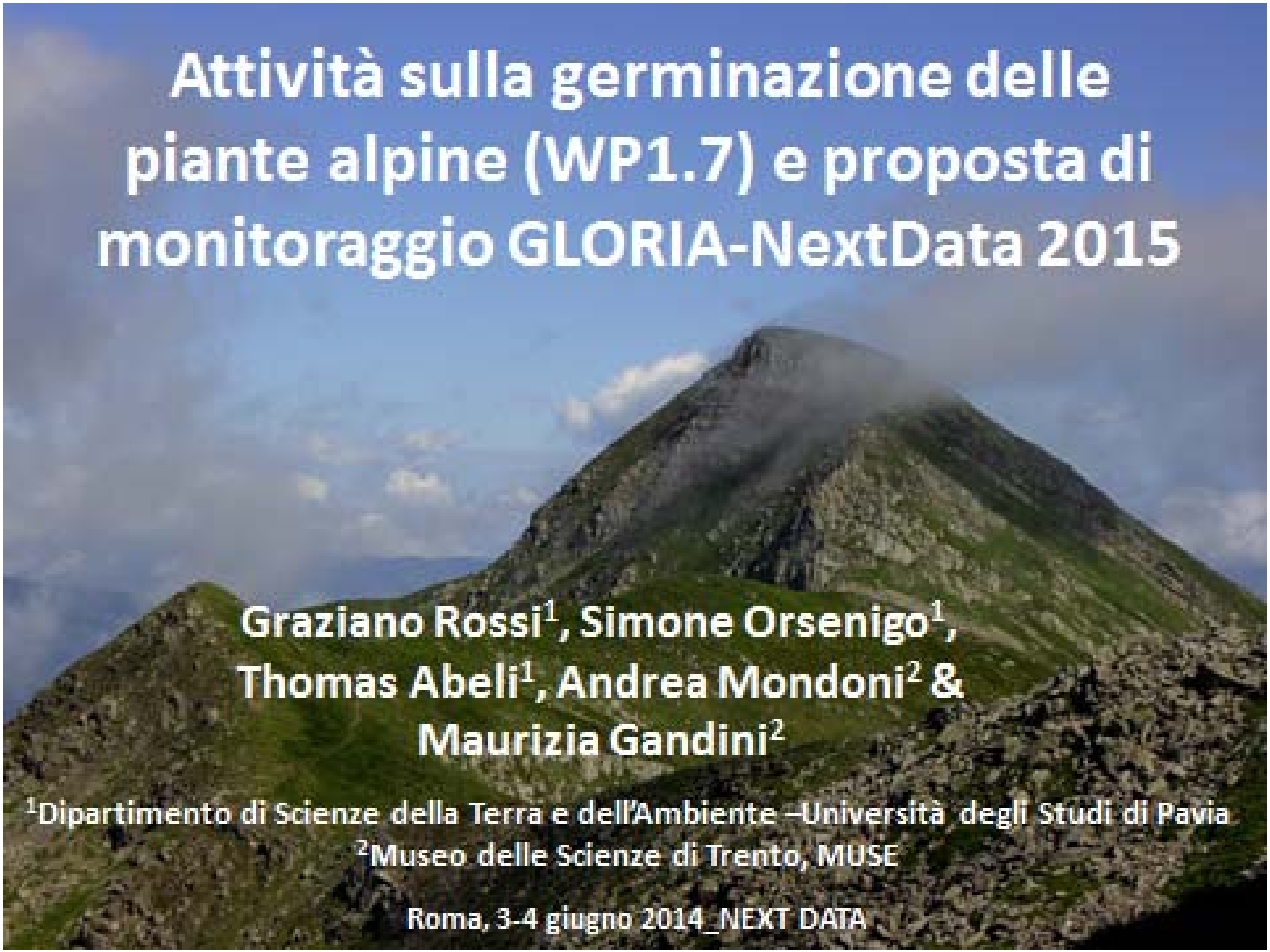


Attività sulla germinazione delle piante alpine (WP1.7) e proposta di monitoraggio GLORIA-NextData 2015

Graziano Rossi[1], Simone Orsenigo[1], Thomas Abeli[1], Andrea Mondoni[2] & Maurizia Gandini[2]

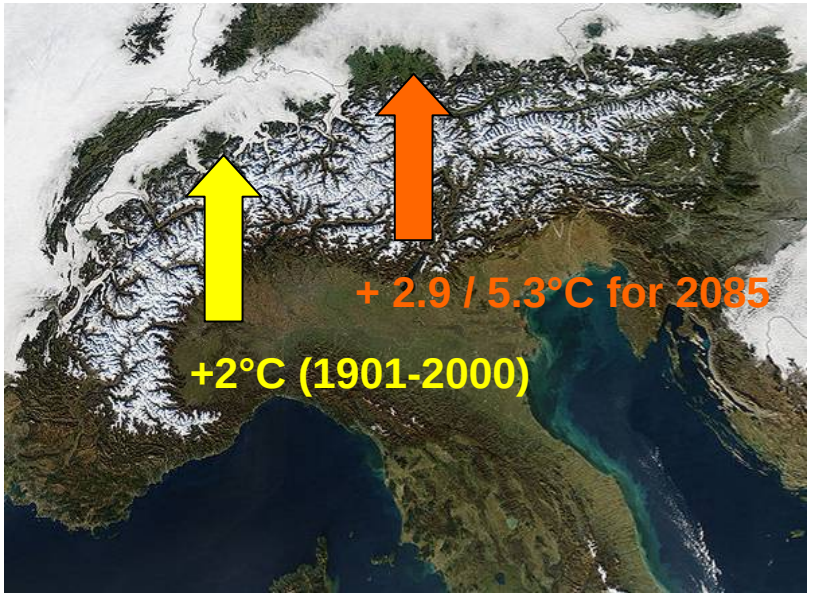
[1]Dipartimento di Scienze della Terra e dell'Ambiente –Università degli Studi di Pavia

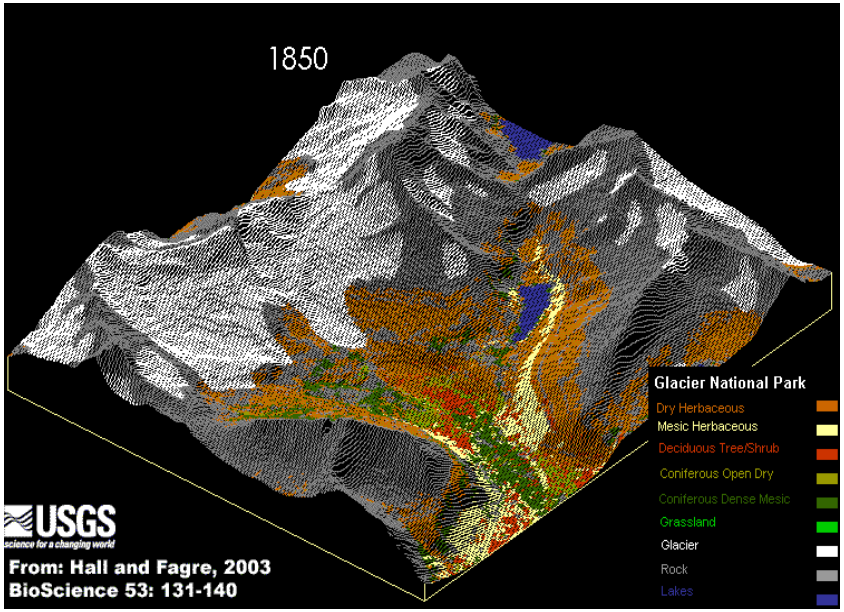
[2]Museo delle Scienze di Trento, MUSE

Roma, 3-4 giugno 2014_NEXT DATA

Why this study?

The upward migration of plant species is clearly one of the responses to climate warming and **seeds** are thought to be the **main vehicles** for such migration





Germination phenology of alpine plants

What is known

Seed dispersal occurs mostly at the end of summer, but seed germination tends to occur rapidly after snowmelt, in spring.

What is NOT known

The alteration of temperature and water supply may preclude, delay or enhance regeneration from seeds (Walk et al. 2012)

Possible scenarios:

- An increase in temperature may stimulate **autumn germination**
- With shortening of winter:

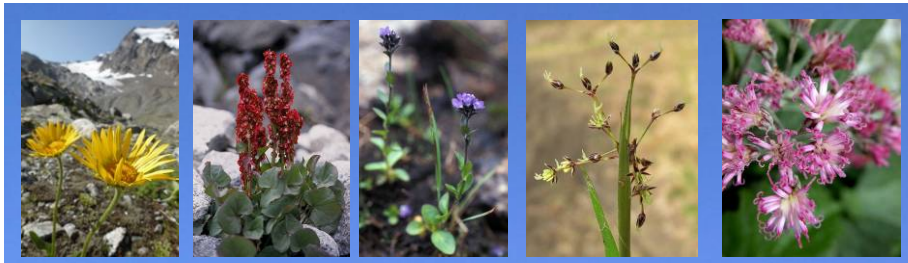
➢ **seeds** may **remain** partially **dormant** (deep dormant);

➢ early spring emergence may increase the chances of **seedlings** being **exposed to freezing.**

- **Seedling survival** may be **reduced** by summer heat waves (heat/drought stress)
- **Seedling survival** may be **enhanced** by longer growing season

Possible approaches:

1) Long term monitoring/revisiting (e.g. Diemer 2002)
2) Experimental warming (OTC, green house, infrared heaters)



Poa laxa subsp. laxa (Poaceae)
Geum reptans (Rosaceae)
Luzula alpinopilosa (Juncaceae)
Veronica alpina (Scrophulariaceae)
Adenostyles leucophylla. (Asteraceae)
Doronicum clusii (All.) (Asteraceae)
Cerastium pedunculatum (Caryophyllaceae)
Oxyria digyna (Polygonaceae)

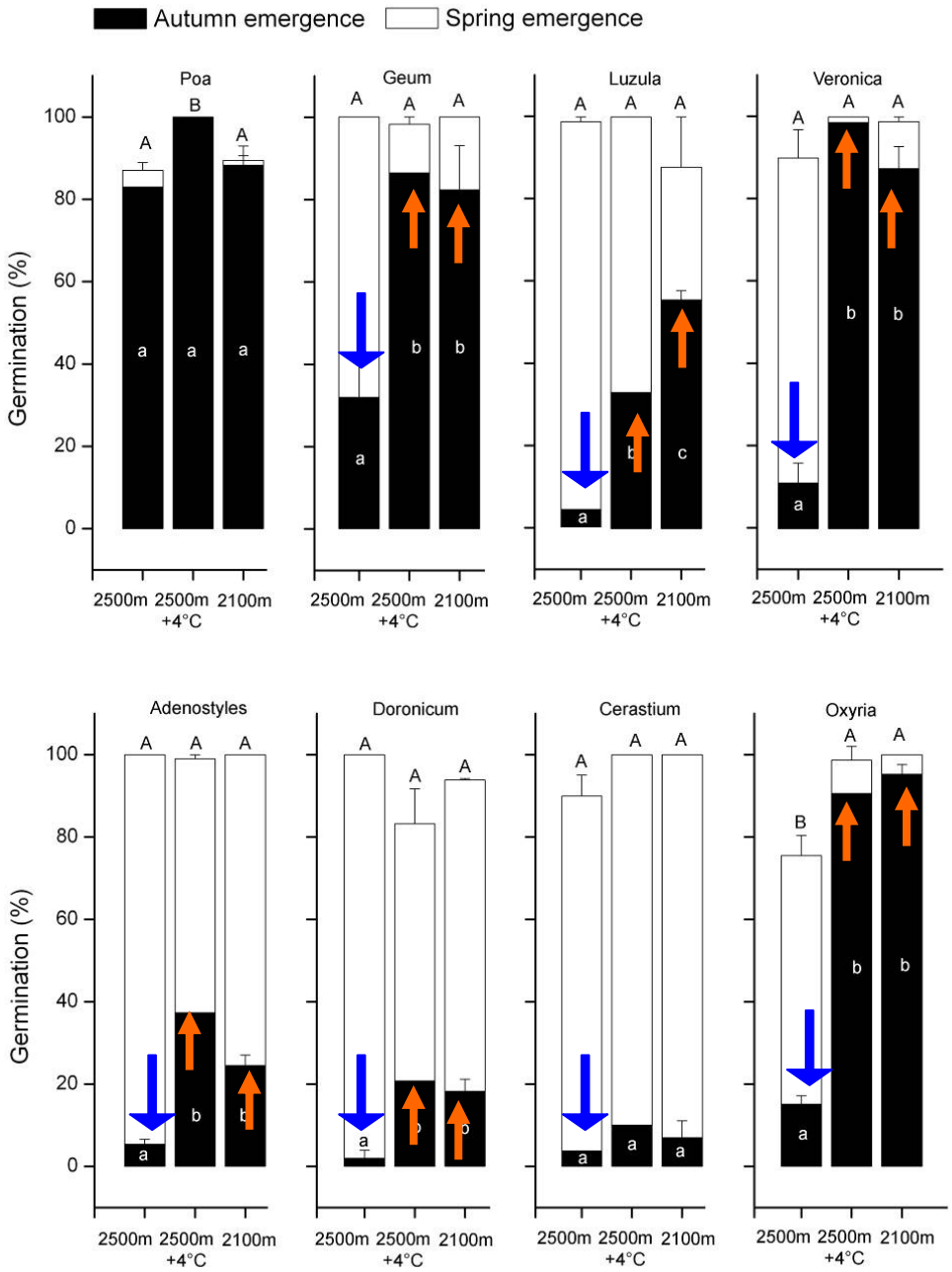
2500 m asl

+ 2,4 °C

2100 m asl

Simulated cycle of mean diurnal/nocturnal monthly temperatures

Week of the experiments	Equivalent time of year	2500m	2500m +4°C	2100m
1-4	September	12/5	16/9	17/6
5-9	October-November	0	0	0
10-26	December-March	0	0	0
27-31	April	0	0	0
32-36	May	0	0	15/3
37-41	June	0	0	21/7
42-46	July	20/8	24/12	24/10
47-51	Aug	16/6	20/10	19/8



Results

Cumulative germination percentage of each species under 3 temperature treatments at the end of autumn (**black** columns) and at the end of summer (**white** columns).

Take home messages

•Climate warming will lead to a **shift from spring to autumn emergence** but the extent of this change across species will be driven by seed dormancy status.

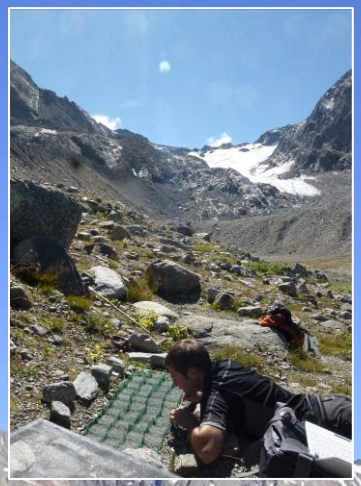
Non-deep PD → autumn germination INCREASE

Deep PD → NO autumn germination

- Because of the anticipated snowmelt, un-germinated seeds at the end of autumn will be exposed to **shorter winter seasons and lower spring temperatures in a future, warmer climate,** but these changes will only have a minor impact on germination.

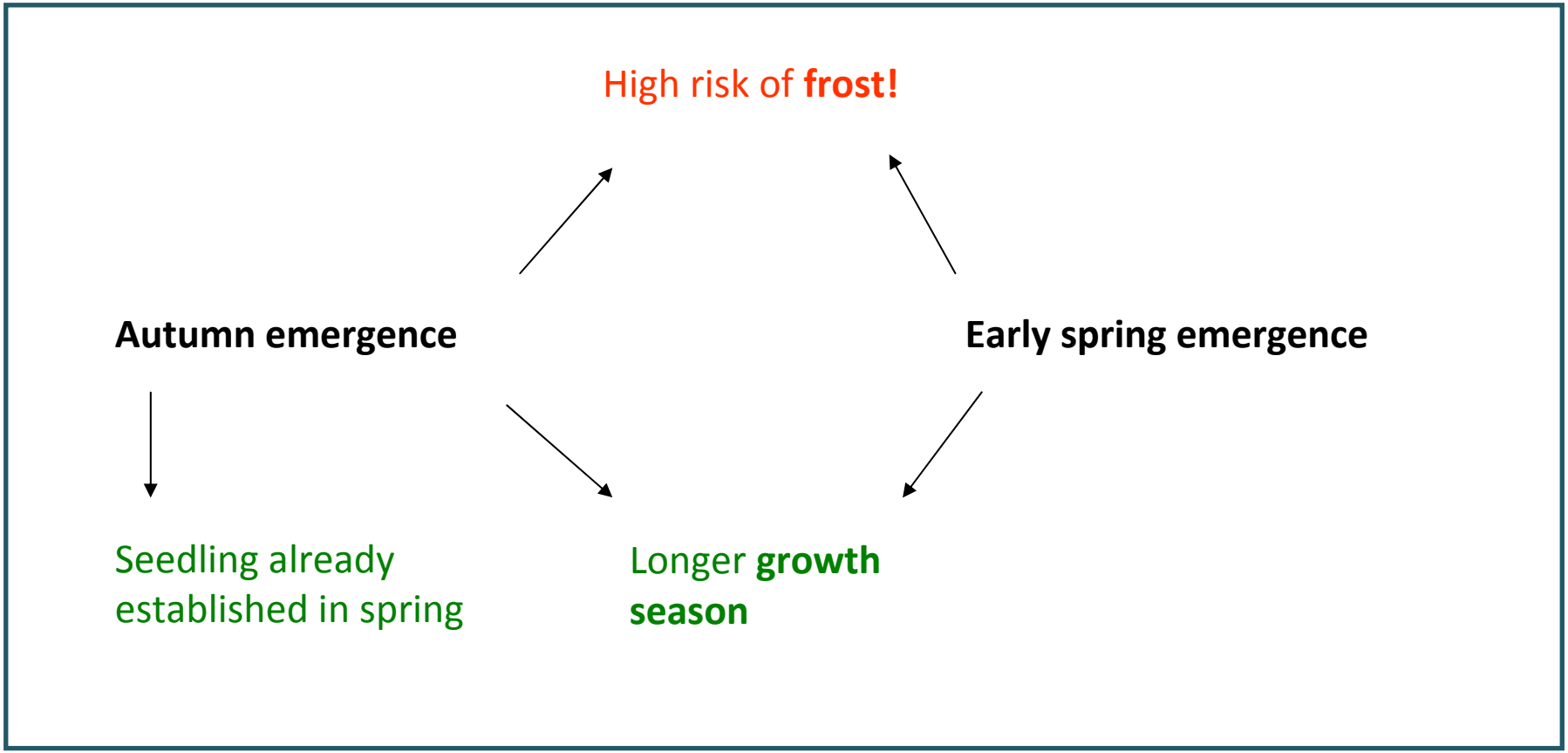
In order to understand which of these possibilities will prevail…

Field experiments



Take home messages

How autumn and early spring emergence will affect seedling survival?

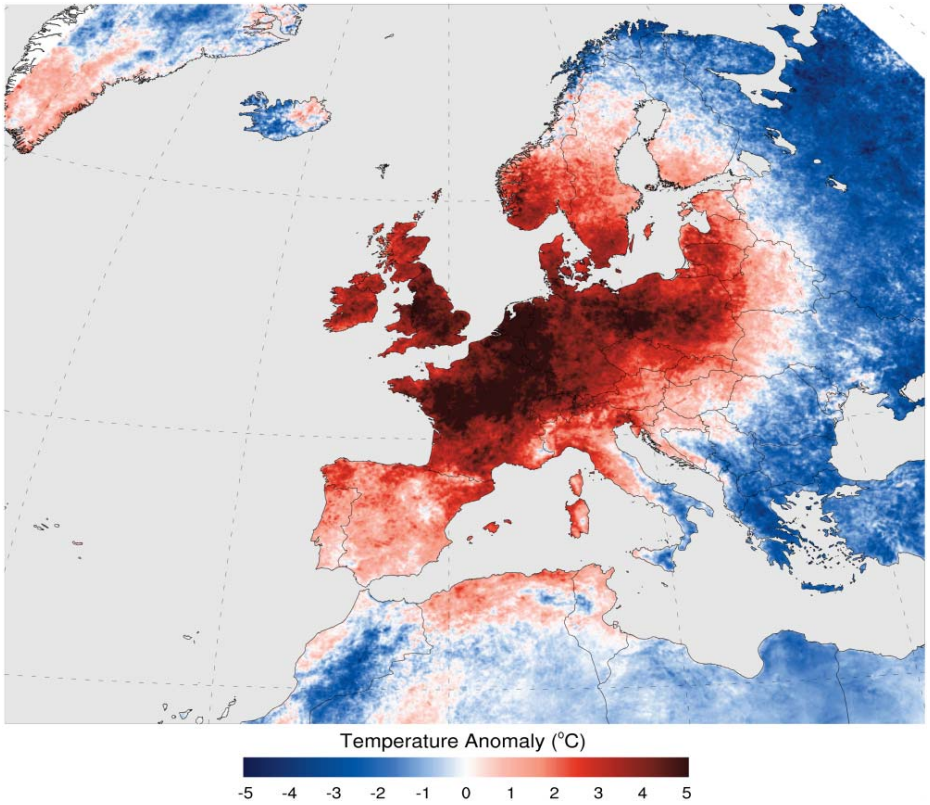


HWs EFFECTS ON GERMINATION OF ALPINE PLANTS

2 heat waves tested:

2003⟶ summer

2011⟶ autumn



METHODS

Seeds were exposed to three simulated cycles of weekly mean temperatures in the lab, derived from measurements taken from a weather station located near the species growing sites.

Effects of ozone on seed germination

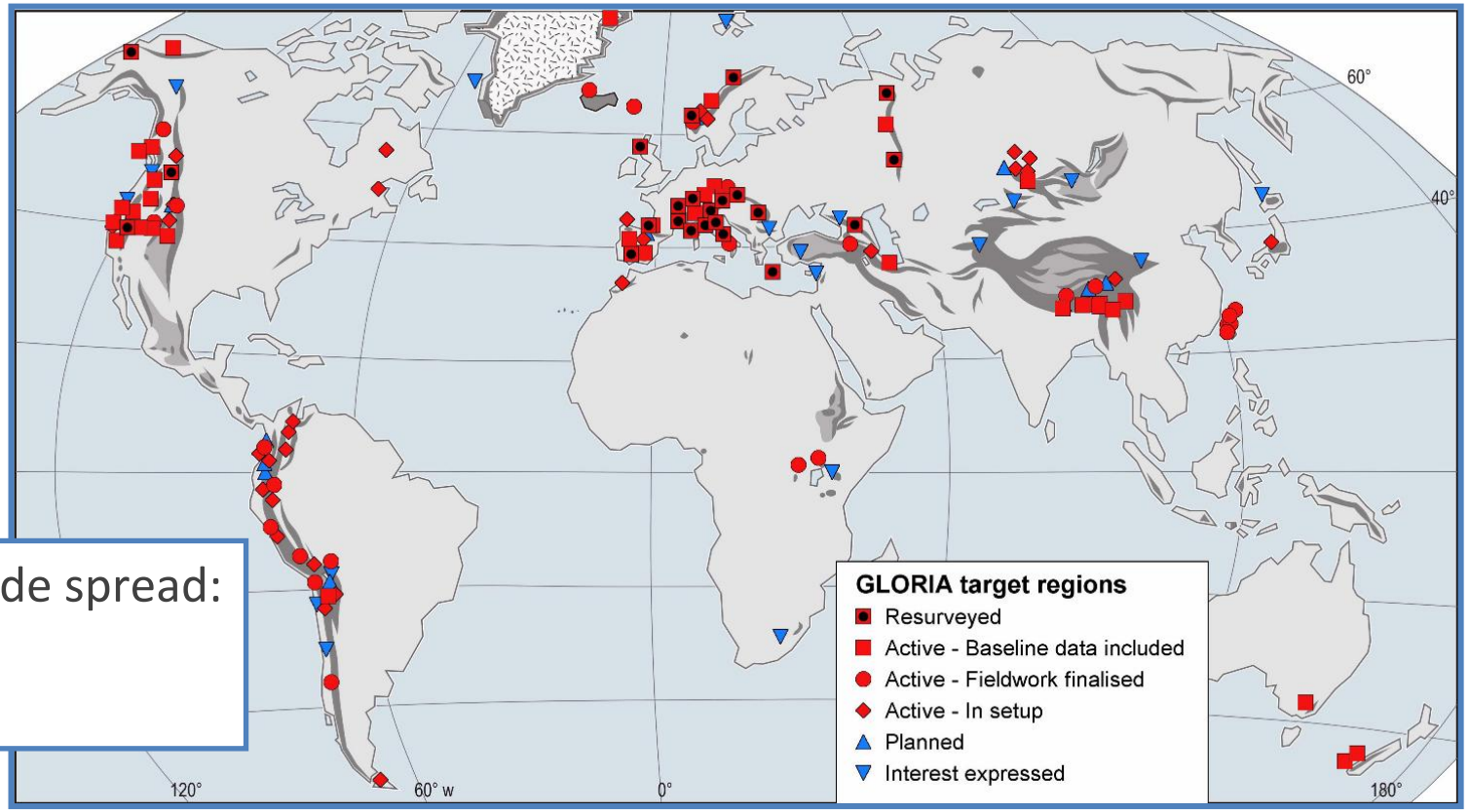
High ozone levels during heat waves recorded in Monte Cimone area

We are testing effects of different ozone levels on seed germination of alpine plants from Northern Apennines.

- 125 ppb for 5 days
- 125 ppb for 10 days
- 185 ppb for 5 days

GLORIA - Global Observation Research Initiative in Alpine environments

- Long-term monitoring project in alpine environment
- Launched in 2001 by University of Vienna



- Today worldwide spread:
  - ➢ 118 active TR
  - ➢30 planned

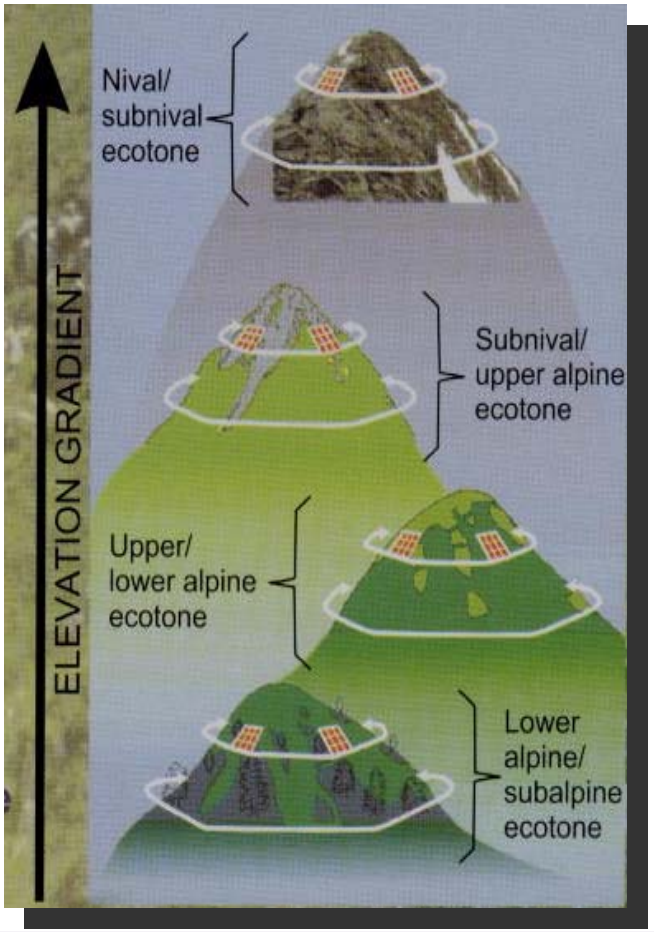
GLORIA: Protocol

TARGET REGION
MULTI-SUMMIT APPROACH

- ✓Comparability
- ✓Simplicity
- ✓Economy

Four summit sites along the elevation gradient are the minimum requirements for a GLORIA target region.

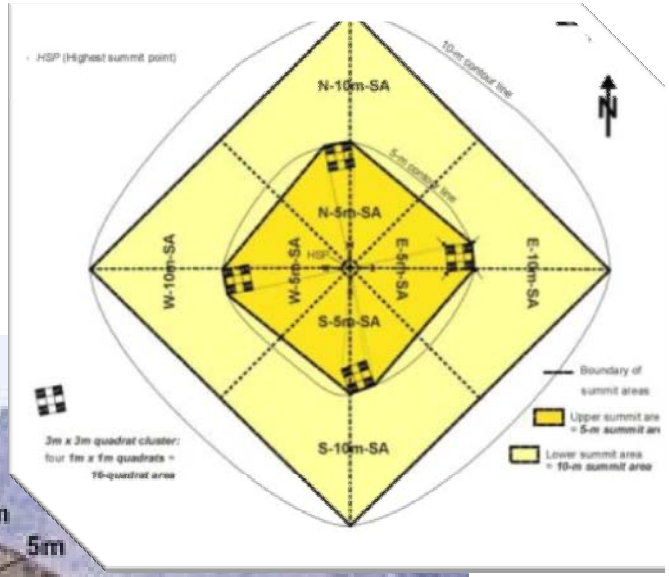
elevation gradient

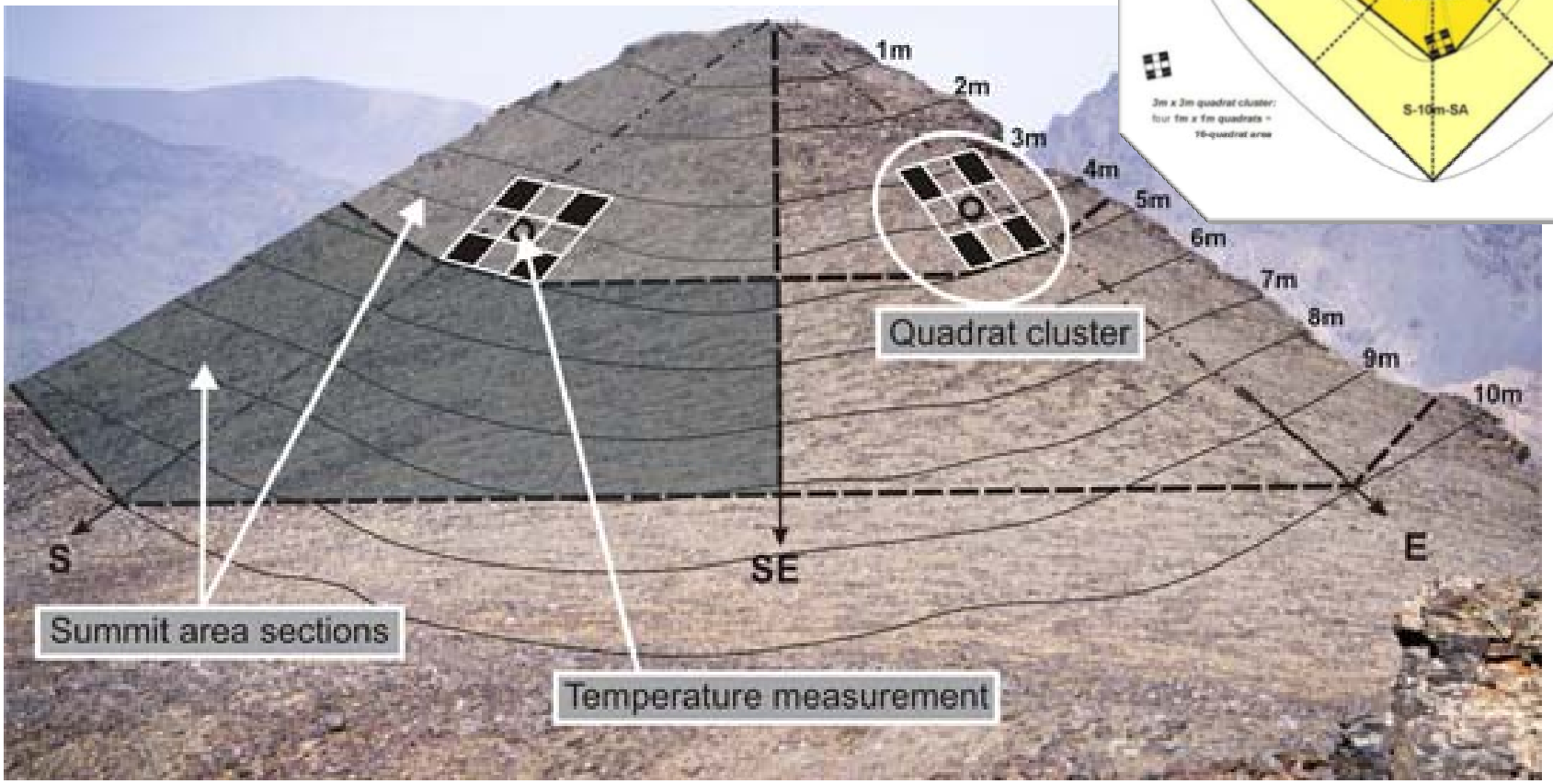


GLORIA: Sampling methods

SUMMIT AREA SECTIONS

Summit is divided into <u>8 sections</u>: samples of the summit flora to detect species migration





GLORIA: Sampling methods

1 M² QUADRATS

detailed species cover sampling to detect changes in the species composition

TEMPERATURE MEASUREMENTS

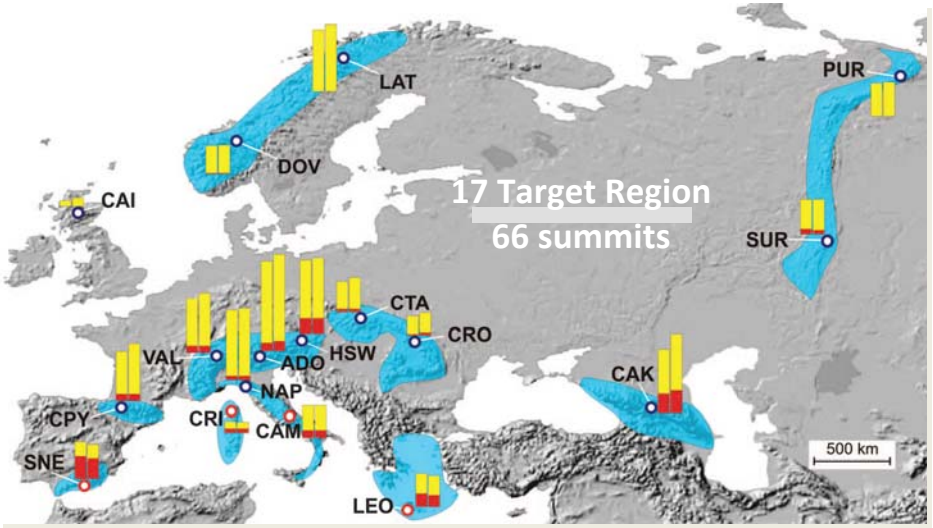
in each 3m x 3m quadrat cluster in one-hour intervals to compare changes of the temperature and to estimate duration of snow cover

GLORIA: Aims

Contribute to assess the magnitude and the extent of Global Warming impact on plant biodiversity in alpine ecosystems by means of:

provide data on the altitudinal differences in **species richness, species composition and plant cover, on the soil temperature and on the snow cover duration** in mountain systems world-wide	assess the potential **risks for biodiversity** losses	provide a **baseline** for the long-term monitoring	provide a substantial **input to data-based scenarios** on risks for biodiversity losses and on risks for ecosystem instability

GLORIA EUROPE - Results



Pauli *et al.* (2012) *Science* 336: 353-355

SPECIES HAVE MOVED UPSLOPE

with opposite effects on richness:

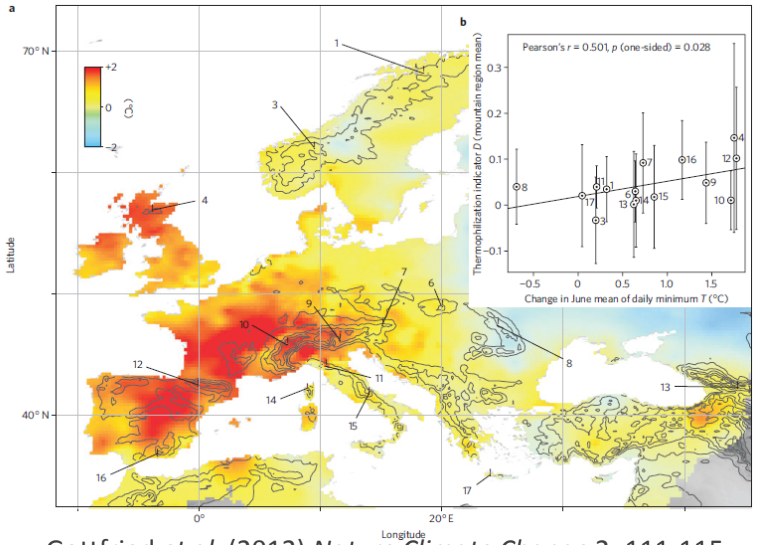
- **Boreal-temperate, increase (+3.9 species)**
- **Mediterranean, decrease (–1.4 species)**

LOSS of ENDEMICS:
shrink the European mountain flora, despite an average increase in species richness

- 60 summit sites in Europe
- 867 vegetation samples above the treeline

cold-adapted species decline
warm-adapted species increase

THERMOPHILIZATION



Gottfried *et al.* (2012) *Nature Climate Change* 2: 111-115

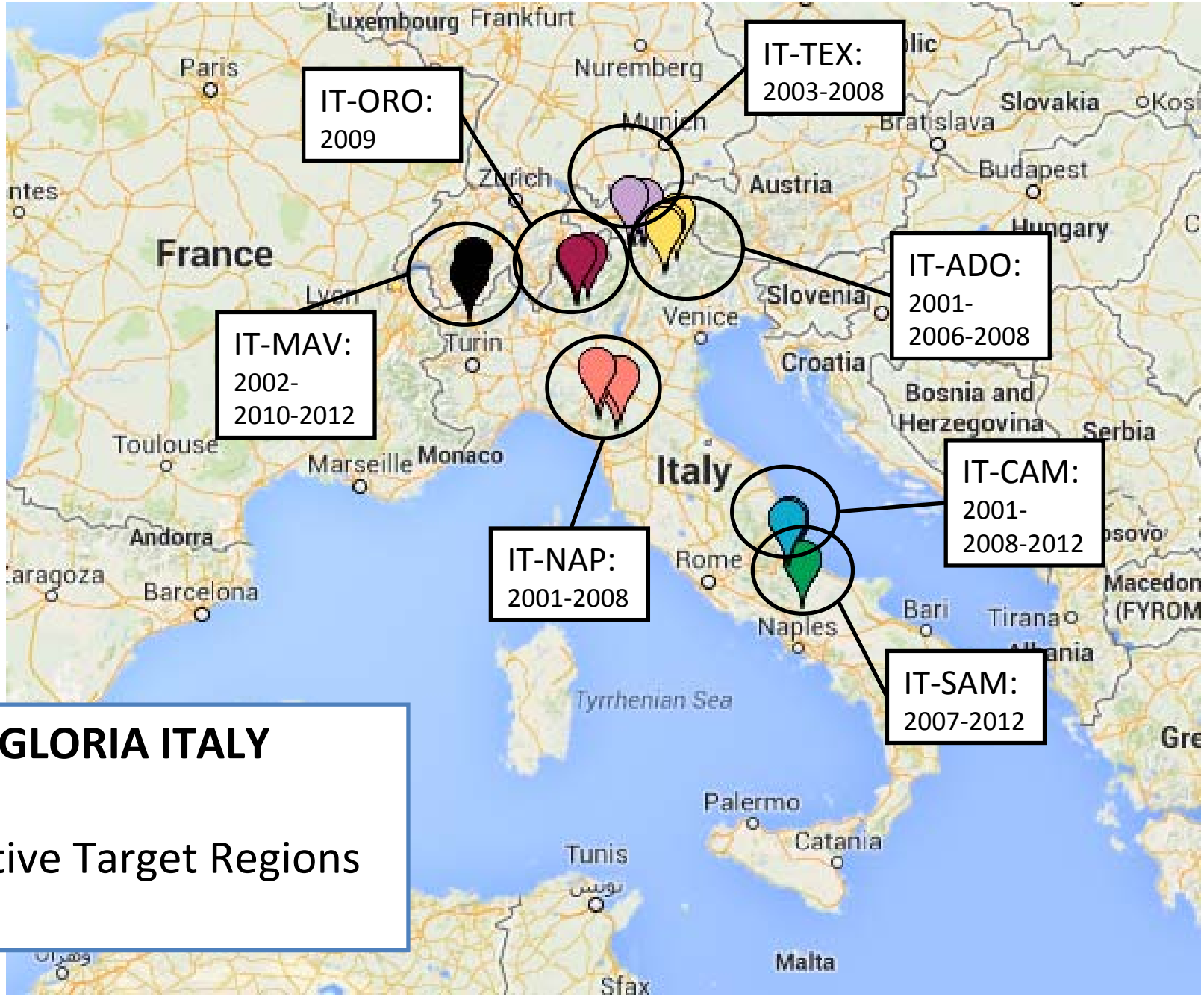
GLORIA 2015: the upcoming survey

At the **GLORIA Conference 2010 Sept. 23-26**, Perth, Scotland, around **100 members of GLORIA agreed on a refined and streamlined catalogue of methods** resulting from the field experience of the first decade of GLORIA.

Pre 2008 – REVISED DATA SAMPLING – Post 2008

Obligatory activities:	Species (vascular plants) recording in 16 1m x 1m quadrats:	visual cover estimation
		point framing (100 points per quadrat as a new application)
	Species recording in 8 Summit-Area-Sections + abundance estimation defined on an ordinal scale (rl, very rare; r, rare; s, scattered; c, common; d, dominant)	
	A careful photo documentation of plots and summit set-up	
	Continuous soil temperature measurements (4 points per summit site)	

Optional activities :	Bryophytes and lichens recording
	Subplot-frequency of species in 1m x 1m quadrats (previously this was a standard method)
	Increase of 1m x 1m quadrats up to 32 per summit site
	Estimation of species cover in Summit-Area-Sections
	Line-pointing in 10-m squares (4 per summit)



GLORIA ITALY

7 Active Target Regions

GLORIA ITALY 2015 & NextData

Great opportunity to gather data from an active network of long-term monitoring system spread across the principal mountain systems of Italy

What kind of data?

Obligatory

PLANTS

- SAS level:
  - Species composition
  - Relative Abundance
- QUADRATS level:
  - % cover
  - Species list

SOIL TEMPERATURES:

- continouos series (4 per summit)

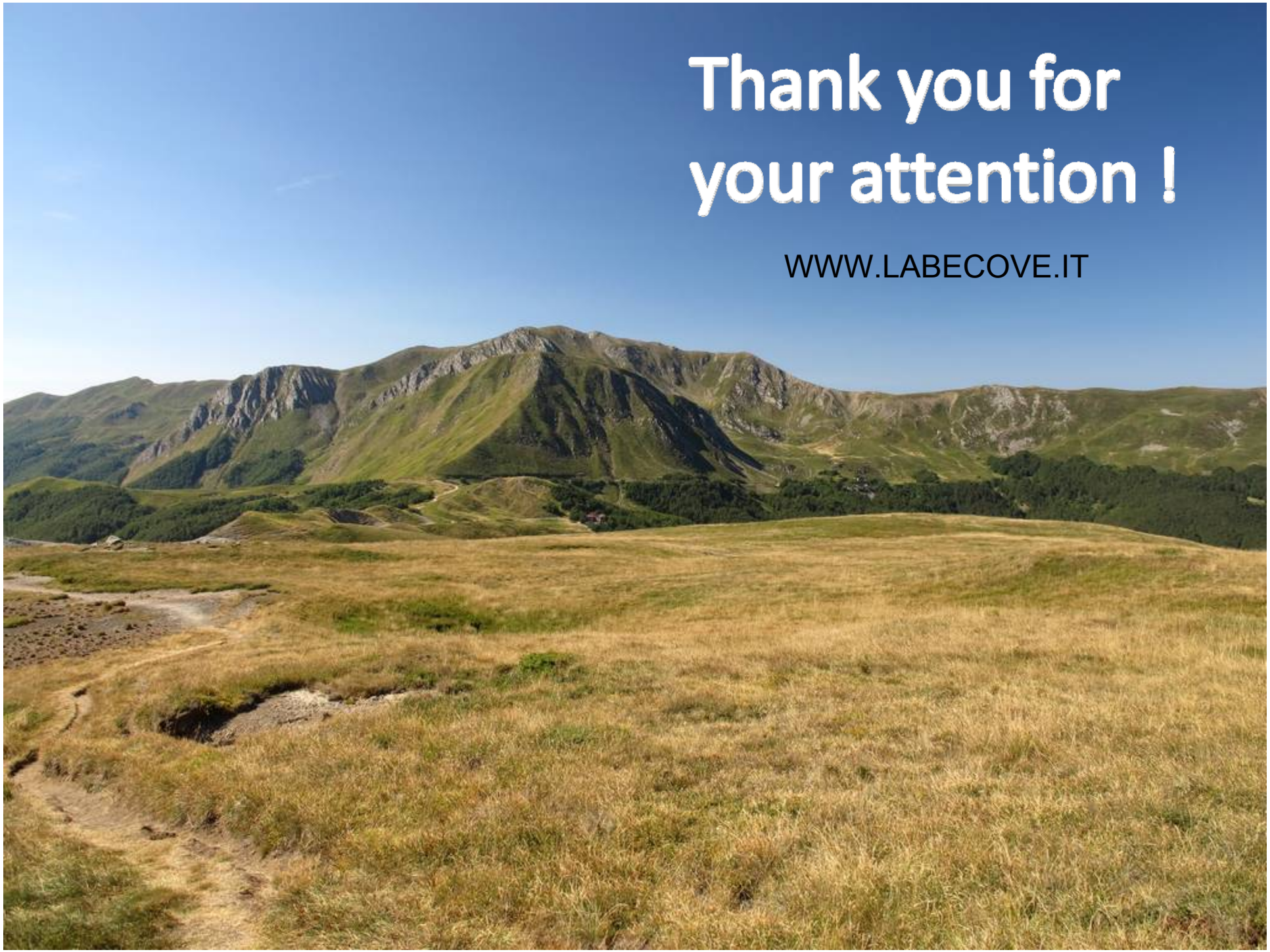
Optional

PLANTS

- Bryophytes and lichens recording
- Line-pointing in 10m squares (4 per summit)
- SAS level:
  - Estimation of species cover
- QUADRATS level:
  - Increase up to 32 quadrats per summit
  - Sub-plot frequency of species

Condizioni per includere dati in NextData

- Il coordinatore di GLORIA in Vienna ci autorizza a cedere nostri dati a nextData
- Resurvay 2015 si farà, ma dobbiamo decidere dove e se con nuovo manuale, con procedura semplificata; allora però dati su quadrati 1x1 m non si prendono x frequenze %, quindi difformità rispetto 2001 e 2008.
- Serve aiuto x finanziare il rilievo 2015 e travaso tutti dati
- Ipotesi di rendere liberi subito tutti dati pre-2015, quelli del 2015 liberi da sett 2016
- App centrale e M Avic sono già in Next data pro-parte


Thank you for
your attention !
WWW.LABECOVE.IT