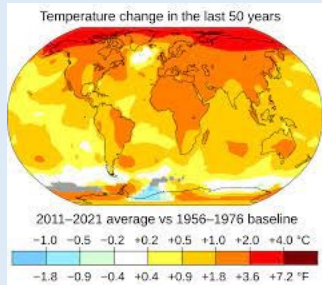




Pastoral management and climate have a comparable effect on the variation of botanical composition of alpine pastures: an evaluation over a 20-year time span

Pittarello M., Nota G., Marengo G., Lombardi G., Lonati M.

BACKGROUND



Evidence of climate change around the world

Impacts are particularly visible in mountain environments
(melting glaciers, shifting vegetation zones, extreme weather events, declining snow cover)



changes in plant species composition and distribution



Interaction between natural ecosystems and farming systems in the Alps for thousands of years

Seed transport

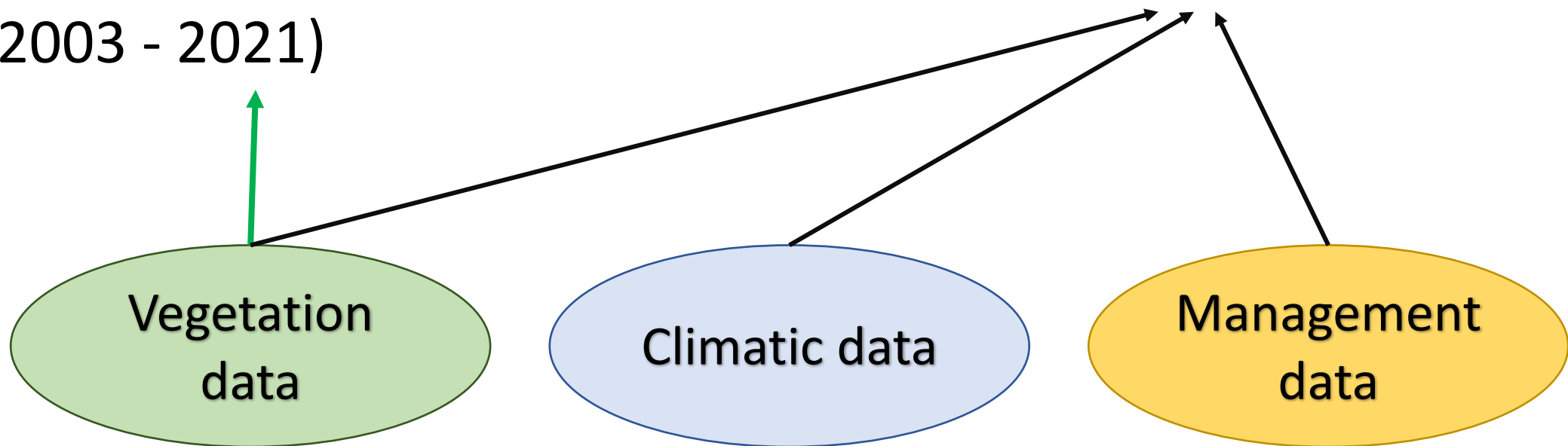
Fecal and urine depositions

Trampling

Grazing

Objectives

- to assess the **magnitude of variation in botanical composition** of pastures over a ~20-year period (2003 - 2021)
- to test the **effect and weight** of **climatic and management variables on botanical composition**



Study area

Interreg



Cofinancé par
l'Union Européenne
Cofinanziato
dall'Unione Europea

France – Italia ALCOTRA






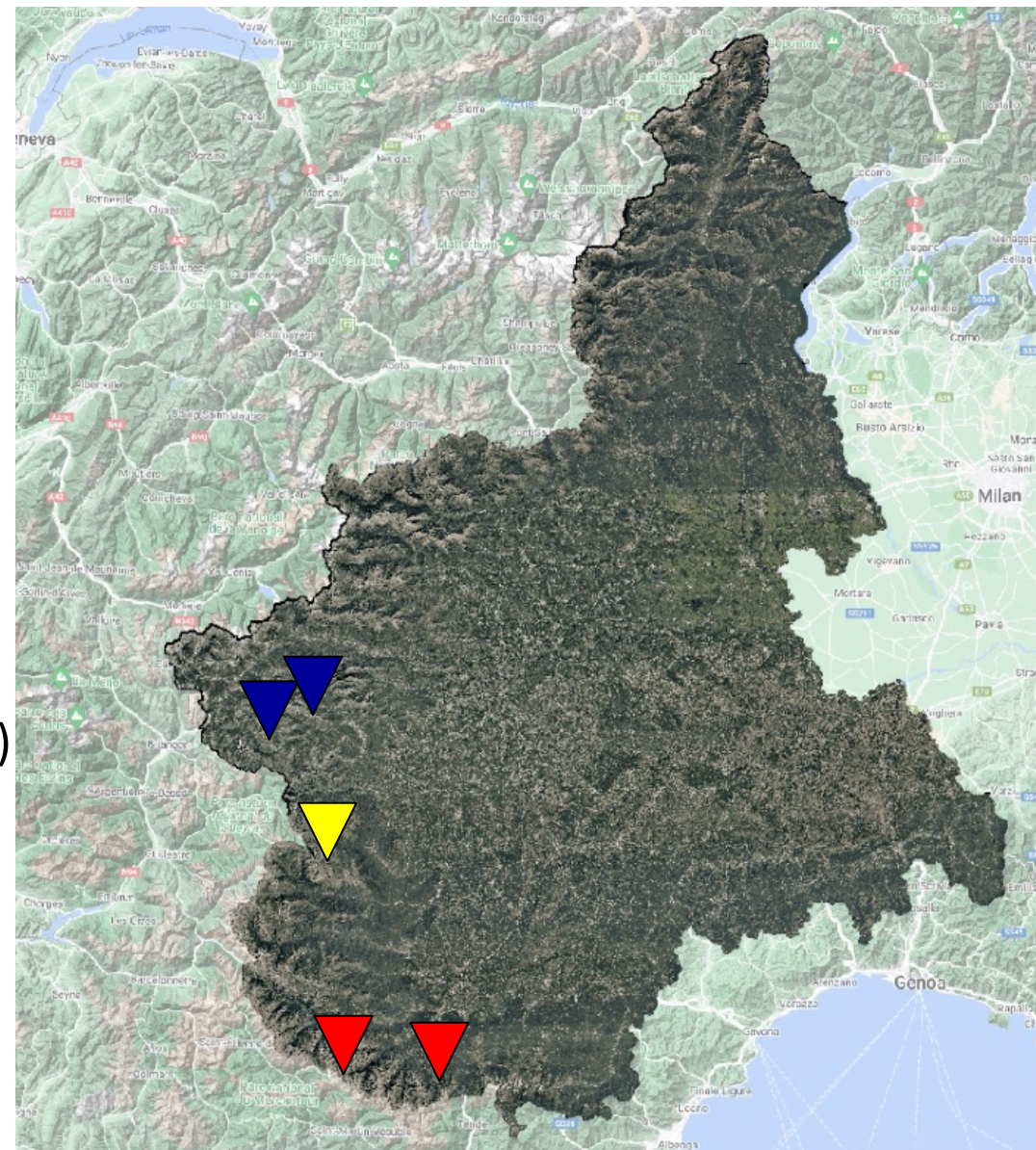
Biodiv'ALP

Alpage Sentinelles

Piedmont Region (NW- Italy)



-  Alpi Marittime Natural Park (Sabbione and Valasco Pastures)
-  Monviso Natural Park (Rocca Bianca Pasture)
-  Alpi Cozie Natural Park (Chanfoulcre e Troncea Pastures)



Vegetation data

>4000 **vegetation surveys** carried out by Cavallero et al. (2007) on the entire Piedmontese Alpine chain between 2001 and 2007



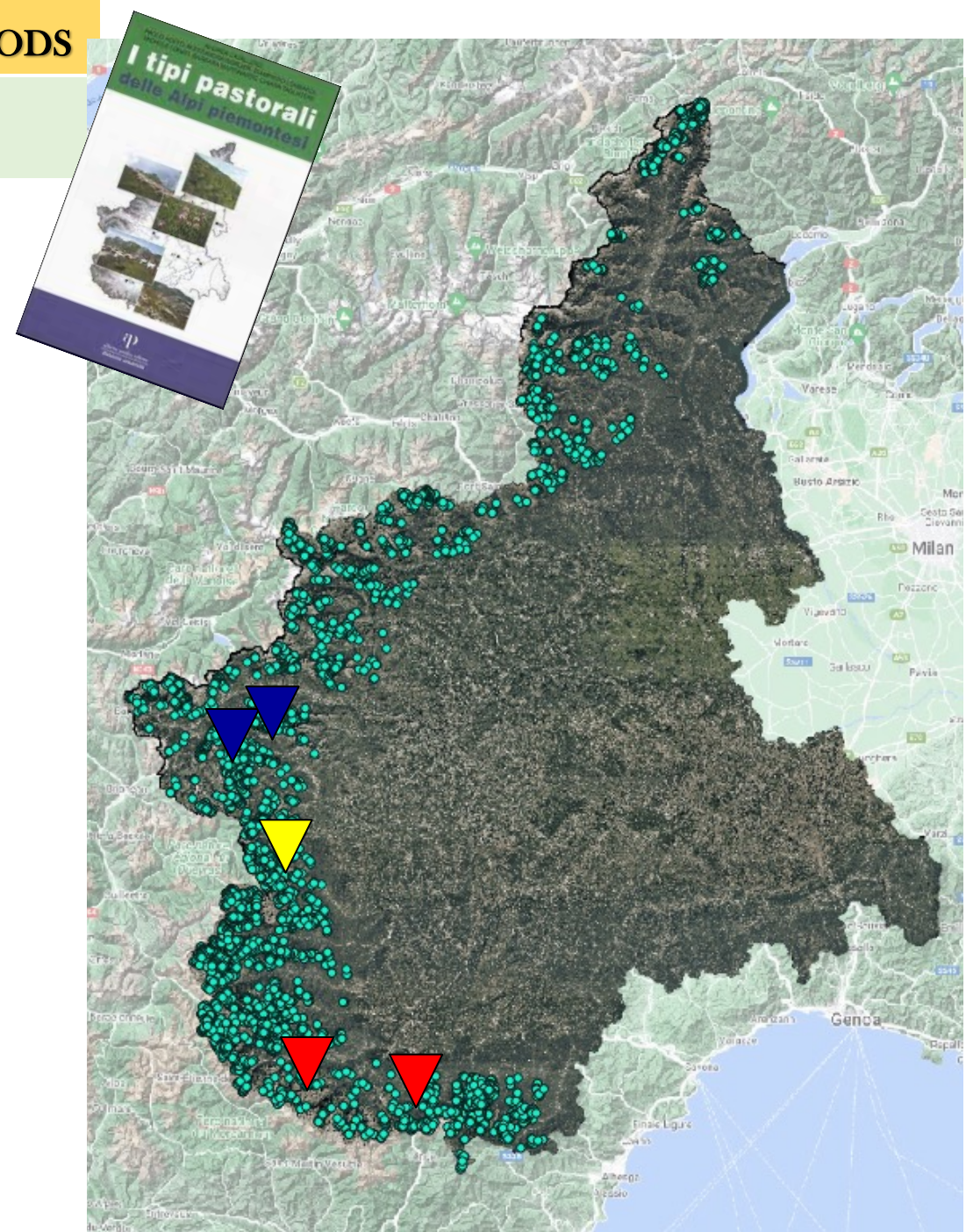
Selection of vegetation surveys of Cavallero et al (2007) within the alpine pastures selected by the Biodiv'ALP project



Vegetation surveys

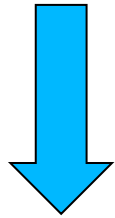
Alpi Cozie Natural Park	
Chanfoulcre	15
Tronca	15
Alpi Marittime Natural Park	
Sabbione	14
Valasco	4
Monviso Natural Park	
Rocca Bianca	12

58



Vegetation data

Vegetation surveys in correspondence of the 58 historical surveys
(vertical point quadrat method + occasional species)



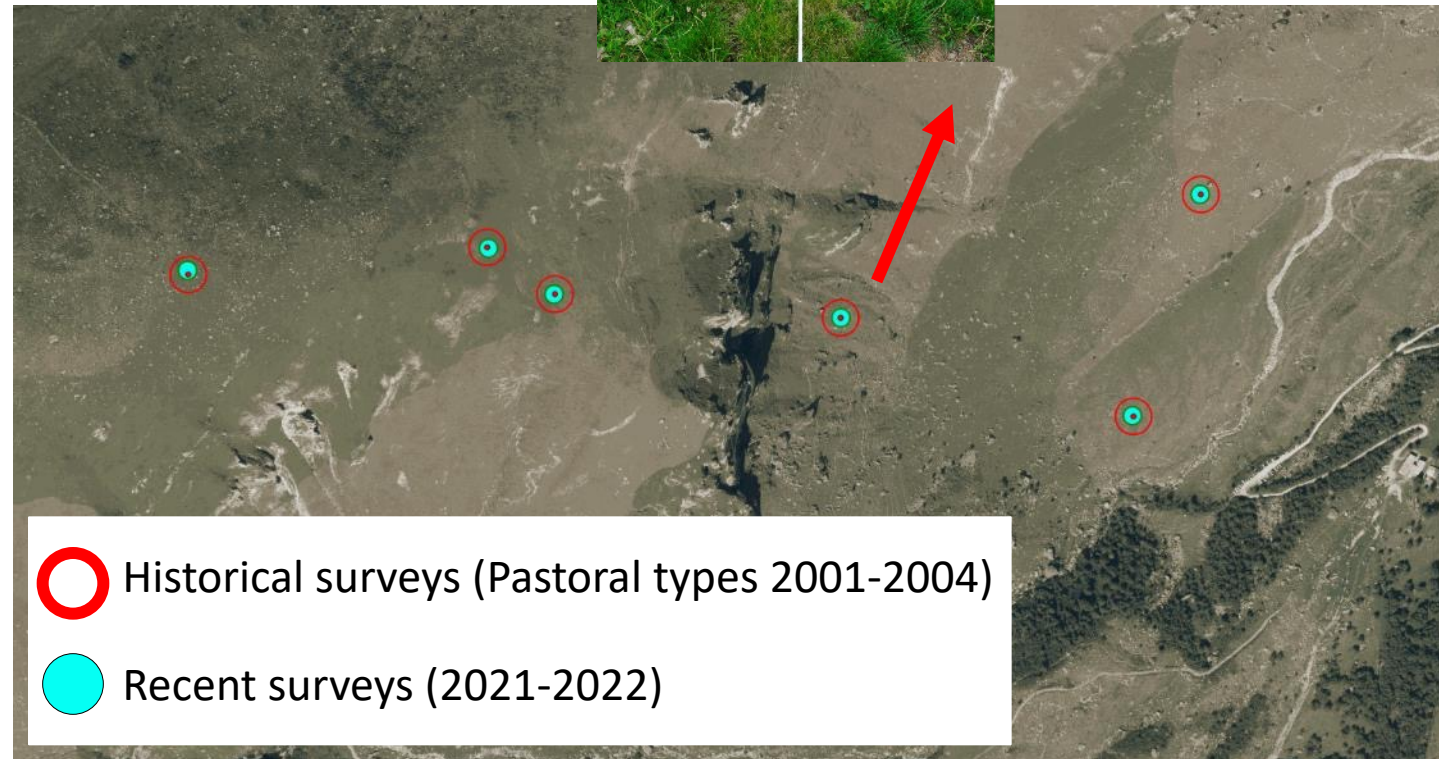
Historical composition (early 2000s)

VS

Current composition (2021-22)

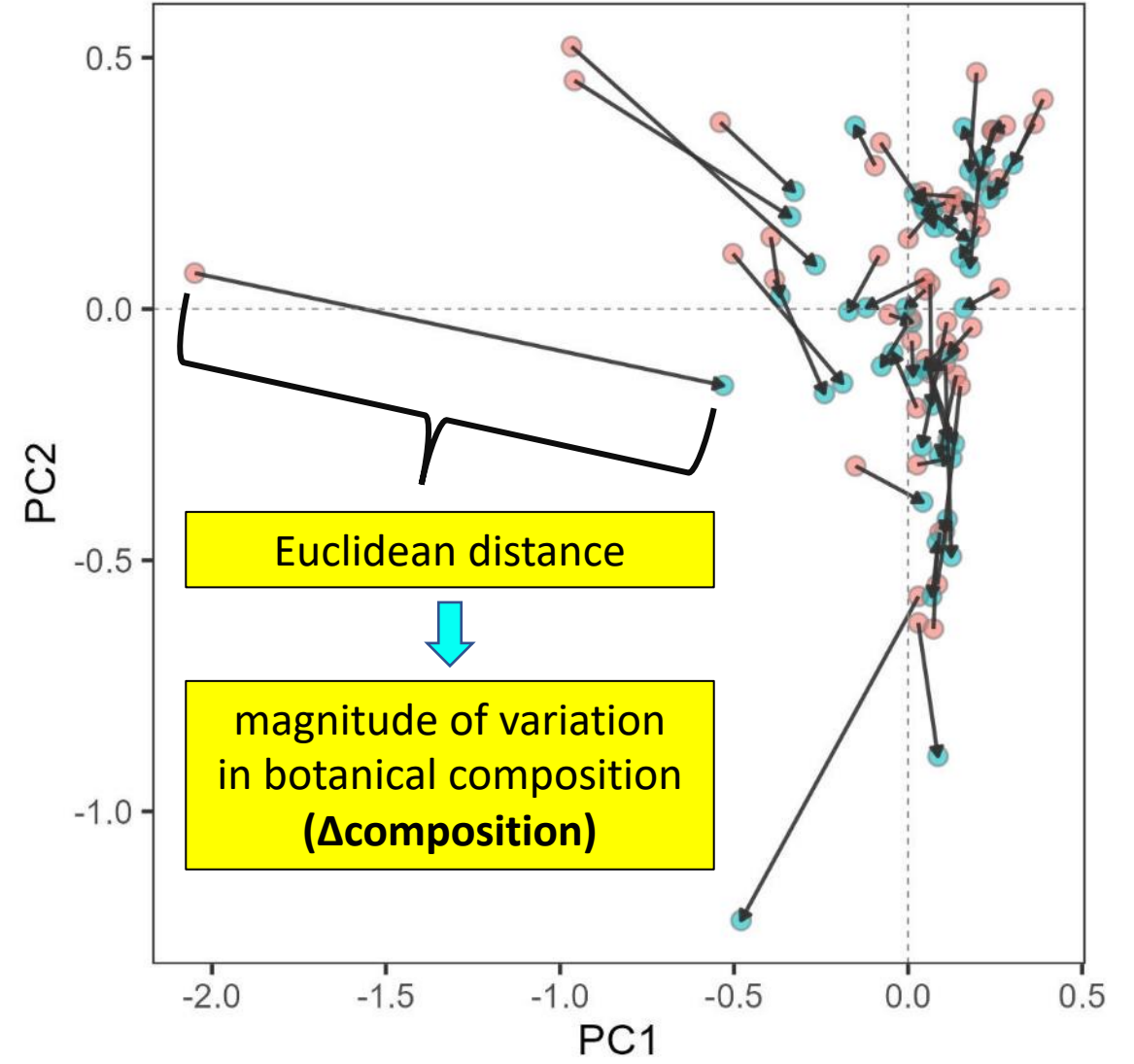
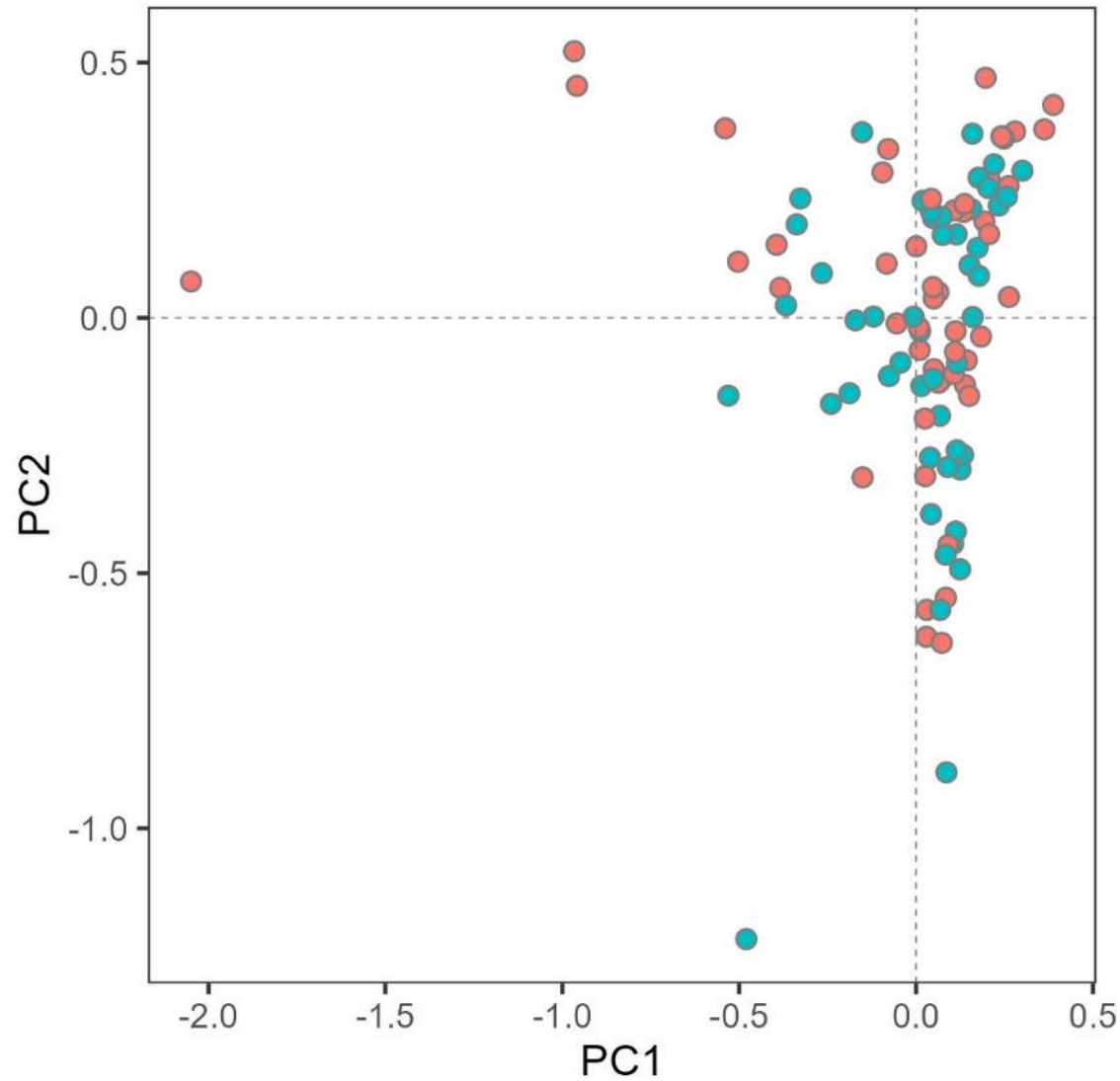


51 survey pairs (7 pairs excluded)



MATERIALS AND METHODS

Vegetation data → Hellinger transformation → Transform-based Principal Component Analysis (tb-PCA)



- Historical Surveys (Pastoral Types 2001-2004)
- Recent surveys (2021-2022)

Climatic data

 **Arpa Piemonte**
 Agenzia Regionale
 per la Protezione Ambientale
Meteoreological database

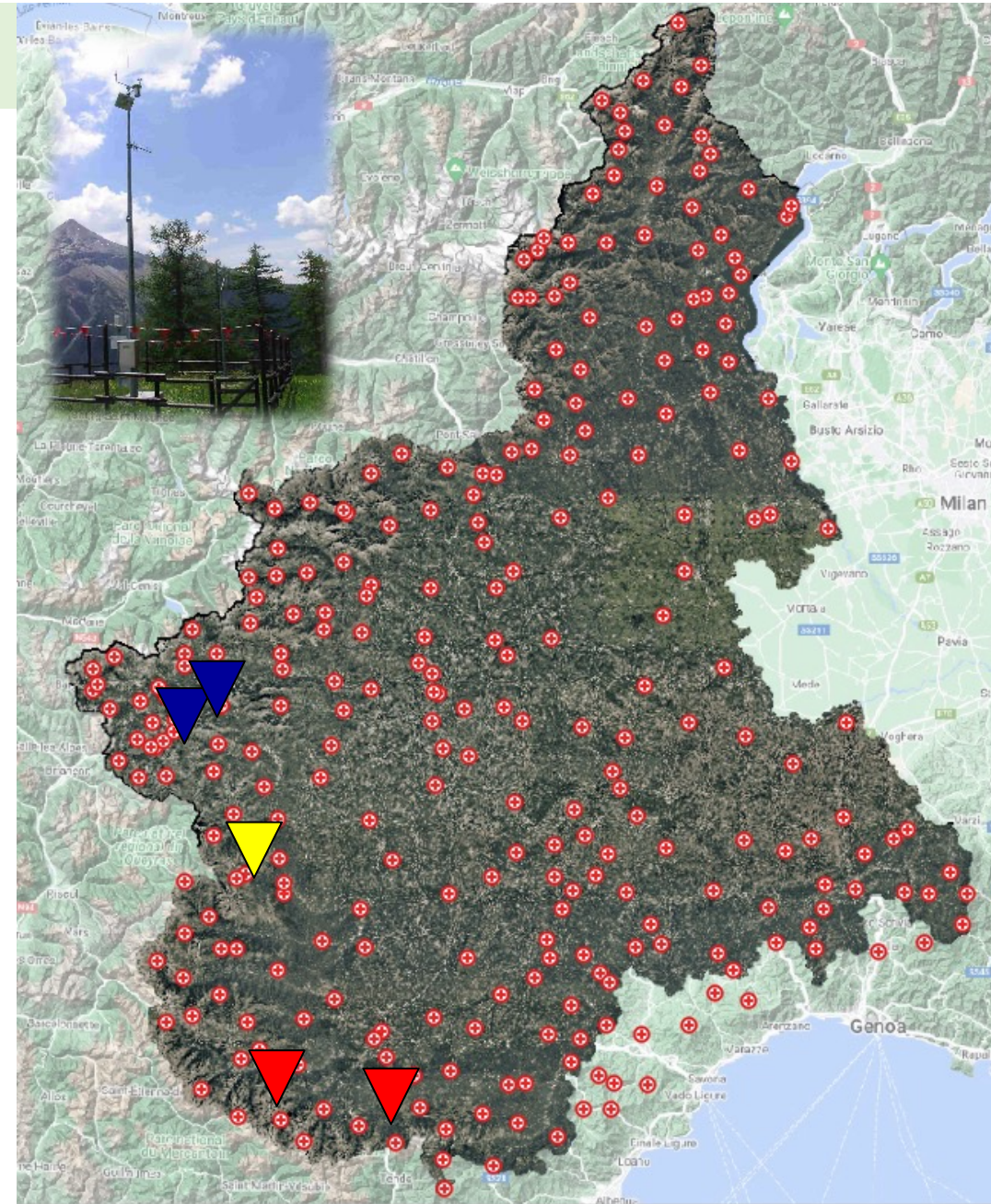


Selection of the most representative weather stations for each pasture

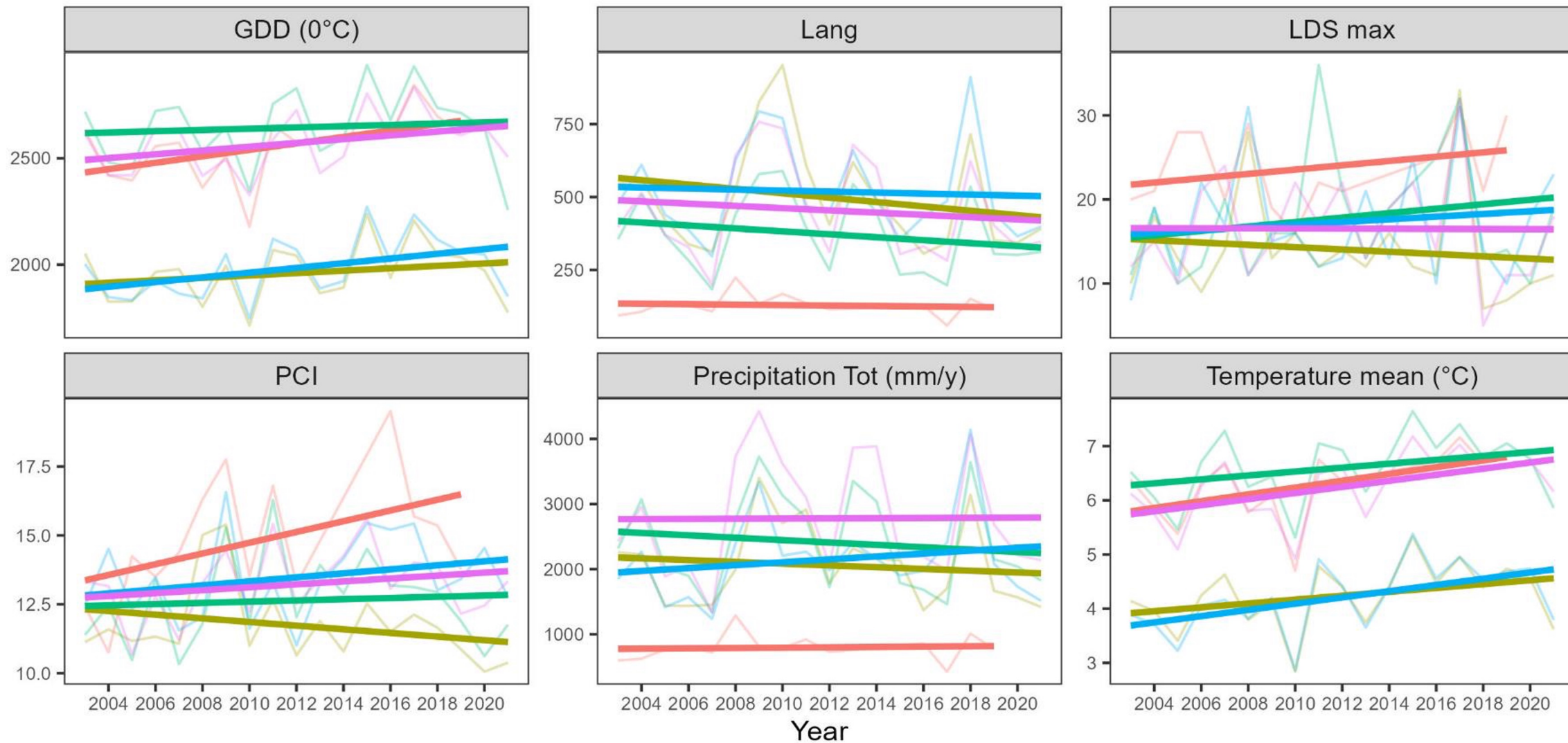


For each year from 2003 to 2021 → calculation of the following climatic and agro-climatic indices for each pasture :

- Annual mean Temperature (°C)
- Total annual precipitation (mm)
- Precipitation Concentration Index (PCI)
- Max Length of Dry Spell (LDS max)
- Lang Index (Lang)
- Growing Degree Days > 0°C (GDD)



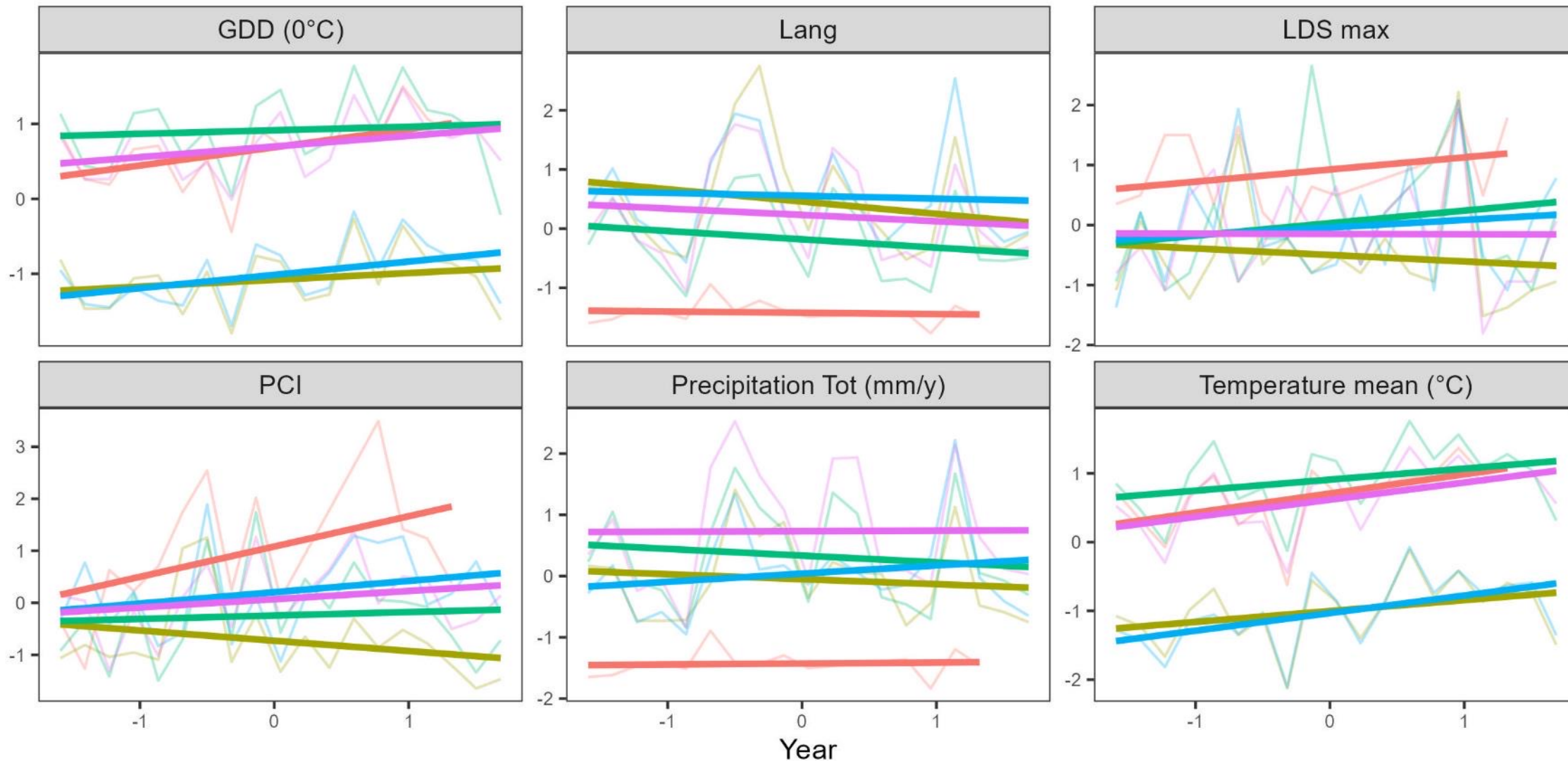
Use of linear models to describe the trend of climate variables in the period 2003 - 2021



Pasture — Chanfoulcre — Rocca Bianca — Sabbione — Troncea — Valasco

Use of linear models to describe the trend of climate variables in the period 2003 - 2021

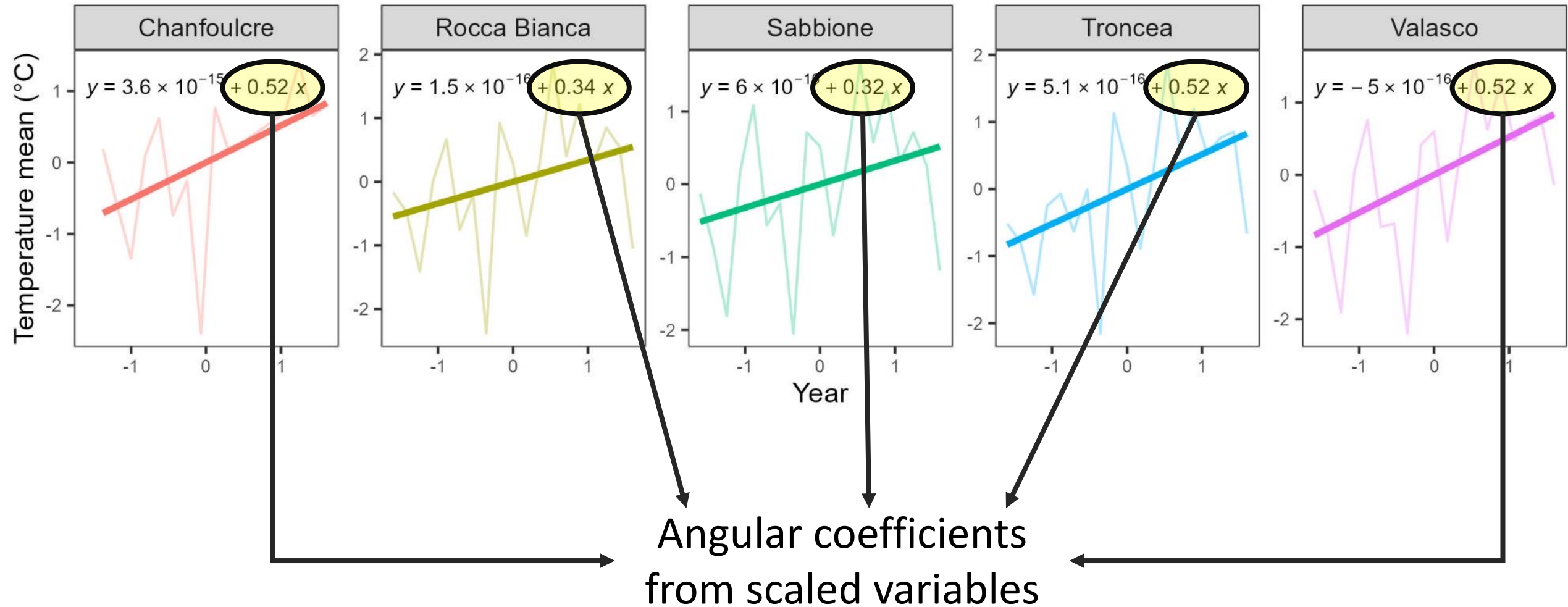
Variable standardization → Z scores



Variable standardization → Z scores

Pasture Chanfoulcre Rocca Bianca Sabbione Troncea Valasco

MATERIALS AND METHODS



Quantification of the degree of variation

Management data

«Modello 4» form

a) Stocking rate trends over time

Colore: rosa
Modello 4: del 25/05/2021
Progressivo di allevamento: 16/2021

Codice controllo: 1
N. Modello 4: 00016

DICHIARAZIONE DI PROVENIENZA E DI DESTINAZIONE DEGLI ANIMALI (Mod. 4) DELLA SPECIE BOVINA/BUFALINA

REGIONE PIEMONTE
ASL A210 AZIENDA SANITARIA LOCALE

A) IDENTIFICAZIONE

I n. 291 capi riportati in allegato, provengono dall'allevamento identificato dal Codice Aziendale: , specie allevata BOVINI sito in Cap: Comune di , e registrato presso la AZIENDA SANITARIA LOCALE .

PROPRIETARIO: CODICE FISCALE:
DETTENTORE: CODICE FISCALE:

I capi riportati in allegato, fatto salvo quanto citato nel riquadro E), NON SONO sottoposti al divieto di spostamento, in applicazione a misure di polizia veterinaria.

Tali animali, se non nati in azienda, sono stati altresì introdotti in azienda con regolare documentazione di accompagnamento (disponibile informaticamente in BDN) e, per ciascuno di essi, in allegato viene riportata l'azienda o, nel caso di scambi o importazioni scortati dalle certificazioni previste, la nazione di provenienza e gli estremi della documentazione di accompagnamento.

B) INFORMAZIONI SUI TRATTAMENTI E SULLA CATENA ALIMENTARE (L.C.A.), di cui al Reg.853 del 2004

Sezione non compilata.

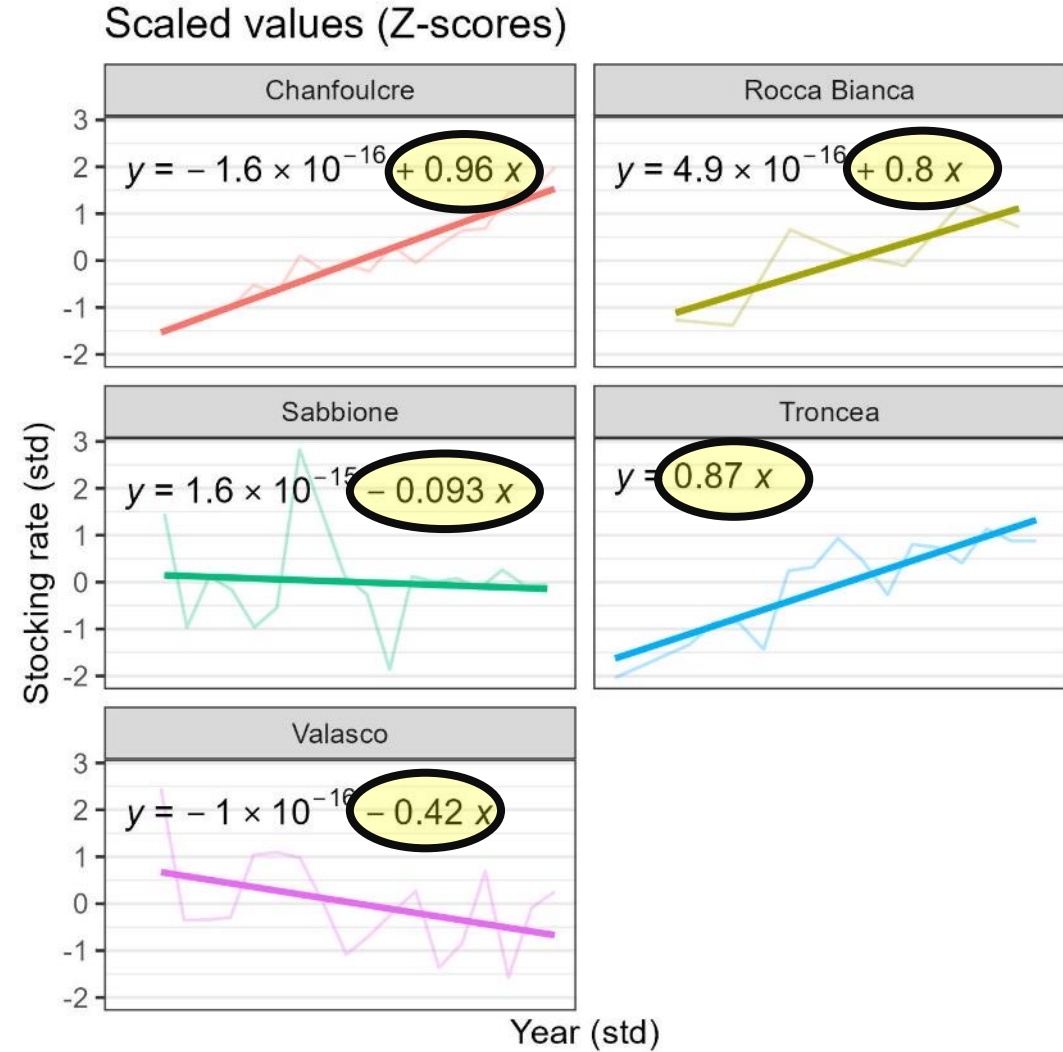
C) DESTINAZIONE

Gli animali sono destinati a:

Allevamento

Codice:
Denominazione:
Responsabile:
Detentore al pascolo:
Indirizzo: , Comune di
Data di uscita prevista 29/05/2021

I n. 291 capi riportati



Management data

b) Livestock site-use intensity within pastures

PLOS ONE

RESEARCH ARTICLE

Slope and distance from buildings are easy-to-retrieve proxies for estimating livestock site-use intensity in alpine summer pastures

Marco Pittarello *, Simone Ravetto Enri , Michele Lonati, Giampiero Lombardi 

Department of Agricultural, Forest and Food Sciences, University of Torino, Grugliasco, Italy

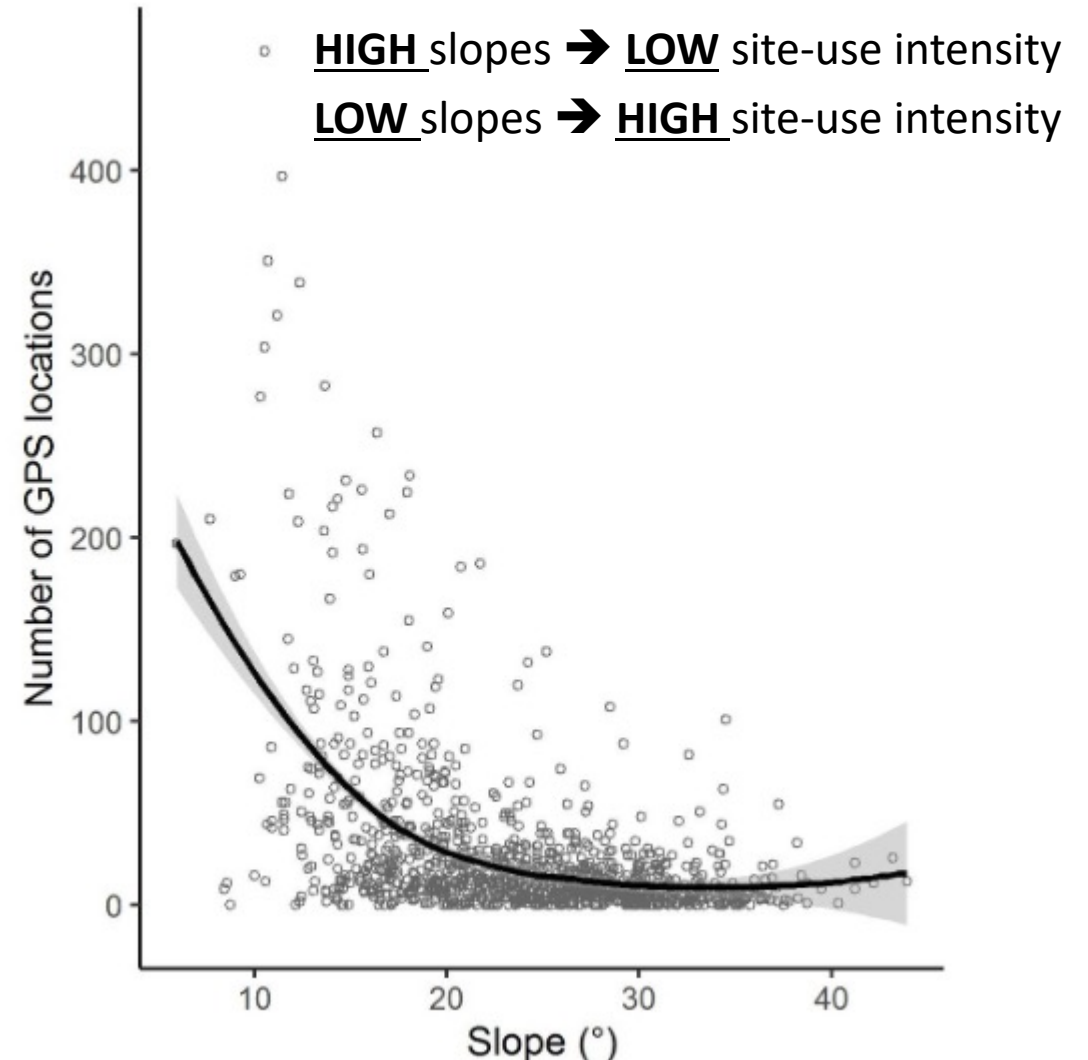
* marco.pittarello@unito.it



Slope from Digital Terrain Model
for each vegetation surveys



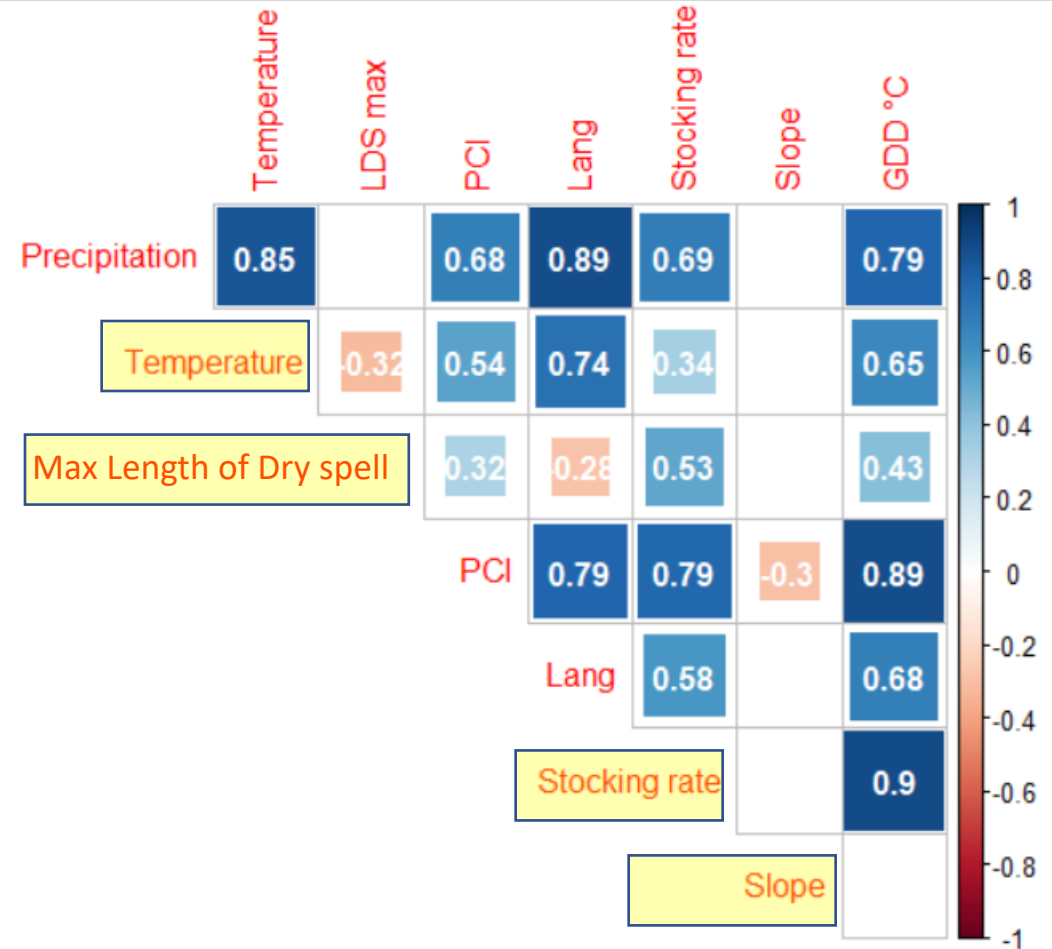
**Slope as proxy of livestock site-use
intensity within pastures**



Statistical analyses

Climatic and management variables

Spearman correlation matrix ($r < 0.60$)
 (to remove the variables with the largest mean absolute correlation)



Statistical analyses

Climatic and management variables

Spearman correlation matrix ($r < 0.60$)
(to remove the variables with the largest mean absolute correlation)

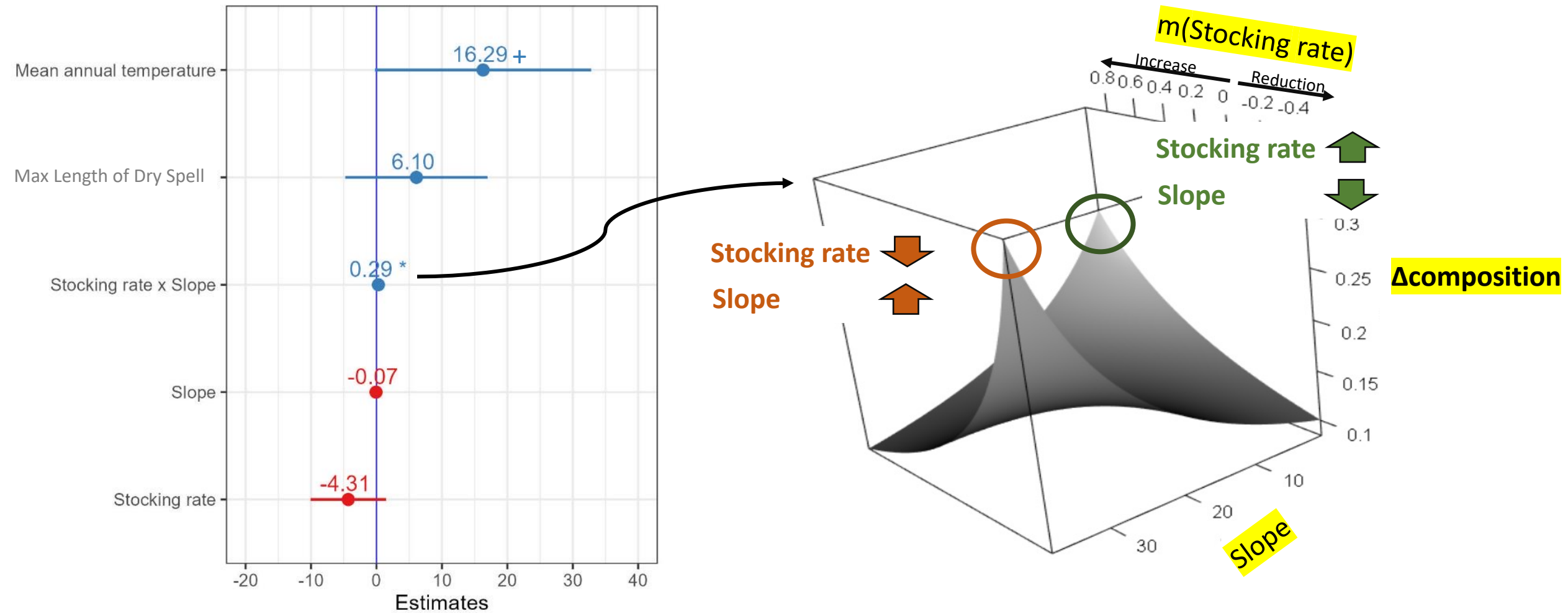
Generalized Linear Model
(Gamma distribution)

Variance Inflation Factor (VIF) < 10

Cross Validation
(variable importance)

$f(\Delta\text{composition}) = \text{Stocking rate} +$
 $\text{Slope} +$
 $\text{Stocking rate} \times \text{Slope} +$
 $\text{Mean annual temperature} +$
 $\text{Max Length of Dry Spell}$

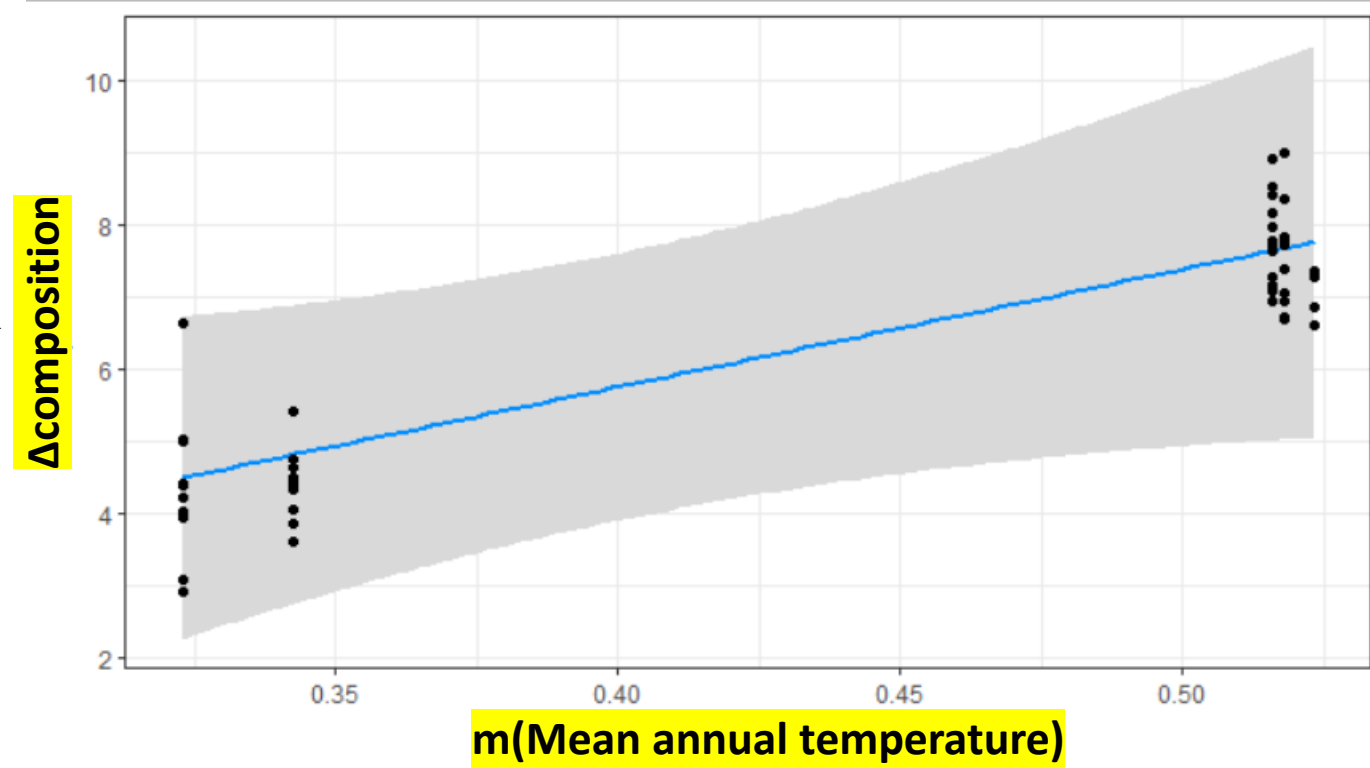
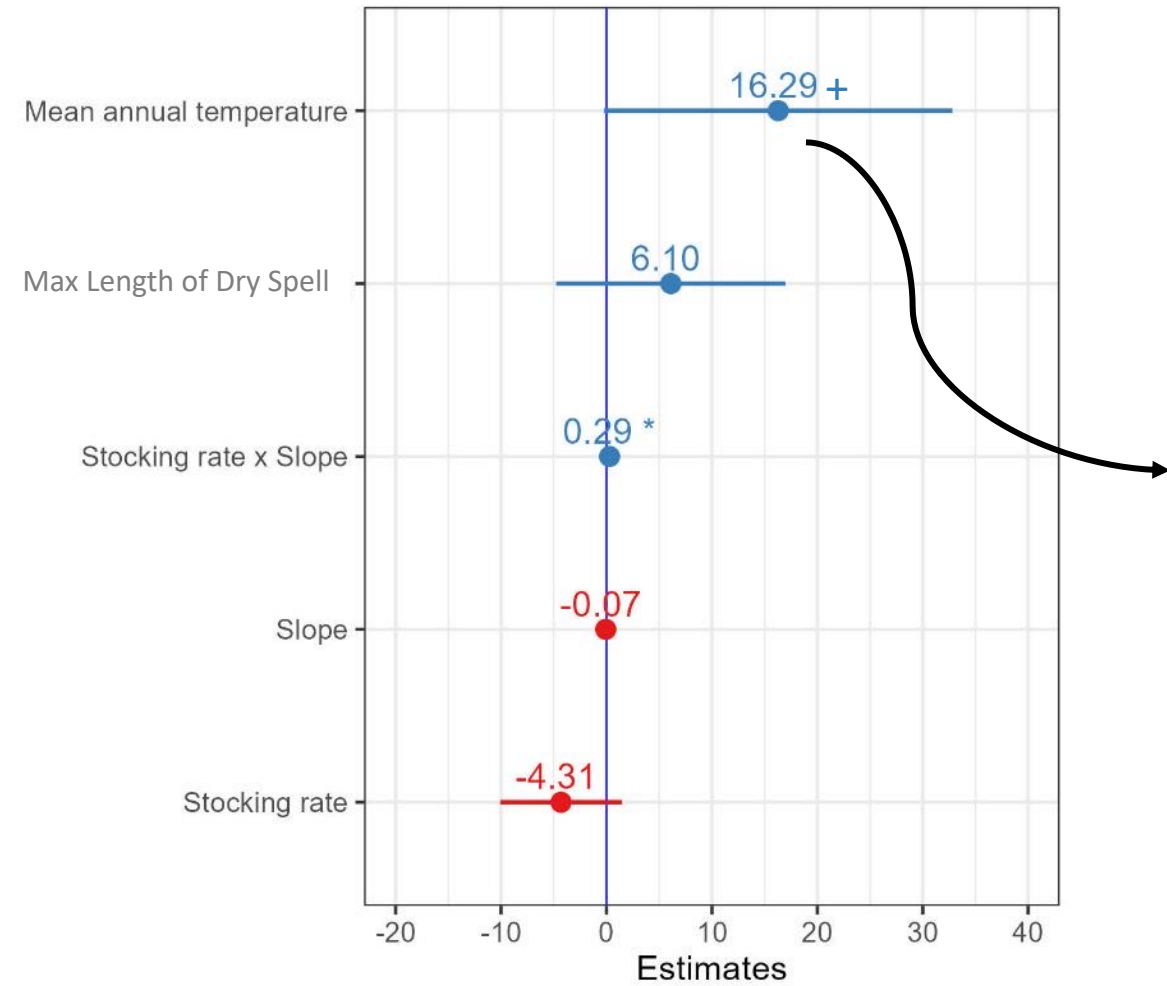
GLM output

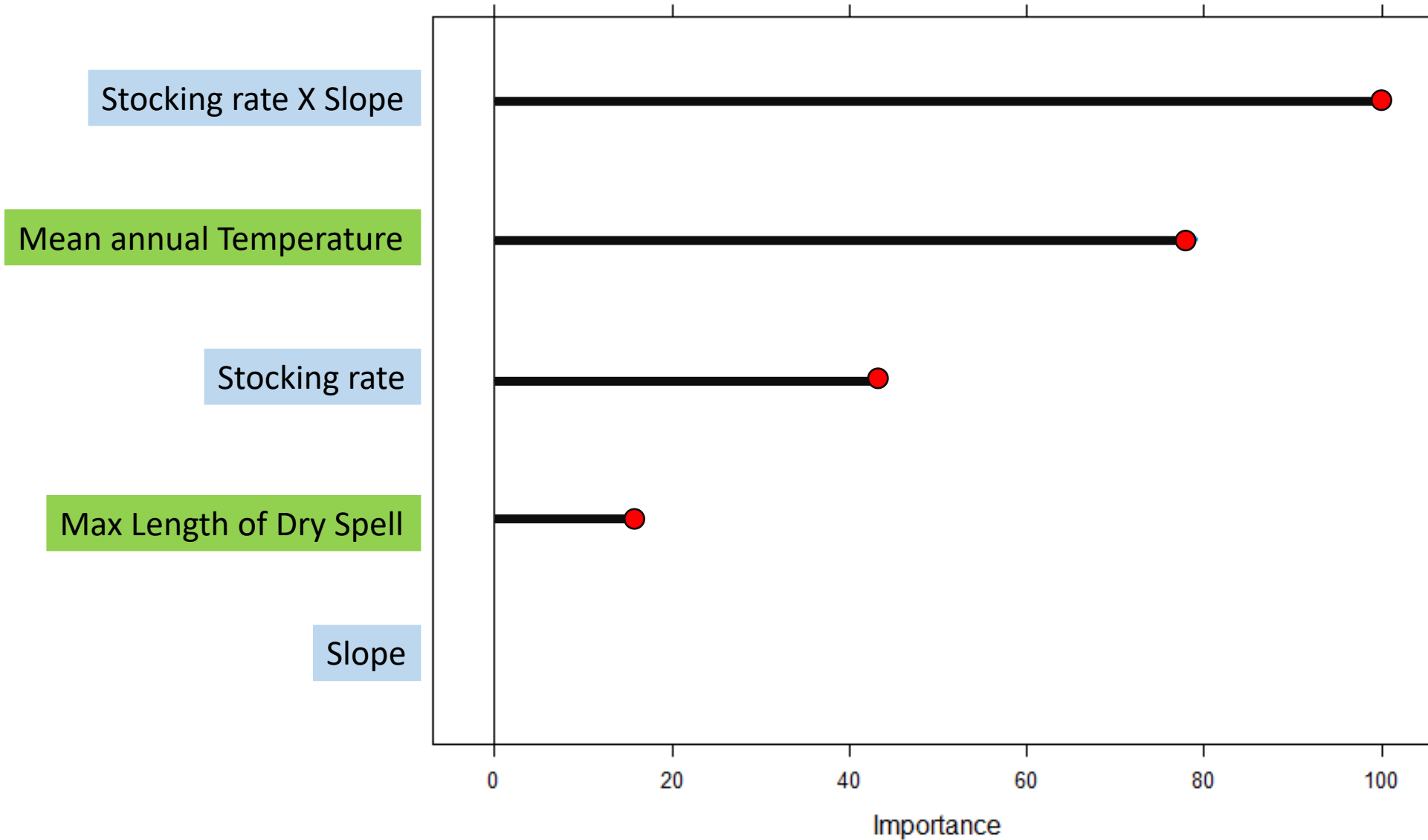


Major changes in vegetation when:

- Stocking rate has **reduced** over time and in **steep** areas → **UNDERGRAZING**
- Stocking rate has **increased** over time and in **flat** areas → **OVERGRAZING**

GLM output



Cross Validation \rightarrow Variable importance

- **Management and climatic variables** showed a **similar importance** in affecting changes in botanical composition.
- the **most pronounced changes** in botanical composition occurred in conditions with **over-** and **under grazing**.
- in a climate-change context, **management plays a crucial role** in conditioning the botanical composition of grazed alpine pastures
- Promoting the application of farm-specific tools for the regulation sustainable grazing management actions would be advisable → stocking rate has to balance the grassland carrying capacity (e.g. Grazing Management Plans).

Thank you for your attention

Special thanks to:



Ente di gestione delle aree protette
delle Alpi Cozie



	N° surveys
THERMIC CONDITIONS	
<i>Carex humilis</i>	2
<i>Festuca ovina</i>	14
<i>Patzkea paniculata</i>	3
<i>Brachypodium rupestre</i>	4
INTERMEDIATE CONDITIONS	
2.1 - Oligotrophic	
<i>Nardus stricta</i>	9
<i>Carex sempervirens</i> e <i>Festuca violacea</i>	6
2.2 - Mesotrophic	
<i>Festuca rubra</i>	5
2.3 - Eutrophic	
<i>Dactylis glomerata</i>	5
<i>Phleum rhaeticum</i>	1

