Expected future challenges: reporting of agricultural activities

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Outline

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General concepts

European Commission

Reporting and accounting

Reporting: inclusion of GHG estimates (and methods used) in GHG inventory

Accounting: use of the reported information to calculate the GHG contribution towards a target, e.g. towards Kyoto Protocol (KP) target.

Estimation and Reporting shall follow IPCC guidance on:

- consistent representation of areas (3 **approaches**)
- estimating changes in **C pools** using 3 **Tiers**
- **Key categories (KC):** the most important categories/ subcategories/ C pools in the overall country GHG budget

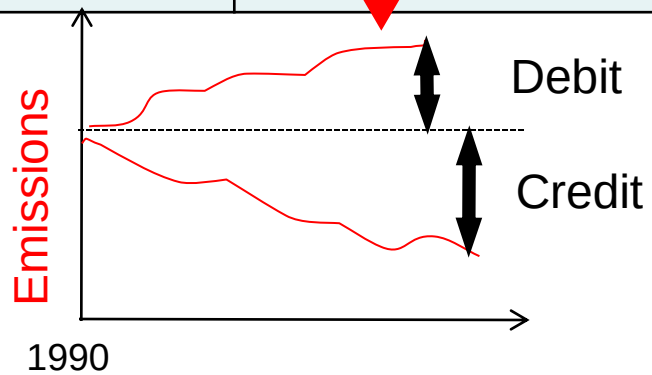
For cost-effective use of resources, priority should be given to estimating KC with Tiers 2-3. Non-KC may be estimated (and accounted) with Tier-1.

Estimate must be: transparent,consistent,comparable,complete,accurate

General concepts

Cropland and grassland within UNFCCC/KP

	UNFCCC	KP	
	Reporting	Reporting	Accounting
AGRI CULTURE	CH4 and N20 from soils, livestock, manure	= UNFCCC	**Mandatory**, relative to 1990 (**net-net**)
LULUCF	GHG from 6 **land uses** (all managed lands) FL Forest land CL **Cropland** GL **Grassland** WL Wetland S Settl. O Other	GHG <u>only</u> from direct human induced **activities** AR Aff/Refor. D Defor. FM Forest manag. CM **Cropland man.** GM **Grazing land man.** RV Reveget. WM Wetland	relative to 1990 (**net-net**)



(in following slides, CL and GL will be assumed as proxy for CM and GM)

Current reporting by MS on CL and GL

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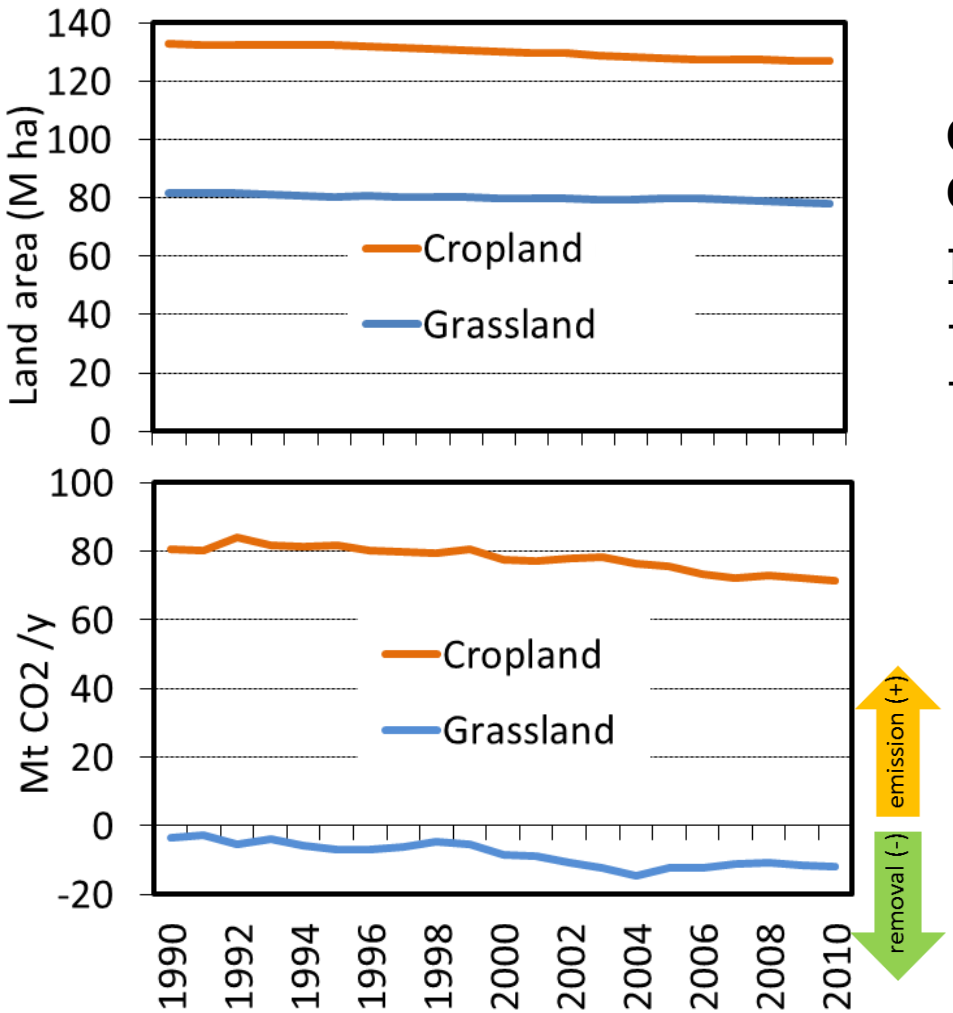
EU trends



CL: slightly decreasing emissions
GL: slightly increasing removals

In both cases:

- most emissions from organic soils
- uncertainty of emissions is high, but the trend is robust: mainly driven by area

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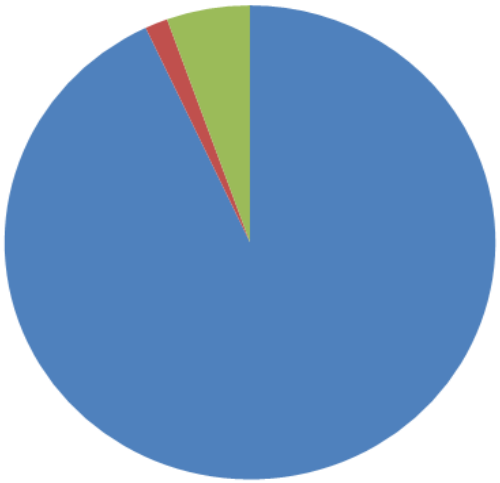
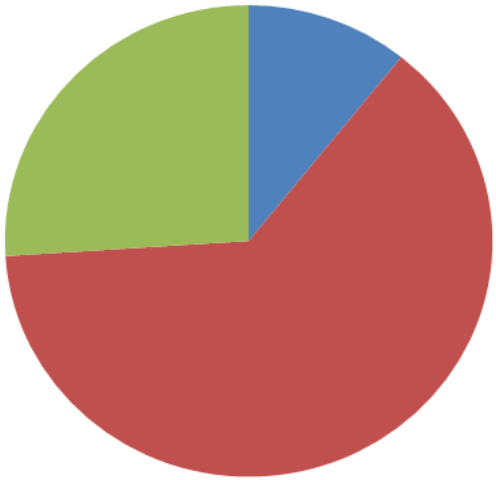
The hotspots

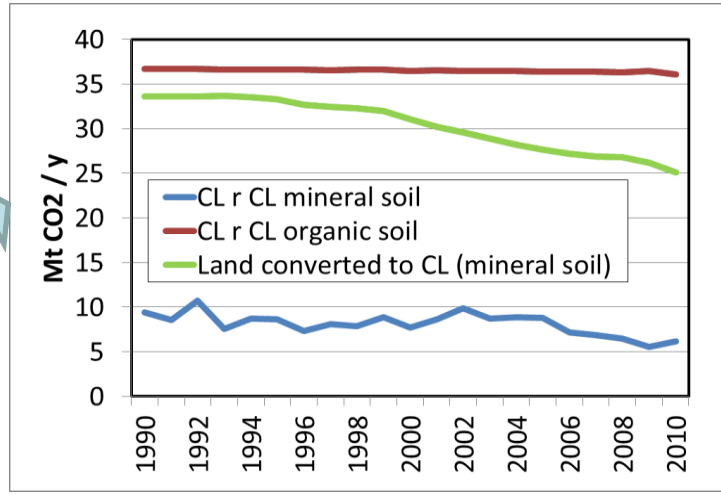
The most important C pool in GL and CL is soil
Share of different subcategories in Cropland (EU):



% of area



% of soil emissions



CL r CL mineral soil	≈ 92% of area, 10% of CL soil emissions
CL r CL organic soil	≈ 2% of area, 60% of CL soil emissions
Land converted to CL	≈ 6% of area, 30% of CL soil emissions

} important "hotspots"

Current reporting by MS on CL and GL

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Overview of the methods used for CL and GL

	Cropland (CL)					
	CL remaining CL			Land converted to CL		
	Biomass	Soil Min	Soil Org	Biomass	Soil Min	Soil Org
Austria	D,CS	CS,CS		CS,CS	CS	
Belgium		CS		CS	CS	
Denmark	CS	CS	CS	CS,CS	CS	CS
Finland	CS	D	CS	D	CS,D	CS
France	D			CS	CS	
Germany			CS	CS,CS	CS	CS
Greece	CS	D,D	D	CS	IE	
Ireland		CS,D			CS	
Italy	CS		D		CS	
Luxembourg	D			CS	CS	
Netherlands			IE	CS		
Portugal	CS	CS		CS,CS	CS	
Spain	CS	CS				
Sweden	CS	CS	CS	CS,CS	CS	CS
UK	CS	CS	CS	CS,CS	CS	CS
Bulgaria	CS,D	CS		CS,D	CS	
Cyprus						
Czech Rep.	D	CS,D		CS,D	CS	
Estonia	CS		CS,D	IE		CS,D
Hungary	D	D,D		CS,D	D	
Latvia			D	CS	CS	CS
Lithuania	D		CS	D	D	
Malta	CS			CS		
Poland	D	CS	CS		CS	
Romania	D	CS			CS	
Slovakia	D			CS,D	CS	
Slovenia	CS	CS	CS	CS	CS	

(based on MS' 2012 GHG inventories)

D: default data (tier 1)
CS: country data (tier 2 or 3)
IE: included elsewhere
Empty cells: not estimated
Grey cells: Key category

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Current reporting by MS on CL and GL

	Grassland (GL)					
	GL remaining GL			Land converted to GL		
	Biomass	SOM Min	SOM Org	Biomass	SOM Min	SOM Org
Austria		CS,CS	CS	CS	CS	
Belgium	D	CS		CS	CS	
Denmark	CS		D	D	CS	CS
Finland	D	D	CS	D	CS	CS
France	D			CS	CS	
Germany	CS	CS	CS	CS	CS	CS
Greece	D	IE,		D	IE,	
Ireland	D	CS	CS,D	CS	CS	CS
Italy	CS			D	CS	
Luxembourg	D			CS	CS	
Netherlands	D		CS	CS		
Portugal	D			CS	CS	
Spain	D				CS	
Sweden	CS	CS	CS	CS	CS	CS
UK	D	CS		CS	CS	CS
Bulgaria	D			CS,D	CS	
Cyprus	D					
Czech Rep.	D	CS,D		CS,D	CS	
Estonia	CS,D		CS,D	CS		CS,D
Hungary	D	D,D		CS	D	
Latvia	D		CS			
Lithuania	D		CS	D	D	CS
Malta	D					
Poland	D	CS	CS		CS	IE
Romania	D	NO			CS	
Slovakia	D			CS	CS	
Slovenia	D		CS	CS	CS	

(based on MS' 2012 GHG inventories)

D: default data (tier 1)
CS: country data (tier 2 or 3)
IE: included elsewhere
Empty cells: not estimated
Grey cells: Key category

Let's imagine to be a reviewer…. from these tables, two types of "potential problems" appear:

1)Missing estimates
2)Tier 1 for key categories

Are these real problems?
In some cases, no
(or not necessarily)

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Potential problems for CL and GL

1) Missing estimates

Not always necessarily a problem:

- In some cases, C pool does not exist (e.g. organic soil), or IPCC tier 1 assumes no change in C stock (e.g. dead organic matter).
- In many cases (e.g. mineral soil), no change in management practices is assumed.

The IPCC assumes that, on long-existing cropland/grasslands, carbon stock changes occur between different equilibrium levels corresponding to different types of land management practices
No change in management practices → C stocks assumed in equilibrium.

Several MS make this assumption. Although this approach is likely to be conservative (i.e. in most cases management practices are less intensive now than 20 years ago), an overview of MS' inventory reports suggest that, often, more transparent evidence supporting this assumption should be provided.

In many cases, what is needed is simply a better justification of current assumptions. In other cases, estimates should be provided… (see next presentations)

Current reporting by MS on CL and GL

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2) Key categories (KC) analysis

For cost-effective use of resources, non-KC may be estimated/accounted with Tier 1

Example of a KC analysis (CL, Sweden):

Table A 1.2. Key Category Analysis Tier 1 Level Assessment Including LULUCF

IPCC Source Category	Gas	Base year emissions or removals	Year 2010 emissions or removals	Level Assessment Year 2010 (Incl LULUCF)
5.A (Forest Land)	CO2	-44107	-38152	0.347
1.AA.3.B (Road Transportation)	CO2	17310	18962	0.172
1.AA.1.A (Public Electricity and Heat Production)	CO2	7718	10014	0.091
1.AA.2.F (Other Manufacturing Industries and Construction)	CO2	5462	4564	0.041
5.E (Settlements)	CO2	1228	2865	0.026
4.A (Enteric Fermentation)	CH4	3070	2713	0.025
2.C.1 (Iron and Steel Production)	CO2	2465	2701	0.025
4.D.1 (Direct Soil Emissions)	N2O	2792	2482	0.023
1.AA.1.B (Petroleum Refining)	CO2	1778	2130	0.019
5.B (Cropland)	CO2	2414	1805	0.016
1.AA.2.A (Iron and Steel)	CO2	1638	1773	0.016
1.AA.1.A (Public Electricity and Heat Production)	N2O	304	502	0.005
1.AA.2.E (Food Processing. Beverages and Tobacco)	CO2	948	484	0.004
1.AA.3.A (Civil Aviation)	CO2	673	465	0.004
4.B (Manure Management)	N2O	733	460	0.004
4.D.2 (Pasture, Range and Paddock Manure)	N2O	386	406	0.004
Total				0.95

KC calculated as those cumulatively contributing to 95% of total emissions. Here, the smallest KC is 406 Gg CO2/yr.

This KC suggests that the whole CL area (3.0 M ha) should be estimated with tiers 2-3.

Example of a <u>disaggregated KC analysis</u>:

CL includes:

	$GgCO_2$/yr	Mha
CL remaining CL	1571	2.9
Land converted to CL	143	0.1

→ not a KC

IPCC suggests, for each KC, to determine the "significant pools" (i.e. together more than 60% to the KC)

CL remaining CL includes:

	$GgCO_2$/yr	Mha
Biomass	-358	
DOM	9	
Mineral soil	-19	2.8
Organic soil	1939	0.1

→ not significant pools

A more disaggregated KC analysis reduces the area to be estimated with tiers 2-3 from 3.0 Mha to 0.1 Mha !

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(references to IPCC are taken from IPCC 2006 GL , Vol. 1, Ch. 4)

Additional accounting requirements

While accounting may be largely based on the current reporting, some additional requirement exists, the most relevant being:

1) If a pool is not accounted, it should be demonstrated that it is **not a source**. This provision is aimed to help countries.

The "not a source" does not necessarily requires a "statistical" demonstration of a sink, but rather, demonstration can be based on an element or a number of elements which, although not enough to quantify accurately a sink estimate, strongly suggest that a pool is not a source (i.e. they show the most likely sign).

2) Lands should be identified and tracked over time, with *spatially-explicit* or *statistical techniques* (approach 3 or 2 + supplementary information).

Additional accounting requirements

European Commission

Land identification and tracking

Existing *spatially-explicit EU datasets* such as **CORINE**, **LUCAS** and **LPIS** may provide useful information, directly usable for recent years and for supporting assumptions and/or backward extrapolations for the base year.

Up to now, only few MS use these datasets for CL and GL in their GHG inventories.

(see also next presentations)

Additional accounting requirements

When each management practice cannot be tracked over time, it is enough defining *land management systems* as a particular mix of crops and practices, and follow these systems over time.

In the absence of proper spatial-explicit data, *statistical techniques* and/or *assumptions* may be applied, e.g. it is possible to estimate the *average history* of lands now under a given management.

Example from IPCC 2003 Good Practice Guidance (box 4.2.1):

Cropland region of 10000 ha, of which 5000 are no-till (NT) in the year 2000, up from 2000 ha in 1990. The remainder, in each year, is under conventional tillage (CT).

The estimated soil carbon change is based on a matrix of coefficients; say 0.3 Mg C/ha/yr for land shifting from CT to NT, -0.3 Mg C/ha/yr for a shift from NT to CT. Unfortunately, there has been no tracking of management on individual land. However, based on a statistical analysis (e.g., a survey), it is possible to estimate, with reasonable confidence, the following shifts:

CT	→ NT	3500 ha	CT	→ CT	4500 ha
NT	→ CT	500 ha	NT	→ NT	1500 ha

The total carbon gain is therefore:

(3500 • 0.3 + 4500 • 0 + 500 • (-0.3) + 1500 • 0) Mg C/yr = 900 Mg C/yr.

Additional accounting requirements

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Can data reported CL/GL be used for accounting CM/GM?

Yes, IF the following conditions are met:

1) the area is the same. While CM=CL, GM may be < than GL (to large extent it's up to the country to define GM)*. For DK and PT, GL=GM.

2) If lands subject to CM/GM can be identified and tracked over time, with geo-referenced or statistical techniques. The majority of MS seems already doing it for CL/GL.

3) The estimates are complete (including demonstration of "not a source" for missing pools!), transparent, comparable, consistent through time and accurate (or anyway defensible during a review)

* **Potential issues related to definition of GM:**

1) Difficult to decide what to include in GM. However, the flexibility allowed in the definition of GM should be seen as potential advantage, i.e. to some extent a country may use information on available datasets to decide on the best definition of GM.

2) It might be difficult to decide whether an area should be GM or CM. This is not so important. What is essential is the transparency of definitions and their consistent application through time.

Additional accounting requirements

European Commission

Suggestions for dealing with problems of accuracy in CM and GM

a) Improve data availability and quality (obvious, but often not easy)

b) With available data, make the best use of reporting/accounting rules

Examples of b)

1. Base year: IPCC allows flexibility, e.g.:
-Use data from another yr as a proxy for the base yr (preferably more recent yrs)

"Golden rule" during accounting: when accuracy cannot be met, be conservative

E.g.:
- Assume no changes in previous years if conservative
- Report "0" if can be shown that 1990 was a source
- if no certainty on the share of area with low or medium input pre-1990, assume all as medium input

2. CM is a key category, but no resources for tier-2.

- If Tier 2 cannot be applied due to (documented) lack of resources, Tier 1 can be used
- More disaggregated KC analysis (eg. at pool level) allows more extensive use of Tier 1

Conclusions

Despite some challenges (e.g., missing estimates, appropriate tier, land identification & tracking), we express a *high level of confidence that accounting of CM and GM* is *technically feasible*:

1) IPCC allows a cost-effective and flexible reporting, e.g. if necessary, the majority of the C pools can be estimated with tier 1.

2) MS do not start from zero: in most cases, CL/GL reporting is already a good starting point for accounting.

3) Large unexploited potential. Many of the potential challenges not addressed so far because there was no urgent need to do so, i.e. most of past efforts focused on forest activities. It is likely that in most MS there is large potential in terms of better analysis of already known national datasets and/or use of still largely unexploited EU datasets (e.g. LPIS and LUCAS).

Conclusions

4) Much time to improve. Given that the accounting will occur and the end of the commitment period, enough time is available to MS for improving estimates. Reporting is a learning-by-doing process.

5) A number of simplifying assumptions may be done if available data does not allow obtaining accurate estimates (e.g. for the base year). As long as these assumptions can be shown to be conservative, estimates shall be accepted for accounting purposes.

Tier 1 is always better than tier 0 (i.e. no accounting) !

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Thank you for your attention!

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Example: estimating C stock changes in mineral soil

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Difference of soil C stock (SOM, 0-30 cm) in the yr 2010

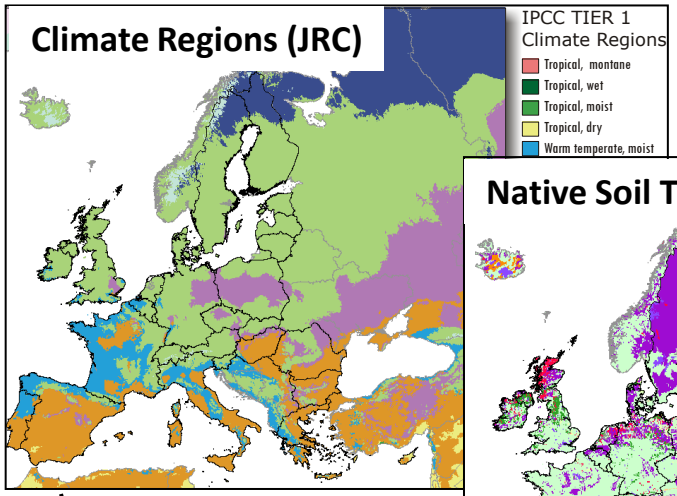
$$\Delta C_{\text{mineral soil}} = (SOC_{2010} - SOC_{1990}) / 20$$

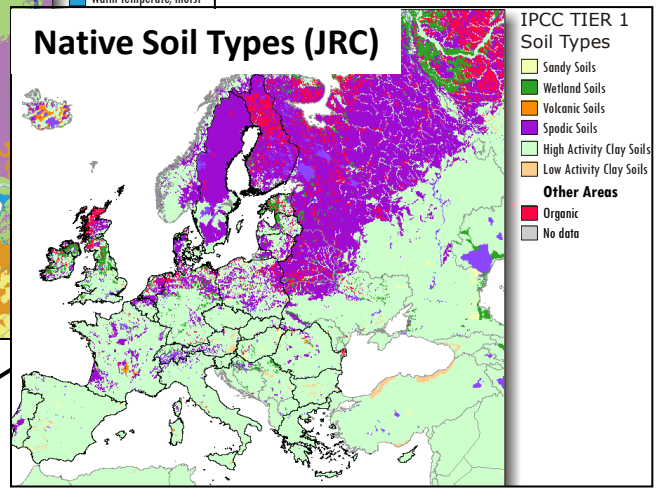
$$SOC = \sum_x (SOC_{REF} * F_{LU} * F_{MG} * F_I * \text{area})$$

Reference soil C (by soil/climate):

IPCC stock change factors:

Stratify CL/GL area by broad climate, soil and management type, and apply **C stock * C stock change factors** (default IPCC values for **tier 1**, country-sp. information for **tier 2**)





	Soil		
Climate			

IPCC table, for tier-1

	Factor	level	value
CROPLAN	F_{LU} (land use)	Long-term cultivated	0.8
		Paddy rice	1.1
		Tree crop	1.0
		Set-aside	0.93
	F_{MG} (tillage)	full	1.0
		reduced	1.02

	Factor	level	value
GRASSLAND	F_{LU} (land use)	Permanent grassland	1.0
	F_{MG} (managem ent)	Non degraded	1.0
		Degraded	0.95
		Severely degraded	0.7
		Improved	1.14
	F_I (input)	Normal	1.0
		High	1.11

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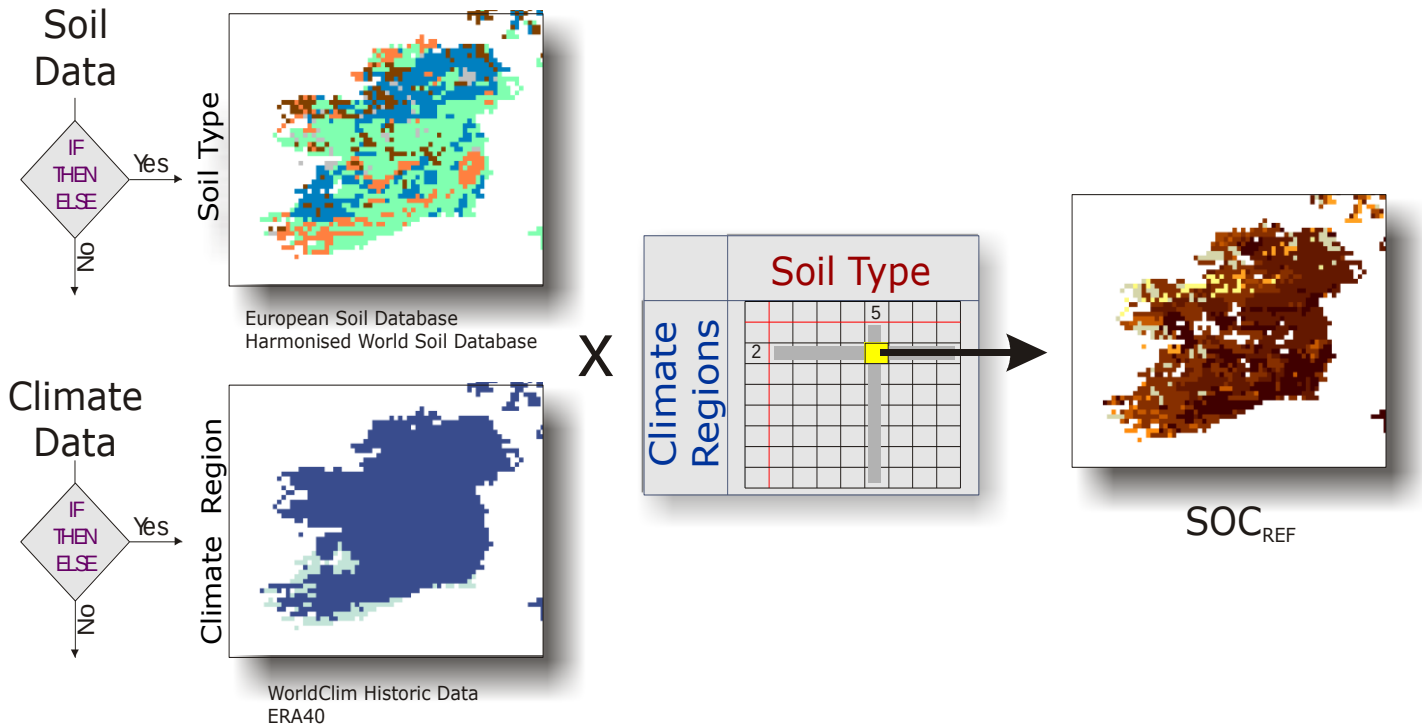
Default Reference Soil Organic C Stocks

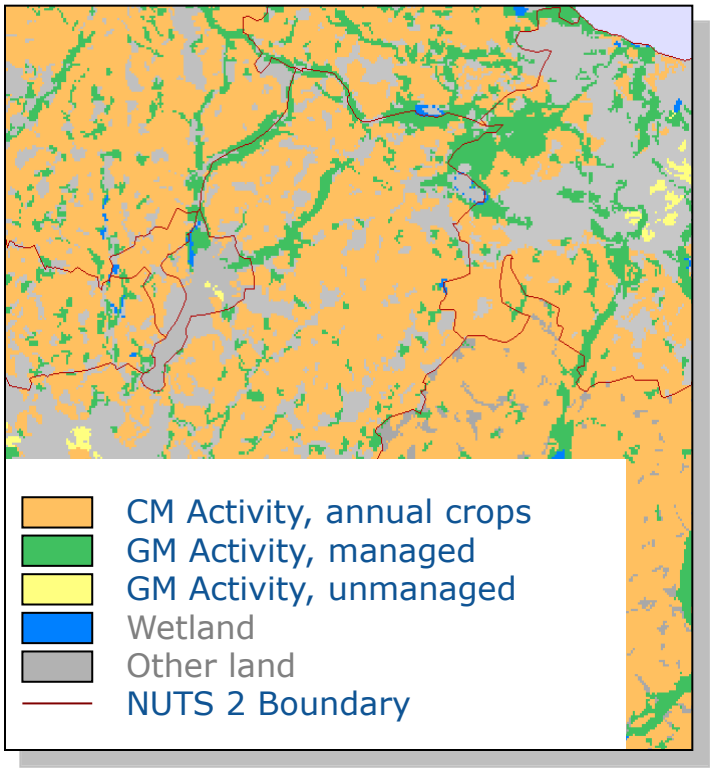


Decision Tree → Parameter Layer → Parameter Matrix → Local SOC Stock

IPCC Method for Defining *Default Reference Soil Organic Carbon Stocks*

Possible use of CORINE, ESDB, LUCAS and LPIS for delineating F_{LU} and F_{MG}

Corine Land Cover*



CM Activity Areas

Annual Crops
- Non-irrigated arable land
- Permanently irrigated land
- Annual crops associated with permanent crops

Perennial Crops
- Vineyards
- Fruit trees and berry plantations
- Olive groves

Rice

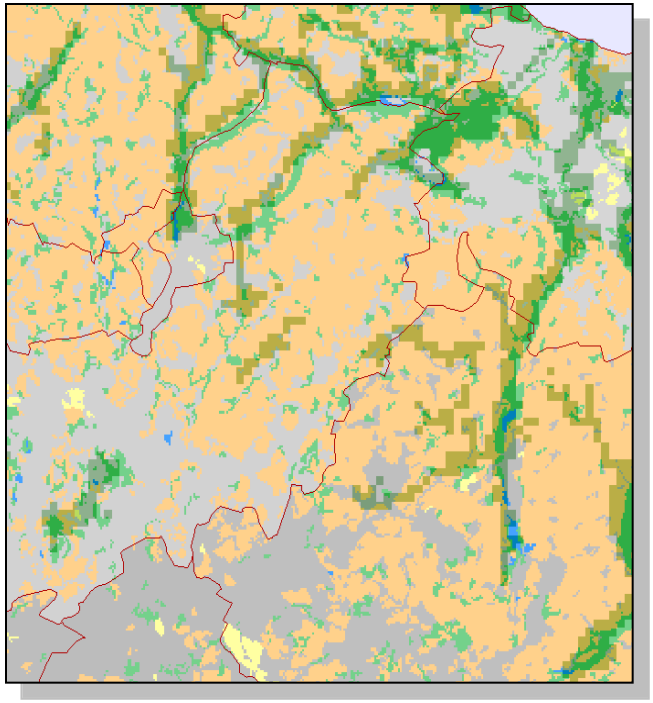
GM Activity Areas

Managed Grassland
- Pasture

Unmanaged Grassland
- Natural grasslands
- Moors and heathland

* For 1990 only partial cover of EU27. Complete cover for Corine LC2000.
Data source: http://www.eea.europa.eu/data-and-maps/data/corine-land-cover-1990-raster-2

European Soil Database* - Mineral and Organic Soils



Organic Soil (Histosol)
Mineral soils for other areas

CM Activity Areas

Crops on mineral soil
» C-stock change

Crops on organic soil
» area is drained -> C-flux method

GM Activity Areas

Managed Grassland on mineral soil
» C-stock change

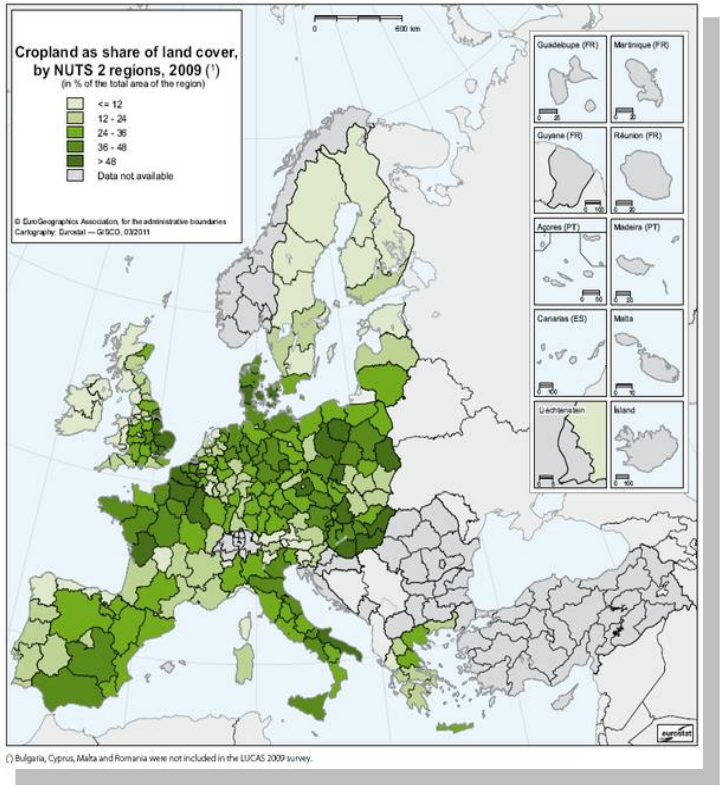
Managed Grassland on organic soil
» Area is drained -> C-flux method

Unmanaged Grassland on mineral soil
» If seasonal grazing: C-stock change

Unmanaged Grassland on organic soil
» Area is not drained
» If seasonal grazing: not included

*http://eusoils.jrc.ec.europa.eu/esdb_archive/ESDB/Index.htm

LUCAS* regional statistics



- Regional statistics of land use / cover change (2009) at NUTS 2.
- From repeated surveys at same location changes between land use categories could be derived for strata.
- Some information on land management practice (F_{MG})

* The **Land Use and Cover Area frame Survey** (**LUCAS**) gathers harmonised data on land use/cover and their changes over time. LUCAS covers all EU MS, based on 265000 geo-referenced points. Performed in 2009 for EU25, in 2012 for EU27.
http://epp.eurostat.ec.europa.eu/portal/page/portal/lucas/introduction

LPIS* Land Cover and Land Use

Covers information on (reference) parcels, together with the orthophotos and the attribute information on the land use.

In some MS the LPIS is effectively becoming a Land Management Information System for rural areas.

- Information on individual land parcels on Management (F_{MG}) and Input (F_I)
- History on management practice of parcel supports identification of crop rotation system.

* The **Land Parcel Identification System** (**LPIS**) provides geo-referenced, and often on-line information supported by up-to-date nationwide image datasets. Designed for the implementation of the CAP first pillar, it provides the unambiguous tool to locate all declared agricultural parcels by farmer and inspectors. Digital geo-referencing is available for EU25 since 2005 (2007 for EU27). It includes 140 million reference parcels (at 1/10.000 scale). LPIS are managed and are property of Member States. http://ies.jrc.ec.europa.eu/our-activities/support-for-member-states/lpis-iacs.html.