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Soil Carbon Status Indicators for agricultural soil of the European Union

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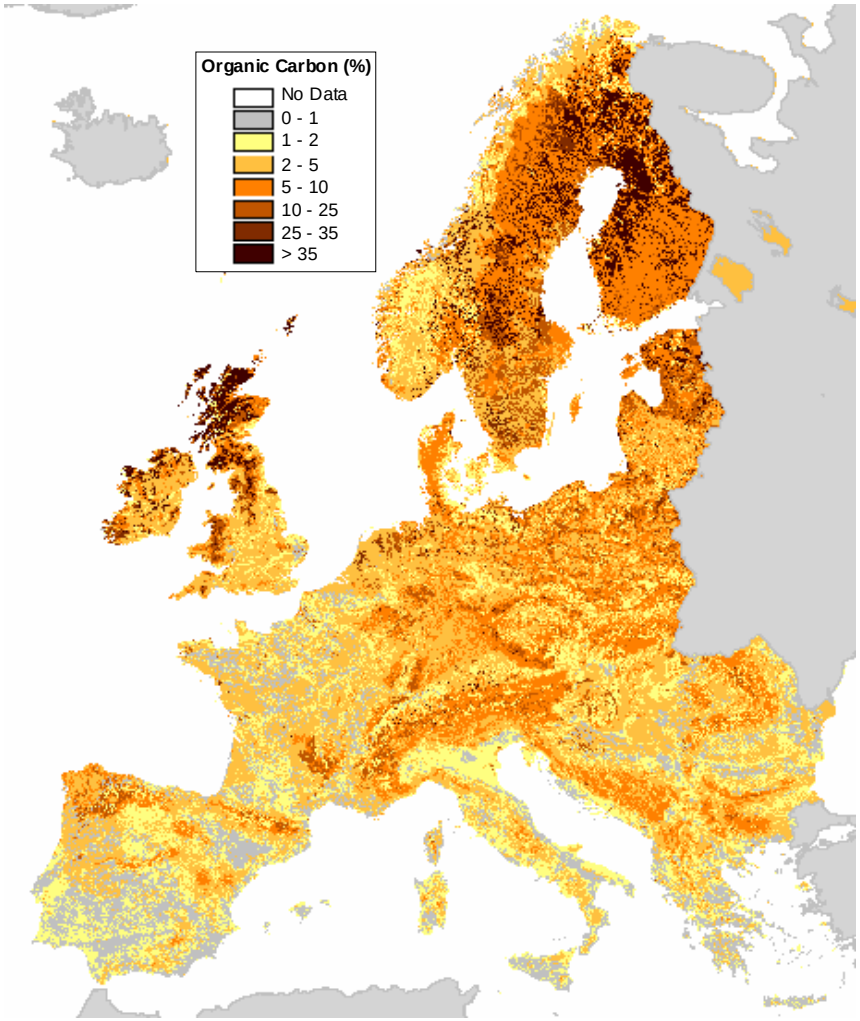
Organic carbon in soil: what user can learn?



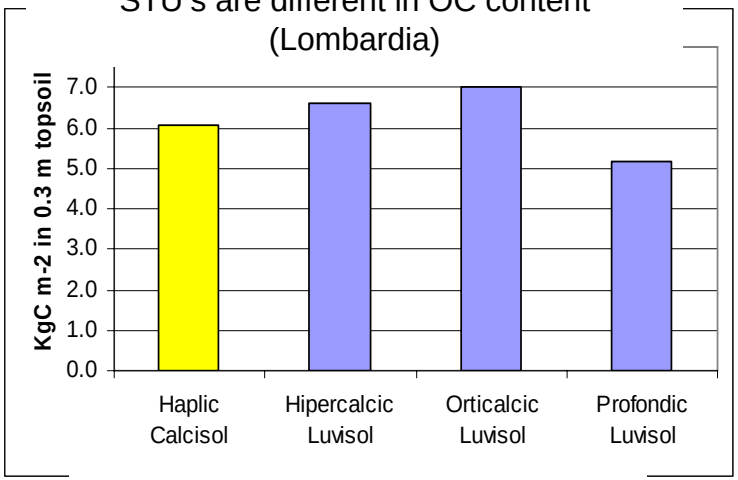
Source: Hiederer *et al.*, 2004

Lesson 1. Pedologists can provide relevant data.

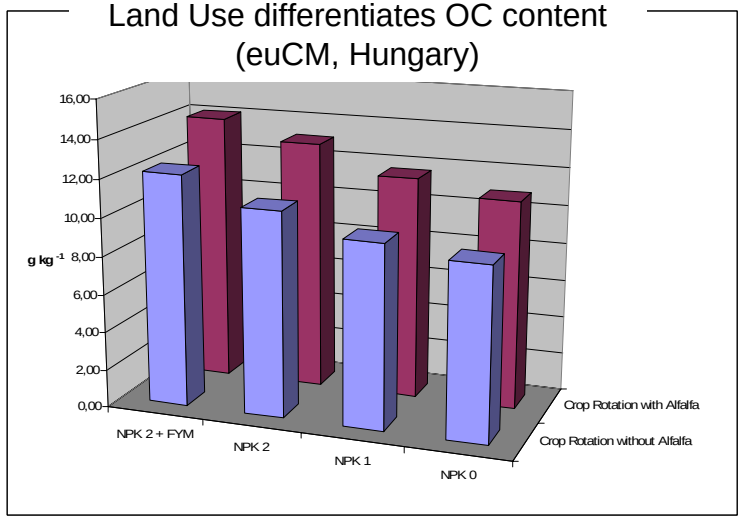
Lesson 2. However raw data needs translation (interpretation) into user-friendly information.

Organic carbon in soil: what soil experts know?

STU's are different in OC content (Lombardia)

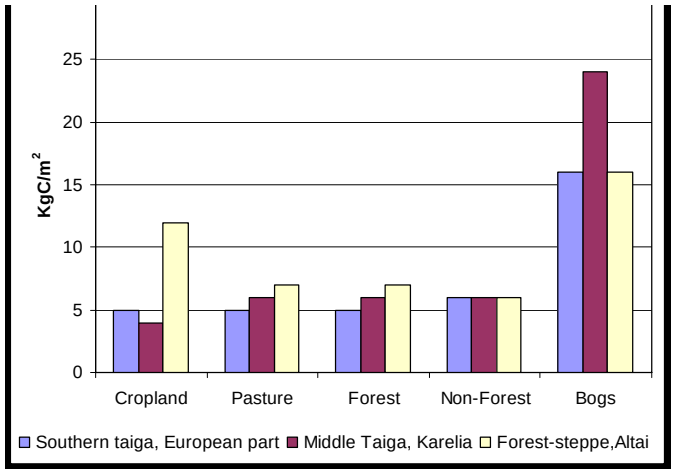


Land Use differentiates OC content (euCM, Hungary)



Source: *Toth, Hermann and Kismanyoky, in print*

OC content varies by LU and geographically



Source: *Stolbovoi, 2000.*

Lesson 3. Interpretation needs understanding of both soil data and professional knowledge.

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Important facts on organic carbon in soil

1. STU's are different in OC content;
2. OC content results from combination of STU and LU/management;
3. Each STU/LU combination has specific OC margins e.g. MAX and MIN;
4. The OC change in STU is limited by OC margins;
5. Potential for the change depends on the actual OC content.

What Soil Organic Carbon Status Indicators are about?

Definition: *"Soil Organic Carbon Status Indicators" (SOCSI) is a set of parameters describing current organic carbon content and potential for organic carbon change (e.g. via management, land use change etc.).*

Method: *The SOCSI are knowledge-based and derived from available soil data.*

Customer: *Decision-policy makers*

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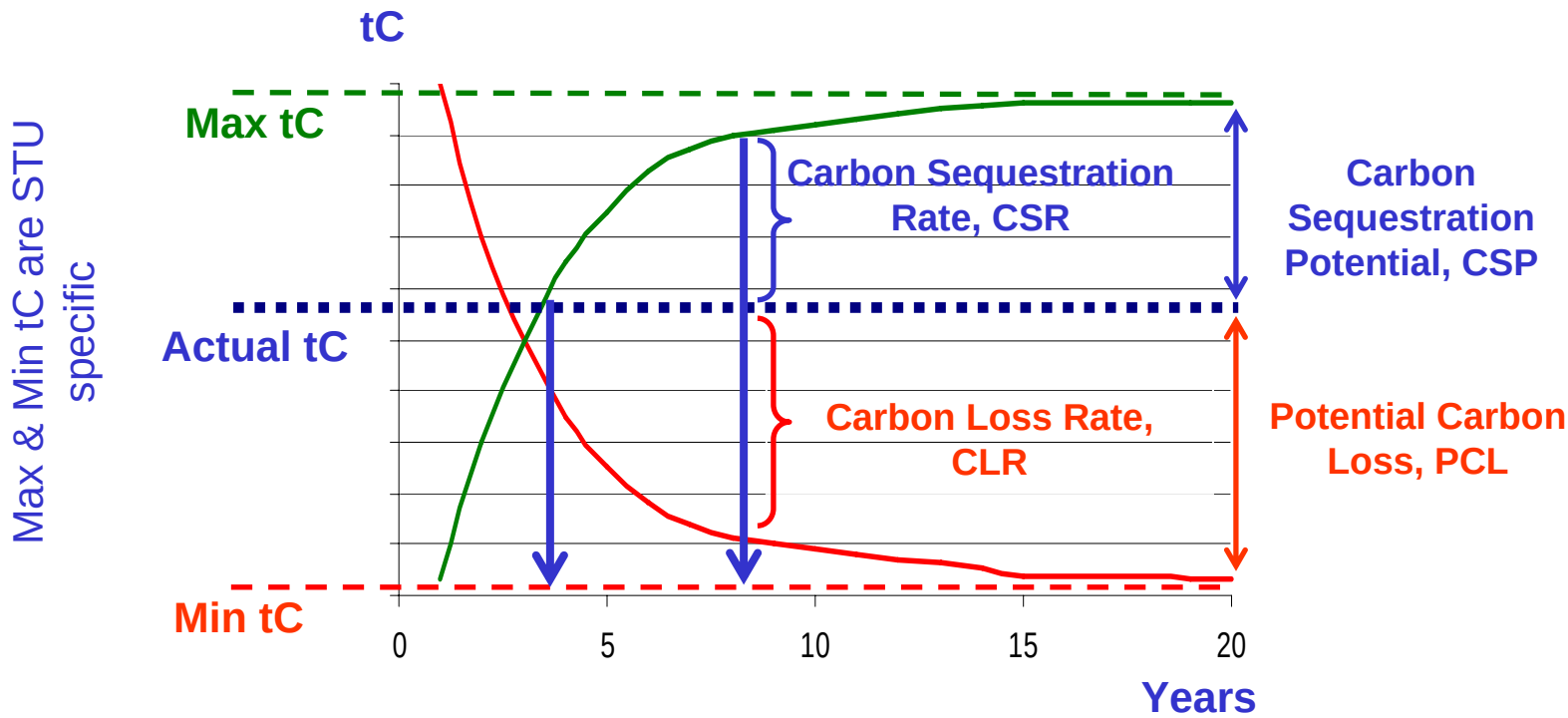
Concept 1: potentials for organic carbon enhancement and loss in soil



Computation:

CSP = MAX OC – Actual OC (MED OC)

CSR = PCS/Yr

PCL = Actual OC (MED OC) – MIN OC

CLR = PCL/Yr

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Example of carbon sequestration potential (Piemonte region)

Land Cover	Soil Carbon Density, tC ha-1			CSP, tC ha-1	CSR*, tC yr-1
	Min	Actual (Med)	Max		
Cropland	4.0	9.0	12.4	3.4	0.15/0.02
Forest	n.d.	4.1	6.3	2.2	n.d.

n.d. – not defined;

*CSR = carbon sequestration rate per yr: first 5 yr / next 15 yr

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Example of potential carbon loss (Piemonte region)

Land Cover	Soil Carbon Density, tC ha-1			PCL, tC ha-1	CLR*, tC yr-1
	Min	Actual (Med)	Max		
Cropland	4.0	9.0	12.4	5.0	0.8/0.07
Forest	n.d.	4.1	6.3	n.d.	n.d.

n.d. – not defined;

PCL is potential for C loss

CSP* = is C carbon loss rate per yr: first 5 yr / next 15 yr

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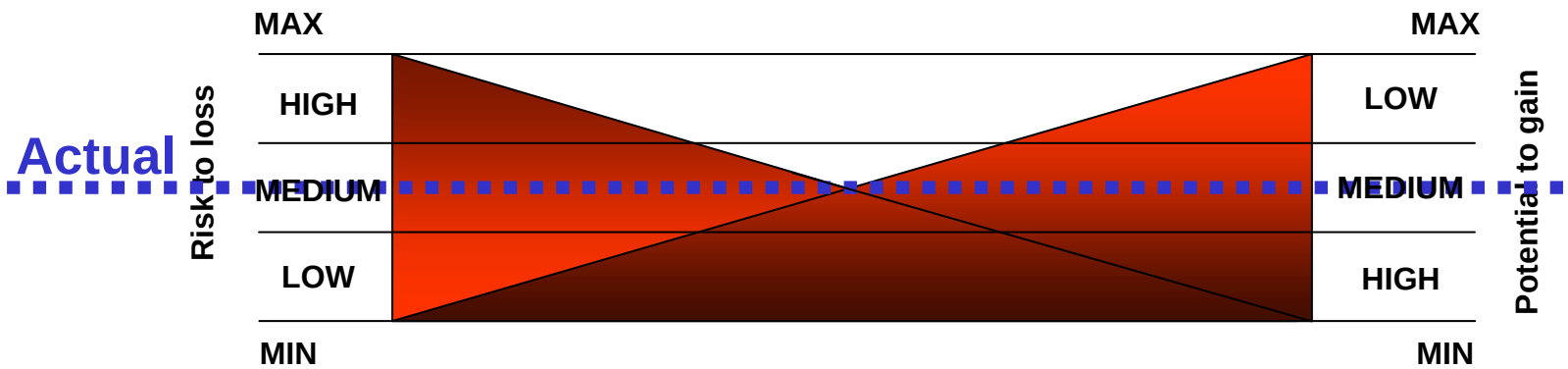
Concept 2: soil capability to OC change

Formulation

Soil carbon status indicators are relative terms (see facts above) therefore

the absolute values of CSP and PCL do not reflect the ability of soil to gain or loss OC. For example, STU's with the same OC content can be different in CSP and PCL and STU's with different OC content can have the same CSP and PCL.

Definition of soil capability classes to loss and potentials to gain OC



Threshold = (Max-Min)/3

Capability classes:
less than [Min+ (Max-Min)/3]
more than [Min+2(Max-Min)/3]

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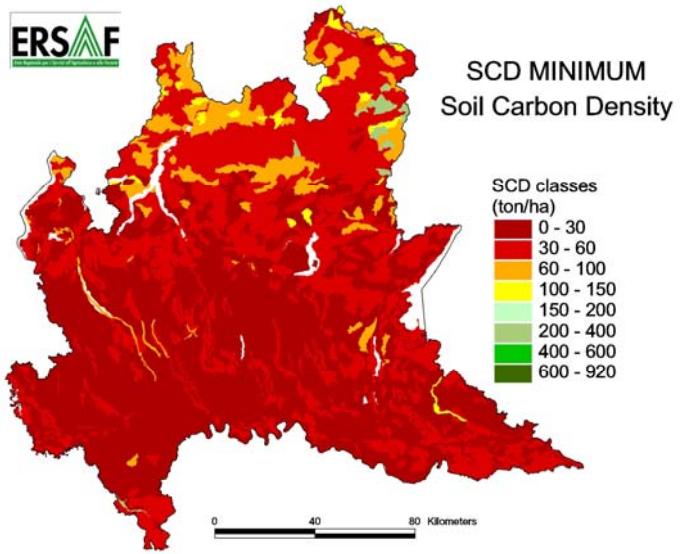
Example, capability classes to loss and potentials to gain soil OC (Lombardia region)

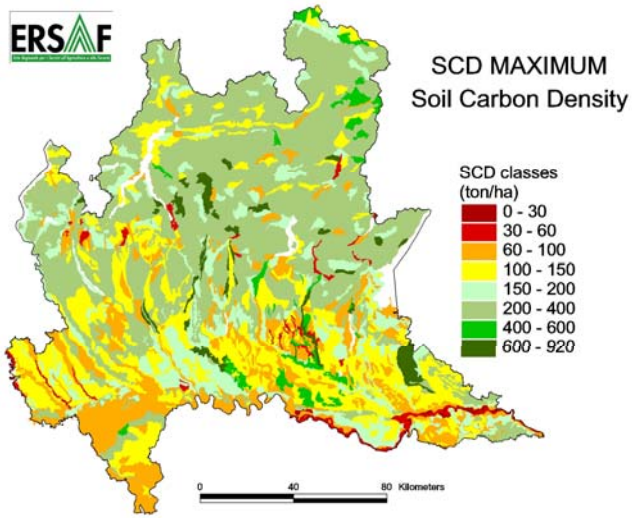
STU	SCD, tC ha			Threshold, (Max-Min)/3	Content intervals, tC ha			Capability Class of loss/gain
	Min	Med	Max					
profondic LV	35	61	102	22	< 57	57-79	> 79	M / M
orticalcic LV	23	66	175	51	< 74	74-125	> 125	L / H
hipercalcic LV	51	70	90	13	< 64	64-77	> 77	M / M
haplic CL	25	52	85	20	<45	45-65	>65	M / M

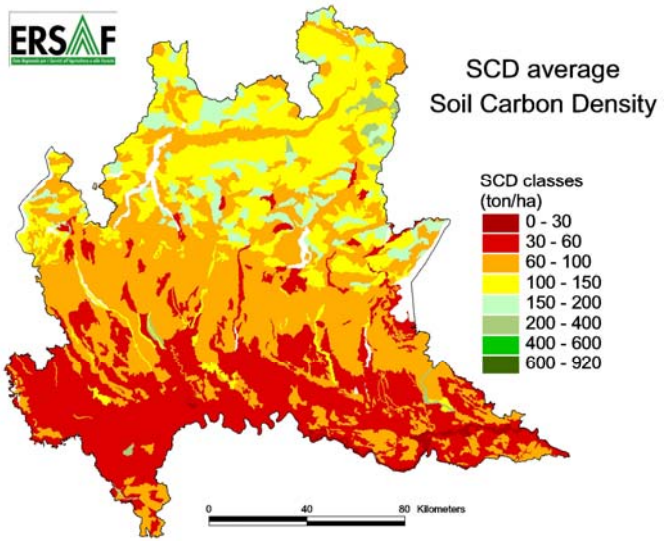
Example, Carbon Status Indicators for four soils in Lombardia region

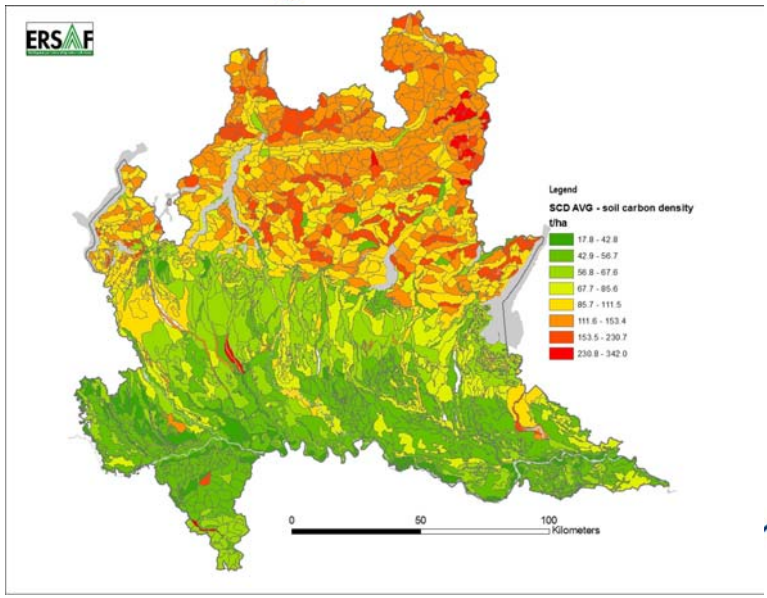
STU	SCD, tC ha			Potential to gain OC		Potential to loss OC	
	Min	Med	Max	CSP, tC ha	Class CSP	PCL, tC ha	Class PCL
profondic LV	30	61	102	41	2	31	2
orticalcic LV	19	66	175	109	1	47	3
hipercalcic LV	44	70	90	20	2	26	2
haplic CL	25	52	85	33	2	27	2

Mapping of measured OC Status Indicators









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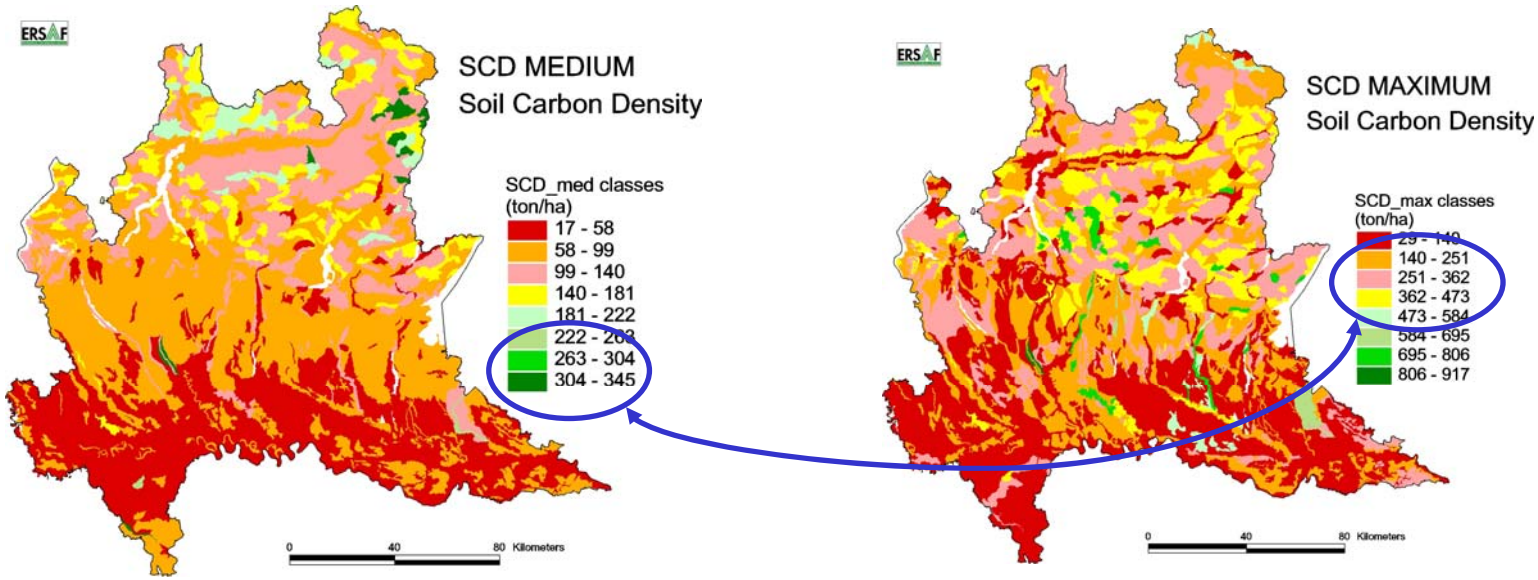
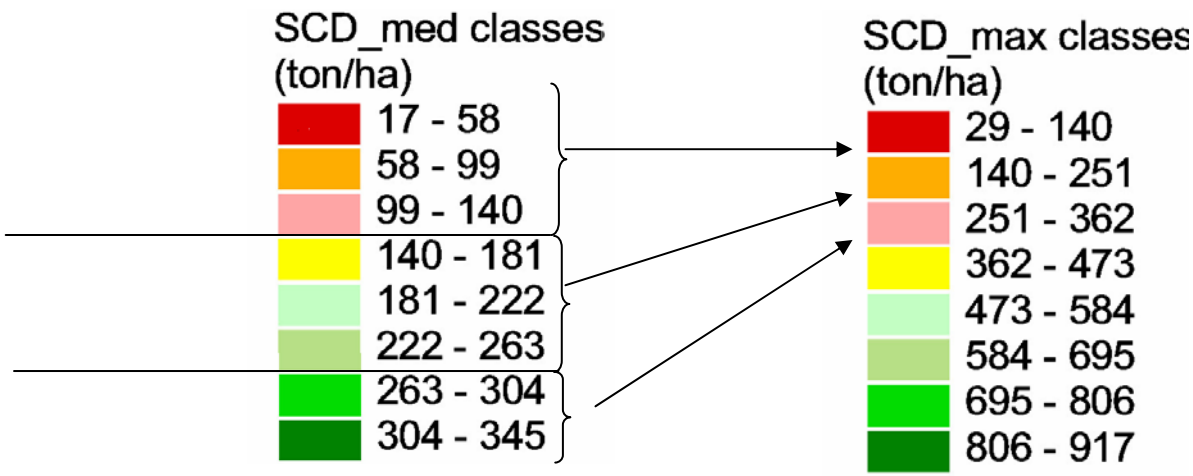
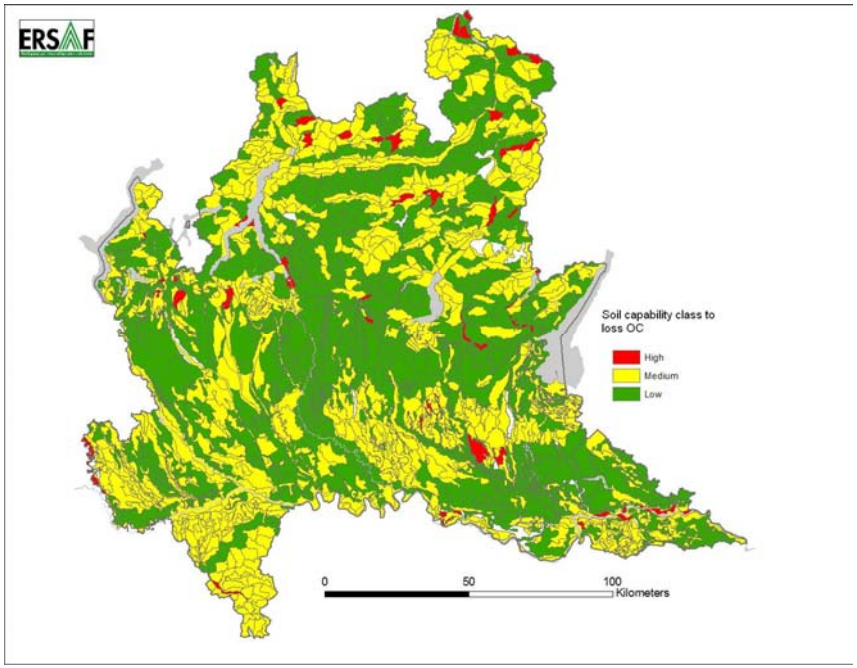
Cartographic unification



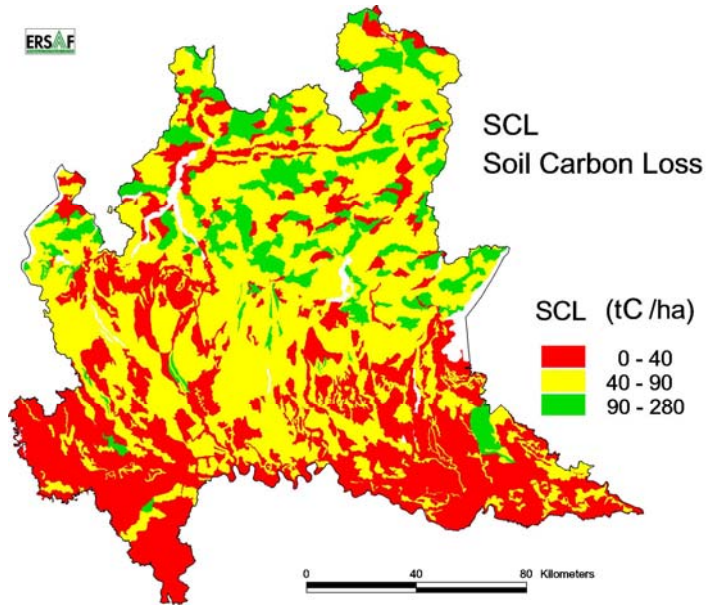


Computed OC Status Indicators

Soil Capability Classes to loss Carbon



Soil Carbon Loss potentials (tC ha-1)



Conclusions

- A set of Soil Organic Carbon Status Indicators (SOCSI) has been proposed. They include:
  - Data-derived parameters (e.g., STU/LU specific OC margins: MAX, MED, MIN)
  - Knowledge-derived parameters: CSP, CSR, PCL, CLR and capability classes for OC change.
- The SOCSI are aimed at supporting authorities to setup region-specific policy-decisions regarding carbon management.
- The SOCSI should be regionally tested and validated against empirical observations.