

Adaptation of Mediterranean local cattle breeds to climate changes: a preliminary study on genome-wide diversity

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Introduction

Adaptive ability of livestock to climate variations is a key factor in the context of global climate change. In order to investigate the genetic basis of cattle adaptation abilities, an international Project GALIMED "Genetic Adaptation of Bovine Livestock and production systems in MEDiterranean region", has been funded by INRA (metaprogram ACCAF). The GALIMED project proposes a multidisciplinary approach combining population genetic, environmental, climatic, livestock management and production systems data to characterize Mediterranean cattle breeds, quantify biodiversity and describe the covariation of these different factors in order to detect genetic variants and selection signals associated with adaptive traits. We present here first results of a joint analysis of genetic and climatic data on 8 local breeds from the central Mediterranean area aimed at reconstruct their genetic structure and identify genomic regions related to adaptation to climate change.

Materials & Methods

- 299 individuals genotyped with the Bovine SNP50K v2 BeadChip (Illumina Inc., San Diego, CA). After editing, 43,625 SNPs & 290 individuals
- Geographic coordinates and 19 bioclimatic variables downloaded from [WORLDCLIM database www.worldclim.org](http://www.worldclim.org).
- Estimation of within-breed genetic diversity indices (Table 1).
- Principal Components Analysis (PCA) performed on SNPs data and climatic variables.
- Co-inertia (CIA) analysis to detect a possible common structure between genotypes and climatic variables.

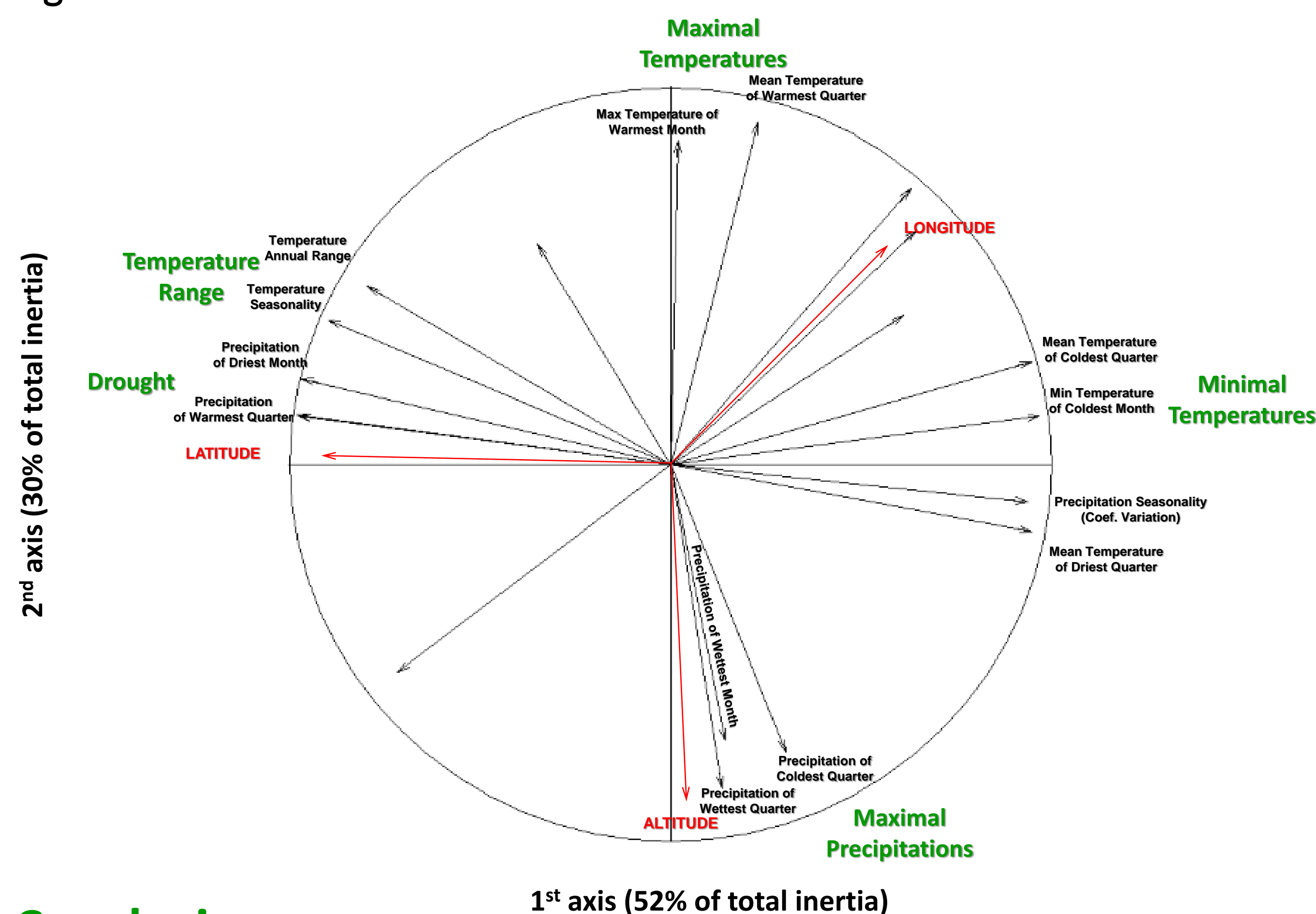
Results

Table 1: Genetic diversity indices

Breed	n	npSNP	Ho ± s.d	He ± s.d	MAF ± s.d	F ± s.d	Ne
Cinisara	71	589	0.323 ± 0.155	0.332 ± 0.152	0.250 ± 0.146	0.05 ± 0.07	934
Modicana	72	1957	0.310 ± 0.176	0.307 ± 0.167	0.230 ± 0.153	0.09 ± 0.06	454
Piemontese	21	2305	0.337 ± 0.180	0.327 ± 0.157	0.247 ± 0.149	0.01 ± 0.01	657
Corsa	31	2006	0.328 ± 0.170	0.328 ± 0.156	0.248 ± 0.149	0.03 ± 0.04	779
Maremmana	25	4623	0.315 ± 0.195	0.300 ± 0.173	0.225 ± 0.156	0.07 ± 0.03	287
Romagnola	21	4339	0.306 ± 0.192	0.300 ± 0.173	0.225 ± 0.156	0.10 ± 0.03	295
Sarda	30	1479	0.325 ± 0.165	0.332 ± 0.154	0.251 ± 0.148	0.04 ± 0.06	873
Sardo-Modicana	28	2413	0.325 ± 0.179	0.320 ± 0.162	0.240 ± 0.151	0.04 ± 0.03	536

n. of individuals, number of monomorphic loci (npSNP), average MAF, observed (Ho) and expected (He) heterozygosity, inbreeding coefficient (F) and effective population size (Ne) estimated from the extent of linkage disequilibrium (LD) at 50 generation ago

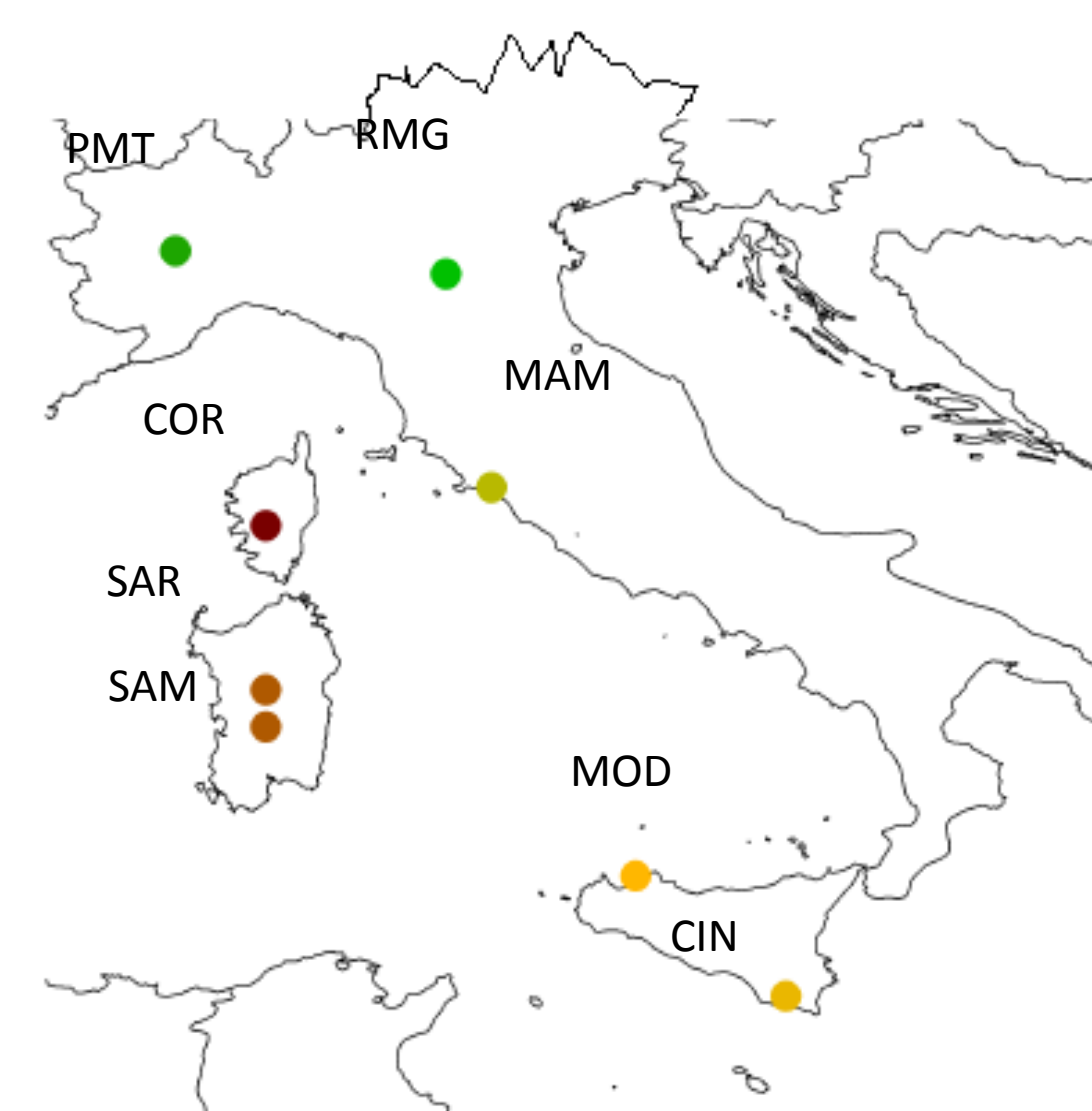
Fig. 3: PCA on climatic data



Conclusions

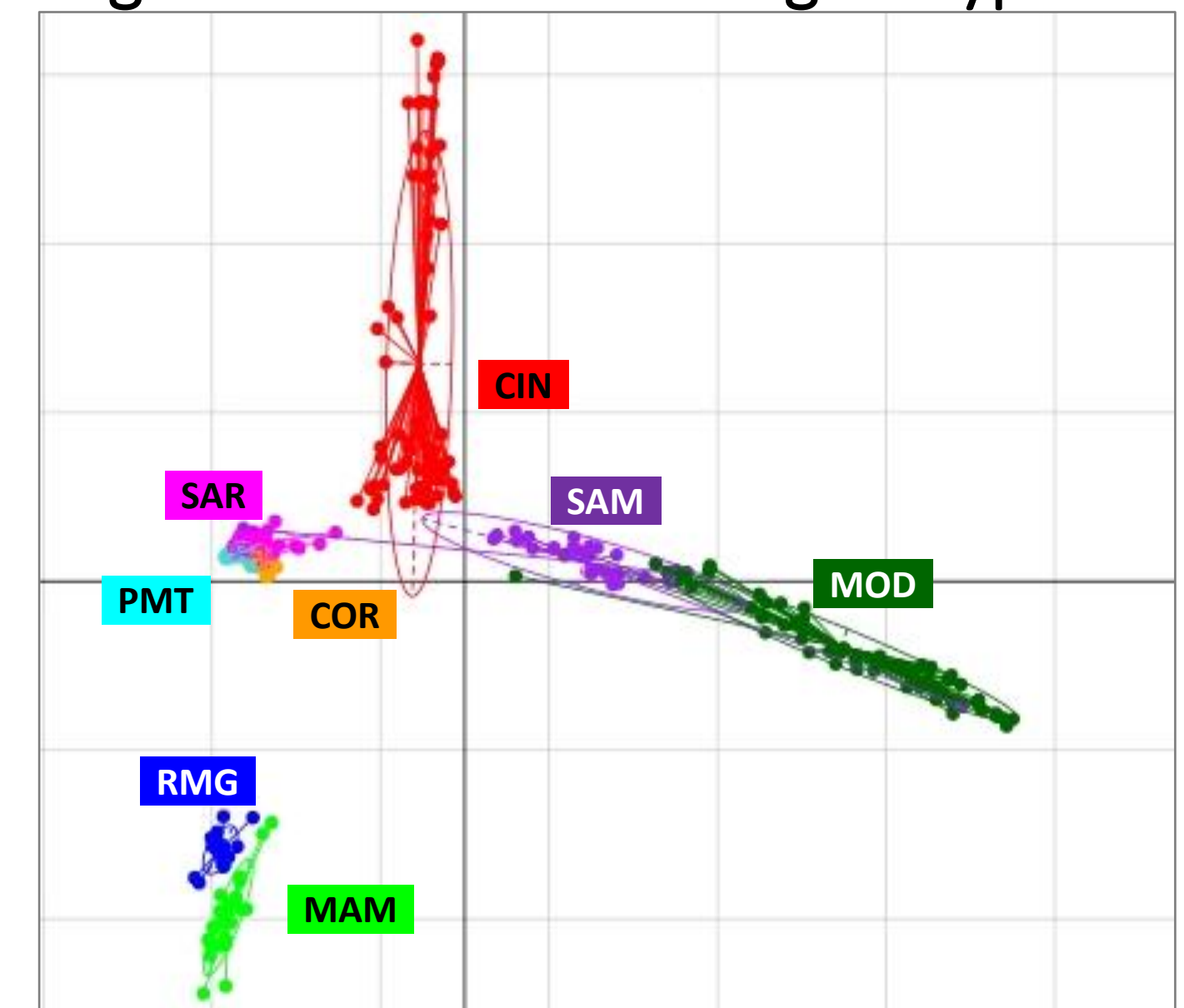
First results of combined genotypic and climatic data suggests that the 8 investigated cattle breeds from central Mediterranean area show genetic differences which may have been shaped by different climatic conditions. Further analyses are on going to identify the genetic regions with a potential adaptive role.

Fig. 1 Location of breeds



CIN: Cinisara; MOD: Modicana; PMT: Piemontese; COR: Corsa; MAM: Maremmana; RMG: Romagnola; SAR: Sarda; SAM: Sardo-Modicana

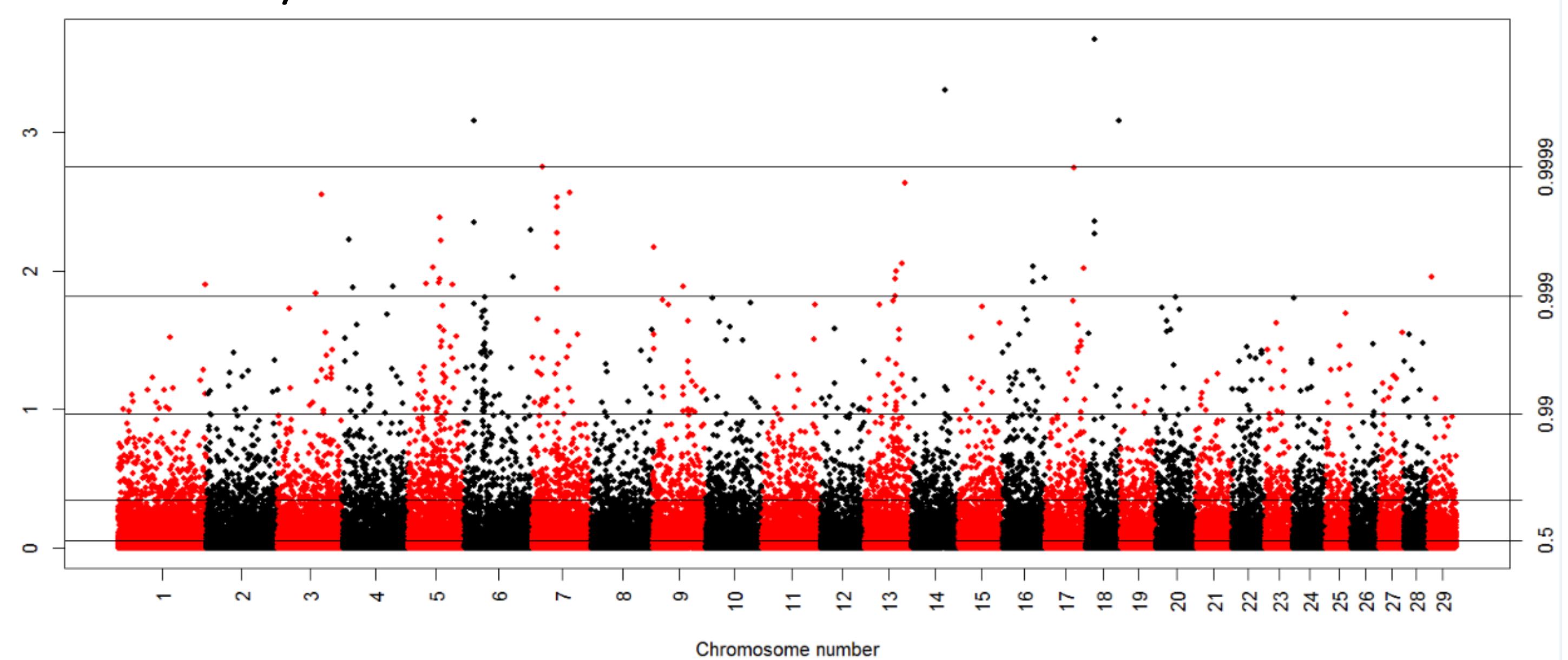
Fig. 2: PCA on individual genotypes



A joint analysis (coinertia) on climatic and genetic data

RV coefficient between molecular data and both geographic and climatic information=0.38 at individual level and 0.61 at breed level (p-value=0.001). Several genomic regions associated with the 1st coinertia axis were detected (Fig. 4).

Fig. 4: Contributions (squared scores) of SNPs to the 1st component of the coinertia analysis



Acknowledgments

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