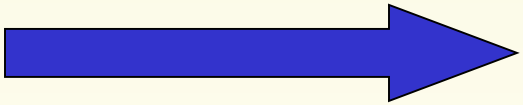
Are $FOCUS_{gw}$ and $FOCUS_{sw}$ scenarios representative for Italian conditions?

- Definition and search of data at national level
  - Collection, check and organisation of data
    - Selection of methods for statistical and spatial analysis
      - Creation of a database and of a GIS suitable for both analysis and result presentation
        - Comparison of Italian data with the nine $FOCUS_{gw}$ scenarios and ten $FOCUS_{sw}$ scenarios
          - Definition of the scenarios relevant for Italy

Definition and search of data: $FOCUS_{gw}$ scenarios

Location	Mean annual temperature (°C)	Mean annual rainfall (mm)	Topsoil	OC (%)
Châteaudun	11.4	648 + I	silty clay loam	1.4
Hamburg	9.2	786	sandy loam	1.5
Jokioinen	4.3	638	loamy sand	4.1
Kremsmünster	8.8	900	loam/silt loam	2.1
Okehampton	10.4	1038	loam	2.2
Piacenza	13.3	857 + I	loam	1.0
Porto	14.8	1150	loam	3.8
Sevilla	18.1	493 + I	silt loam	0.9
Thiva	16.2	500 + I	loam	0.7

main data



Mean annual temperature (°C)

Mean annual rainfall (mm)

Textural class of first metre of soil

Organic carbon content (%)

Definition and search of data: FOCUS$_{sw}$ scenarios

Name	Mean annual T (°C)	Annual Rainfall (mm)	Topsoil	OM (%)	Slope (%)	Water bodies
D1	6.1	556	Silty clay	2.0	0 – 0.5	Ditch, stream
D2	9.7	642	Clay	3.3	0.5 – 2	Ditch, stream
D3	9.9	747	Sand	2.3	0 – 0.5	Ditch
D4	8.2	659	Loam	1.4	0.5 – 2	Pond, Stream
D5	11.8	651	Loam	2.1	2 – 4	Pond, stream
D6	16.7	683	Clay loam	1.2	0 – 0.5	Ditch
R1	10.0	744	Silt loam	1.2	3	Pond, stream
R2	14.8	1402	Sandy loam	4.0	20*	Stream
R3	13.6	682	Clay loam	1.0	10*	Stream
R4	14.0	756	Sandy clay loam	0.6	5	Stream

main data

Same pedoclimatic database as gw

Slope (%)

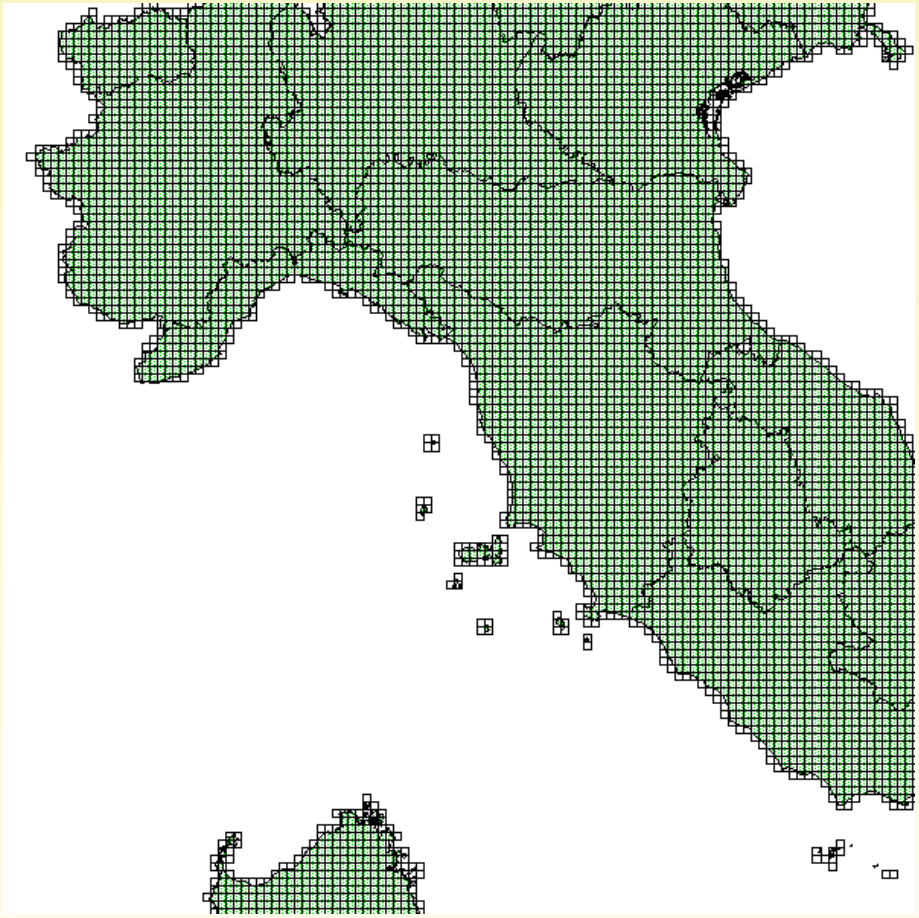
Water bodies

Collection check and organisation of data

Type of data	Source of data
Ecopedological map of Italy: ecopedological unit with different attributes. Three dominant soils.Scale 1:250.000	ESB – JRC, ISPRA (Dott.Rusco) Ministry for the environment
Database from Consorzio ITA: wide series of measures on pedological profile (minipits), referred to ecopedological units	
Digital map Corine Landcover	
Meteo-climatic data of Italy. Series of data on temperature and rainfall from 58 stations distributed on national territory	Centro Epson Meteo- Segrate (MI) Col. M. Giuliacci – Dott. S. Abelli.
Map of administrative boundaries of Italy: national, regional, provincial.	ESRI – Esri Maps (provided with software ESRI)
GTOPO30 – World database on digital model of territory.	Land Processes – Distributed Active Archive Center (NASA – USGS)
Agricultural area in Italy	ISTAT - CENSUS 2000,
Hydrographical network	Ministry for the environment

Similarity analysis

Extracted grid of spatial analysis on Italy (5 km × 5 km)



Gower index: $$c_{ij} = \frac{\sum_{k=1}^{p} s_{ijk}}{\sum_{k=1}^{p} \delta_{ijk}};$$

δ_i = Kronecker delta

s_{ijk} = similarity

Quantitative variables

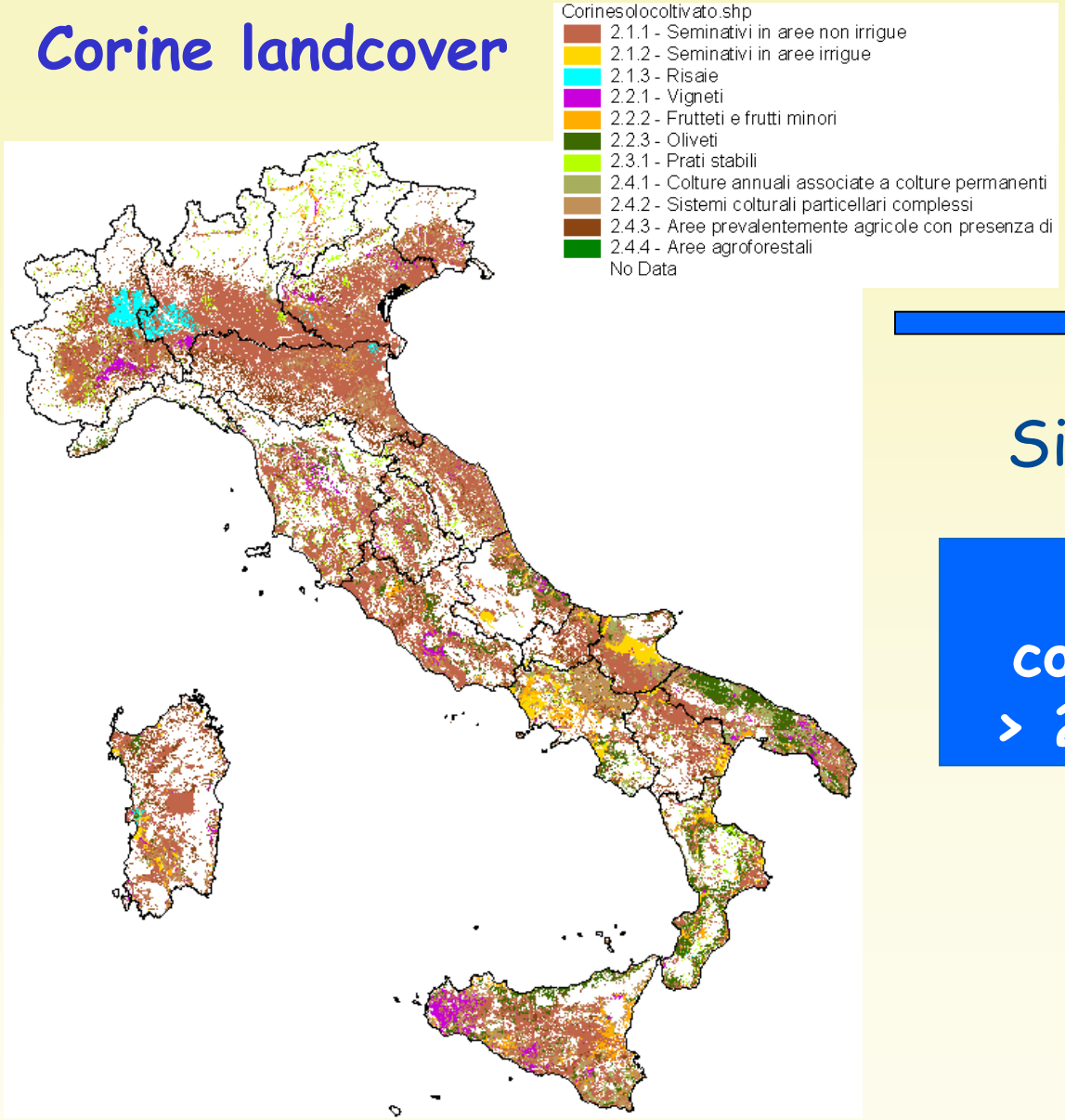
$$s_{ijk} = 1 - \frac{\left| x_{ik} - x_{jk} \right|}{(\text{range of variable k})}$$

Qualitative variables

$$s_{ijk} = \begin{cases} 1 & \text{if } i \text{ e } j \text{ agrees with respect to variable } k \\ 0 & \text{otherwise} \end{cases}$$

Identification of cultivated areas of Italy

Corine landcover



→ Polygonal map

Similarity: grid map

Maps overlay: considered cells with > 20% cultivated area

96,3% Italian cultivated area

Statistical and spatial analysis: meteo data

58 meteorological stations, geographically located (Centro Epson Meteo).

Mean annual values on temperature and rainfall.
Series: 1979-2001

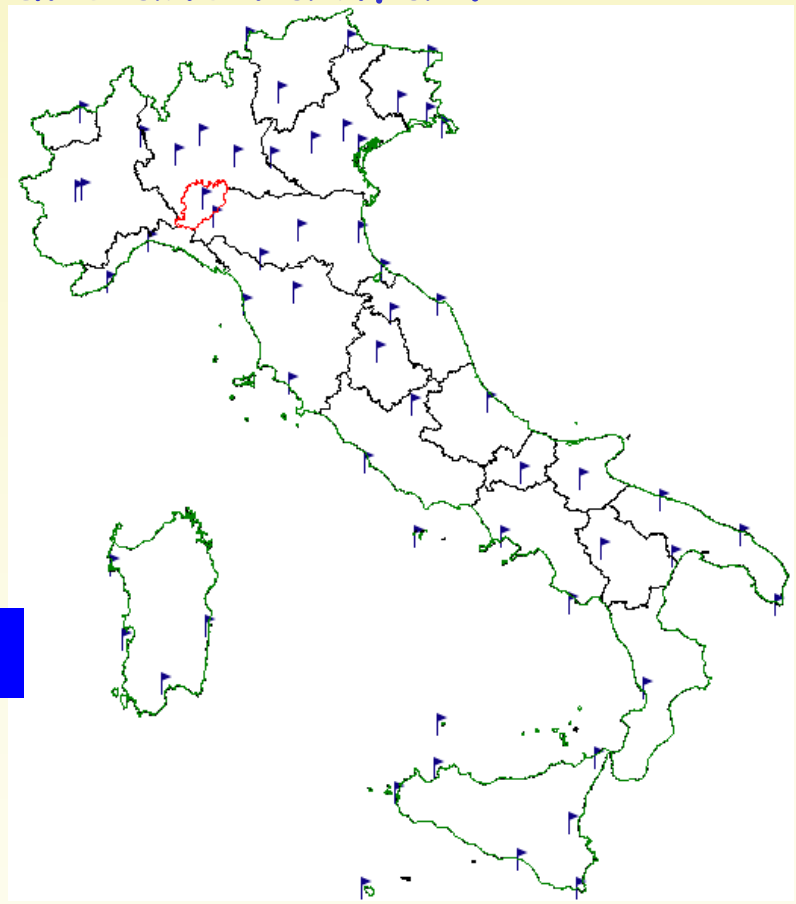
Temperature

multiple regression with altitude, latitude and slope

Rainfall

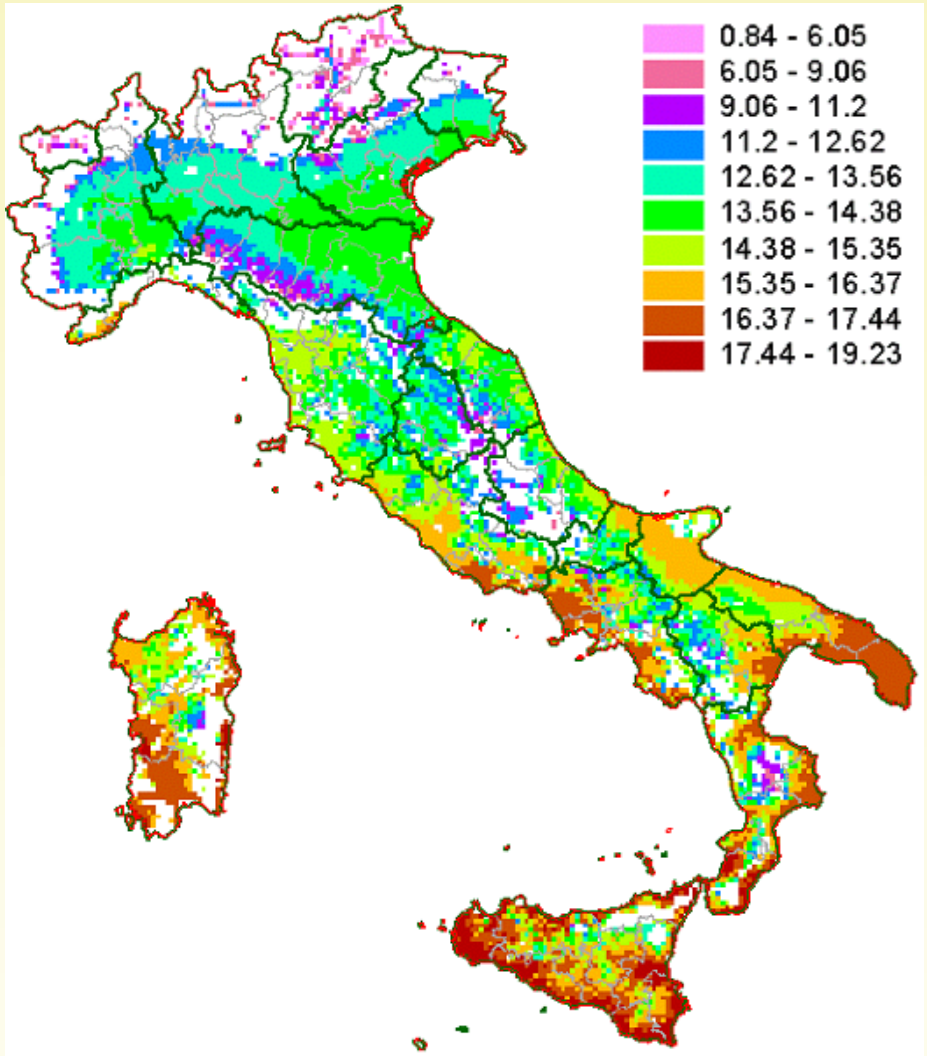
ordinary kriging to interpolate data

Spatial resolution: 1 km

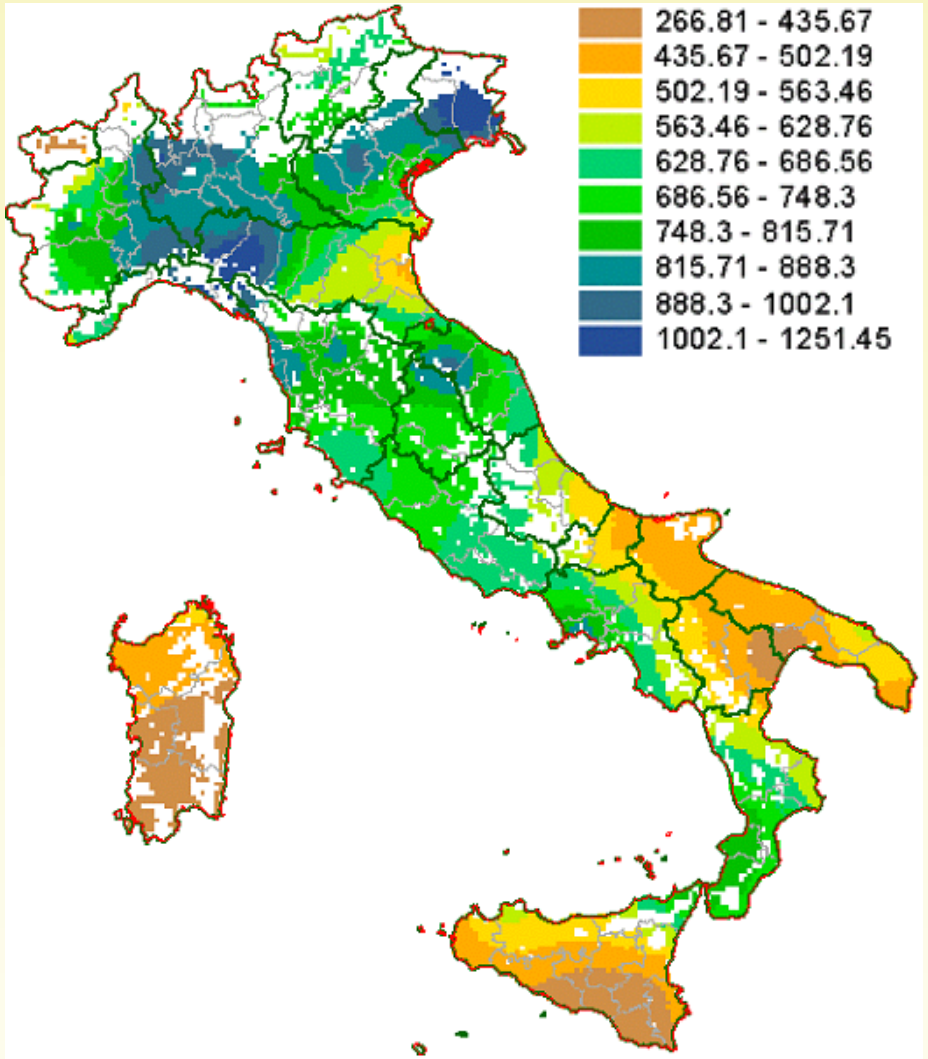


Meteo database

Mean annual temperature (C°)



Mean annual rainfall (mm/y)



Statistical and spatial analysis: soil data

Ecopedological map of Italy
scale 1:250.000 (ESB- JRC)
+
Database Consorzio ITA
(minipits)

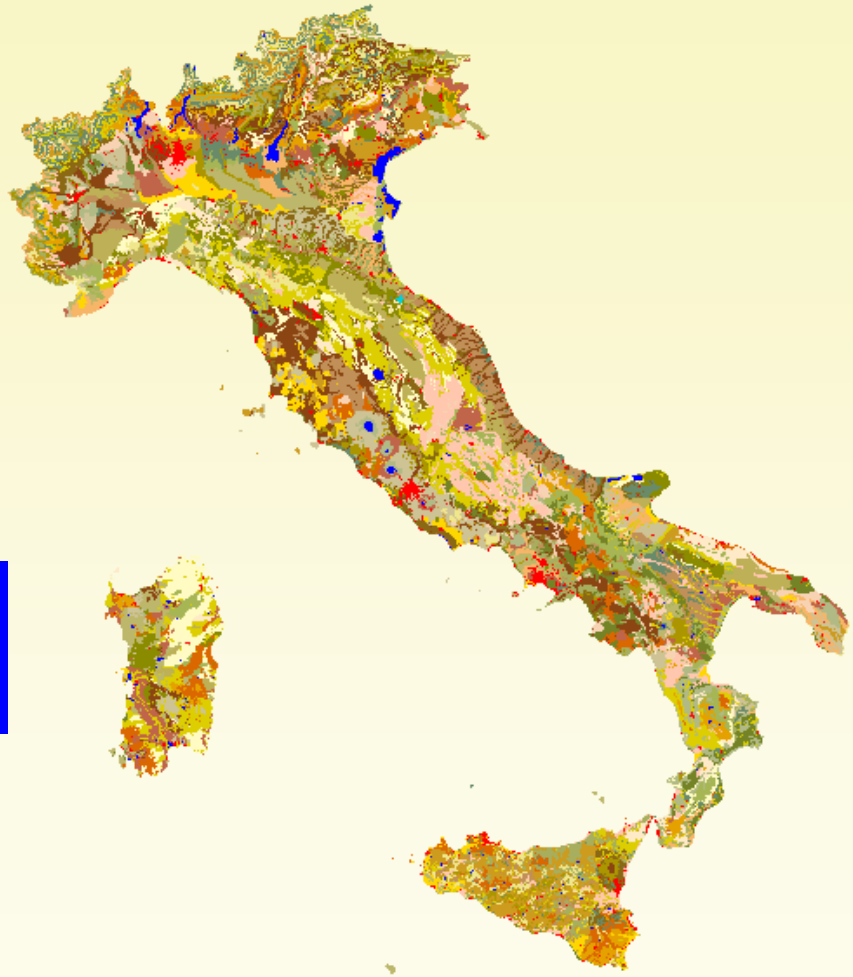
Different minipits per each ecopedological unit

↓

Ecopedological unit: mean values derived from minipits

↓

Single cell: mean values weighted on area

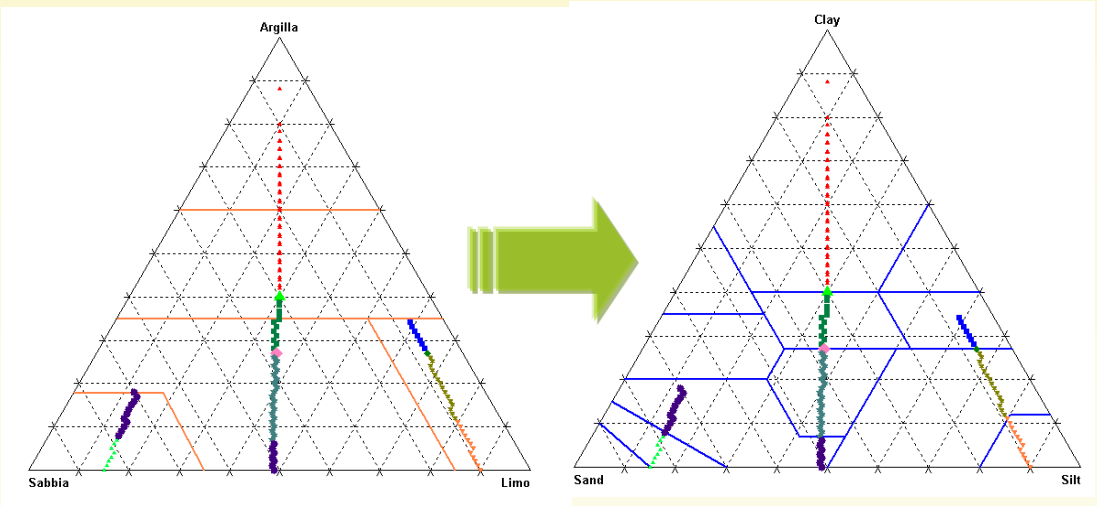


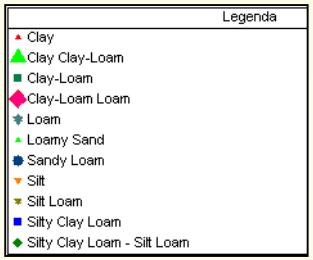
Statistical and spatial analysis: soil data

Data available in minipits: OC, clay content

Textural European classification (CEC, 1985)

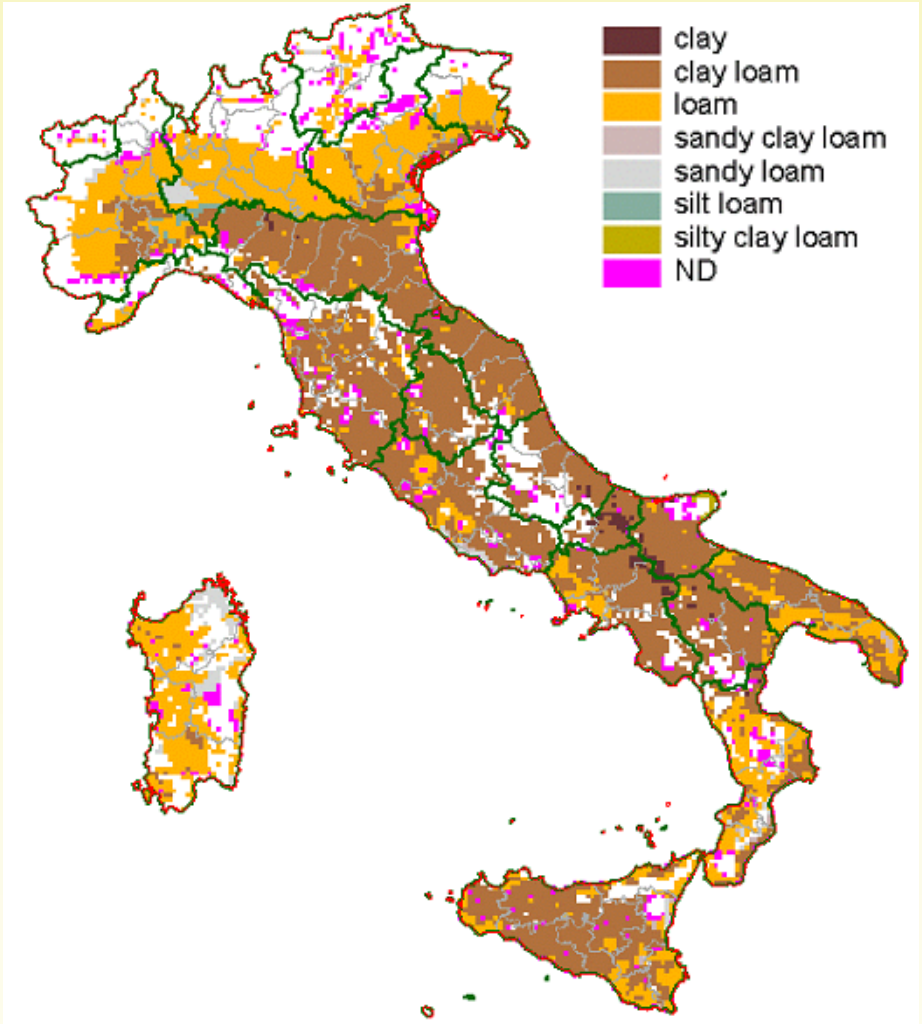
variation of clay, sand and silt: constant proportion with respect to the "centroid" of each original class

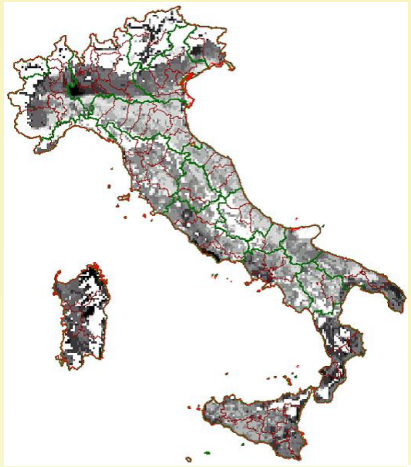




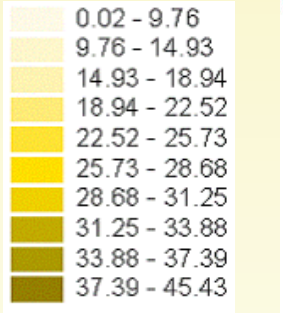
Pedological database (1)

Textural classes (USDA)





Sand (%)

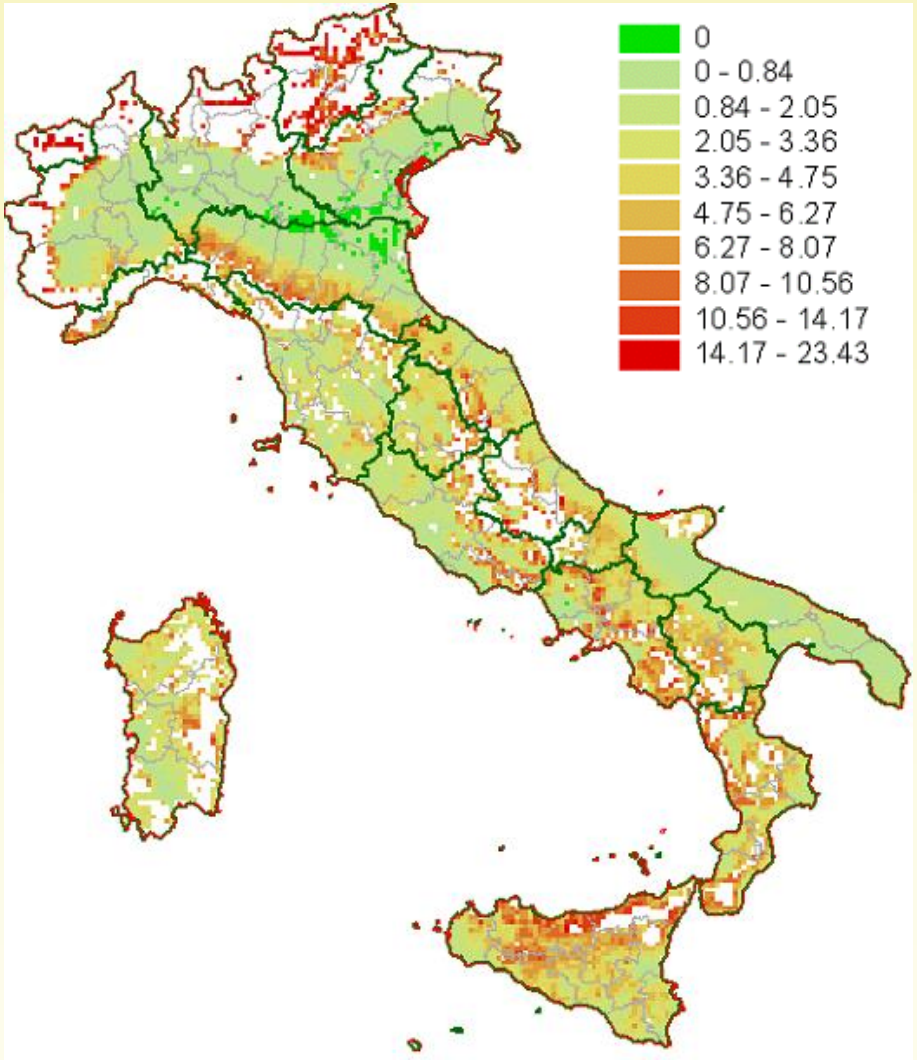


Clay (%)

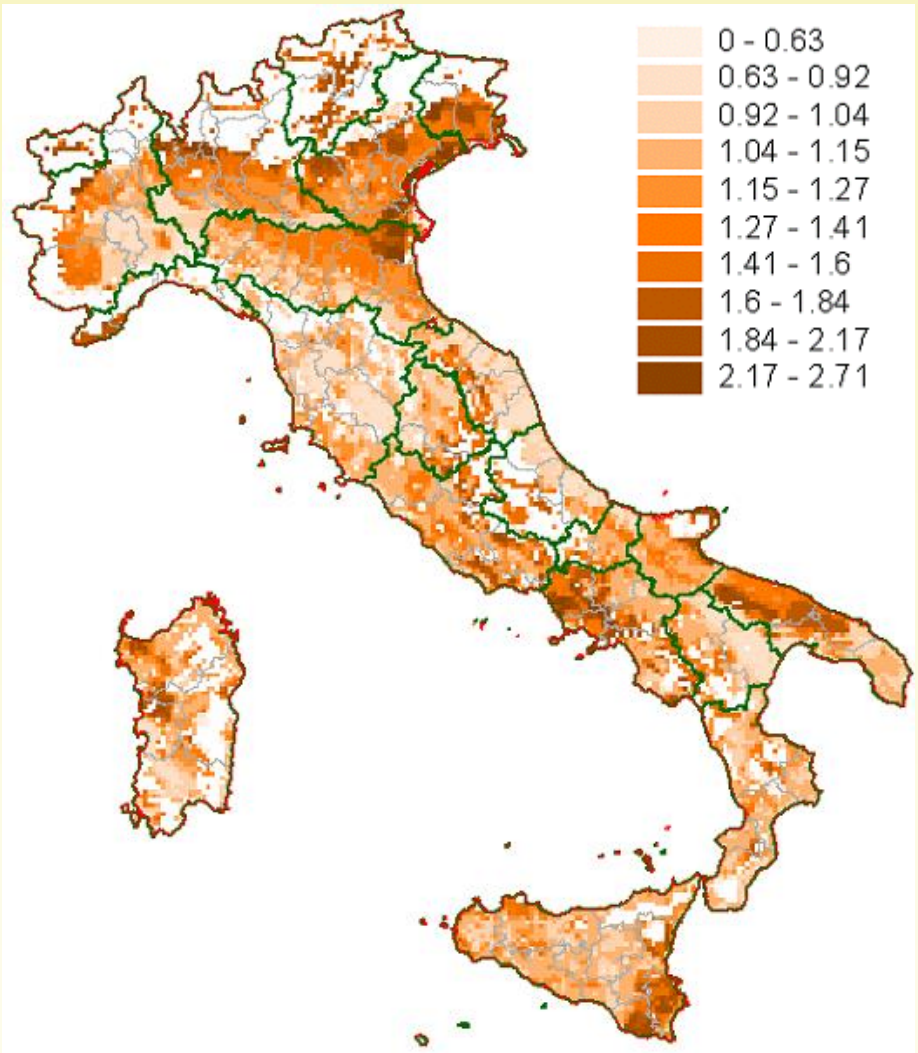
Silt (%)

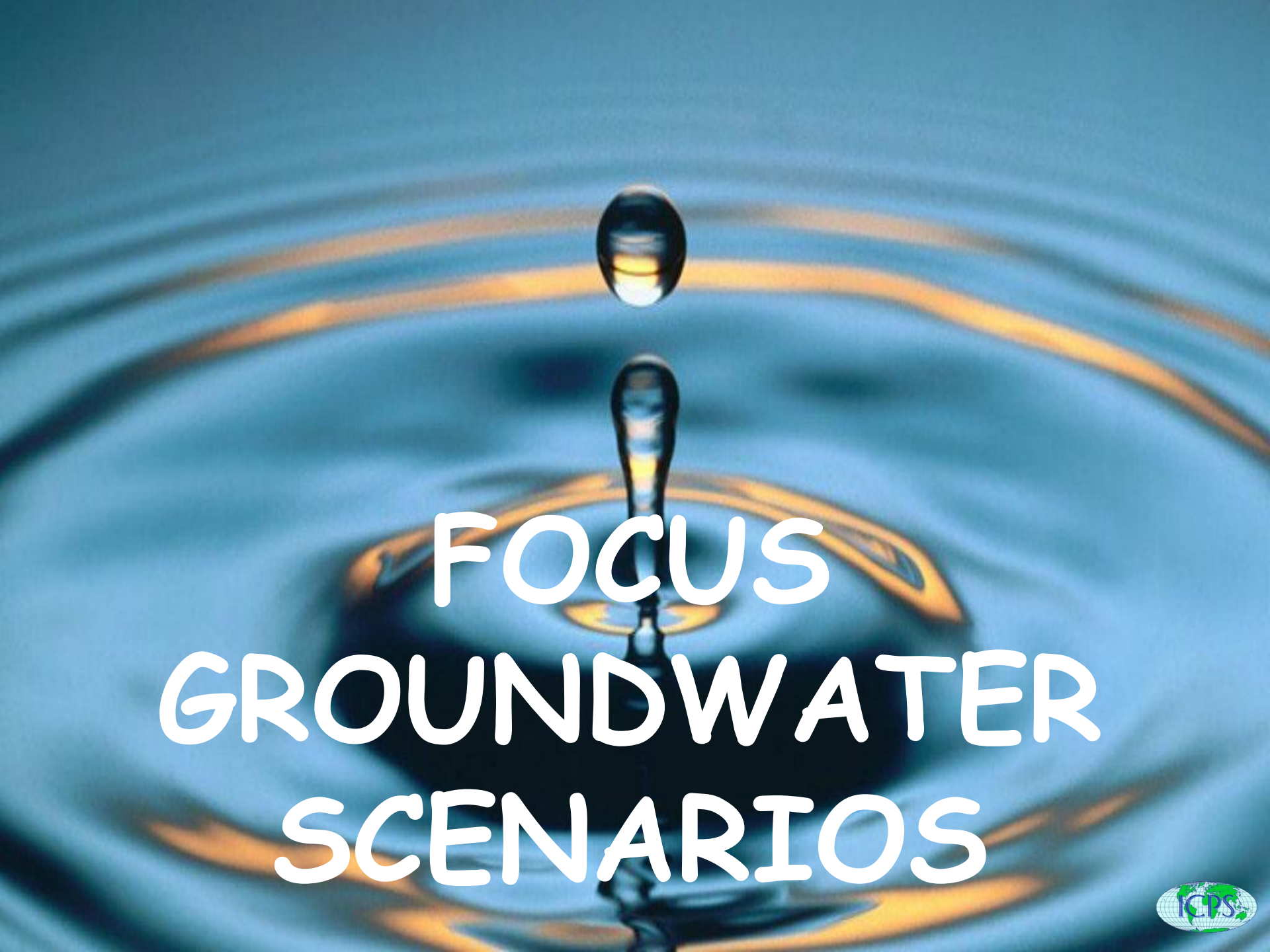
Pedological database (2)

Slope (%)



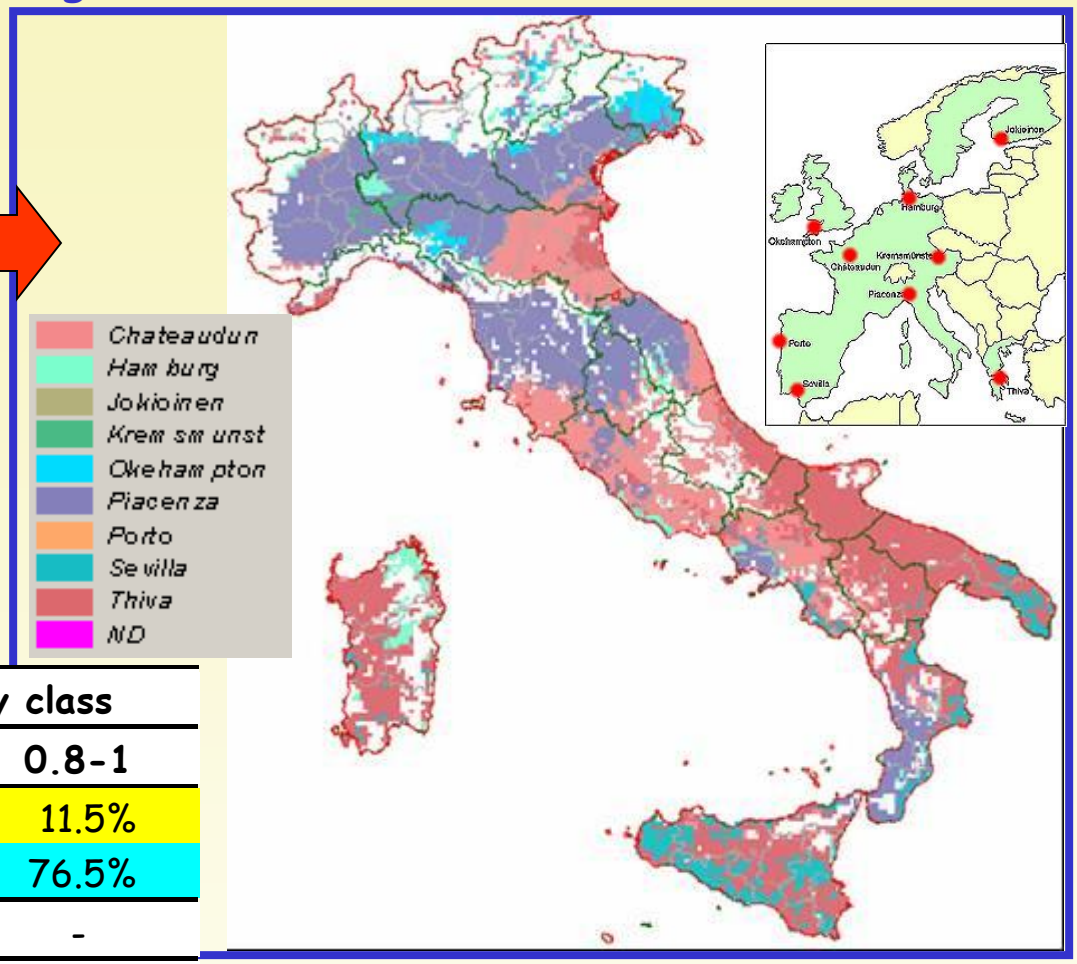
Mean Organic Carbon (%)




FOCUS
GROUNDWATER
SCENARIOS

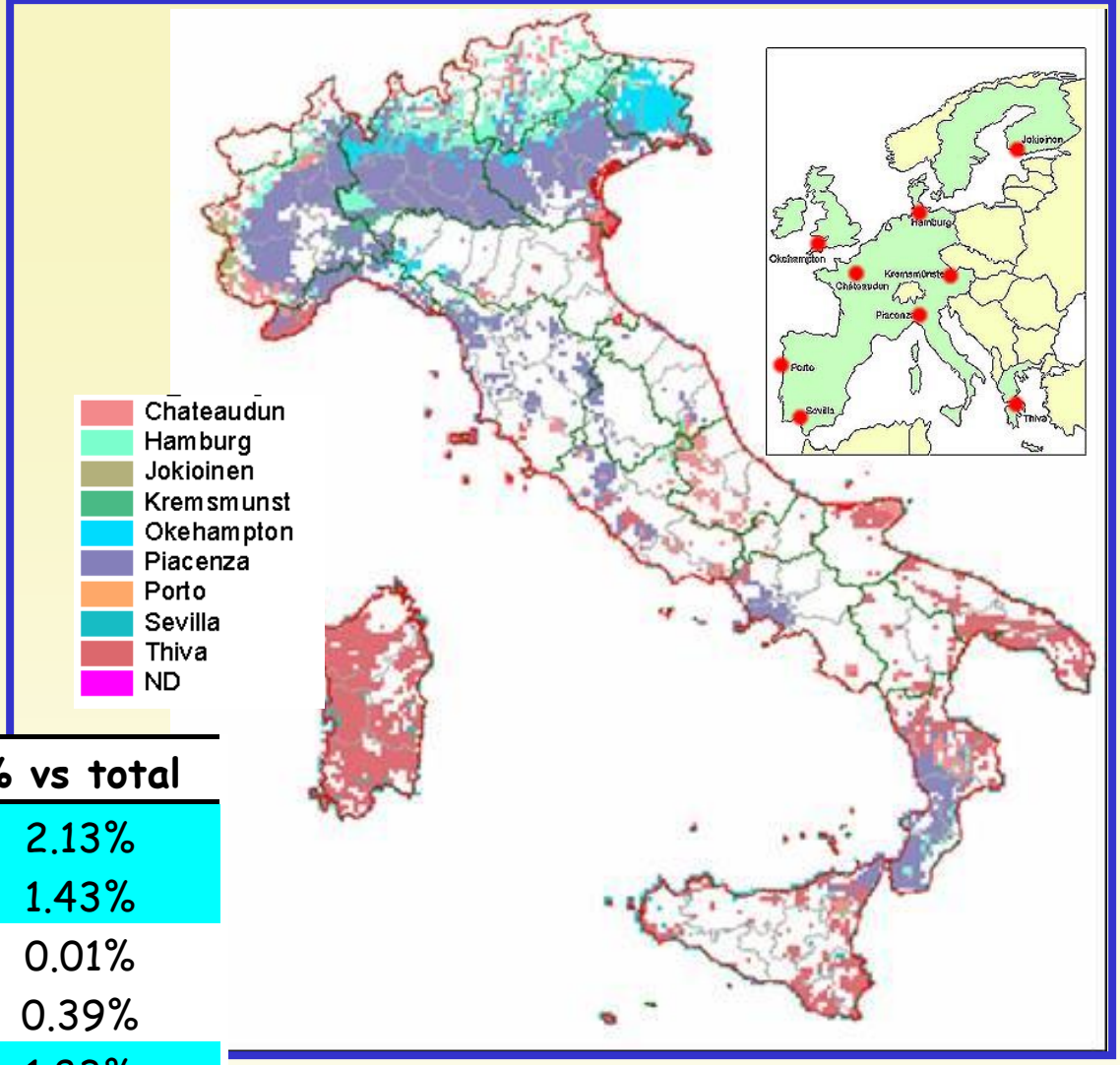
Comparison with $FOCUS_{gw}$ scenarios

Prevailing scenarios with respect to similarity analysis



		Similarity class	
Scenarios	**% vs total**	**0.6-0.8**	**0.8-1**
Châteaudun	20.6%	88.5%	11.5%
Hamburg	4.13%	23.5%	76.5%
Jokioinen	0.01%	-	-
Kremsmünster	0.52%	14.9%	85.1%
Okehampton	2.62%	20.9%	79.2%
Piacenza	35.6%	40.7%	59.3%
Porto	0	-	-
Sevilla	6.70%	83.7%	16.3%
Thiva	29.8%	52.0%	48.0%

Maximum similarity analysis: threshold 0.9



Scenarios	% relative to 0.9	% vs total
Châteaudun	5.14%	2.13%
Hamburg	3.45%	1.43%
Jokioinen	0.03%	0.01%
Kremsmünster	0.94%	0.39%
Okehampton	4.42%	1.83%
Piacenza	49.9%	20.7%
Porto	0.00%	0.00%
Sevilla	2.61%	1.08%
Thiva	33.5%	13.9%
Total		**41.4%**

Areas not covered by FOCUS scenarios

Textural class	Cells	% relative	% absolute
clay	85	1.62%	0.95%
clay loam	4854	92.5%	54.2%
silty clay loam	3	0.06%	0.03%
silt loam	4	0.08%	0.04%
sandy clay loam	28	0.53%	0.31%
loam	85	1.62%	0.95%
sandy loam	148	2.82%	1.65%
non definito	43	0.82%	0.48%
Total	**5250**	**100%**	**58.6%**

Ca. 94% of cells with similarity< 0.9 is clay, clay loam

First approximation:

- area less at risk than FOCUS scenario
- only 6% of total data is not "covered" by FOCUS scenarios.

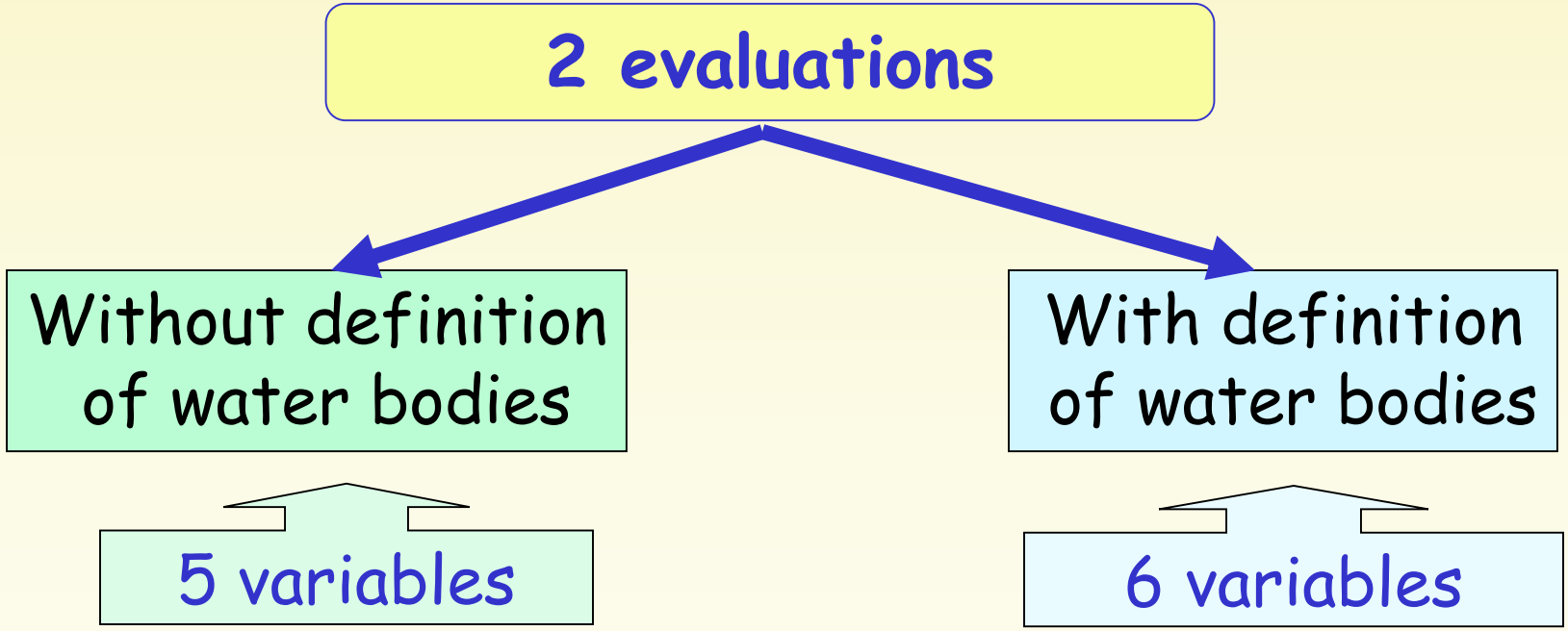
Scenarios and crops

Main crop	Total (ha) in Italy	FOCUS scenarios including the crop
Wheat	2 232 988	All (considered as winter cereals)
Grass+alfalfa	1 319 325	All
Olives	**1 080 870 (1 061 946 da olio, 18 924 da tavola)**	**Not considered**
Maize	1 068 525	All (excluded Jokioinen)
Vines	717 365	All (excluded Jokioinen and Kremsmünster)
Soybean	226 710	Piacenza
Sugar beet	224 333	All
Rice	**213 886**	**Not considered**
Sunflower	210 999	Piacenza, Sevilla
Other field crops	175 842	To be considered case by case, with the proposed field crop (i.e.: carrots, cabbage, beans, ecc.)
Citrus	132 475	Piacenza, Porto, Sevilla, Thiva
Tomatoes	80 543	Piacenza, Porto, Sevilla, Thiva, Châteaudun
Apples	64 394	All
Potatoes	39 112	All
Tobacco	35 399	Piacenza, Thiva
Oil seed rape	30 317	All (excluded Sevilla, Thiva)

FOCUS SURFACE WATER SCENARIOS

Similarity analysis

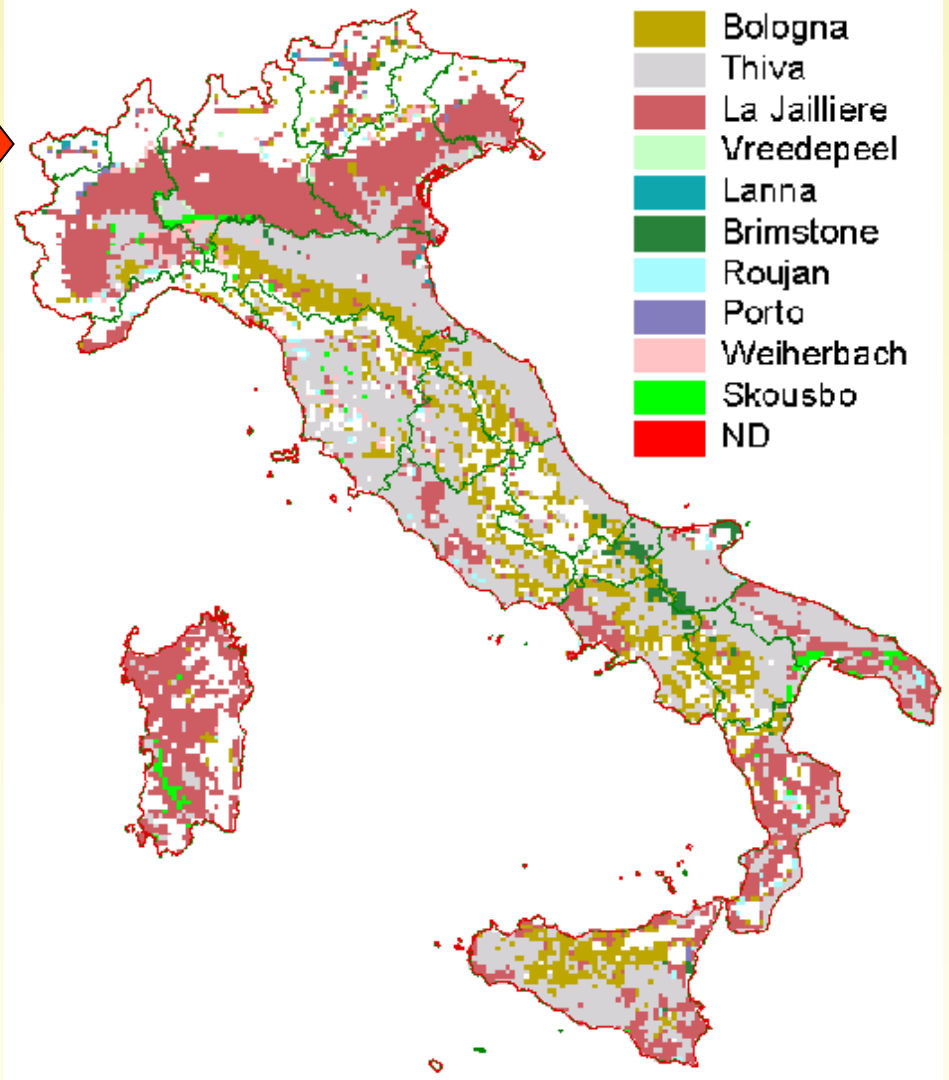
Gower index on all cultivated cells of Italy (about 9000 cells, 5 km×5 km) with respect to ten EU s.w. scenarios



Comparison with $FOCUS_{sw}$ scenarios: water bodies not considered

Prevailing scenarios with respect to similarity analysis

Scenarios	Name	N. of cells	%
Lanna	D1	13	0.1%
Brimstone	D2	141	1.6%
Vreedepeel	D3	41	0.5%
Skousbo	D4	125	1.4%
La Jailliere	D5	3142	35.1%
Thiva	D6	3782	42.2%
Weiherbach	R1	116	1.3%
Porto	R2	34	0.4%
Bologna	R3	1479	16.5%
Roujan	R4	91	1.0%



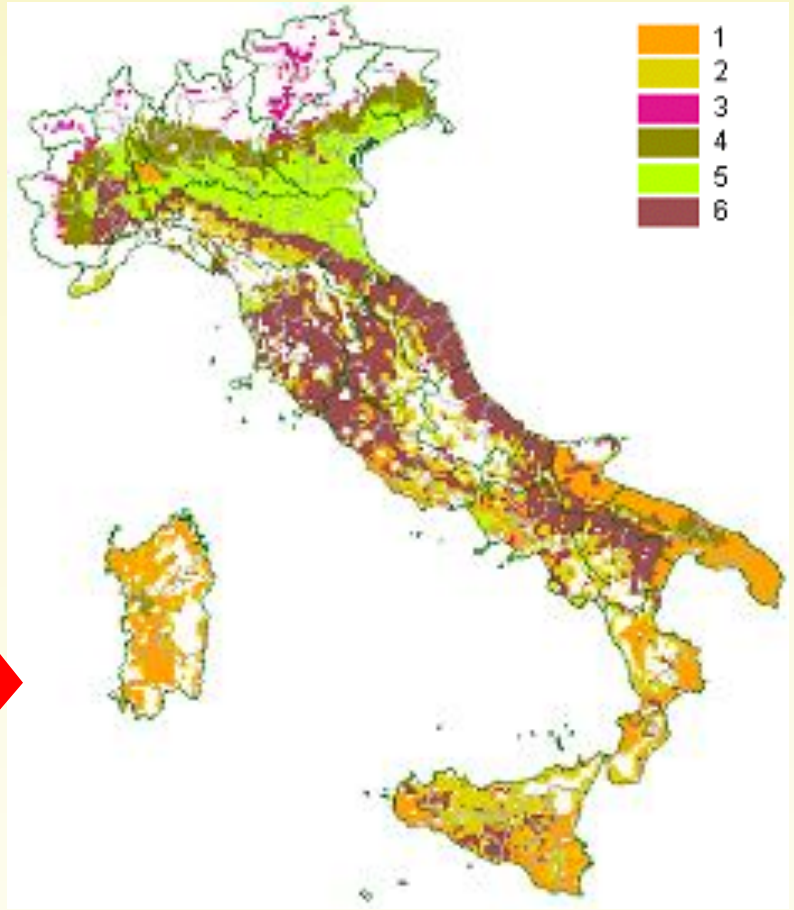
Identification of Italian water bodies

Principal Component Analysis: 14 variables

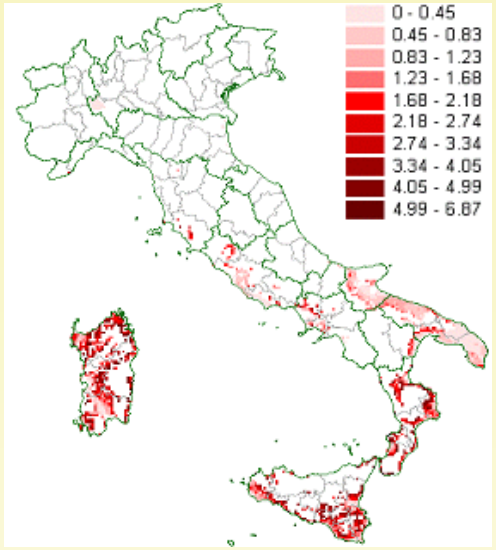
silt, clay, sand, OC, rainfall, T, slope, stone, skeleton, range of slope, std. dev. slope, altitude, difference in height, std. dev. altitude

4 major components identified

Cluster analysis on the 4 components: six clusters identified

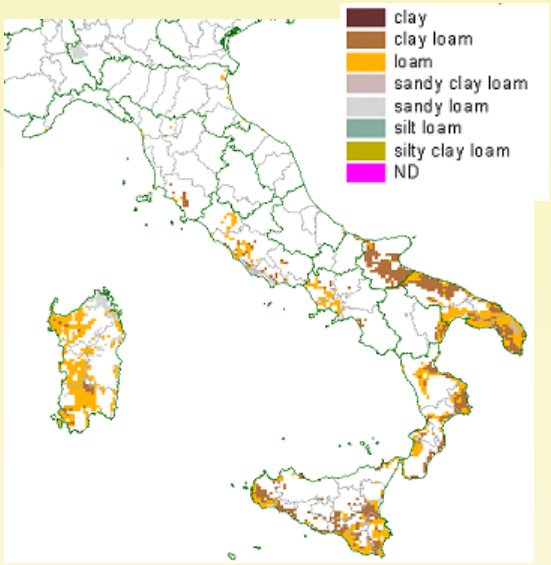


Clusters 1 and 2

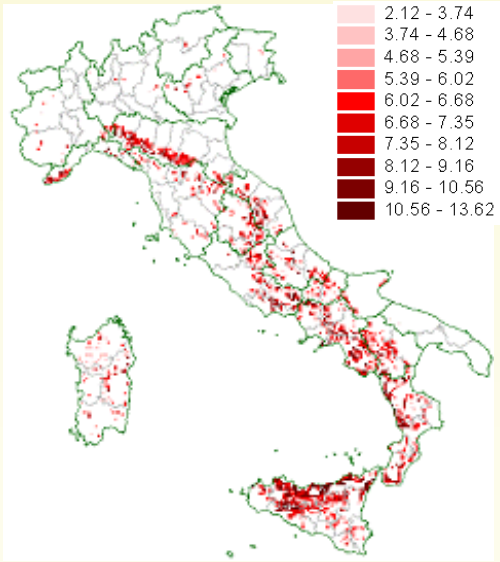


Cluster 1: Southern Italy.

Hills or near mountains. Undulating and variable. Quite dry, stony, high mean annual T. Principally loamy soils with some clay loam soils.



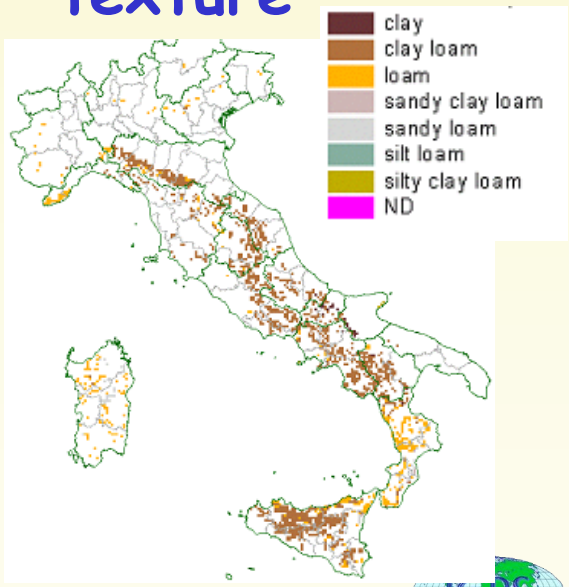
slope



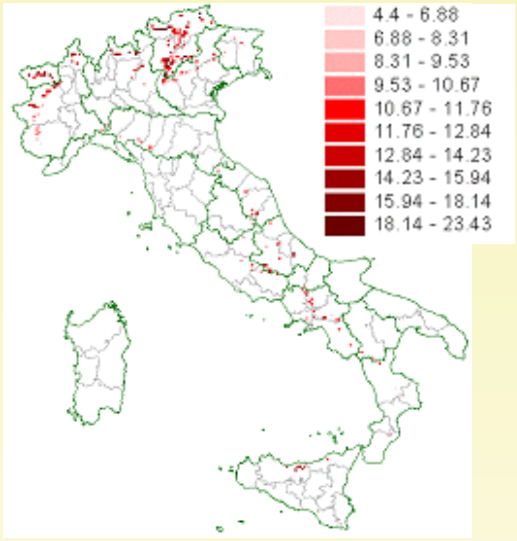
Cluster 2: Southern - Central Italy.

Cultivated mountains, from low to high slope. High rainfall, poor stone, poor sand content. Almost clay loam soils.

texture



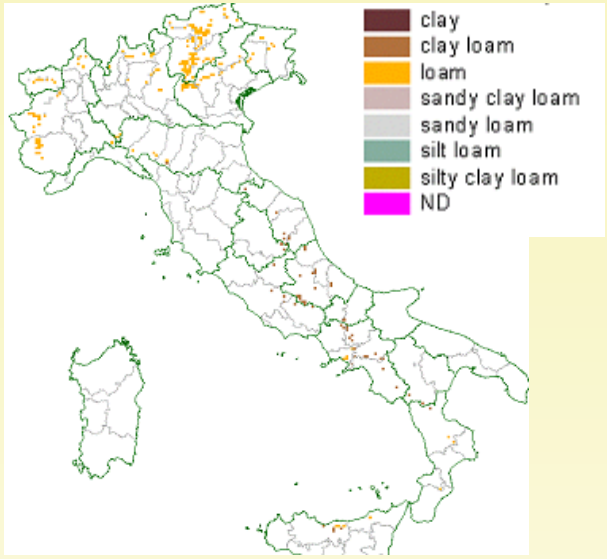
Clusters 3 and 4



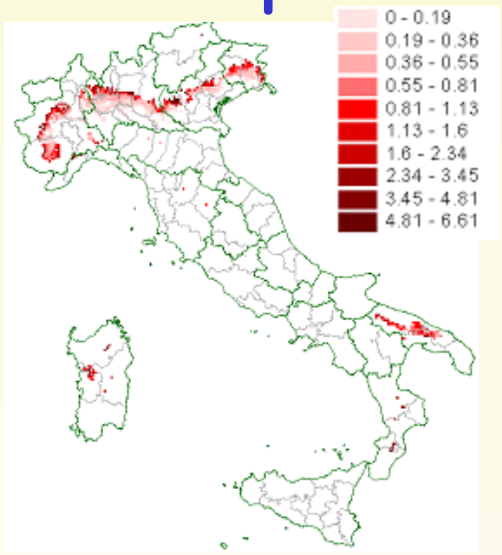
slope

Cluster 3: Northern Italy (the Alps)

Cultivated mountains, from steep to very steep. High rainfall, poor stone, high sand and skeleton content, low clay content. Loam soils and few clay loam soils.

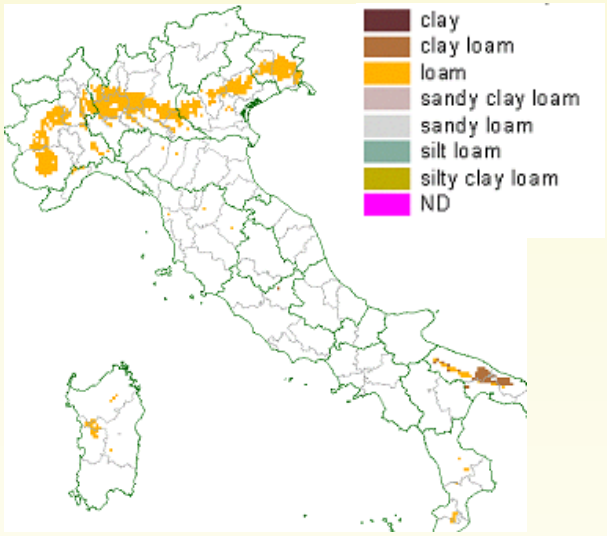


texture

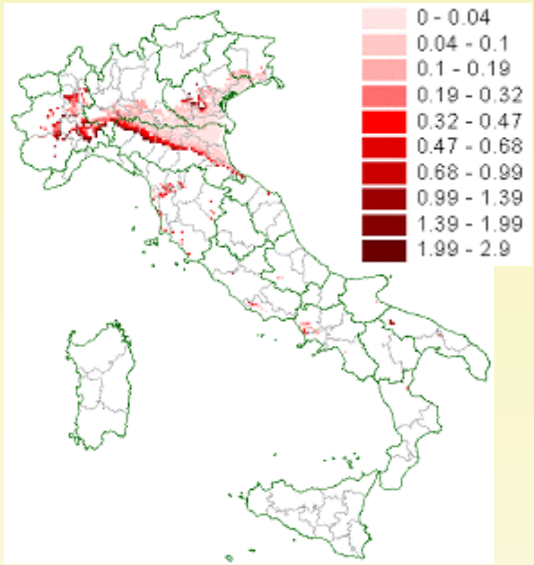


Cluster 4: Northern Italy.

Cultivated plain areas and low mountains, from level to sloping land. Quite high rainfall; fresh- temperate. High sand and skeleton content, low clay content. Principally loamy soils.

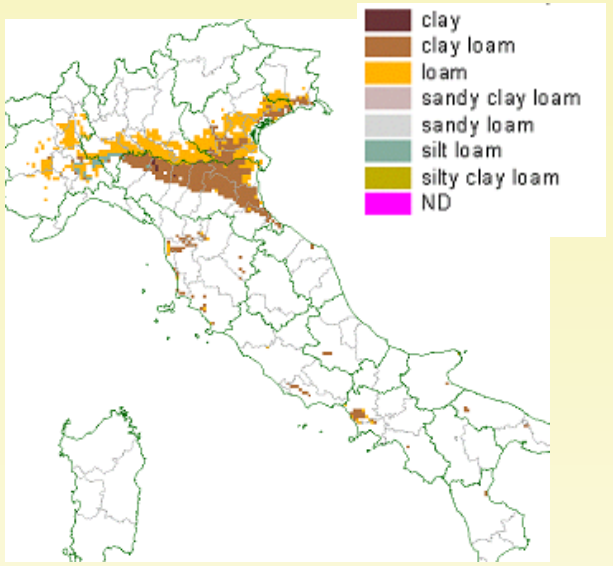


Clusters 5 and 6

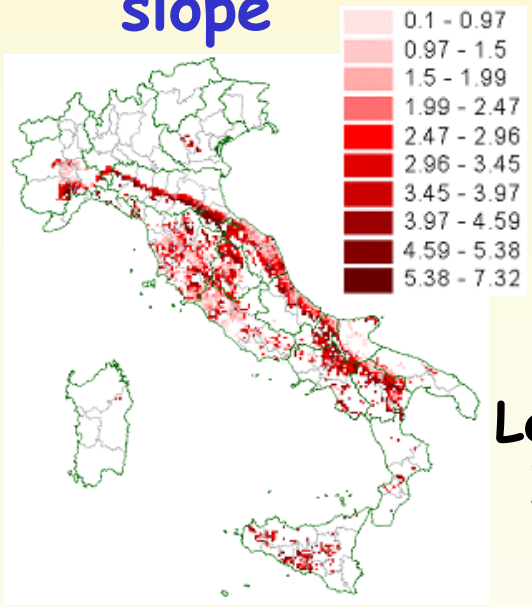


Cluster 5: Northern Italy.

Cultivated areas with almost no elevation. Quite rainfall, temperate. Low sand and skeleton content, low clay content. Loamy soils in the North Po area; clay loam and clay soils in the South Po area.



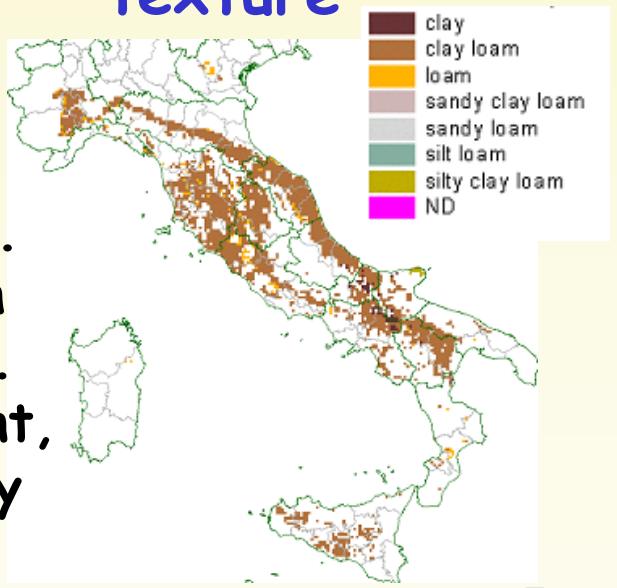
slope



Cluster 6: Central Italy

Hills or close to mountains. Sloping and composite lands. High variability. Quite high rainfall, fresh – temperate. Low sand and skeleton content, high clay content. Principally clay-loam and clay soils.

texture



Definition of water bodies

Cluster 1 Sandy clay loam, Loam, Sandy loam; slope ≤ 4%. **DITCH**
Clay loam; slope ≤ 2% **DITCH STREAM**
Other data with 2%<slope <5% **POND STREAM**
Other data with slope<5% **STREAM**

Cluster 2 Loam, sandy loam, sandy clay loam; slope < 6 % **POND STREAM**
Clay, clay loam; slope < 6 % **STREAM**
Other cells (steep) **STREAM**

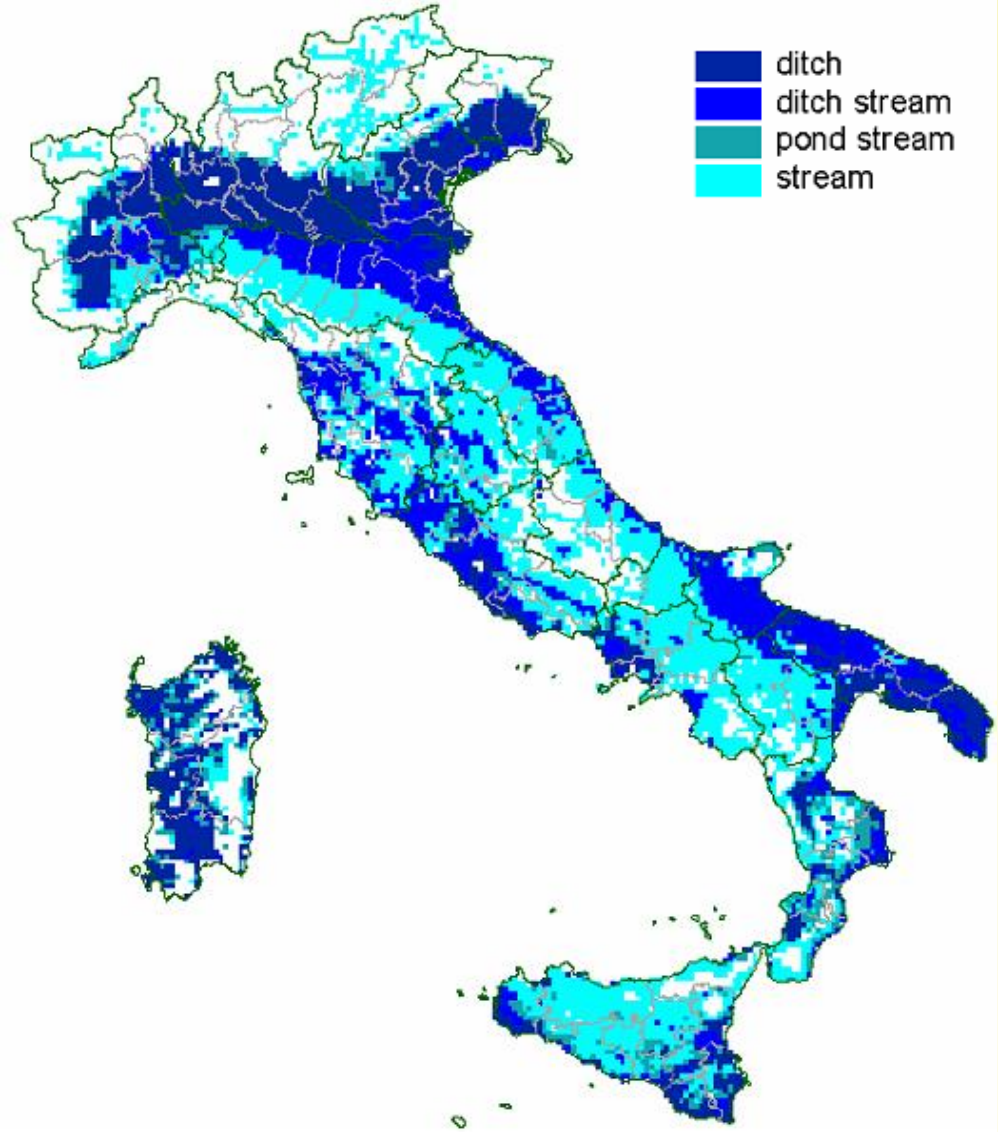
Cluster 3 Very steep cells. **STREAM**

Cluster 4 Loam, sandy loam, sandy clay loam; 0%<slope<2%. **DITCH**
Clay loam; 0%<slope<2%. **DITCH STREAM**
2%<slope<4% and others **POND STREAM**

Cluster 5 All slopes<3%. Silt loam and silt clay loam. **POND STREAM.**
Loam **DITCH**. Clay loam **DITCH STREAM**

Cluster 6 Loam, almost all slope>2%. **POND STREAM**
Clay and clay loam ≤2% **DITCH**
Clay and clay loam >2% **STREAM**

Distribution of water bodies



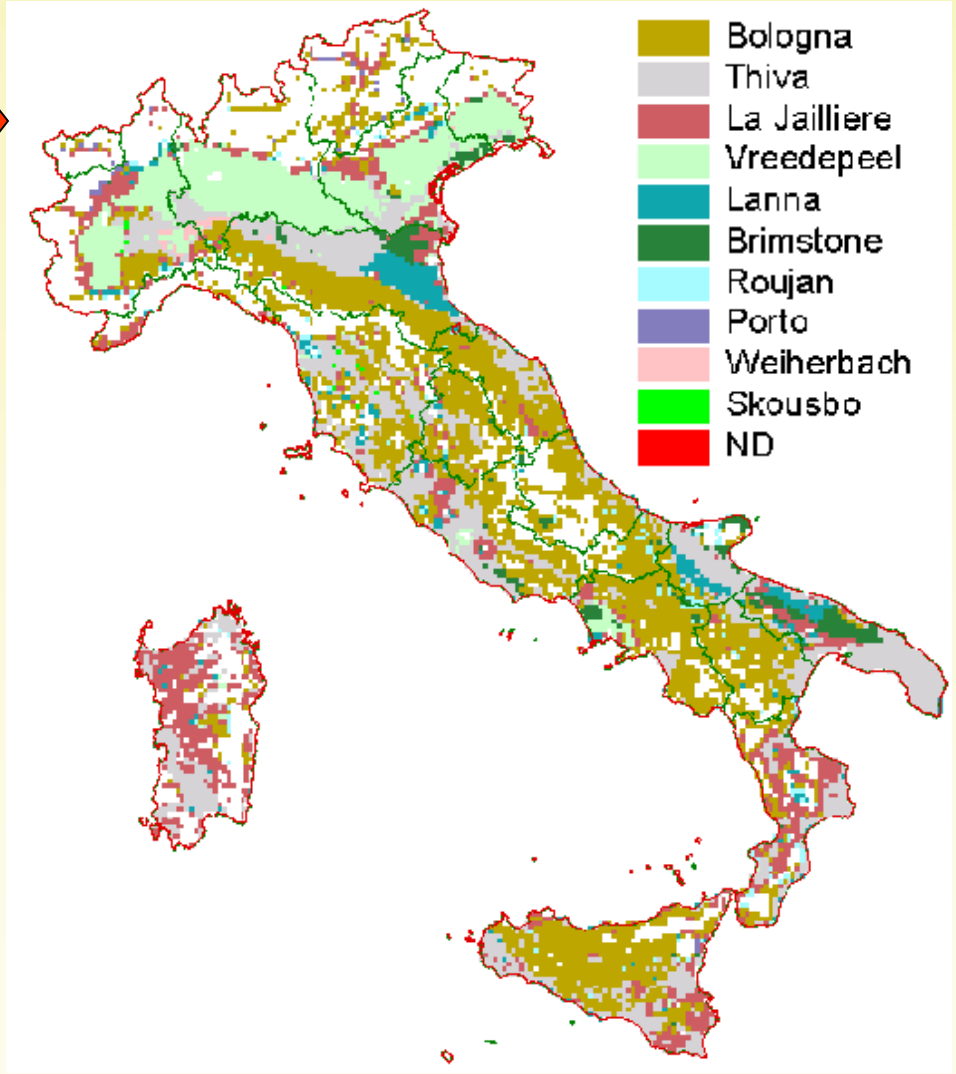
SIMILARITY ANALYSIS:

- T (°C)
- Rainfall (mm/y)
- Slope (%)
- Textural class (USDA)
- OC (%)
- Water bodies

Comparison with FOCUS$_{sw}$ scenarios: water bodies considered

Prevailing scenarios with respect to similarity analysis

Scenarios	Name	N. of cells	%
Lanna	D1	392	4.4%
Brimstone	D2	280	3.1%
Vreedepeel	D3	1175	13.1%
Skousbo	D4	14	0.2%
La Jailliere	D5	1248	13.9%
Thiva	D6	2261	25.2%
Weiherbach	R1	32	0.4%
Porto	R2	36	0.4%
Bologna	R3	3354	37.4%
Roujan	R4	172	1.9%



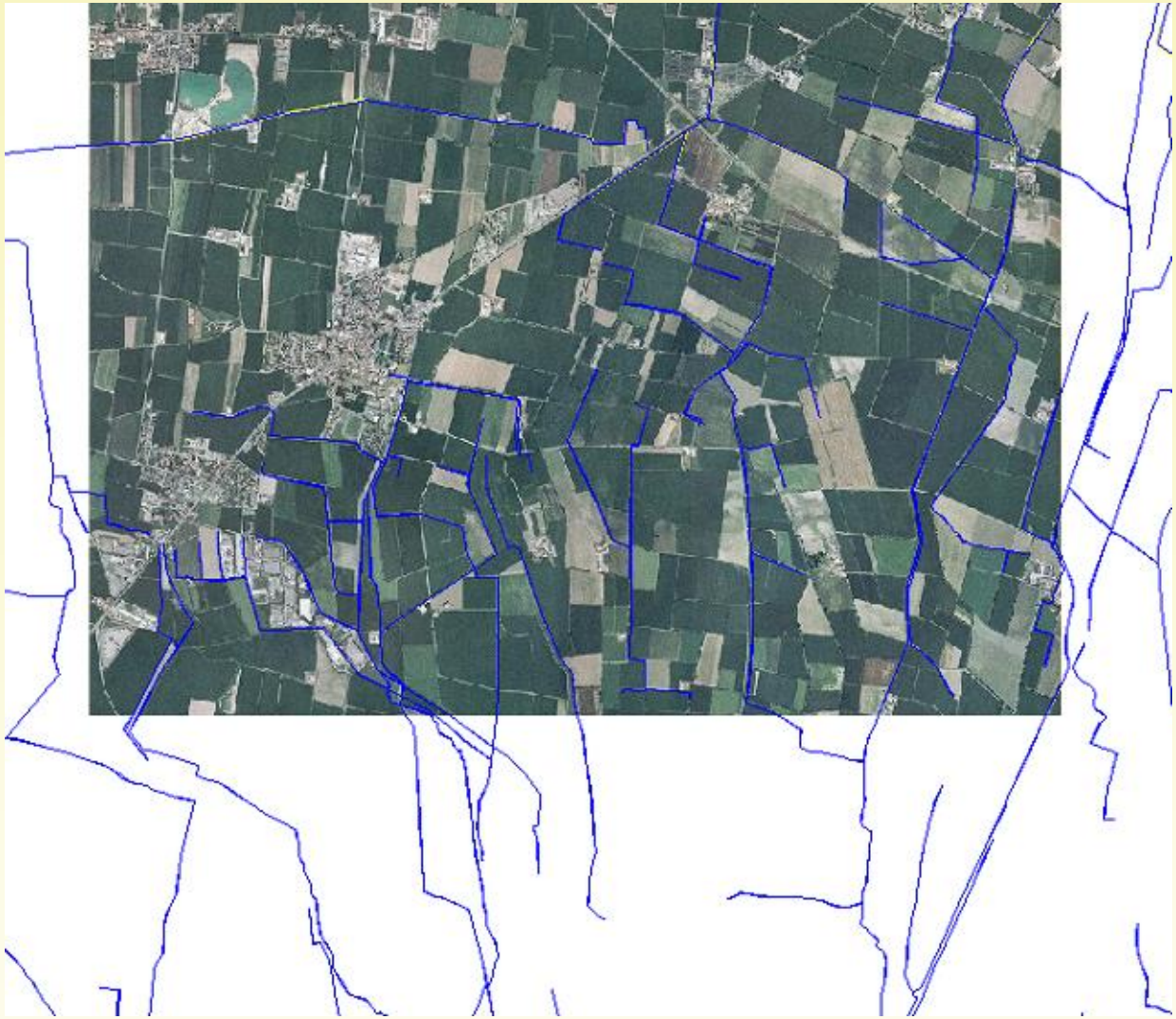
Results comparison

Scenarios	Name	% (no water bodies)	% (with water bodies)
Lanna	D1	0.1%	4.4%
Brimstone	D2	1.6%	3.1%
Vreedepeel	D3	0.5%	13.1%
Skousbo	D4	1.4%	0.2%
La Jailliere	D5	35.1%	13.9%
Thiva	D6	42.2%	25.2%
Weiherbach	R1	1.3%	0.4%
Porto	R2	0.4%	0.4%
Bologna	R3	16.5%	37.4%
Roujan	R4	1.0%	1.9%

98.5% similarity>0.7 (R3), (D6), (D5), (D3).
43% similarity>0.8
R3 80,2%.
24% similarity >0.9
R3 89,6%.

96,9% similarity>0.8 (R3), (D6), (D5)
62% similarity >0.9: R3 10.3%;
D6 48.0%;
D5 37.3%

FUTURE DEVELOPMENTS



Ortho photos

+

Hydrography

+

Irrigation systems

+

Agricultural practices/crops

=

Identification of "real" Italian water bodies

CONCLUSIONS (1)

The suitability of groundwater and surface water FOCUS scenarios for the Italian registration was addressed.

Preliminary result: relevant gw scenarios for Italy

- Piacenza
- Thiva

Two major crops excluded from gw scenarios:

- olives
- rice.

Further work required:

- to better associate relevant crops with scenarios
- to clarify the role of the minor scenarios
- to better define areas not covered by FOCUS scenarios

CONCLUSIONS (2)

Surface water

PRELIMINARY RESULTS

Relevant scenarios for Italy

- Bologna (R3)
- Thiva (D6)
- La Jailliere (D5)
- Vreedepeel (D3) ?

Minor scenarios:

- Brimstone (D2)
- Roujan (R4)
- Lanna (D1)

Scenarios not relevant:

- Porto (R2)
- Weiherbach (R1)?
- Skousbo (D4)?

CONCLUSIONS (3)

Further work

Analysis of selected ortophoto to verify water bodies

Clarification of the role of the minor scenarios

Analysis of Census Data (2000) to associate crop cultivation with irrigation system/water bodies

Analysis of areas not covered by FOCUS scenarios: are to be developed new scenarios for Italy?