



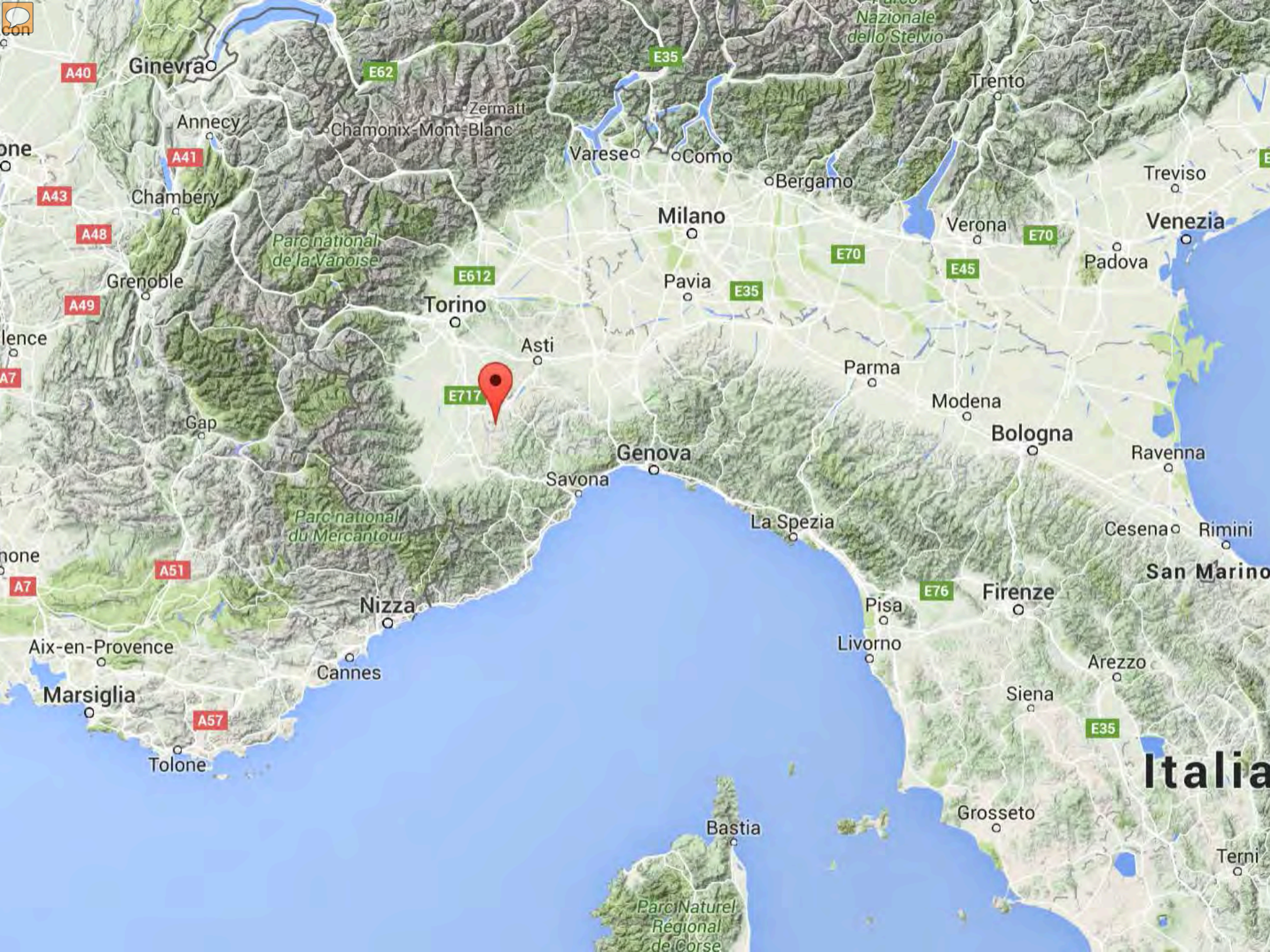
# THE SOIL BIODIVERSITY AS A SUPPORT TO ENVIRONMENTAL SUSTAINABILITY IN VINEYARD

**Elena MANIA, Mauro PIAZZI, Luca GANGEMI,  
Andrea Edmondo ROSSI, Fabrizio CASSI, Silvia GUIDONI**



**11th International Terroir Congress**

Willamette Valley, Oregon July 10-14, 2016



Italia





ASSOCIAZIONE PER IL PATRIMONIO  
DEI PAESAGGI VITIVINICOLI  
DI LANGHE-ROERO E MONFERRATO

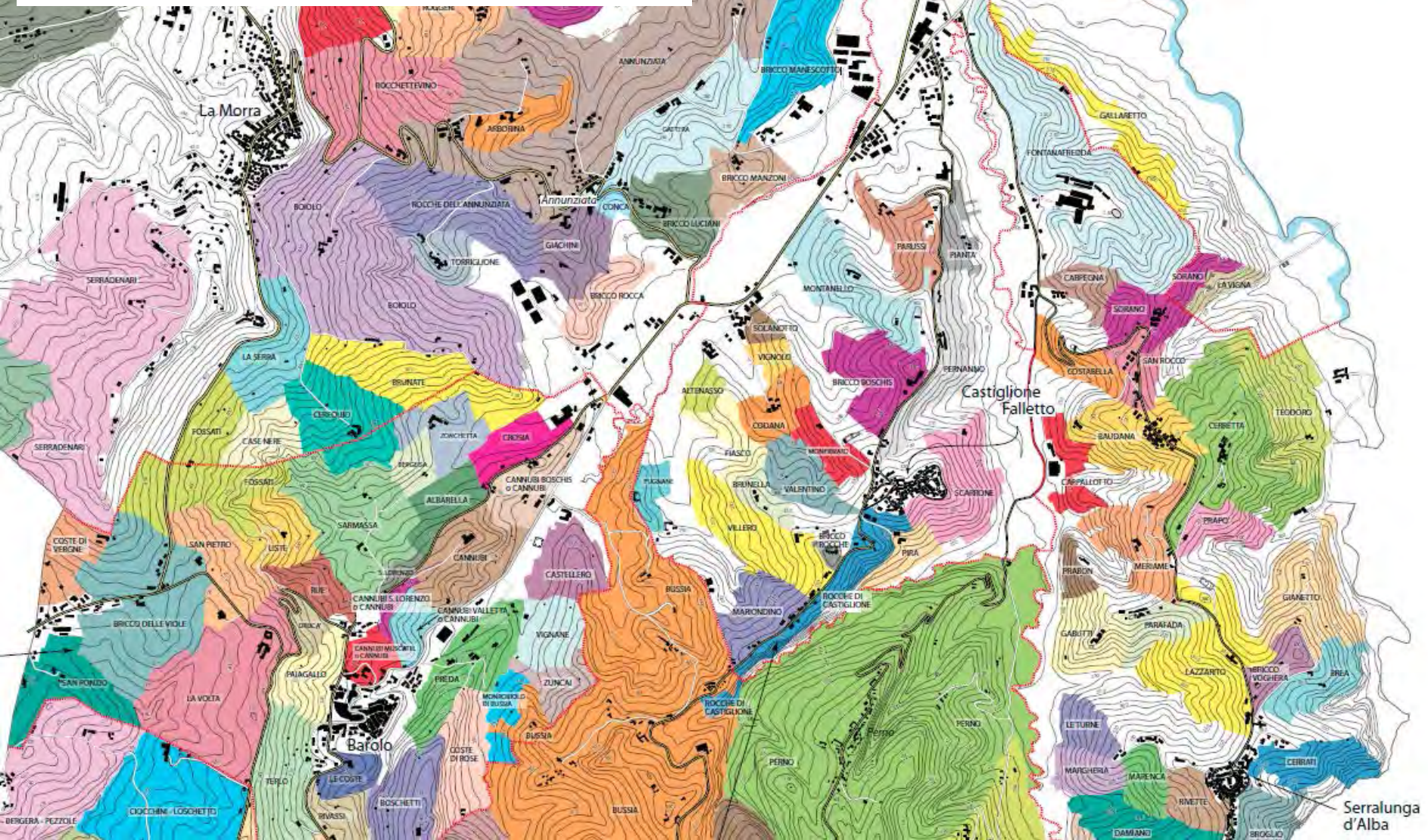


United Nations  
Educational, Scientific and  
Cultural Organization

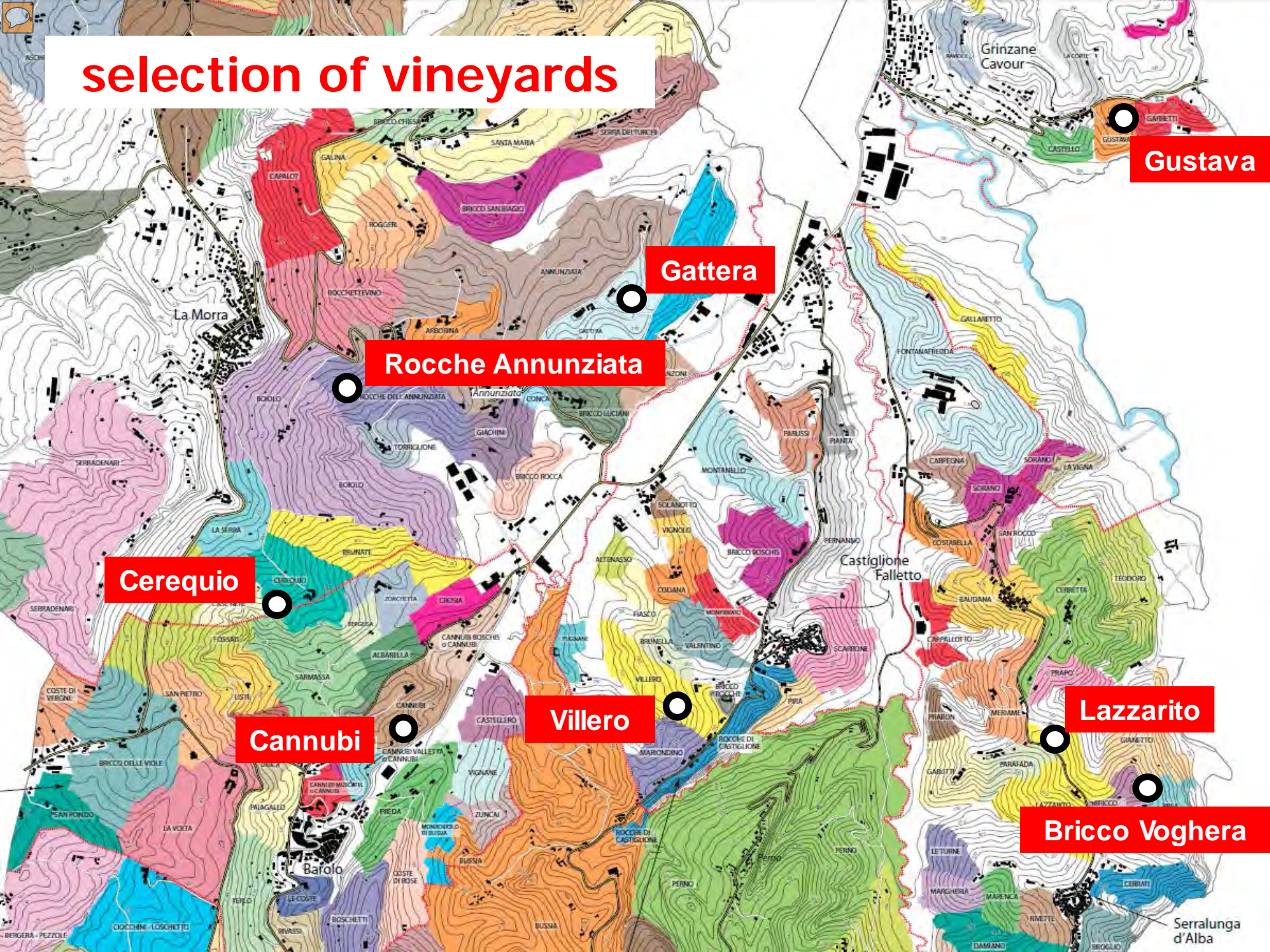


World Heritage  
Convention

# Study area: Barolo *cru*



# selection of vineyards





## Aims of the work

Observe **soil characteristics** from a physical, chemical and biological point of view

**Highlight differences** between sites/vineyards

Identify **indicators for rapid assessment** of environmental quality related to vineyard management

**Define environmental issues concerning *Terroir* and explaining wines differences**

# Geographical characteristics of the sites

Vineyards	Company	Aspect (°)	Elevation (m <i>a.s.l.</i> )
<b>Gustava</b> , Guarene	Pio Cesare	135	258
<b>Gattera</b> , La Morra	Cordero di Montezemolo	200	280
<b>Baudana</b> , Serralunga	Luciano Sandrone	210	300
<b>Rocche Annunziata</b> , La Morra	Paolo Scavino	135	338
<b>Cerequio</b> , La Morra	Michele Chiarlo	125	325
<b>Cannubi</b> , Barolo	Poderi Luigi Einaudi	145	260
<b>Villero</b> , Castiglione Falletto	Cordero di Montezemolo	245	308
<b>Lazzarito</b> , Serralunga	Poderi Gianni Gagliardo	210	365
<b>Bricco Voghera</b> , Serralunga	Azelia	200	378

Two dominant exposure:

**south-est** (La Morra)

**south-west** (Serralunga and Castiglione Falletto)

The variability of elevation is independent from the slope exposure...

# the hill system







# the hill system



# Standard observations on vineyard soils

**Profile description** and soil **sampling**

**Chemical** and **physical** analysis

Soil **physical** properties affect the community of its inhabitants





# CEREQUIO - CHIARLO



# ROCCE ANNUNZIATA – PAOLO SCAVINO





# VILLERO – CORDERO DI MONTEZEMOLO



# LAZZARITO - PODERI GIANNI GAGLIARDO



# Soil chemical analyses

	Average values	Standard error
Sand (%)	21,9	1,8
Silt (%)	59,0	1,4
Clay (%)	19,1	0,7
Texture (USDA)	Silty loam	
pH	8,0	0,03
Total limestone (%)	23,6	1,6
Organic matter (%)	2,53	0,2
C/N	10,7	0,4
C.S.C. (meq/100 g)	15,6	1,0

Sand is the more variable parameter **<30%**



## Second survey stage



**Biodiversity assesment of soil**

**Physical and hydrological soil parameters**



# Biodiversity assessment on vineyard soils

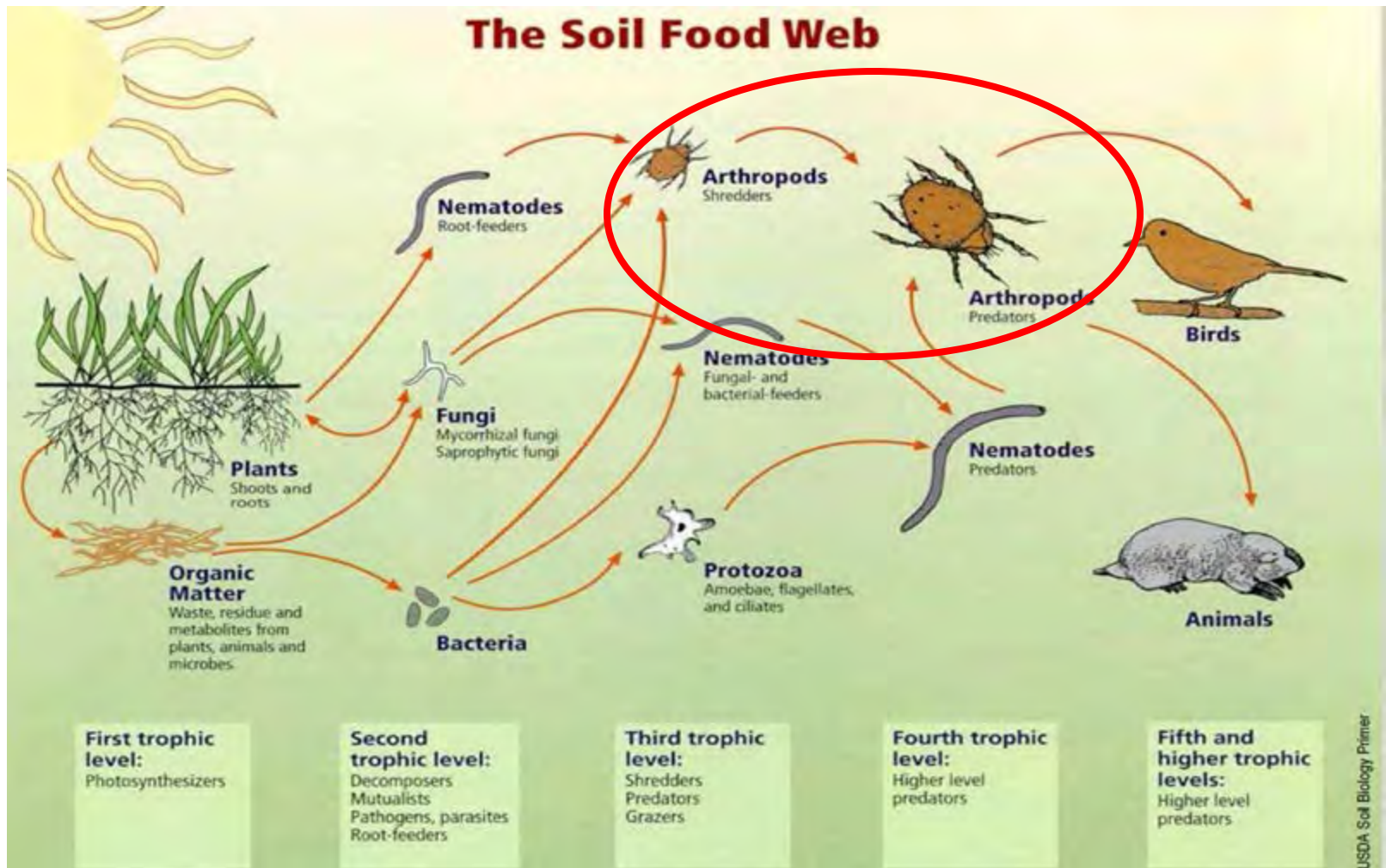
**Soil Biological Quality:** identification of the number and taxonomy of micro-arthropods in soil (**QBS-ar Index**)

**QBS-ar** is easy to monitor, effective in describing the biological quality of the soil and its biodiversity, able to measure the impact of farming systems

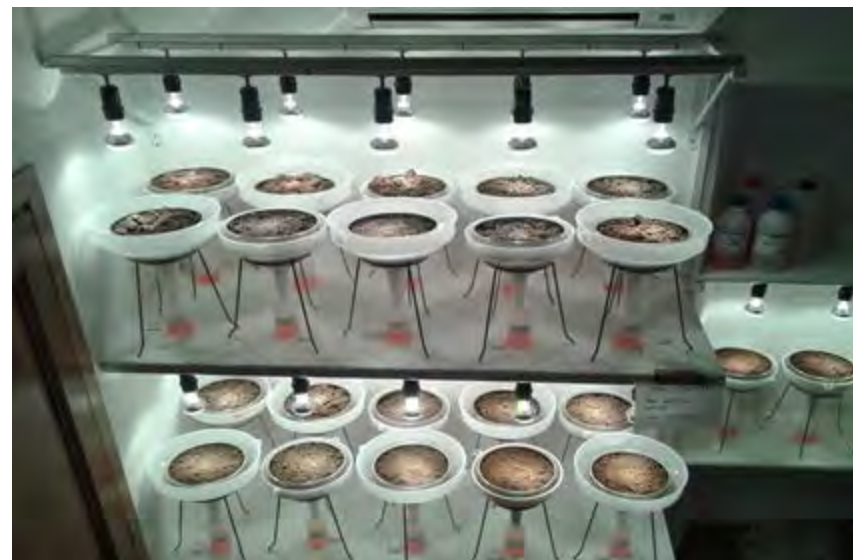


# The QBS-ar index

“Register the biodiversity degree of soil environment. Is **reliable and trusted**, direct expression of organism functionality”.



# Sampling and analyze soil biodiversity



# Soil Biological Quality Index

	Individuals (number)	Taxa (number)	Individual EMI20 (number)	Taxa EMI 20 (number)	QBS max
<b>Average value</b>	<b>922</b>	<b>13.9</b>	<b>74</b>	<b>5.5</b>	<b>187</b>
Minimum	385	9	11	3	170
Maximum	1485	16	135	7	230
<i>Standard error</i>	<i>103</i>	<i>0.15</i>	<i>14.0</i>	<i>0.40</i>	<i>9.26</i>

Generally High QBS values (rarely registered in vineyards)

**Chemical** soil properties do not affect QBS Index

**Physical** soil properties seems more related

Taxa with the highest ecological value (EMI20)



*Sinfila*



*Collembola*



*Diplura*

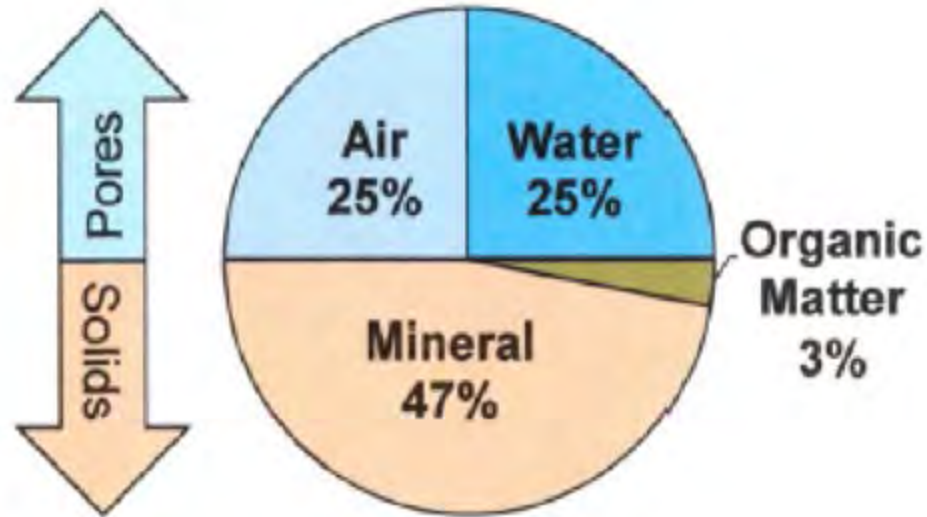


*Protura*



*Acara*

# Physical assessment on vineyard soils



**Soil porosity....** the place where organisms live

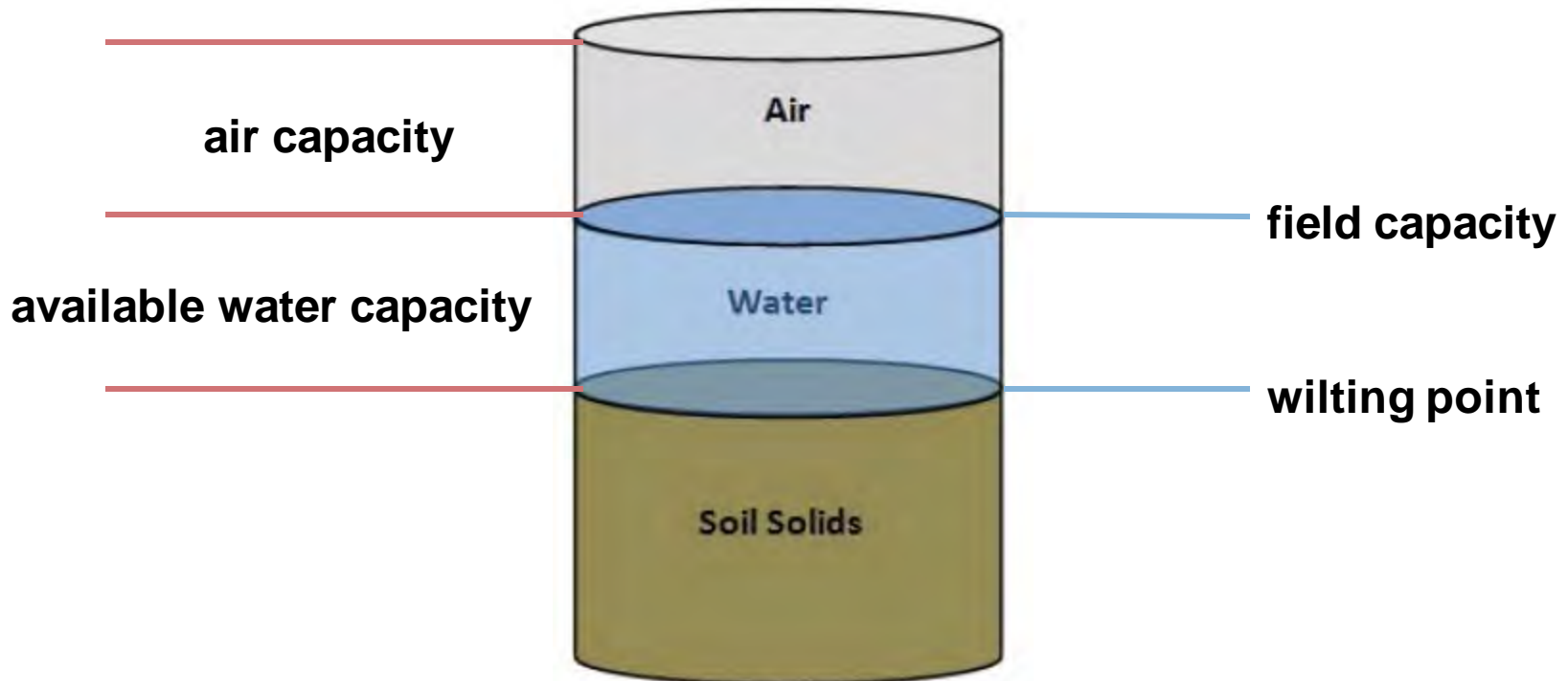
In pores they find **water and oxygen** essential for their life

They build pores themselves, mostly the huge ones.

# Physical assessment on vineyard soils

**Air capacity:** the volume occupied by biggest soil pores

Water is not retained by soil capillary action at its field capacity. It's the **minimum air quantity available into the soil** even in case of heavy rains.



# Sampling for soil physical analysis



# Soil physical analysis



**Sand beds**



**Richards analyzer**

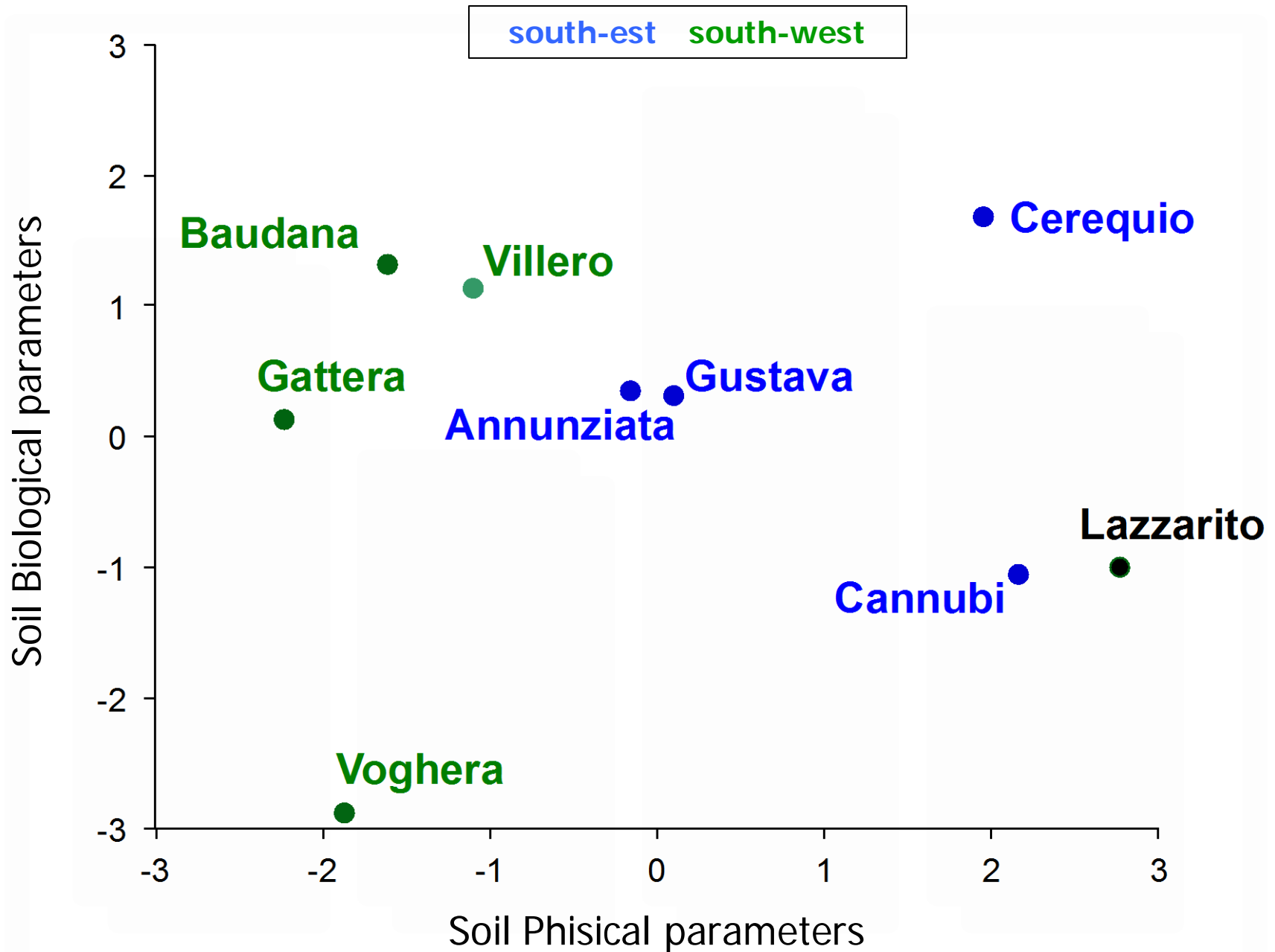


# Soil Physical assessments

	Bulk density kg dm <sup>-3</sup>	Total porosity %	Air capacity %	AWC
<b>Average values</b>	<b>1.41</b>	<b>52.0</b>	<b>12.8</b>	<b>20.4</b>
Minimum value	1.16	46.7	6.8	17.6
Maximum value	1.54	58.1	19.5	24.1
<i>Standard error</i>	<i>0.05</i>	<i>1.47</i>	<i>1.64</i>	<i>0.81</i>



# Principal Component Analysis



# Correlation Matrix

	Individuals	Taxa	QBS max	Bulk density	Porosity	Air capacity	AWC
Individuals							
Taxa	0.237						
QBS max	0.192	<b>0.835</b>					
Bulk density	<b>0.598</b>	-0.281	-0.136				
Porosity	<b>-0.468</b>	0.375	<b>0.553</b>	-0.764			
Air capacity	<b>-0.484</b>	0.183	0.287	-0.863	<b>0.898</b>		
AWC	0.191	0.125	0.191	<b>0.562</b>	-0.331	<b>-0.688</b>	

Positive correlation: **Number of Individual and BD, QBS max and Porosity**

Negative correlation: **Number of Individual and Porosity**

# Matching physical and biological soil aspects

	macrofauna		mesofauna		microfauna				
	MACROPORI		MESOPORI			MICROPORI			
Tensione in cm	0	1	10	50	100	200	333	1000	3000
pF			1	1,7	2	2,3	2,5	3	3,5
Diametro vuoti in mm	> 2,9	2,9	0,291	0,0582	0,0291	0,0145	0,0087	0,0029	0,00097
Chilopodi	■								
Opilioni	■								
Diplopodi	■								
Sinfili	■								
Pseudoscorpioni (Chelonetidi)	■								
Altri insetti	■								
Dipluri	■	■							
Araneidi	■		■						
Proturi	■		■						
Collemboli	■		■	■					
Acari	■		■	■					
Lumbricidi	■								
Molluschi	■		■						
Enchitreidi	■		■						
Nematodi	■		■	■					
Rotiferi	■		■	■					
Tardigradi	■		■	■					
Protozoi	■		■	■	■	■	■		

# Conclusion

Vineyards showed **similarities** for soil parameters usually considered in *terroir* studies, such as name, pH and texture.

Major differences emerged in aspects so far little considered in this kind of studies, such as **soil porosity**, **air capacity** and **biodiversity indices**.

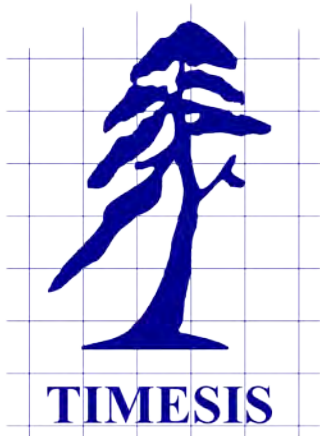
**QBS-ar index** shows relationships with the human impact and may be useful to study the anthropic aspect of the *terroir* variability.

It revealed a good potential for **rapid assessment** of environmental quality although many aspects still remain to be defined including the detail of the relationships with crop management.



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**Thank you**