www.dachsteingletscher.info

1885

I. Kühn

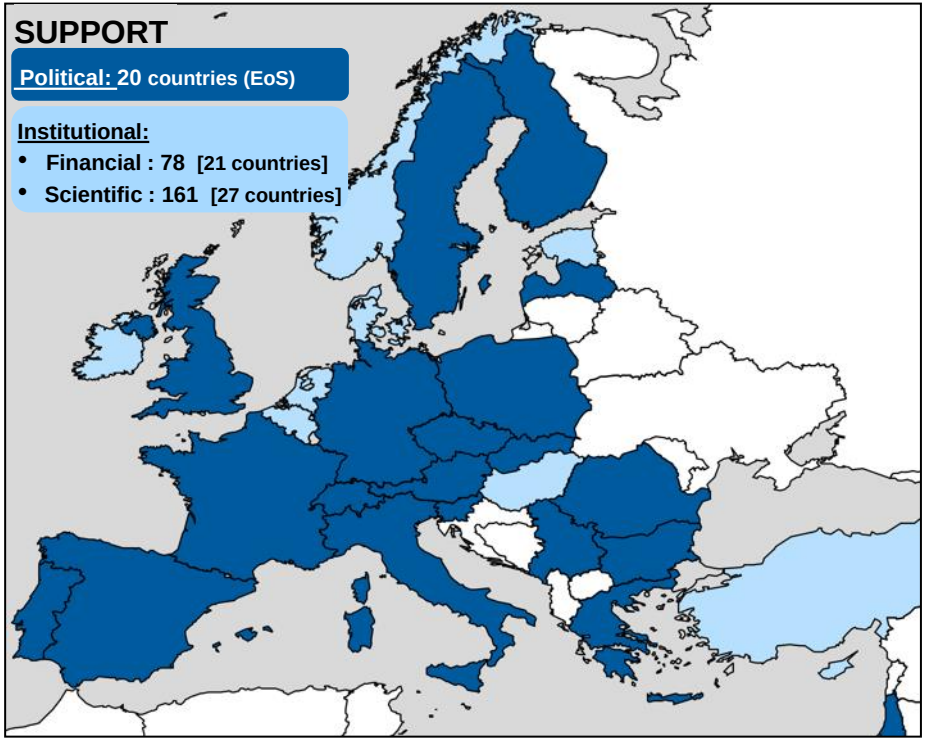
2016

Long term ecological research in the European Alps to uncover effects of Global Change (especially climate change and biological invasions)

Prof. Dr. Ingolf Kühn
Ingolf.kuehn@ufz.de

HELMHOLTZ CENTRE FOR ENVIRONMENTAL RESEARCH – UFZ

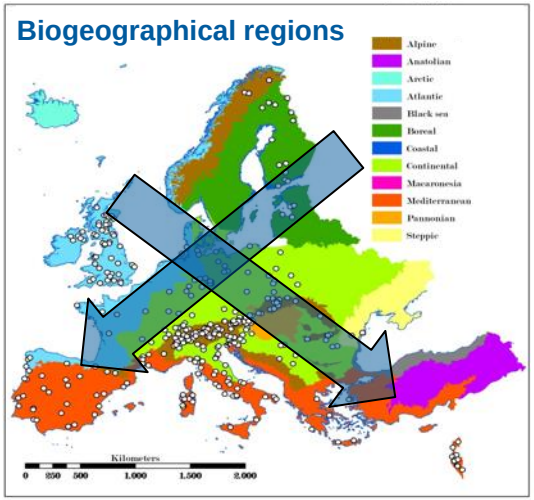
Integrated European Long-Term Ecosystem, critical zone & socio-ecological Research



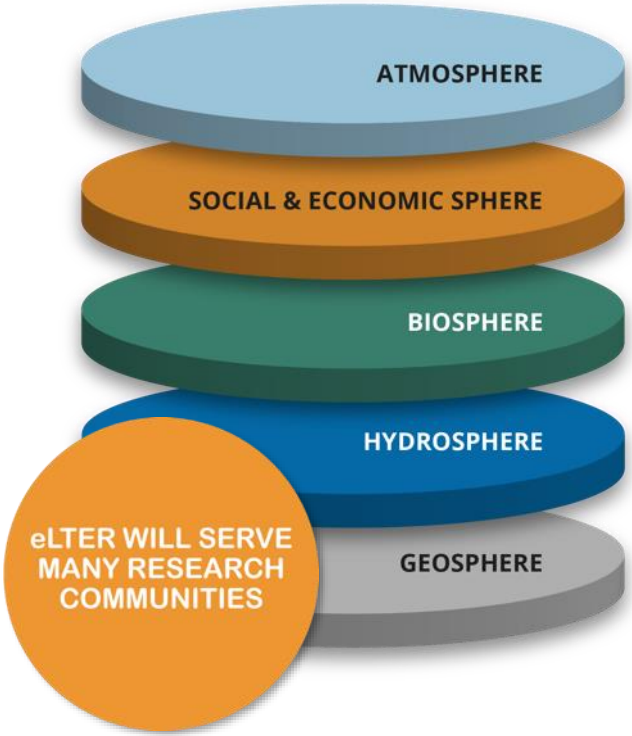
2018→ ESFRI Roadmap

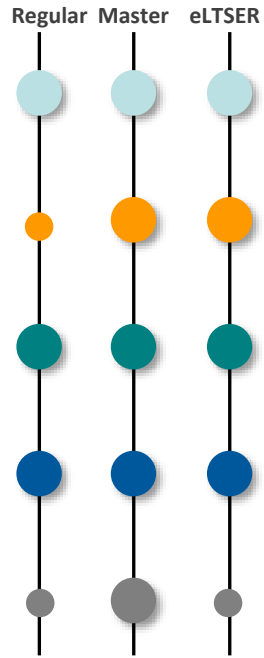
2020→ EU Preparatory Phase Project

2020→ EU Advanced Community Project



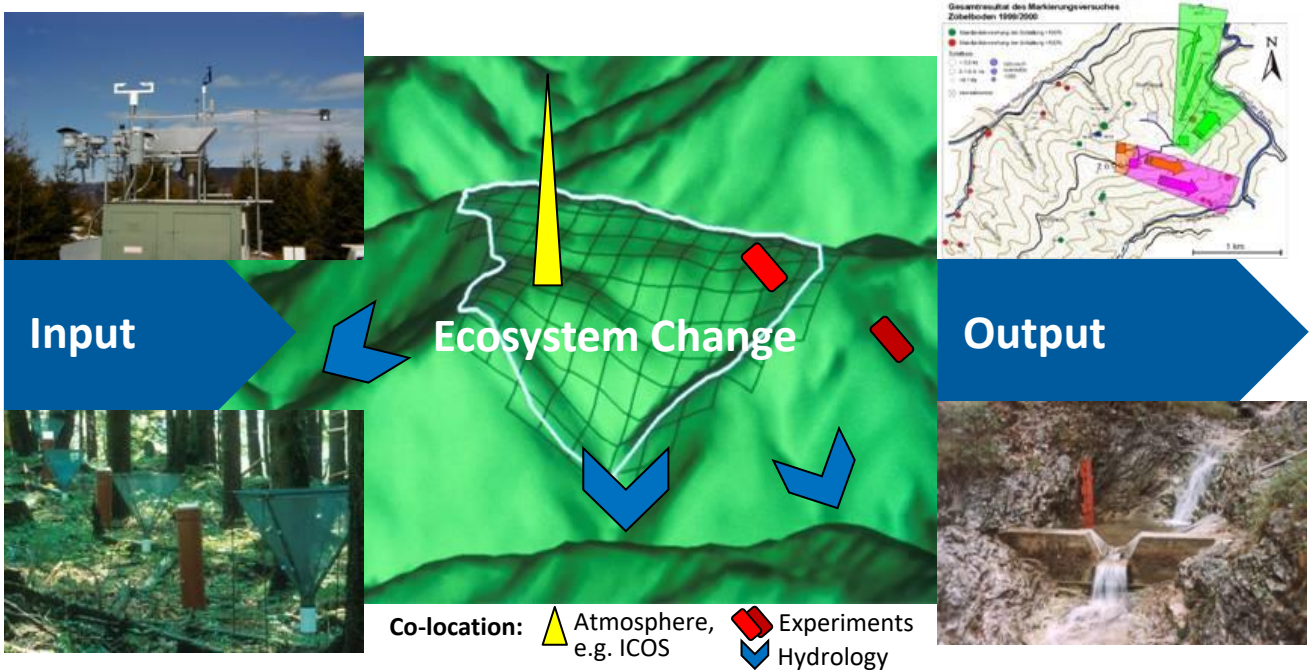
„Whole System“-approach & cross-disciplinarity





LTSER Eisenwurzen: Zöbelboden © LTER Austria

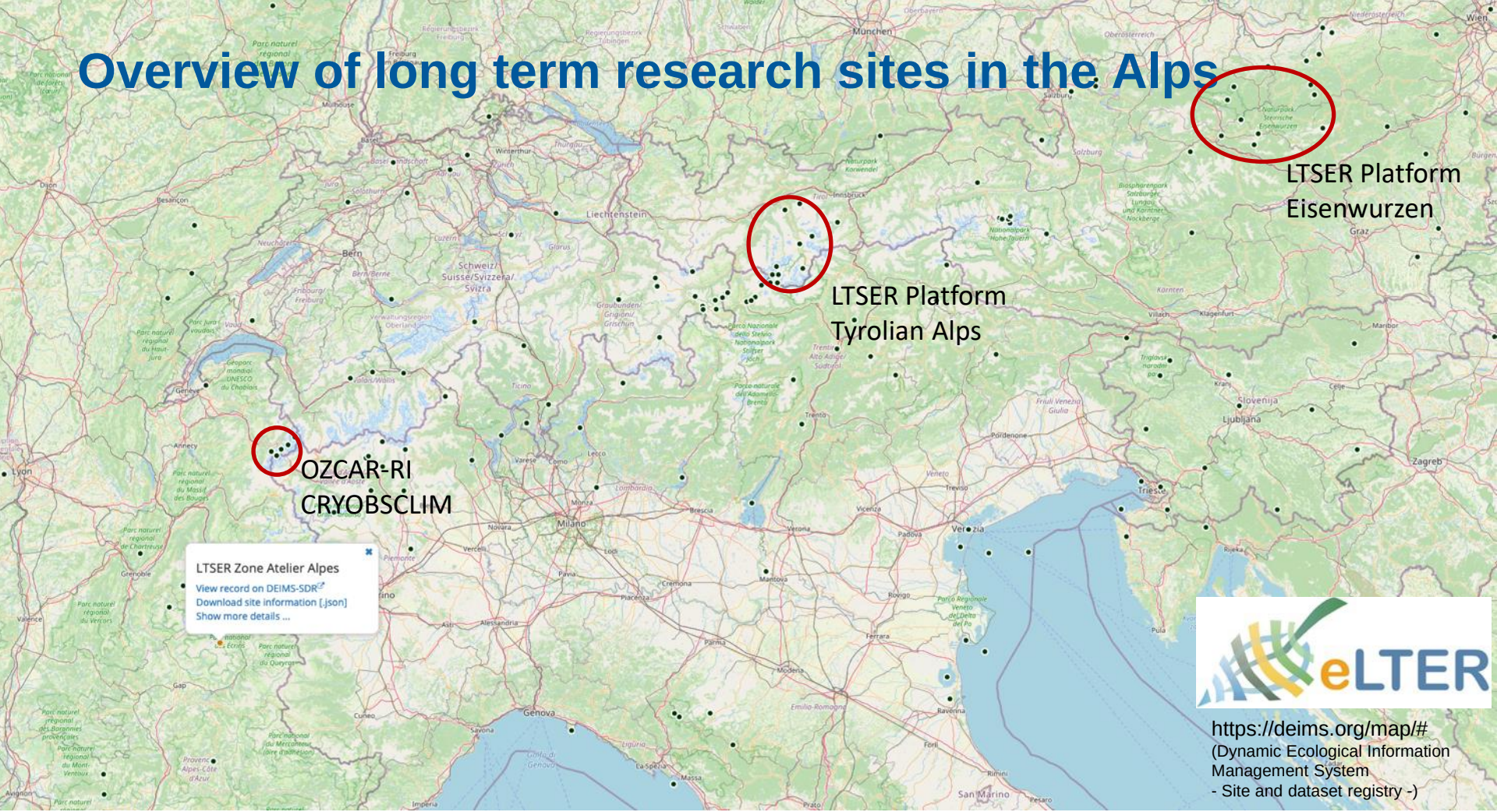
Example for eLTER Site design, activities and co-location



Observed and investigated:

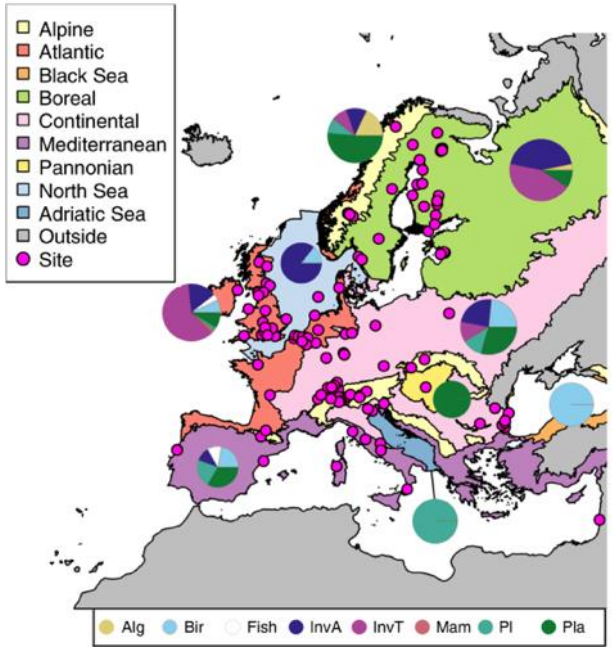
- System structure & functions
- Main drivers of change
- Interactions of slow/fast disturbance effects

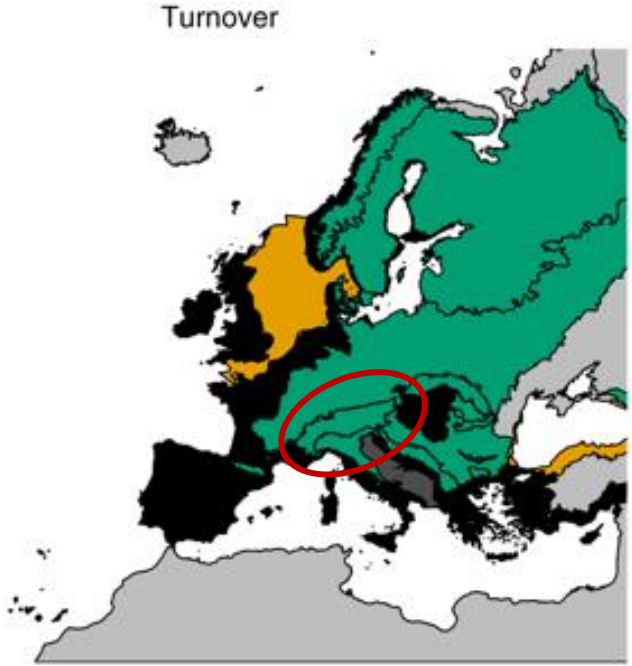
Overview of long term research sites in the Alps



https://deims.org/map/#
(Dynamic Ecological Information Management System
- Site and dataset registry -)

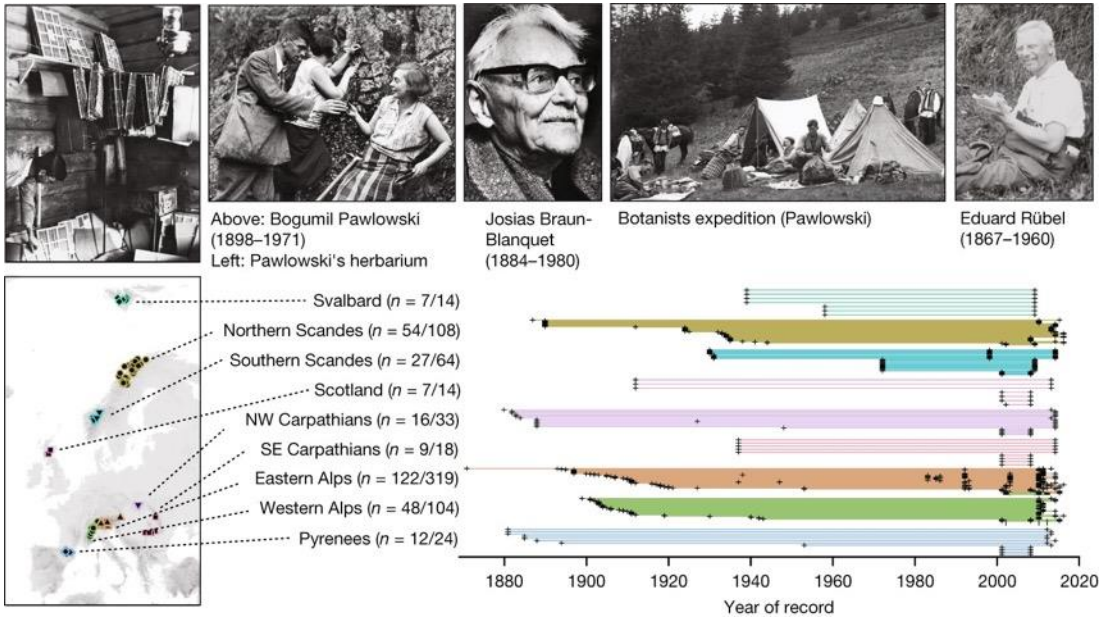
Meta-analysis of long-term biodiversity trends in Europe

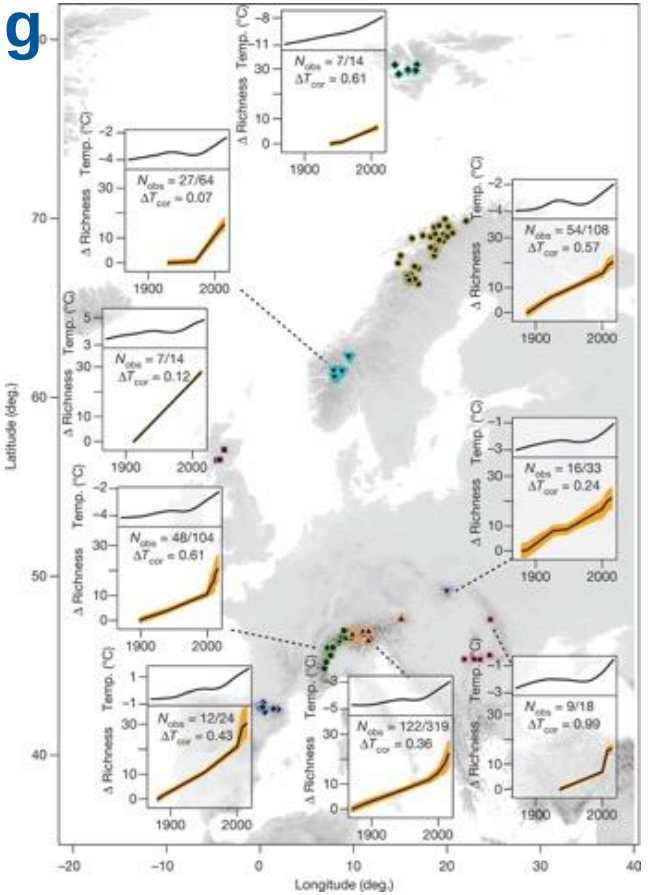




Pilotto, Kühn et al. 2020, *Nature Communications* 11: 3486.

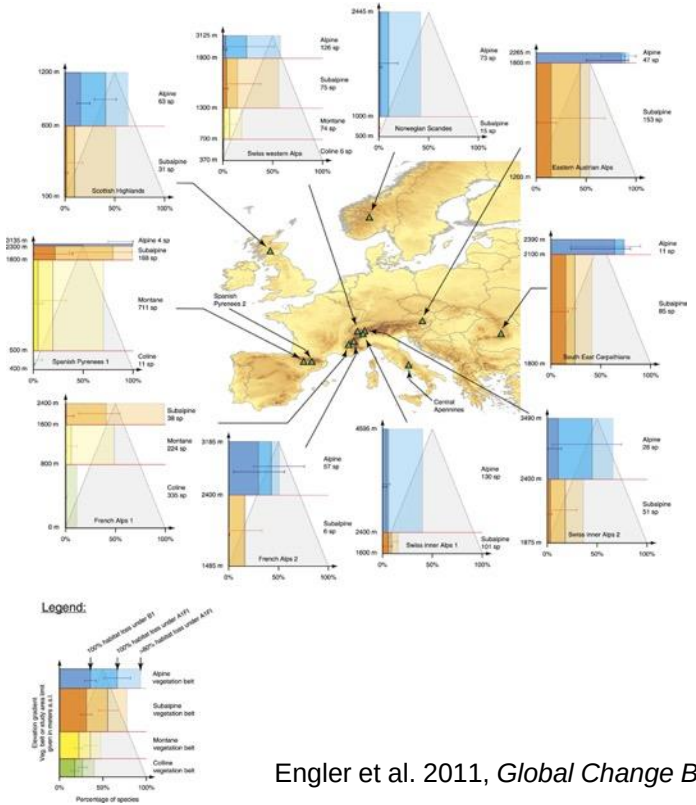
Accelerated increase in plant species richness on mountain summits is linked to warming





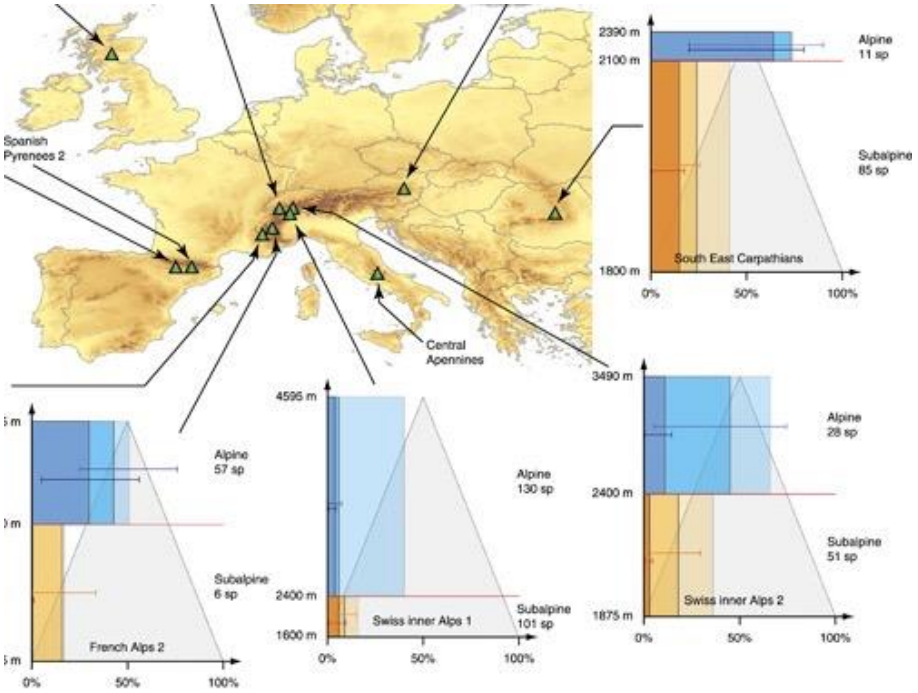
Steinbauer et al. 2018, *Nature* 556: 231-234

High altitude habitats suffer from Climate Change (CC) while low altitude habitats may benefit



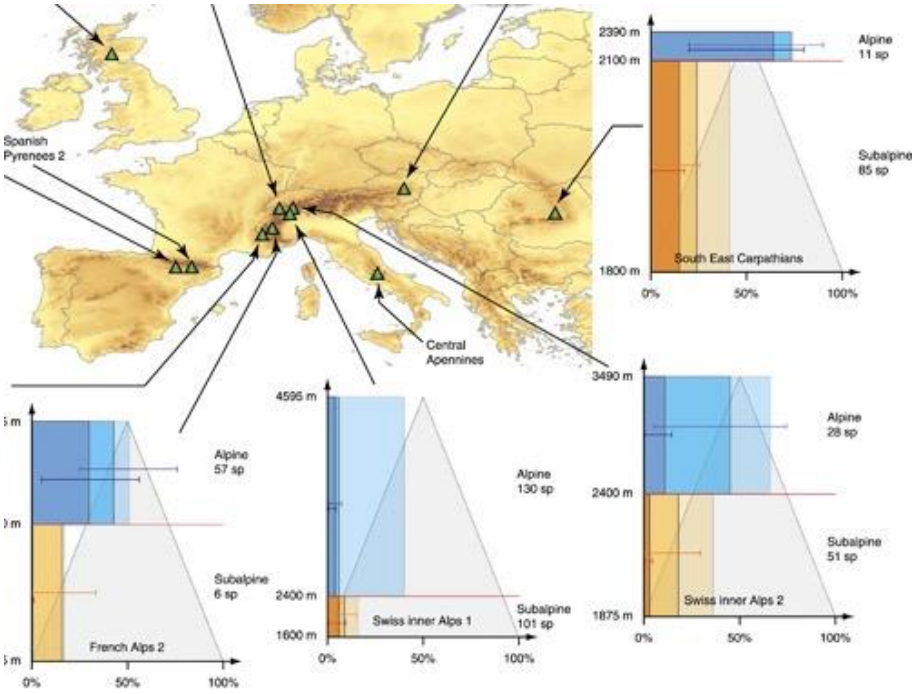
Engler et al. 2011, *Global Change Biology* 17: 2330-2341.

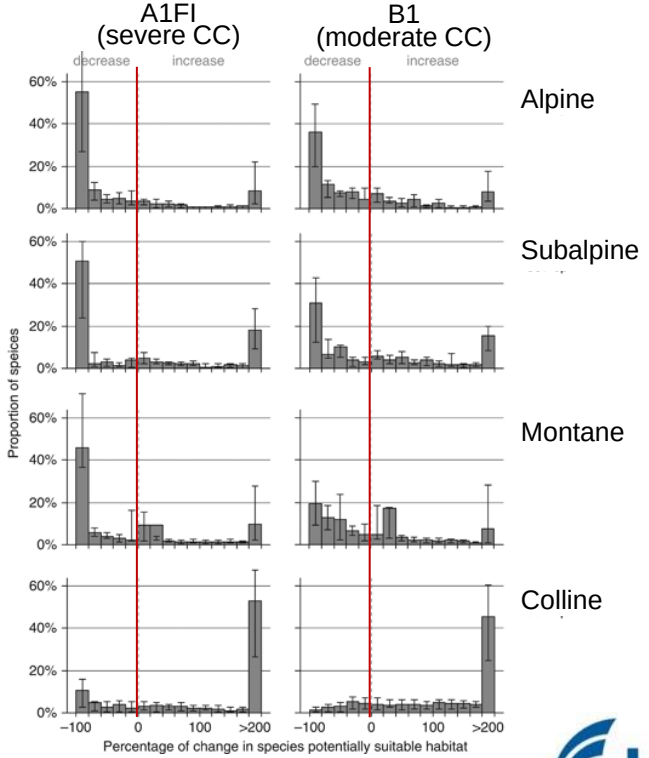
High altitude habitats suffer from Climate Change (CC) while low altitude habitats may benefit



Engler et al. 2011, *Global Change Biology* 17: 2330-2341.

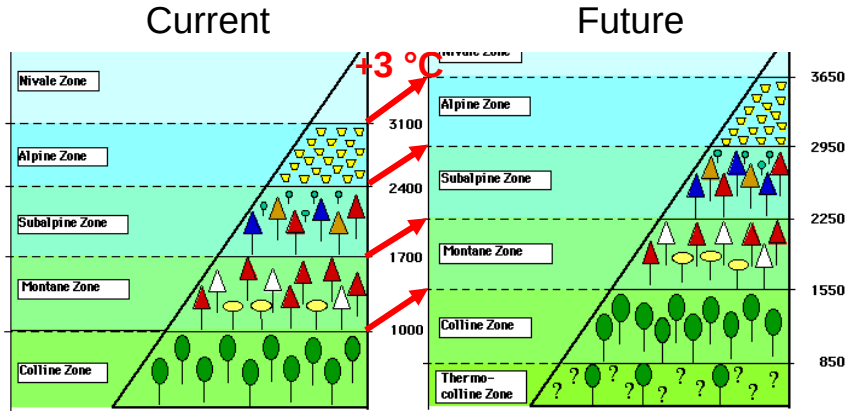
High altitude habitats suffer from Climate Change (CC) while low altitude habitats may benefit



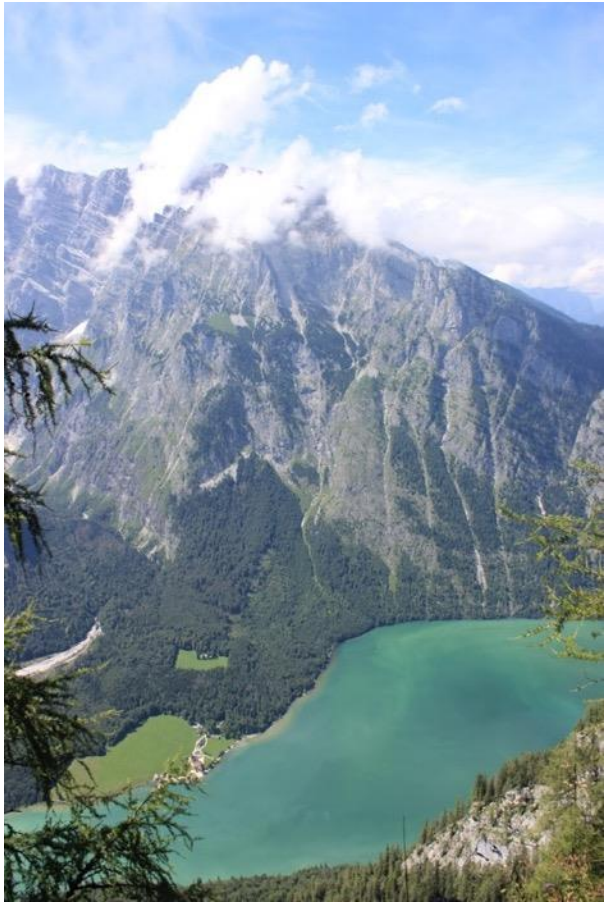


Engler et al. 2011, *Global Change Biology* 17: 2330-2341.

Shift of vegetation belts in the future?

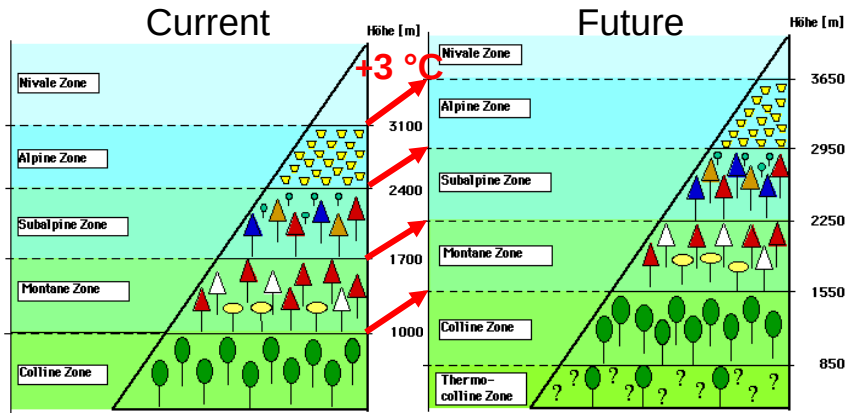


(Theurillat & Schönborn 2000)



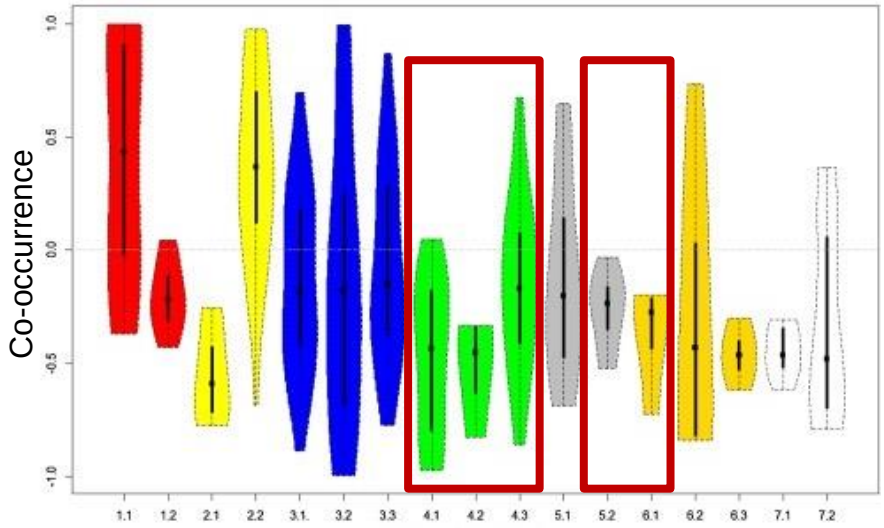
UFZ

Shift of vegetation belts in the future?



(Theurillat & Schönborn 2000)

Modelling species co-occurrence under Climate Change

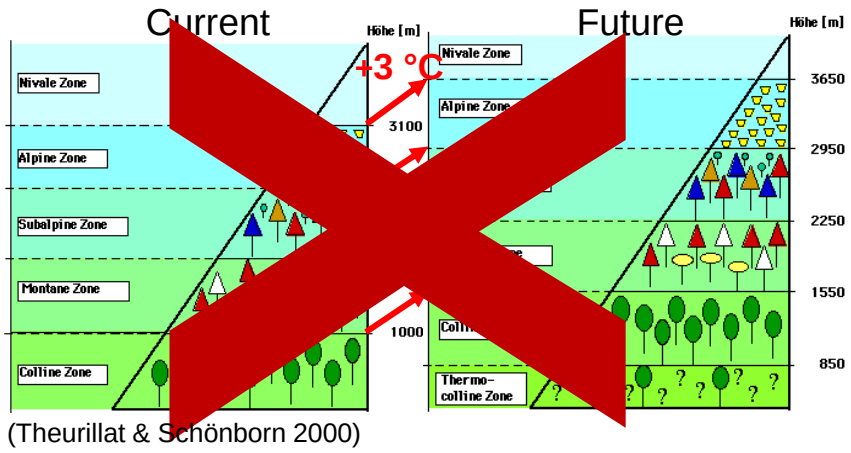


Baatar et al. 2019, Basic Appl Ecol 38: 23-35.

See also Pompe et al. 2010, Basic Appl Ecol 11: 603-611

→ Species co-occurrence in Alpine communities and their areas decrease

Shift of vegetation belts in the future?



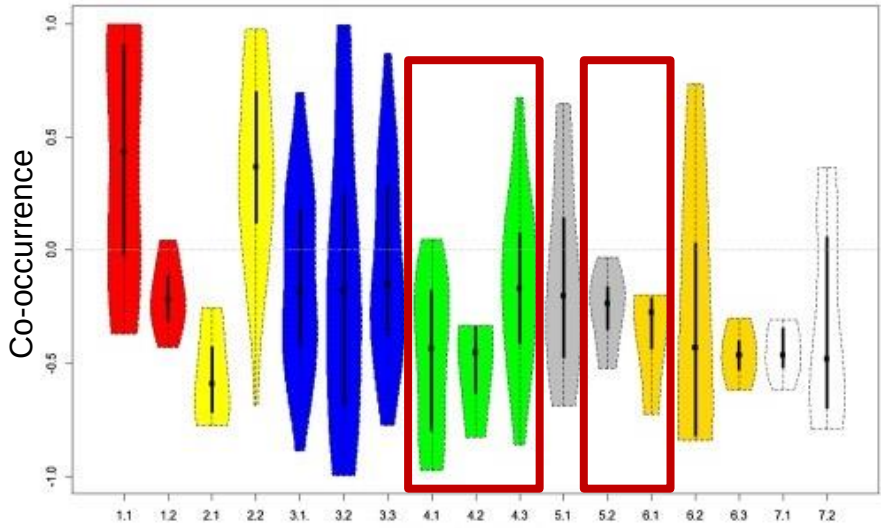
(Theurillat & Schönborn 2000)

- Neither belts, nor communities or species shift!
- Individuals disperse

→ Change in community composition

→ Future communitites may look different

Modelling species co-occurrence under Climate Change

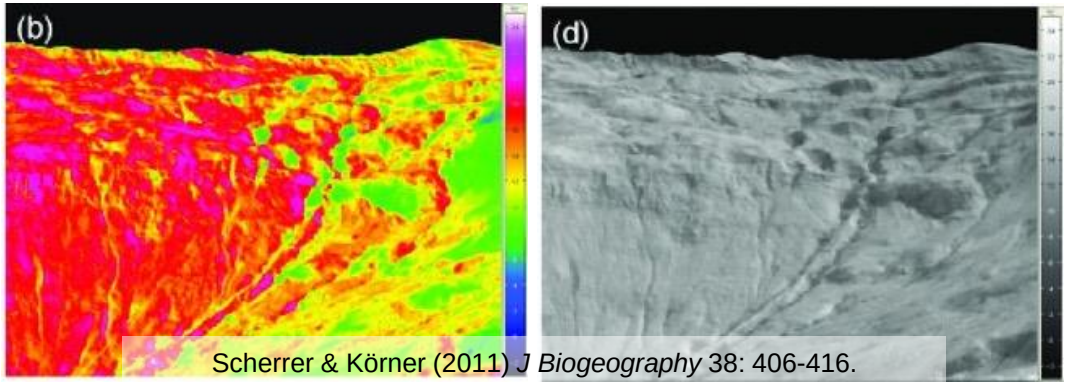


Baatar et al. 2019, Basic Appl Ecol 38: 23-35.

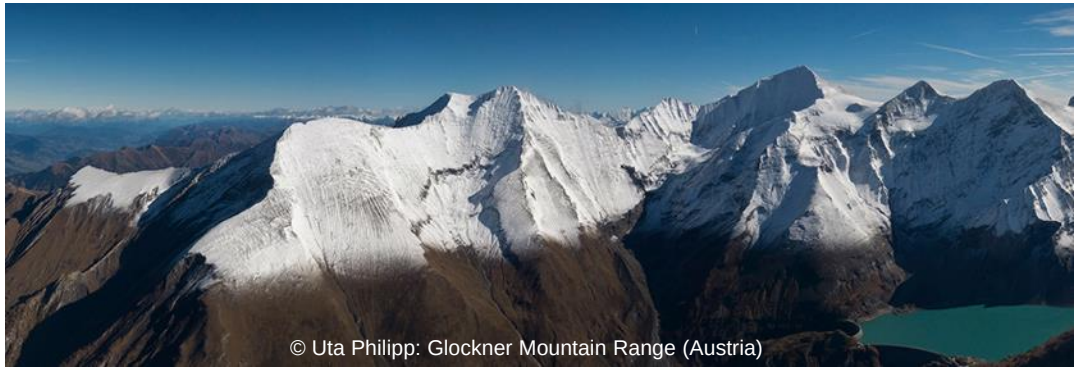
See also Pompe et al. 2010, Basic Appl Ecol 11: 603-611

→ Species co-occurrence in Alpine communities and their areas decrease

Can topographically controlled thermal-habitat differentiation buffers against climate warming?



Scherrer & Körner (2011) *J Biogeography* 38: 406-416.



© Uta Philipp: Glockner Mountain Range (Austria)

Day time → heterogeneity
Night time ~ homogenous

Complex interplay
of micro, meso and macro climate
on species performance
and species interactions

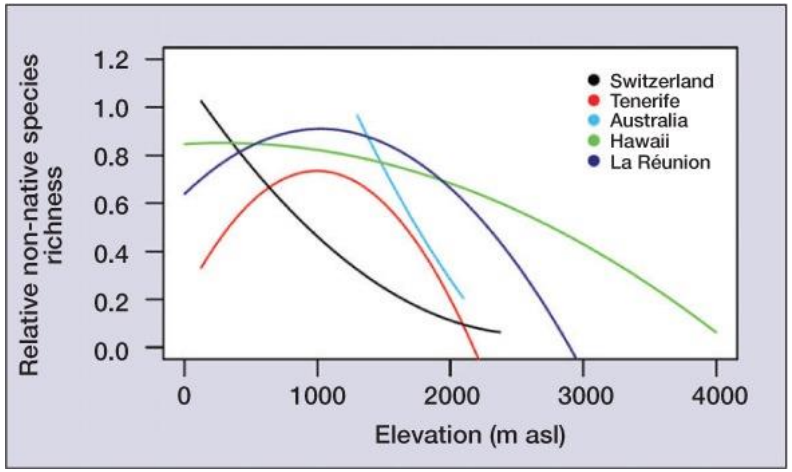
→ long-term cross-scale
studies needed

UFZ

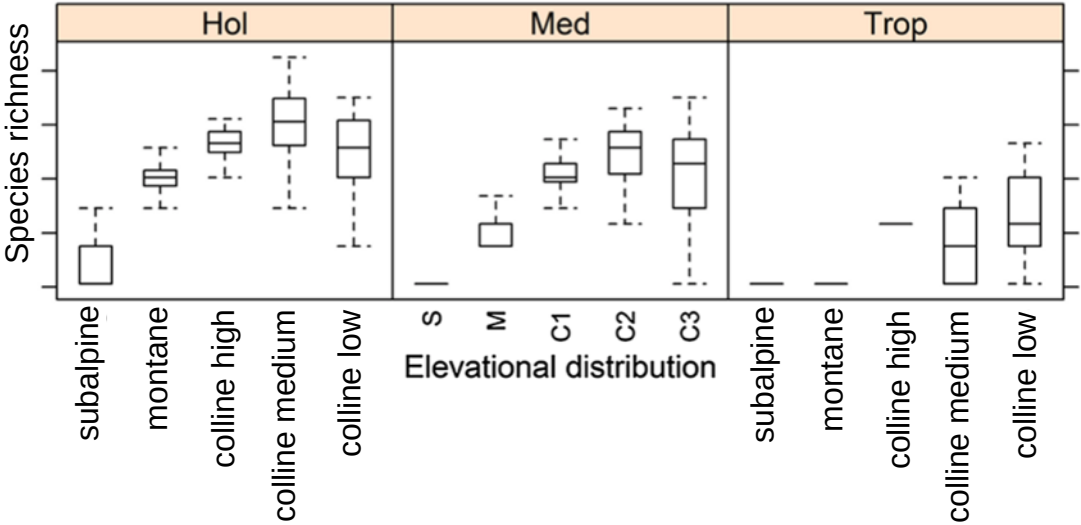
Biological invasions & costs

- *Alien* species are (accidentally or deliberately) *introduced* by humans
- *Invasive* are alien species that cause *ecological* or *economic harm*
- Ecological impacts on biodiversity and ecosystem functions
- Economic costs are enormous: > €12.5 billion/year
  (Kettunen et al. 2008)

Alien species richness decreases with altitude, but…



Pauchard et al. 2008, *Front Ecol Env* 7: 479-486



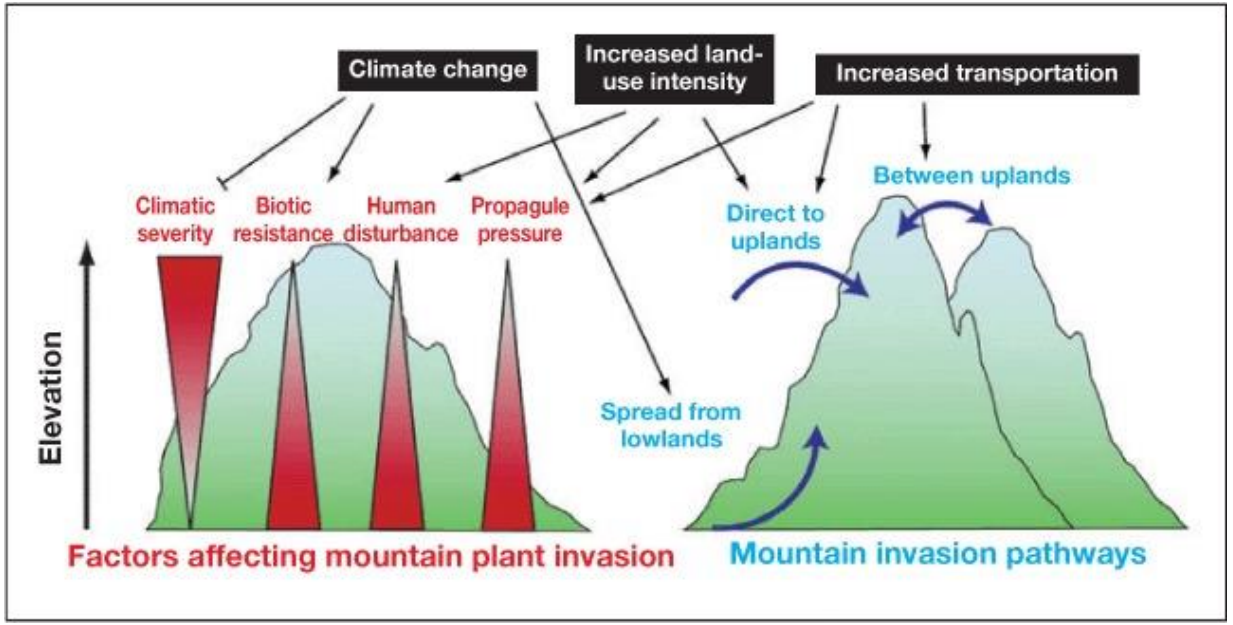
Dainese, Kühn, Bragazza 2014, *Biol Inv* 16: 815-831

- Holarctic species can invade higher altitudes,
- While tropical species remain in the lowlands

→ With CC more alien species moving upslope

UFZ

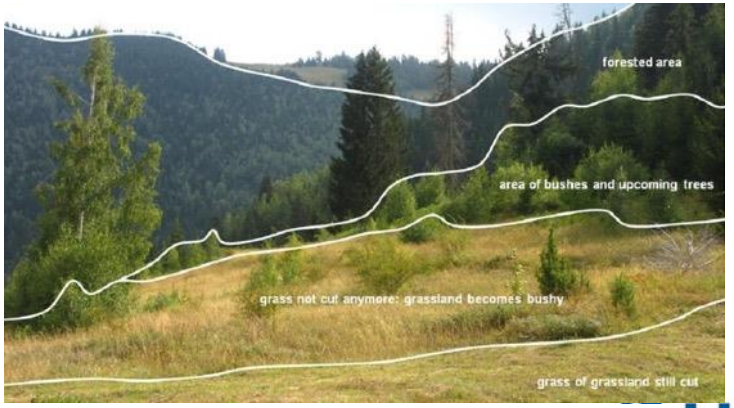
Factors affecting mountain plant invasions and pathways



Pauchard et al. 2008, *Front Ecol Env* 7: 479-486

Global change impacts biodiversity

Driver	Trend	Effect on biodiversity
Climate Change	↗	↘
Biological Invasions	↗	↘
Land Use/ Management:		
• Intensification	?	↘
• Abandonment	↗	↘
• Forest area	↗	?



Kerckhof et al. 2016, *Springerplus* 5: 485

UFZ

Long-term observations are crucial!

- Detect Trends
- Attribute Trends
- Disentangle complexities

  (resolution, extent, climate, land use, …)
- Interactions with humans
- Derive management recommendations

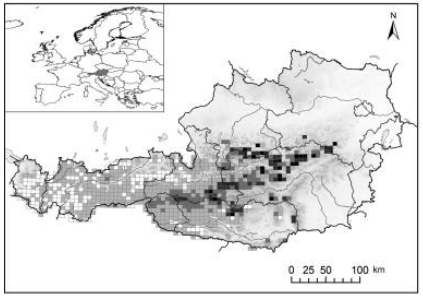
We are currently just at the beginning!

Rotmoosferner (Austria), Long-term study area of Prof. Brigitta Erschbarmer, U. Innsbruck

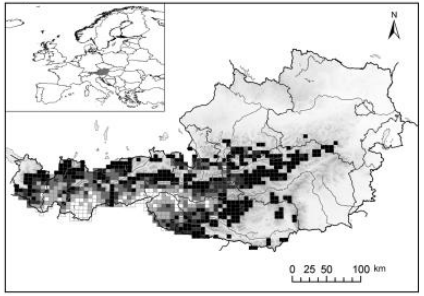

Thank you very much for your attention

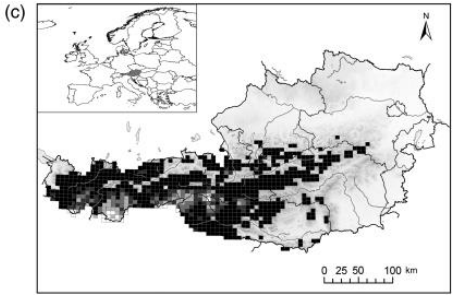
Disproportional risk for habitat loss of high-altitude endemic species under climate change

Current species richness (1-20)



Proportional loss of habitat
Moderate Climate Change Scenario





Severe Climate Change Scenario

Dirnböck, Essl, Rabitsch (2011) Global Change Biology 17: 990-996.

The upward range shift of plants averaging 6.1 m per decade in altitude (IPBES 2018)

Population dynamics may lag behind climatic changes
(Dullinger *et al.* 2012, *Nature Climate Change* 2: 619-622.

UFZ