪，杨燕，冉飞，常瑞英  
中国科学院成都山地灾害与环境研究所







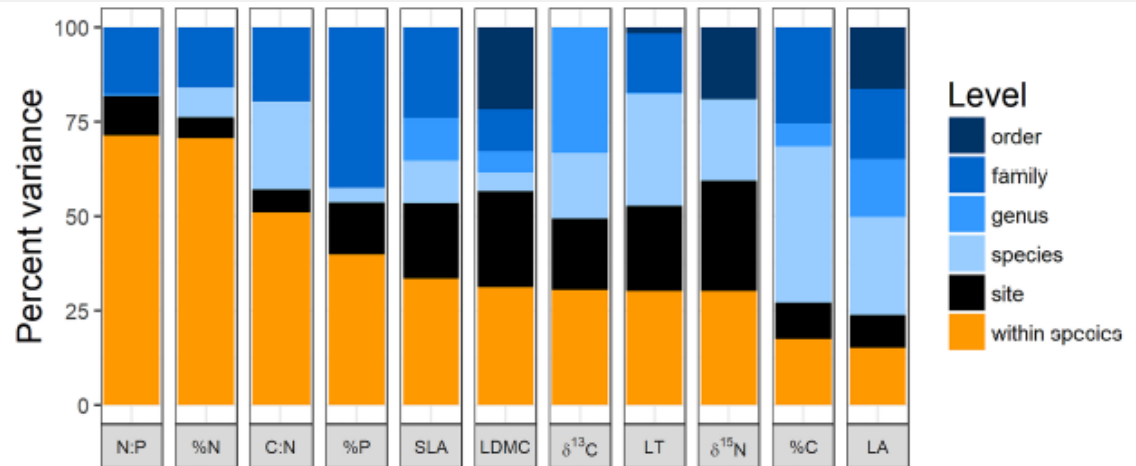
# PFTC1 & 2: What did we find?



Jon Henn

## Intraspecific Trait Variation and Phenotypic Plasticity Mediate Alpine Plant Species Response to Climate Change

Jonathan J. Henn<sup>1\*</sup>, Vanessa Buzzard<sup>2</sup>, Brian J. Enquist<sup>2</sup>, Aud H. Halbritter<sup>3,4</sup>, Kari Klanderud<sup>5</sup>, Brian S. Maitner<sup>2</sup>, Sean T. Michaletz<sup>6,7</sup>, Christine Pötsch<sup>3</sup>, Lorah Seltzer<sup>2</sup>, Richard J. Telford<sup>3,4</sup>, Yan Yang<sup>8</sup>, Li Zhang<sup>8</sup> and Vigdis Vandvik<sup>3,4</sup>



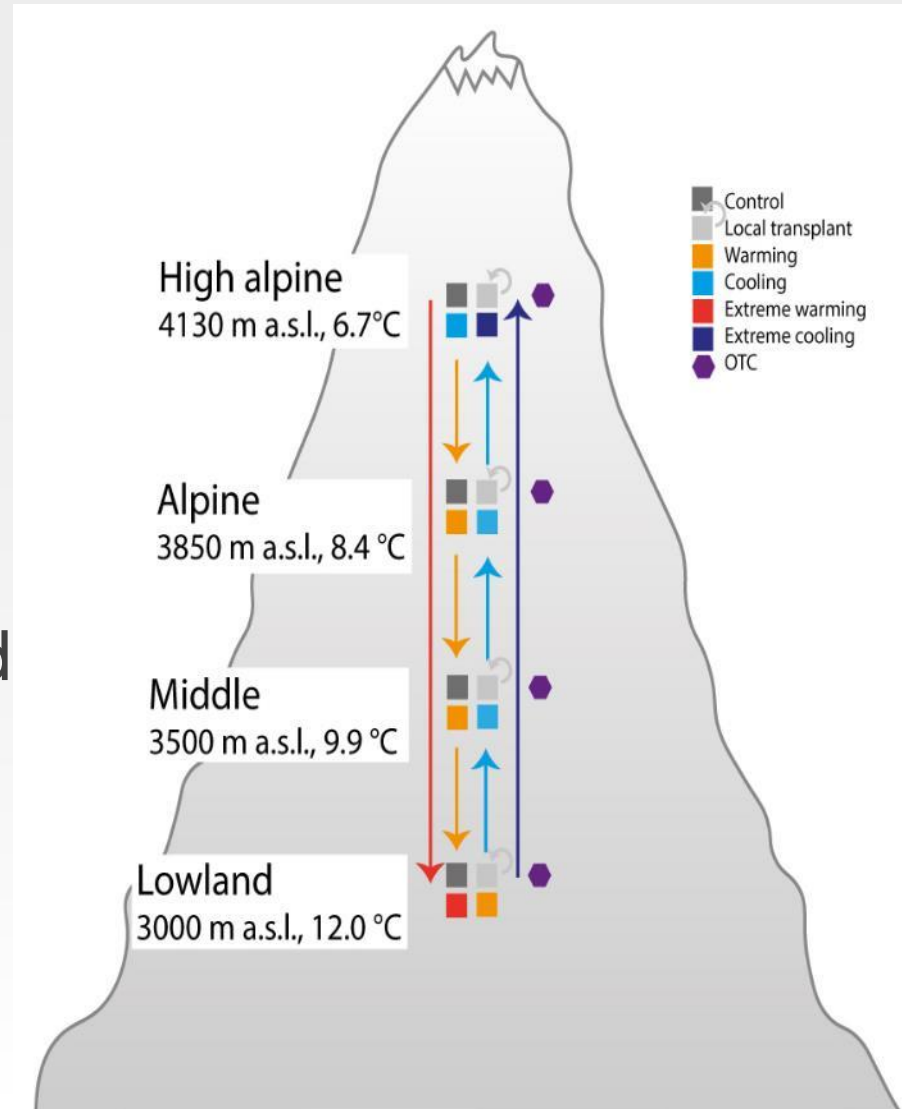
(Henn et al. Frontiers 2018)



# PFTC1 & 2: What did we learn?



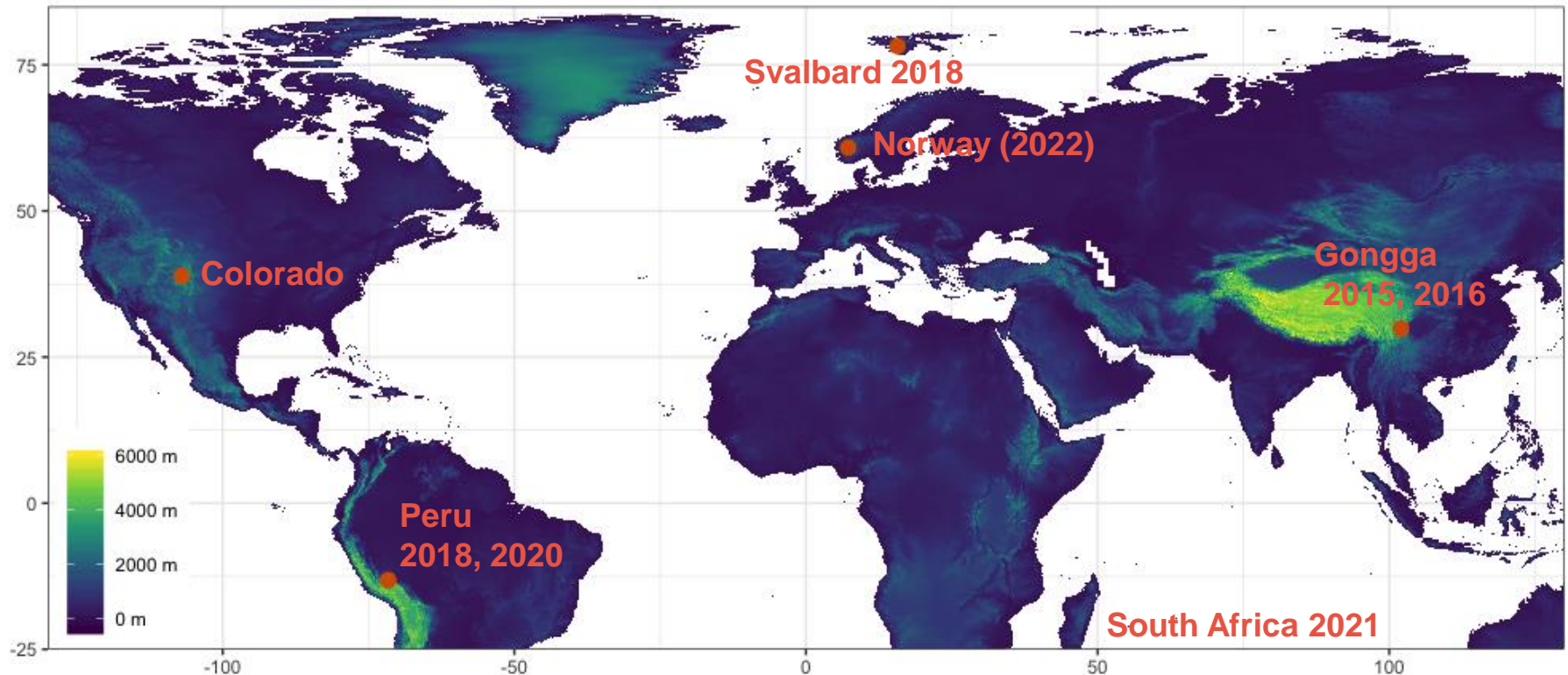
- We can collect loads of cool data in a short time!
  - **193 taxa (100 new)**
  - **6671 leaves**
  - **36.743 trait datapoints (+600%)**
  - **C fluxes, photosynthesis, ....**
- Managing the fieldwork, data, people is harder, and more important, than we first realized...
- **Data documentation!!\***



\*we are now writing up the PFTC data as 'data papers' – you'll be participating for Peru!



# Plant Functional Traits Courses



Collect comparative data along gradients

- [vegetation], leaf traits, ecosystem C fluxes, photosynthesis, imagery,

Tag onto existing studies, experiments

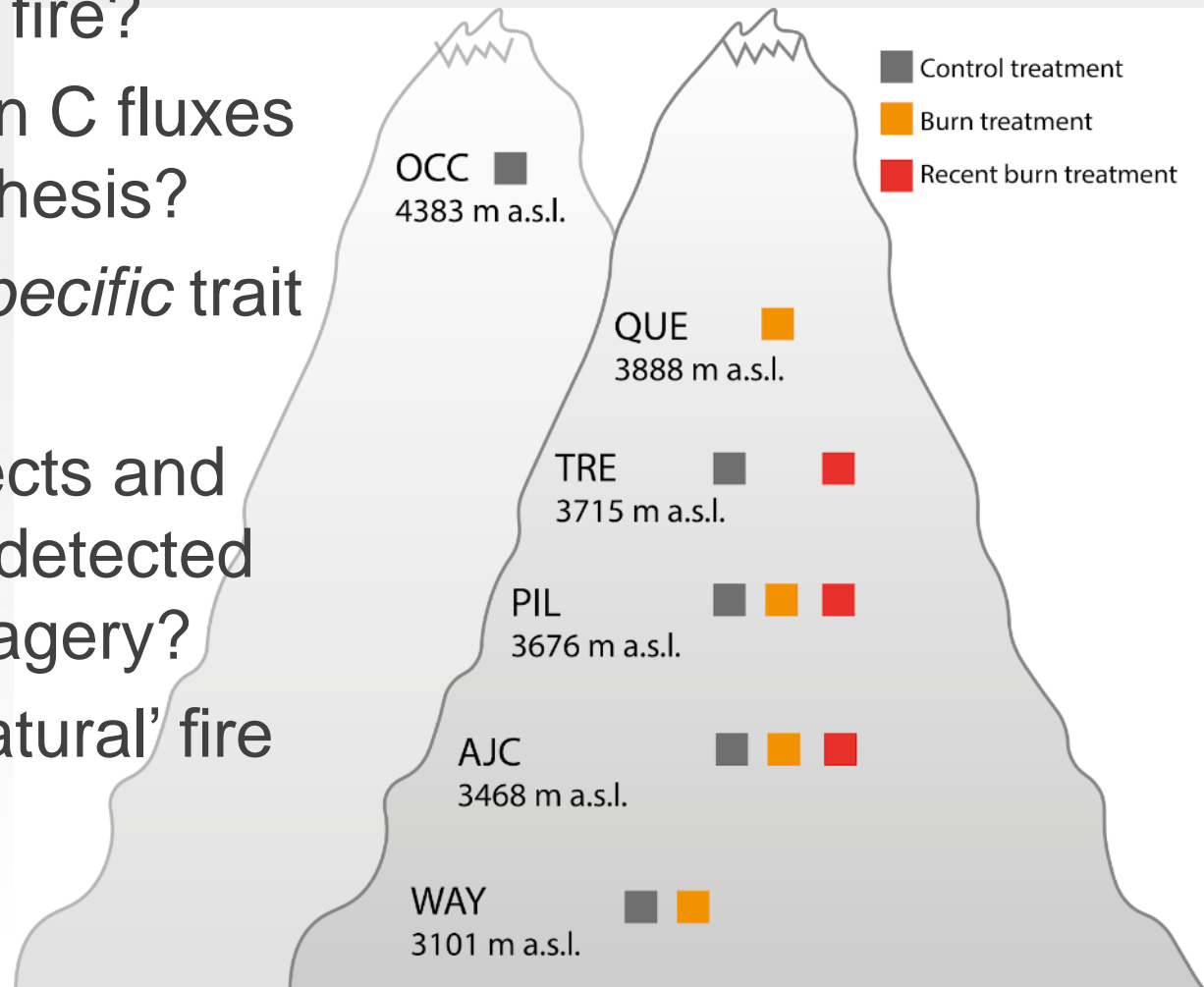
- augment with detailed trait-related data



# PFTC 3 & 5: Wayquecha, Peru



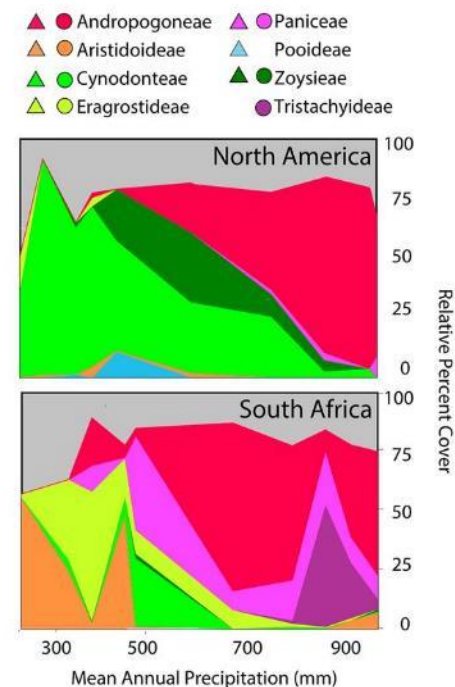
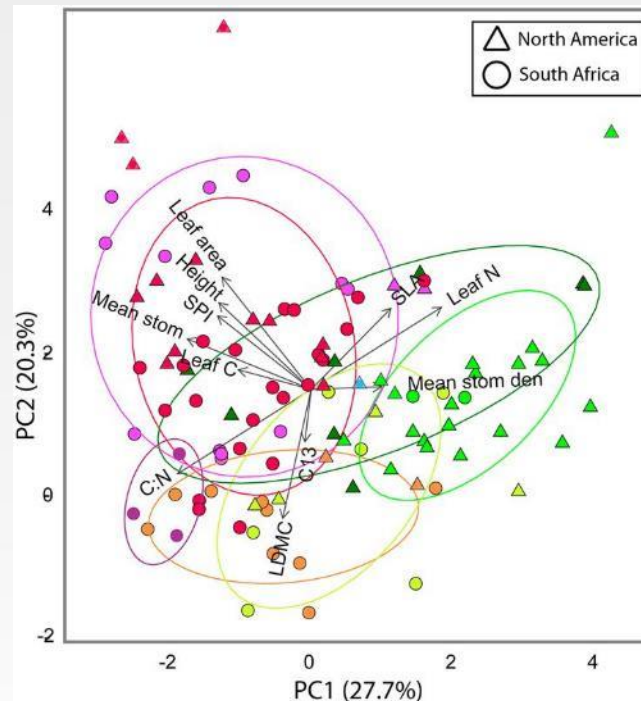
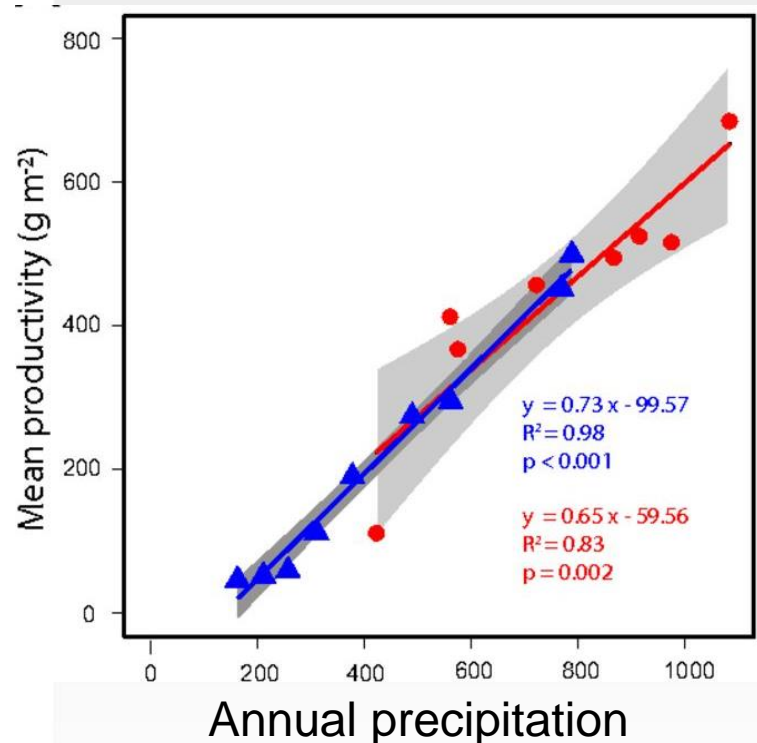
- What are trait *responses* to altitude and fire?
- ..trait *effects* on C fluxes and photosynthesis?
- ..role of *intraspecific* trait variability?
- Can these effects and responses be detected from drone imagery?
- Exploring a 'natural' fire experiment...



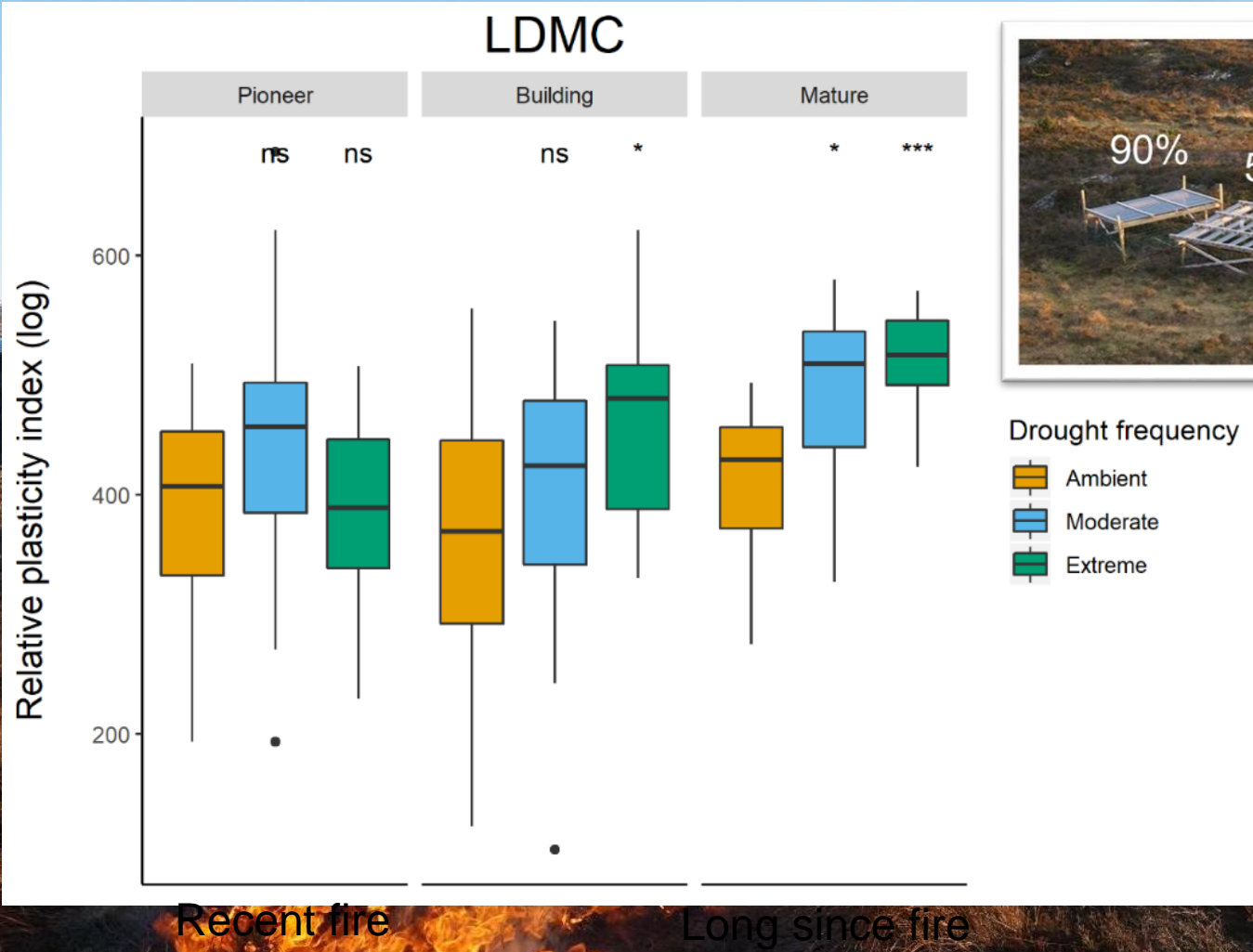




# Comparative: Are trait / function trends repeated across regions? Why (not)?



# Local context: Fire as a driver of function, trait variation - community, plasticity





# Why this focus on \*documenting\* projects, experiments, and data?



Open Science

Open Data

Open Source

Open Methodology

Open Peer Review

Open Access

Open Educational Resources



#spidergate





It's not enough for data to be open:  
they also need to be

F<sub>indable</sub>



A<sub>ccessible</sub>



I<sub>nteroperable</sub>



R<sub>eusable</sub>





# An advertisement....



os://www.britishecologicalsociety.org/publications/guides-to/



Our Journals ▾

Ecological Reviews

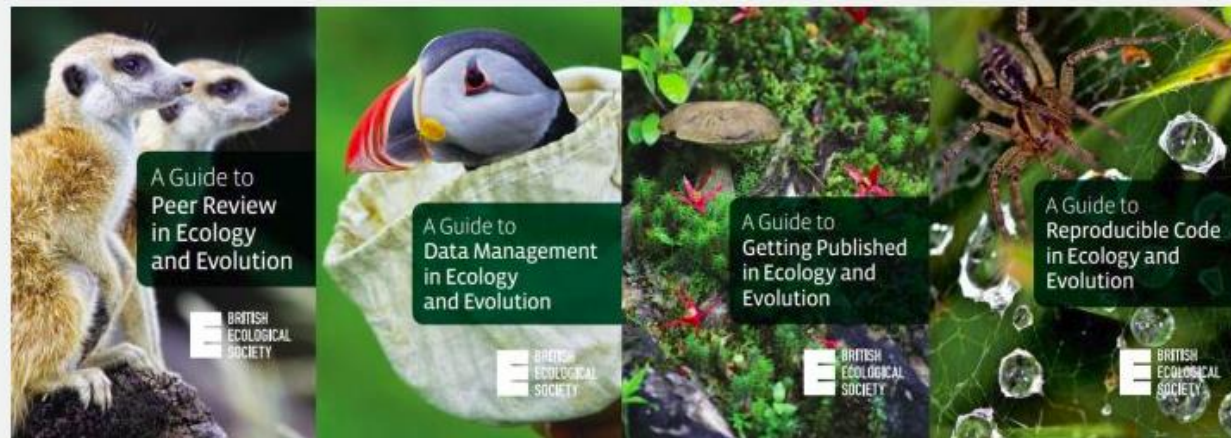
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ciety.org/publications/ecological-reviews/

The way we do science is changing – data are getting bigger, analyses more complex, and management, funding, and the scientific method itself demand transformation and



# What does it take for your data to be useful beyond *your perfect papers*?

## Methods in Ecology and Evolution



RESEARCH ARTICLE |  Full Access

### The handbook for standardised field and laboratory measurements in terrestrial climate-change experiments and observational studies (ClimEx)

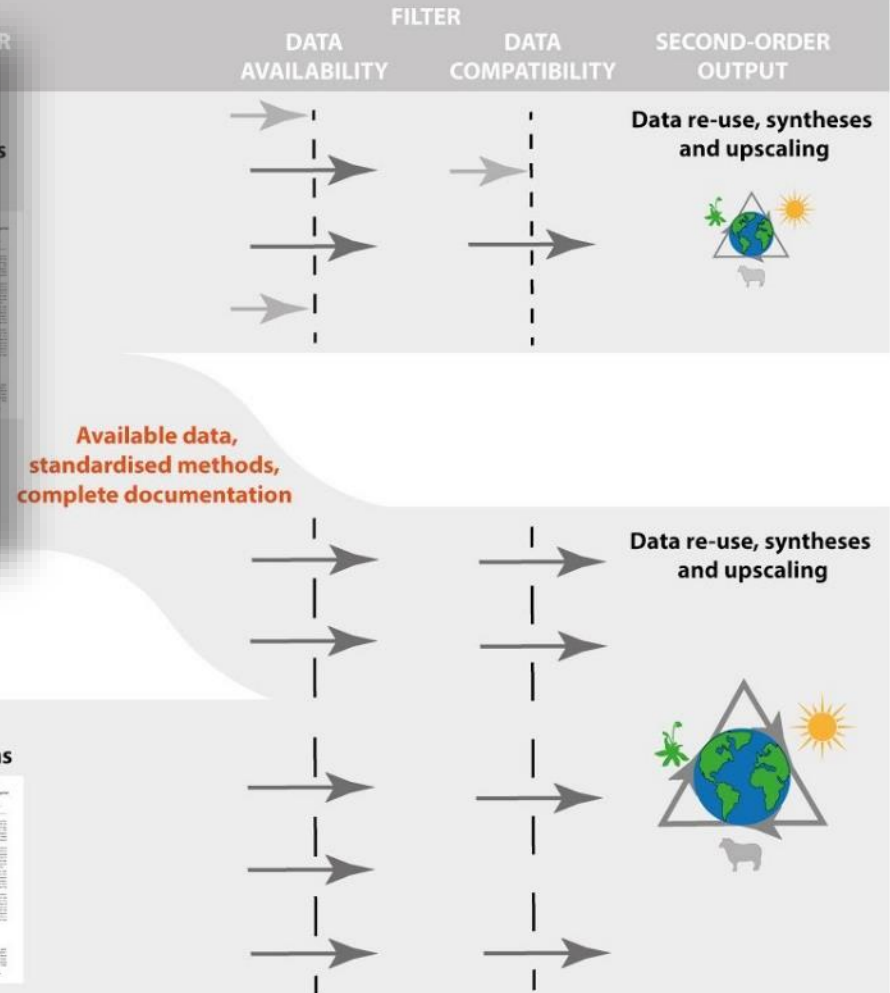
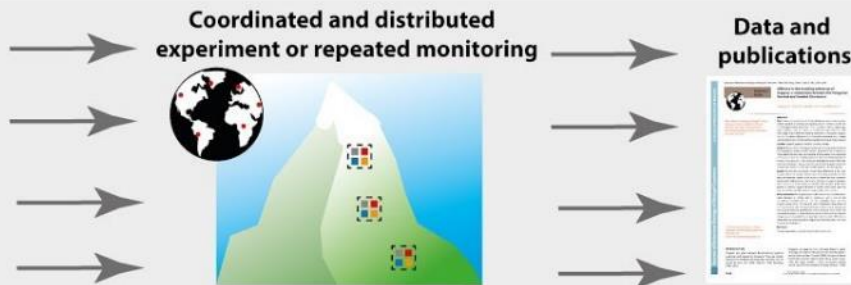
Aud H. Halbritter , Hans J De Boeck, Amy E. Eycott, Sabine Reinsch, David A. Robinson, Sara Vicca, Bernd Berauer, Casper T. Christiansen, Marc Estiarte, José M. Grünzweig, Ragnhild Gya, Karin Hansen, Anke Jentsch, Hanna Lee, Sune Linder, John Marshall, Josep Peñuelas, Inger Kappel Schmidt, Ellen Stuart-Haëntjens, Peter Wilfahrt, The ClimMani working group, Vigdis Vandvik   
... See fewer authors ^

First published: 05 November 2019 | <https://doi.org/10.1111/2041-210X.13331>

[Go here for SFX](#)

CHALLENGE

SOLUTION



(Halbritter et al. MEE 2020) > 500 page of detailed methods descriptions!!



# Gradients, experiments, traits: Beyond «parallel play»?



‘knobs’  
grain & extent  
predictors  
responses

@ Bergen kommune



# Gradients, experiments, traits...



- 1. Be tidy, documented, robust, Open, FAIR**
  - Believe us!!!\*
- 2. Do combine gradients and experiments**
  - Because they ask [partly] different questions!
  - To explore context-depenencies
  - Because they have different strengths [detail vs. duration]
- 3. Optimise study design both within & among sites**
  - Gradients in geographic vs. environmental space
  - Isolate focal factors, minimise confounding
  - Design experiments to address both local and gradient-wide questions
- 4. Make room for (yet) another experiment**
  - Additional experiments can answer new questions
  - Sites are infrastructure others can use
- 5. Join networks, use common protocols, share data**
  - Facilitate coordinated experiments, metaanalysis, data (re)use
- 5. Measure responses / covariates synthesis needs!**
  - Vegetation, traits, soil structure, ecosystem properties, rates and fluxes...

..**[to be continued]**



\*[Actually, no need. We'll get back to all of this in Peru....]





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UNIVERSITY OF BERGEN



Andrew Hendry

@EcoEvoEvoEco



Following

F\*\*k replication. F\*\*k controls  
Prioritize field experiments even if they have  
low replication & imperfect controls  
[ecoevoevoeco.blogspot.ca/2017/01/fk-rep ...](http://ecoevoevoeco.blogspot.ca/2017/01/fk-rep...)



RETWEETS

40

LIKES

41



7:50 AM - 1 Jan 2017

(full disclosure – I do have an inordinate fondness of field experiments)