Multifunctional soil conservation and land management through the development of a web based spatial decision supporting system (s-DSS)

A new vision in land management and soil conservation

Department of Agriculture, University of Naples

Institute for Mediterranean Agriculture and Forestry, National Council of Research

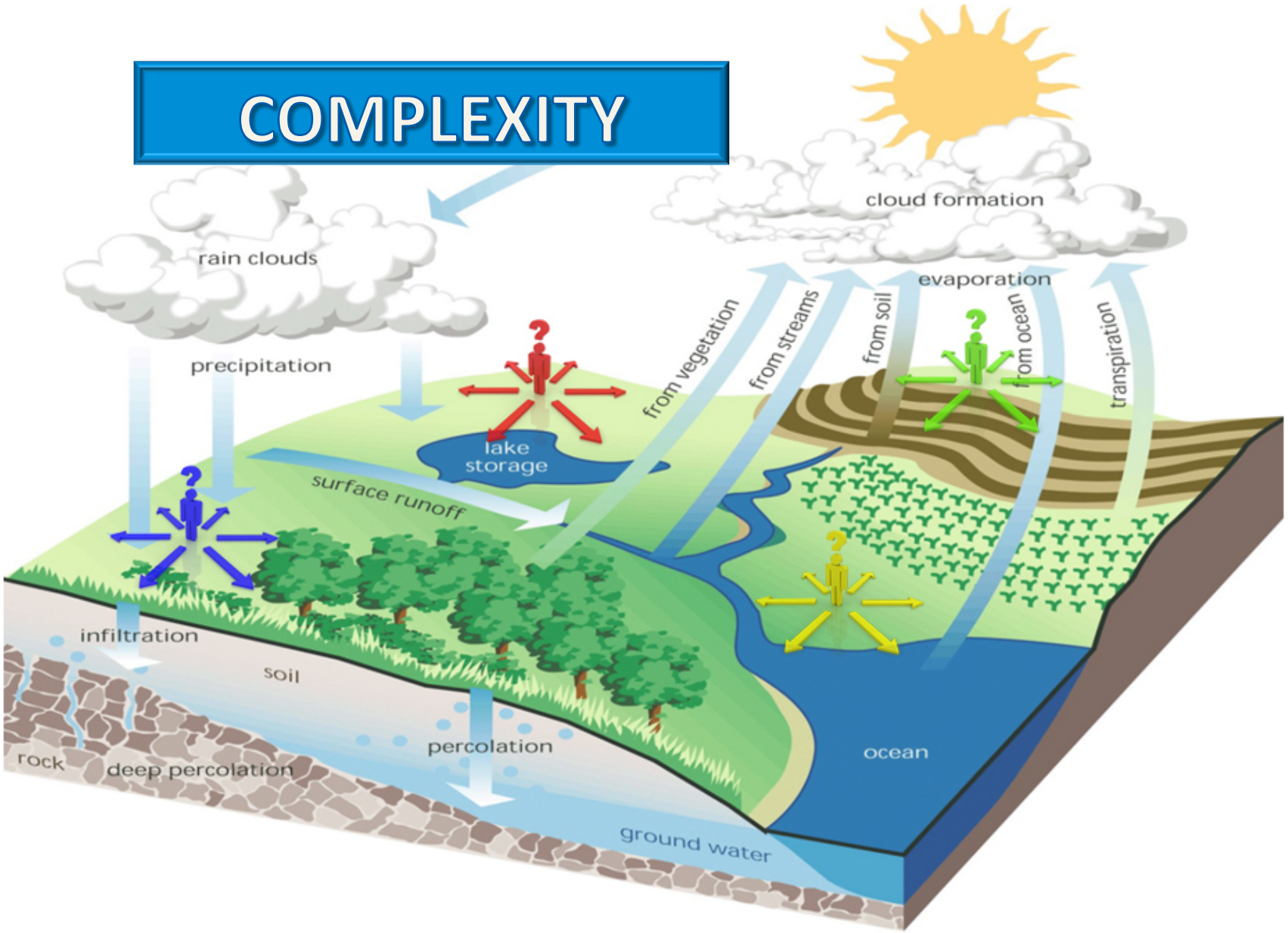
SPIN OFF Company

Campania Region

Total Cost: 3,268,777 €
UE Contribution: 1,591,567 €

1 jan 2010 - 31 Dec 2014

Leader – Prof. Fabio Terribile
Co-Leader **– Dr. Angelo Basile**


COMPLEXITY
cloud formation
rain clouds
evaporation
precipitation
from vegetation
from streams
from soil
from ocean
transpiration
lake storage
surface runoff
infiltration
soil
percolation
rock
deep percolation
ocean
ground water

But why things are complex ?

- ✓ The multifunctional role of agriculture, forest, **soil** and landscape
- ✓ Most of the important processes in soils are not static … but **dynamic**
- ✓ We requires answers across **different scales** (action is often local !)
- ✓ Data quantity/quality **varying in space and time**
- ✓ For several reasons, **the last kilometer** in the interaction between those who produce soil information and the managers of the soil/landscape **is the most difficult to ride** and often the most **overlooked.**

we believe that all these complex things can be faced developing a

Spatial DSS integrated with geospatial analysis and simulation modeling engines

not a standard webGIS

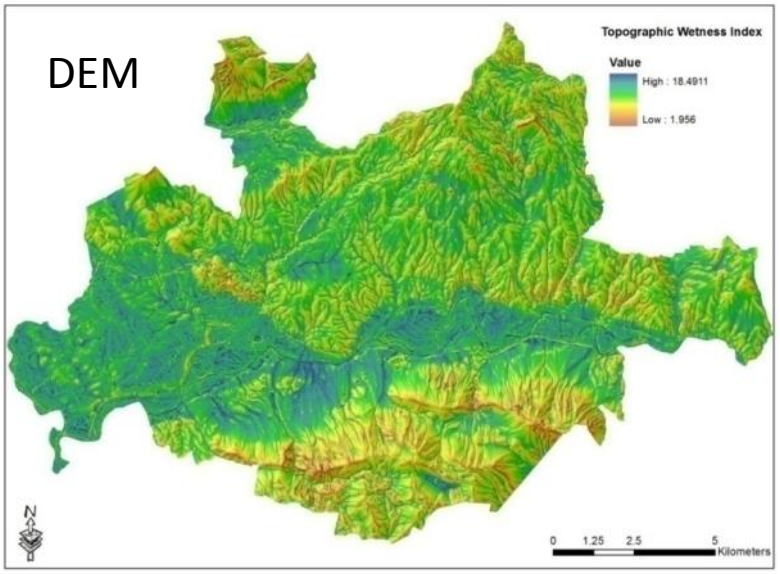
How it works?

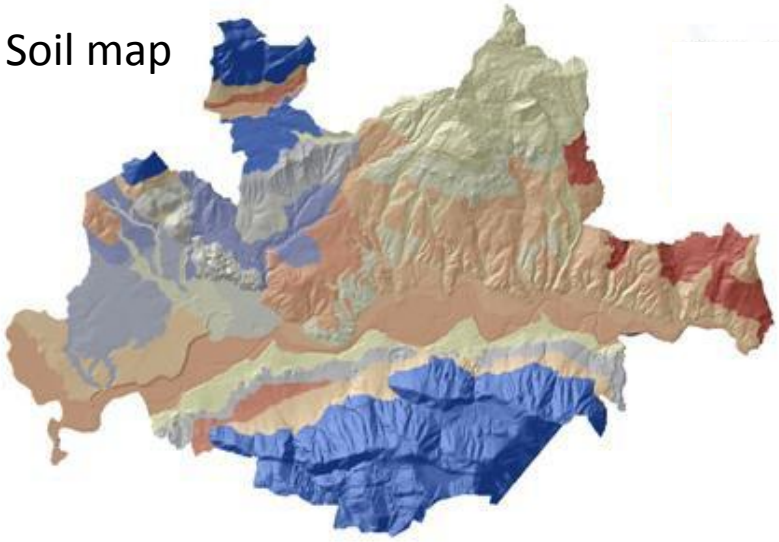
The system has been developed through a "**cyberinfrastructure**" platform that supports the acquisition of advanced and also **dynamic data** (e.g. pedological, daily climatic, land use) and their *storage*, *management* and *integration*, *data mining*, data *visualization* and computer ***applications "on the fly"*** in order to perform simulation modeling (e.g. soil water balance and growth of plants), all freely accessible **via Internet**.

Area of application

- **Valle Telesina** (south of Italy)
- Etna (south Italy) – *Viticulture*
- Lodi plain (north Italy) – *Soil sealing*
- Extremadura (Spain) – *Nitrate vulnerability*
- Scotland – *to be defined*

The system has been implemented and currently it is on testing phase in a pilot area of about 20,000 hectares (Valle Telesina – Campania region, South of Italy).

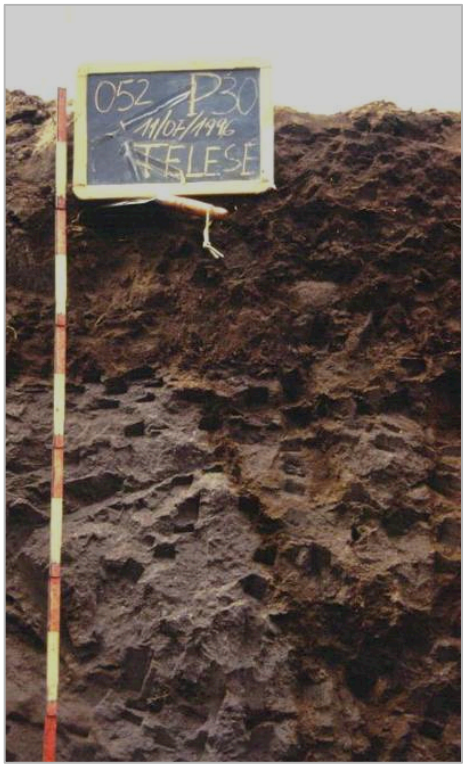




Why the Telesina valley…

- Heterogeneous in soils and landscapes
- Presence of Agricultural and Forestry systems, Tourism, Population pressure
- Competition and pressure on soil and natural resources between economic sectors
- Availability of good quality environmental data (soil maps, climate data, etc)
- High quality wine and olive oil production (needing support on decisions)

The soils of distal volcanic depositions



Vitrandic Haplustolls*

The soils of the ancient alluvial terraces

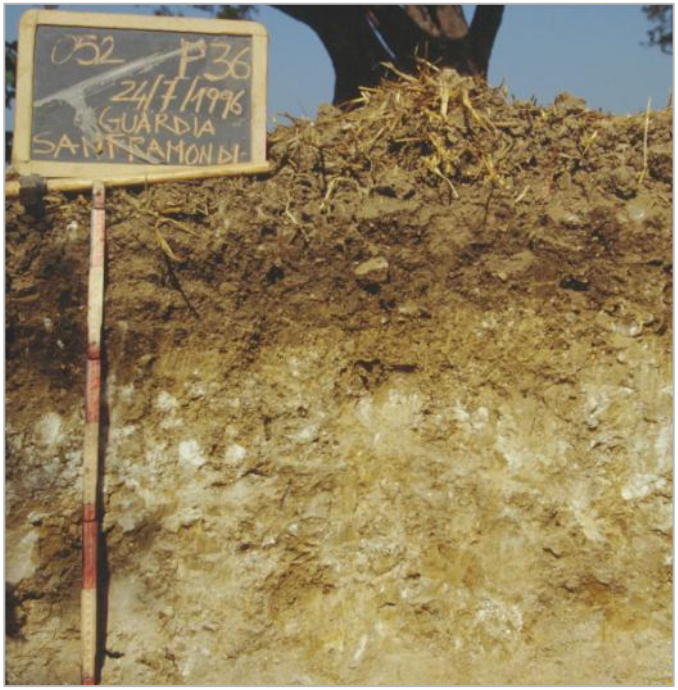
Humic Ustivitrands*

The soils of the Glacis of erosion

Typic Calciustolls*

***Soil Taxonomy (USDA 1998)**

The soils of marly loamy hills



Typic Calciustepts*

The soils of piedmont areas

Typic Hapludands*

The mountain soils

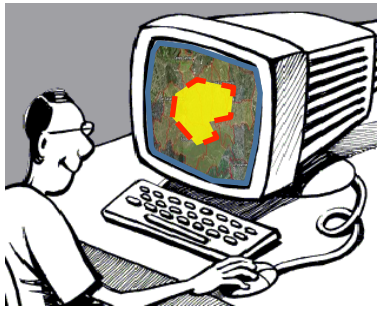
Typic Melanudands*

***Soil Taxonomy (USDA 1998)**

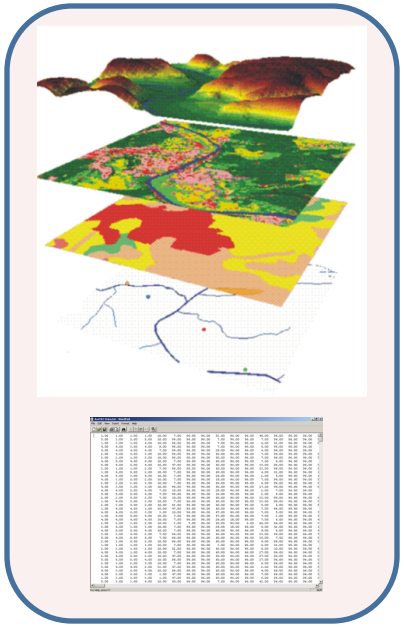
System functioning – **webGIS standard**

CLIENT | SERVER | DATABASE

System Answer



Manage maps, process data



Query

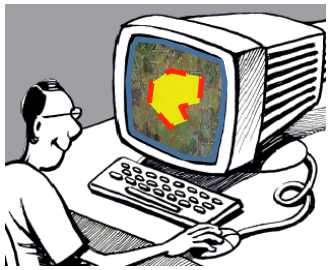
Thematic maps:
climate data, soil data, geology, nitrate vulnerability, potential solar radiation, and many others etc.

Raster and vector format;

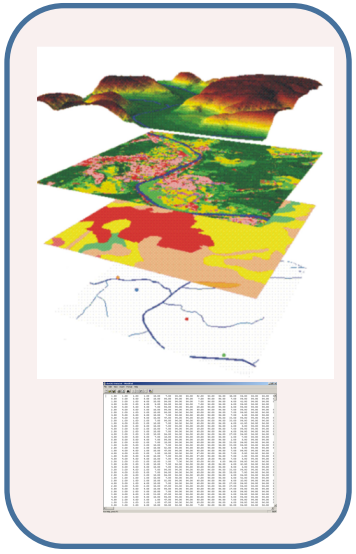
System functioning – **Advanced tools**

CLIENT | SERVER | DATABASE

Answer in (quasi) real time of the bio-physical system



Manage maps, data processing



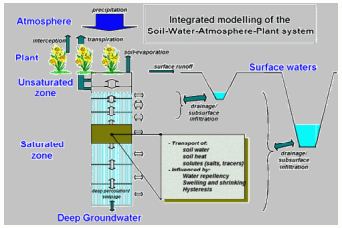
The database is constantly updated: i.e. daily spatialized climate data deriving by monitoring network

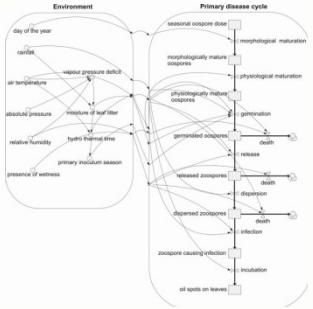
(1) Monitoring system

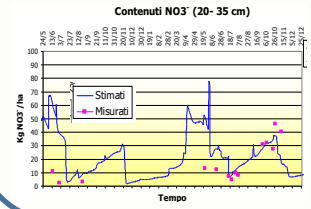
Query

(3) GPU computing

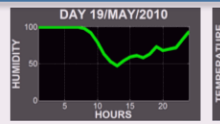
(2) Dynamic simulations

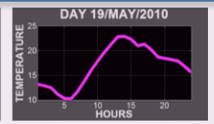


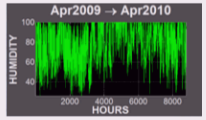


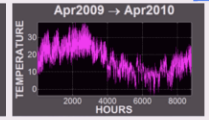


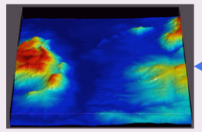
DB











Inference spatialization

Gaps infilling / anomalies

Which soil functions are implemented…

Major theme of the EU regulation/directive	**Specific regulation/directive requirement that the project can address**
EU Soil thematic strategy	Evaluation and tools to combat the following soil threats: **erosion,** **decline in organic matter,** **soil sealing,** **soil compaction,** **decline in soil biodiversity,** **flood and landslides.**
Nitrates Directive and **Water Framework Directive**: to prevent the contamination of surface and groundwater by the leakage of hazardous substances or excessive nutrients from soils	Identification of risk areas having different vulnerability. Quantification of **soils capacity to act as filter** Management models aiming towards reduction of hazardous substances or excessive nutrients (e.g. animal sludge, chemical fertiliser)
Protection of groundwater against pollution caused by certain dangerous substances (e.g. pesticides)	Identification of areas having different vulnerability

Which soil functions are implemented…

Environmental protection and soil protection when **sewage sludge** are employed in agriculture	Evaluation of the land attitude towards sewage sludge distribution and the suitability of the different locations
Reform of the **system of conditionality**. Bound to support compliance with regulatory requirements and compliance with environmental, land protection, food safety, public health and hygiene and welfare standards	Landscape evaluation for applying the system of conditionality. Farm practices required, for a specific landscape, to enter in the system of conditionality.
Establishment of **disadvantaged areas** and related supporting actions. Definition of criteria for the physical demarcation of the area disadvantaged areas	Request to delineate disadvantage areas caused by physical landscape limitations
Protection of **geographical indications and designations of origin** for agricultural products and food	Identifying areas where to apply quality labels (DOP, IGP)
Regulations for using FEASR funds and measures to support rural development	Payments for forest maintenance. Forestry potential recovery by poor land management

www.landconsultingweb.eu

How the system appears?

SOILCONS-WEB

Agriculture and Forestry | Environmental protection

- Main environmental features
  - Discover the environmental features of your farm/landscape
  - Discover the landscape constraints imposed in your territory ()
  - Estimate tha actual soil water storage in your soil
  - Land Use Change Detection (matrix)
- Viticulture
  - Label describing your "Terroir"
  - Support to the analysis of your "Terroir"
    - Soils of your Terroir
    - Winkler Index map
    - Potential soil water stress map
    - Potential solar radiation map
    - Topographic classification map ()
    - Potential viticulture zoning ()
  - Your viticulture farm in climate change scenarios ()
- Olive growing
- Land Suitability to other crops
- Forestry

Long ,Lat (14.83598, 41.18539) proj wgs84 (EPGS:4326)

TABLES

Territorial themes | User themes

Area d'Interesse

- piero2905B
- test2
- test3
- aberdeen3
- Ponte
- Antonello
- Olivo
- piero280613
- pileri

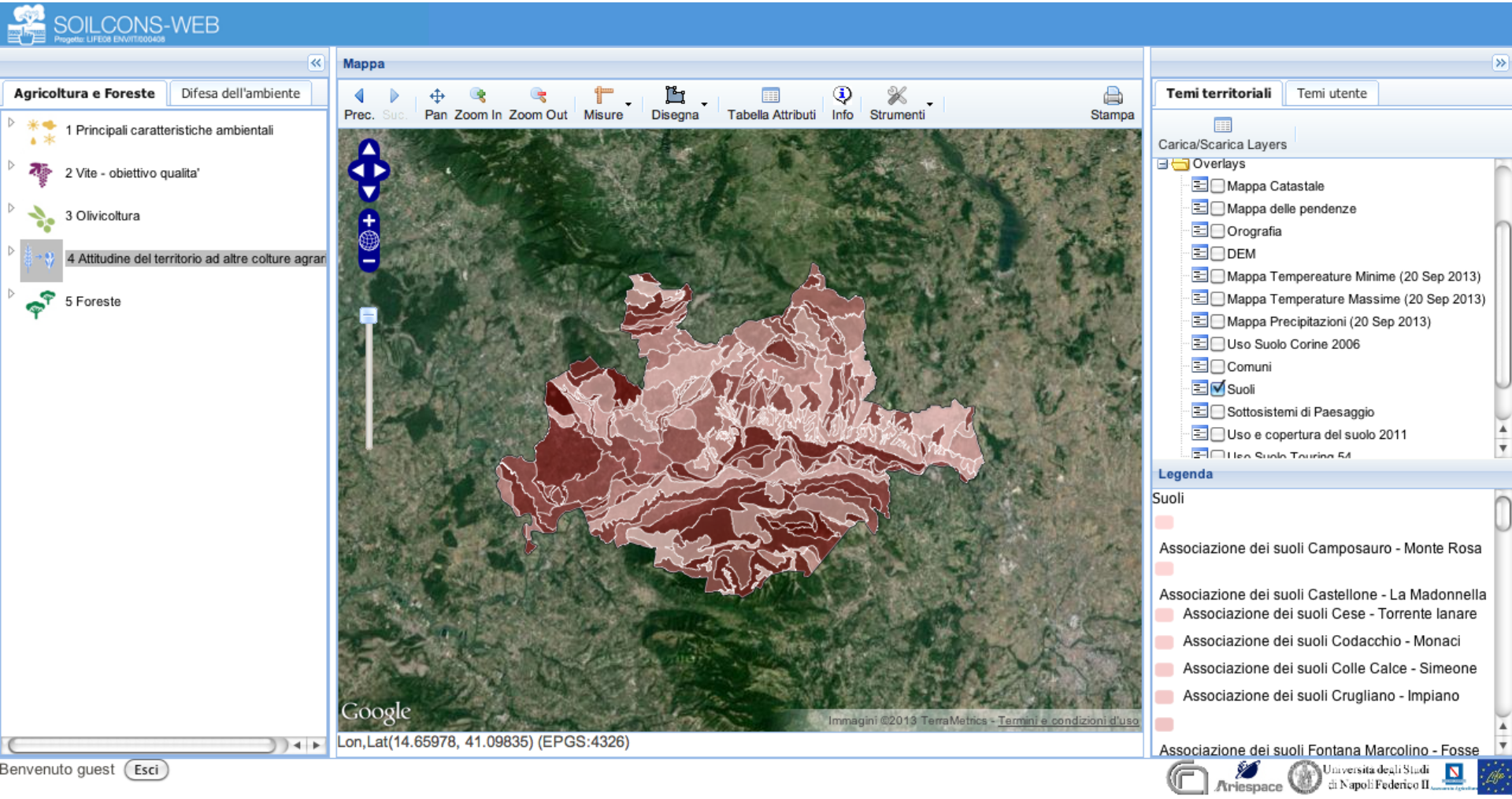
Elaborazioni effettuate

Benvenuto Ospite LogOut

note legali

Ariespace

Università degli Studi di Napoli Federico II


SOILCONS-WEB
Progetto LIFE08 ENV/IT/000408
Agricoltura e Foreste
Difesa dell'ambiente
1 Principali caratteristiche ambientali
2 Vite - obiettivo qualita'
3 Olivicoltura
4 Attitudine del territorio ad altre colture agrar
5 Foreste
Mappa
Prec.
Suc.
Pan
Zoom In
Zoom Out
Misure
Disegna
Tabella Attributi
Info
Strumenti
Stampa
Google
Immagini ©2013 TerraMetrics - Termini e condizioni d'uso
Lon,Lat(14.65978, 41.09835) (EPGS:4326)
Temi territoriali
Temi utente
Carica/Scarica Layers
Overlays
Mappa Catastale
Mappa delle pendenze
Orografia
DEM
Mappa Tempereature Minime (20 Sep 2013)
Mappa Temperature Massime (20 Sep 2013)
Mappa Precipitazioni (20 Sep 2013)
Uso Suolo Corine 2006
Comuni
Suoli
Sottosistemi di Paesaggio
Uso e copertura del suolo 2011
Legenda
Suoli
Associazione dei suoli Camposauro - Monte Rosa
Associazione dei suoli Castellone - La Madonnella
Associazione dei suoli Cese - Torrente Ianare
Associazione dei suoli Codacchio - Monaci
Associazione dei suoli Colle Calce - Simeone
Associazione dei suoli Crugliano - Impiano
Associazione dei suoli Fontana Marcolino - Fosse
Benvenuto guest
Esci
Ariespace
Università degli Studi di Napoli Federico II

SOILCONS-WEB

Agriculture and Forestry | Environmental protection

- Main environmental features
  - Discover the environmental features of your farm/landscape
  - Discover the landscape constraints imposed in your territory ()
  - Estimate tha actual soil water storage in your soil
  - Land Use Change Detection (matrix)
- Viticulture
  - Label describing your "Terroir"
  - Support to the analysis of your "Terroir"
    - Soils of your Terroir
    - Winkler Index map
    - Potential soil water stress map
    - Potential solar radiation map
    - Topographic classification map ()
    - Potential viticulture zoning ()
  - Your viticulture farm in climate change scenarios ()
- Olive growing
- Land Suitability to other crops
- Forestry

Long ,Lat (14.83598, 41.18539) proj wgs84 (EPGS:4326)

TABLES

Territorial themes | User themes

Area d'Interesse

- piero2905B
- test2
- test3
- aberdeen3
- Ponte
- Antonello
- Olivo
- piero280613
- pileri

Elaborazioni effettuate

Benvenuto Ospite LogOut

note legali

Ariespace

Università degli Studi di Napoli Federico II

SOILCONS-WEB

Agriculture and Forestry | Environmental protection

- Soil erosion
- Potential loss of soil organic matter
- Soil protective capability toward groundwater pollution
- Soils and sewages distributiuon
- Soils and landslides
- Disadvantage areas
- Soil sealing

Long ,Lat (14.54827, 41.10680) proj wgs84 (EPGS:4326)

TABLES

Territorial themes | User themes

Area d'Interesse

- piero2905B
- test2
- test3
- aberdeen3
- Ponte
- Antonello
- Olivo
- piero280613
- pileri

Elaborazioni effettuate

Benvenuto Ospite LogOut

note legali

Ariespace

Università degli Studi di Napoli Federico II

-  Soil sealing ⓘ

  - Soil sealing due to the urbanization
    - interactive mapping of 1954, 2004
    - Mapping the PLAND index (years 1954, 2004)
  - Rural landscape fragmentation
    - interactive mapping of 1954, 2004
    - Multi-yearly statistics of rural landscape fragmentation (years 1954, 2004)
    - Mapping the SPRAWL index (years 1954, 2004)
  - Simulate key environmental impacts of your new urbanization

Some conclusions

It is possible to have a (**dynamic**) SDSS system having some key features :

i. based on the concept of soil/landscape **multifunctionality**
ii. potentially **adapted** to the need of **each end-user (action at the local scale)**
iii. enabling **"what if" modelling**
iv. Then we do not to provide "solutions" but "**options**"
v. Local communities **awareness on soil/landscape** conservation/ sustainable management
vi. enabling to incorporate **bottom-up contributions to governance** *(to be developed by 2014)*
vii. **user friendly** (complexity is embedded)