Activities on CM ad GM estimation in Italy: use of LPIS data for reporting and field monitoring of SOC

The ISMEA-ISPRA-CRA-JRC Project

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Arona, 26-27 May 2015

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THE ISMEA-ISPRA-CRA-JRC PROJECT: WORK PROGRAM ON LAND USE AND LAND USE CHANGE

The final aim is to improve the quality of data used in the estimation process of carbon stock changes of CM and GM activities, focusing on the annual change in organic carbon stocks in mineral soils

Two main objectives:

1. Land subject to CM and GM activities: use of LPIS (SIAN, *National Agricultural Information System* in Italy) data in the estimation process; the LPIS data are administrative data, but include information on the use and the management practices
2. Focus on the SOC (soil organic carbon): set up a soil sampling survey, at NUTS2 level to collect new country specific coefficients; the collected data will be used also in modeling, **stratifing by management practices and ecosystem**

The regional administrations will be involved in both the objectives.

LAND SUBJECT TO CM AND GM ACTIVITIES: THE LIPS/SIAN DATA

AREAS BY :

- Perennial woody crops ,
- Annual crops,
- Grazing land management

***Source*: SIAN** (National Agricultural Information System)

REGIONS will contribute to LPIS data use, by adding ancillary information, collected in the RDPs framework, at regional level, related mainly to management practices.

AREAS BY MANAGEMENT/INPUT

With regard to perennial woody crops and annual crops :	**With regard to GRAZING LAND MANAGEMENT:**
- Organic farming - Integrated production - No tillage e minimum tillage - Conventional agriculture - Set aside* - Crop diversification* * *«greening» management from 2015 onwards*	- Organic grassland - Grazing land managed *(other than organic)*

***Sources*:**

- **SIAN** *(National Agricultural Information System)* +
- **Annual Implementation Report of the regional Rural Development Programmes** *(RDPs)*

SOC: The Sampling Plan

TECHNICAL ASSISTANCE TO THE REGIONS IN TWO WAYS:

SAMPLING

- **Definition of Guidelines for the monitoring of soil organic carbon (SOC) content** *(related to land use and management/input types identified)*
- **Technical assistance to the Regions' sampling**

FINANCING

- **Drafting of the measure sheets in order to get the sampling financed by the RPDs:**
  Two potential measures have been identified, by now:
  - ✓ *Measure 7: Basic services and village renewal in rural areas*
  - ✓ *Measure 20: Technical assistance*

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THE PARTNER REGIONS

10 Regions have agreed to partecipate directly or delegating regional bodies or universities:

ZONES	REGIONS
North	Lombardia
	Veneto
	Friuli Venezia Giulia
	Bolzano
Centre	Toscana
	Marche
South + Islands	Campania
	Basilicata
	Sicilia
	Sardegna

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WHY FIELD MONITORING?

Collection of relevant field research results on SOC in relation to Land use, management and inputs: not enough

Status quo

Support to activate field surveys to monitor soil organic carbon

Work plan:

- **Definition of monitoring guidelines (CRA)**
- **Targeting of funds for the monitoring (e.g. Rural Development Programmes)**
- **Involvement of partner Regions in the monitoring**

SPECIFIC OBJECTIVE: Determination of SOC stocks in relation to soil and crop type, productive system, and management practices

GENERAL OBJECTIVE : Improve the calculation coefficients of the emissions, by replacing the calculated SOC (Tier 1) with the measured SOC (change to Tier 2/3)

SAMPLINGS

A. Crop type (arable crops, permanent crops, grasslands)

B. Productive system (organic, integrated/sustainable, conservative, set-aside, conventional, …)

C. Management practices (manuring, organic fertilization, inorganic fertilization, green manuring, incorporation/removal of crop residues, crop rotation, grass cover, mulching, cover crop, minimum tillage, no tillage,….)

CROPLAND MANAGEMENT

Crop type	Arable crops
Productive systems	organic
	integrated/sustainable
	conventional
	conservative
Management practices	manuring
	organic fertilization
	inorganic fertilization
	green manuring
	crop residue incorporation/removal
	monoculture/rotation set-aside
	Minimum tillage/no tillage
	....

CROPLAND MANAGEMENT

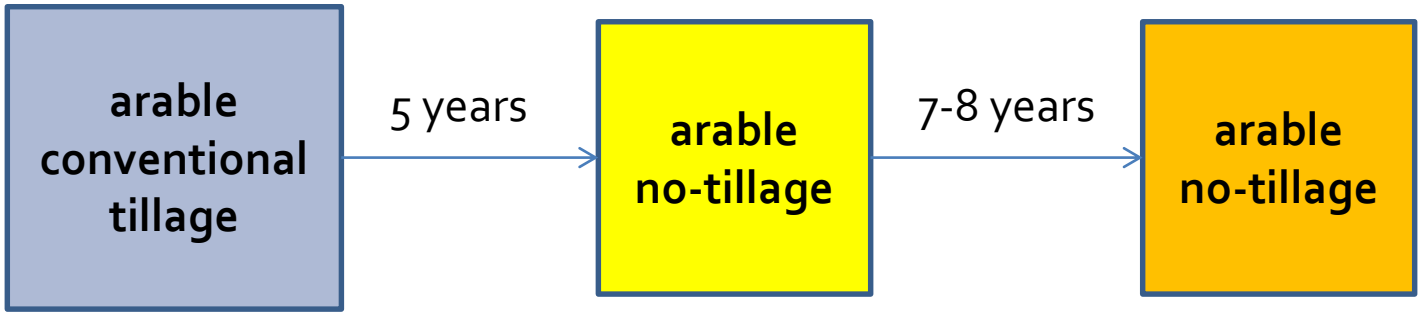
Crop type	Permanent crops
Productive systems	organic
	integrated/sustainable
	conventional
	conservative
	set-aside
Management practices	manuring
	organic fertilization
	inorganic fertilization
	green manuring, cover crop, grass cover, mulching
	pruning residue incorporation/removal
	Minimum tillage/no tillage
	….

GRAZING LAND MANAGEMENT

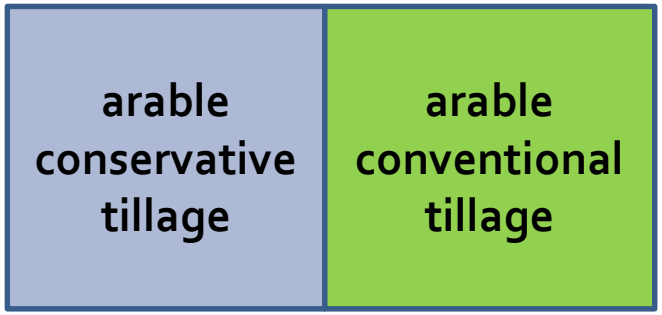
Crop type	Permanent grassland/pasture
Productive systems	natural/extensive
	improved/organic
	managed
Management practices	hay harvesting
	livestock density (LU/ha)
	livestock type (cattle, sheeps, goats, …)
	….

SOIL SAMPLING APPROACHES

1. Samplings repeated in time with LUC (many samplings, at least 5-6 years between samplings);



1. **Samplings repeated in space (chronosequence) comparing SOC changes in two homogeneous situations which only differ in the use/soil management**



THE CHRONOSEQUENCE APPROACH *

A. comparable areas by topography and soil type)
B. different land use and land use change
C. choice of reference areas ideally occupied by natural vegetation, or a previous land use
D. comparison with other areas representing the main current land use with different conversion ages

Sampling time is reduced, no need to resample

* Smith et al., 2012. Towards an integrated global framework to assess the impacts of land use and management change on soil carbon: current capability and future vision. Global Change Biology 18, 2089–2101

CHOICE OF THE SAMPLING SITES

A. Will include the most representative crops
B. Site and number of samples depend on the specific regional situation in relation to crops, productive systems and management practices
C. the regional specialists coordinate with the main local farms
D. overlapping of geographical information related to soil type, use and soil cover, statistical information, expert judgment
E. choice of the sampling areas for each year (e.g. 100 georeferenced sites with 3 replicates = 300 samples)

SOIL SAMPLING AND PREPARATION

A. samplings in the **0-30 cm** layer, as indicated in the IPCC guidelines (2006)

B. air dried samples, crushed and sieved to < 2 mm, removing crop and root residues

C. measure the coarse fraction > 2mm (gravel) to avoid the overestimation of the carbon stocks (t/ha)

D. If no previous classification is available, soils will be analyzed and classified according to the World Reference Base for Soil Resources (2014), and providing for each monitoring site the full description of at least one soil profile with the horizons characterization

SOIL ANALYSES (at the regional labs)

A. pH, in a 1:2.5 soil:water suspension by potentiometric method (pH meter)
B. particle size distribution , if not available, with wet sieving and pipette procedure (Soil Survey Staff, 2011)
C. organic carbon (SOC) and total nitrogen (Ntot), by dry combustion with elemental analyzer or, Springer-Klee and Kieldhal methods respectively (MiPAF, 2000)
D. C/N ratio, as a proxy indicator of soil organic matter humification or mineralization processes
E. Bulk Density (BD) to convert SOC concentration (% or g/kg) to SOC stocks (t/ha). By CRA with a proper pedofunction re-parameterized with data from Mediterranean cultivated soils

FUTURE DEVELOPMENTS: TIER 3

SOC stocks and CO_2 emissions

TIER1
TIER2
TIER3

Ecosystem and process models are used in the estimations of SOC stocks and CO_2 emissions

SOIL data-base

Climatic data

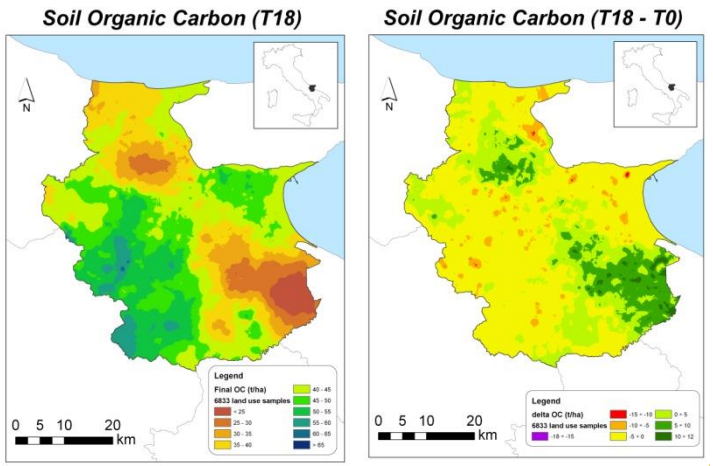
Soil use/land use change (LPIS)

Yield data (statistics)

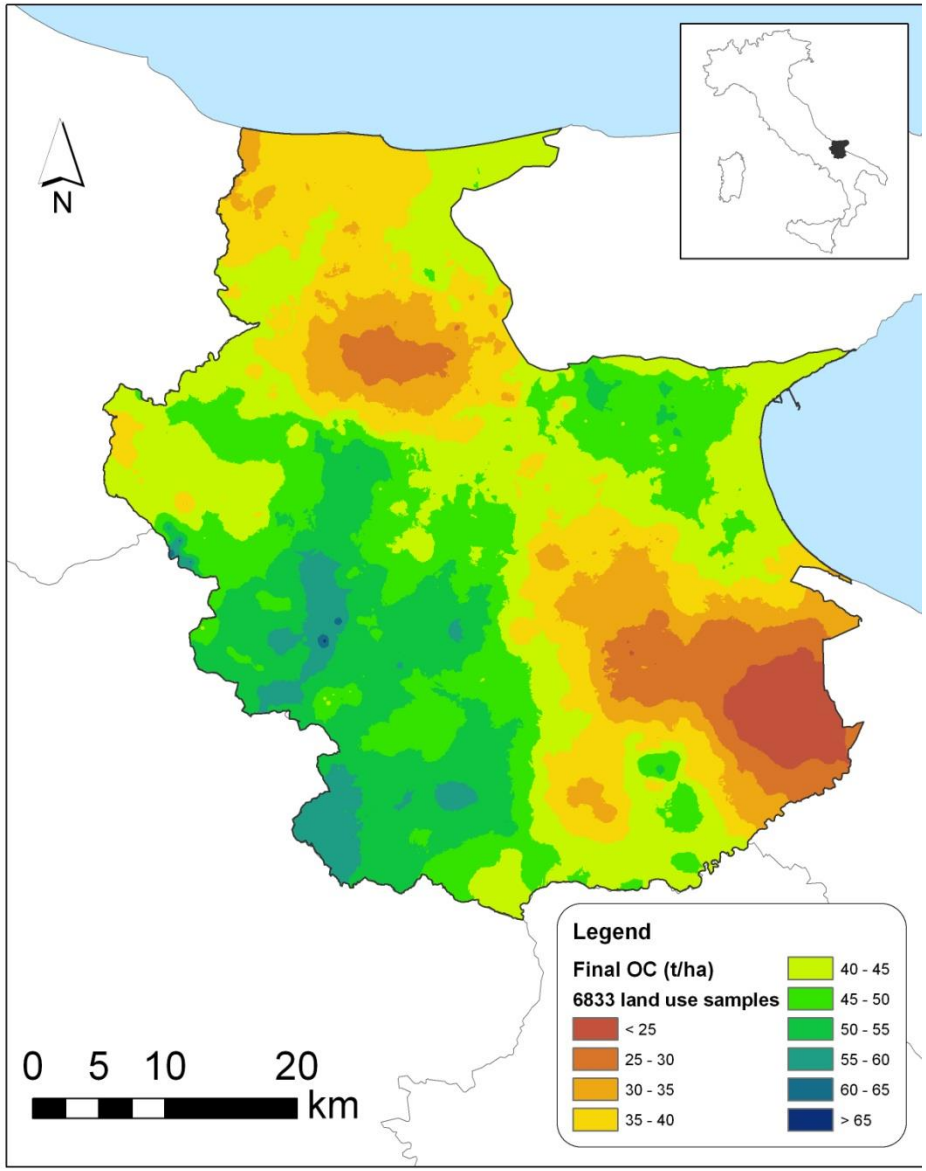
RothC model engineered

Geostatistical methodologies

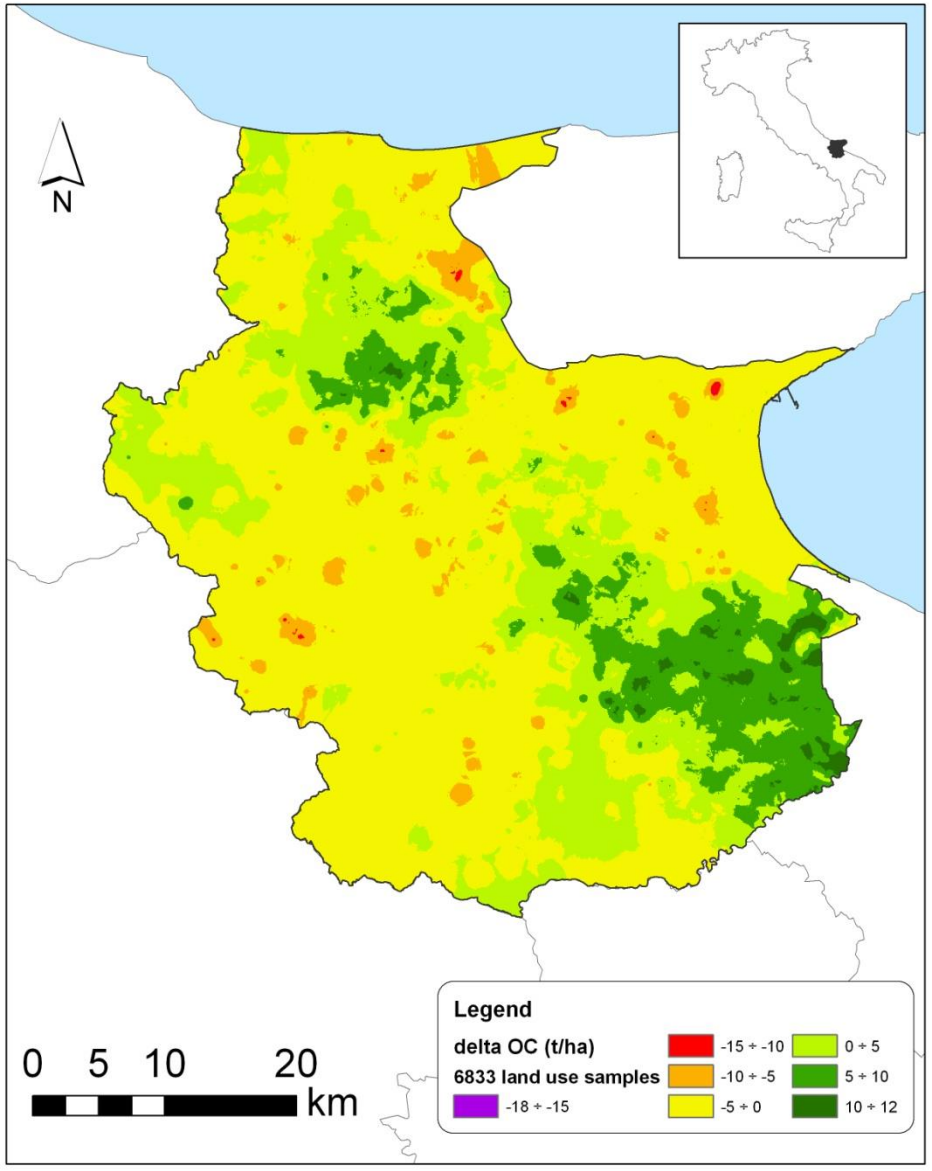
1) SOC stocks in relation to soil, climate, crop
2) SOC changes mapping as a result of deviations from BAU
3) Estimate SOC contents in points/areas where no measured data are available



Soil Organic Carbon (T18)



Soil Organic Carbon (T18 - T0)



Spatialization of modeleled data made using Empirical Bayesan Kriging

FUTURE DEVELOPMENTS: AN EXAMPLE

-olive groves and vineyards were able to stock a considerable amount of C (from 0.4 to 1.5 t ha^{-1} yr^{-1});

-continuous wheat/wheat rotation lead to a reduction of C stocks, ranging from 0.1 to 0.2 t ha^{-1} yr^{-1}, in sandy and clayey soils respectively;

-cereal rotation including irrigated tomato the C stock declined by about 0.4 t ha^{-1} yr^{-1} in the year of tomato;