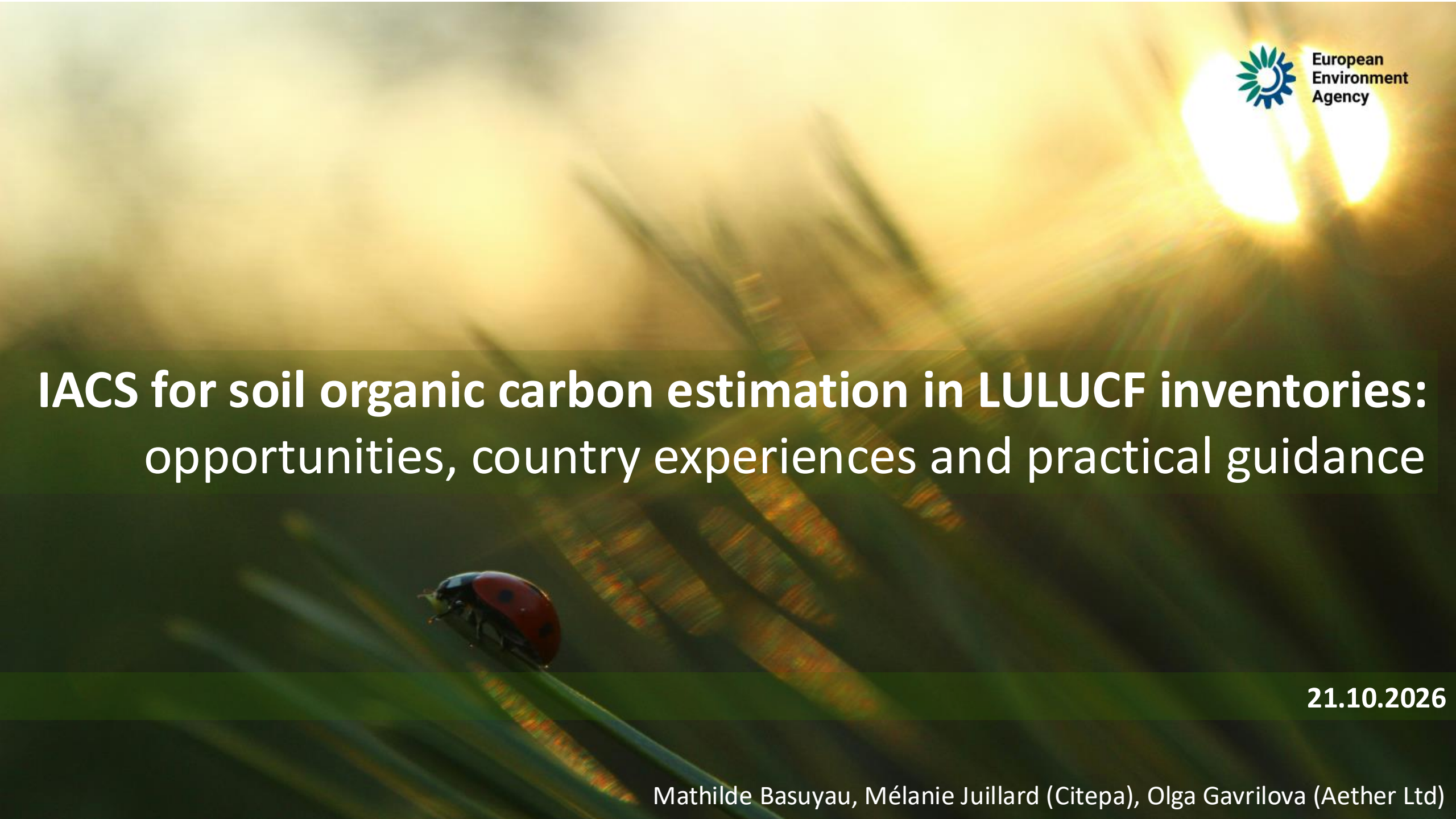


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IACS for soil organic carbon estimation in LULUCF inventories: opportunities, country experiences and practical guidance

21.10.2026

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Outline:

- IPCC requirements and data availability
- Country experiences
- Practical guidance
- Conclusions and key takeaways



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IPCC requirements and data availability

SOC estimation: increasing data requirements across tiers

EQUATION 2.25
ANNUAL CHANGE IN ORGANIC CARBON STOCKS IN MINERAL SOILS

$$\Delta C_{Mineral} = \frac{(SOC_0 - SOC_{(0-T)})}{D}$$

$$SOC = \sum_{c,s,i} \left(SOC_{REF_{c,s,i}} \bullet F_{LU_{c,s,i}} \bullet F_{MG_{c,s,i}} \bullet F_{I_{c,s,i}} \bullet A_{c,s,i} \right)$$

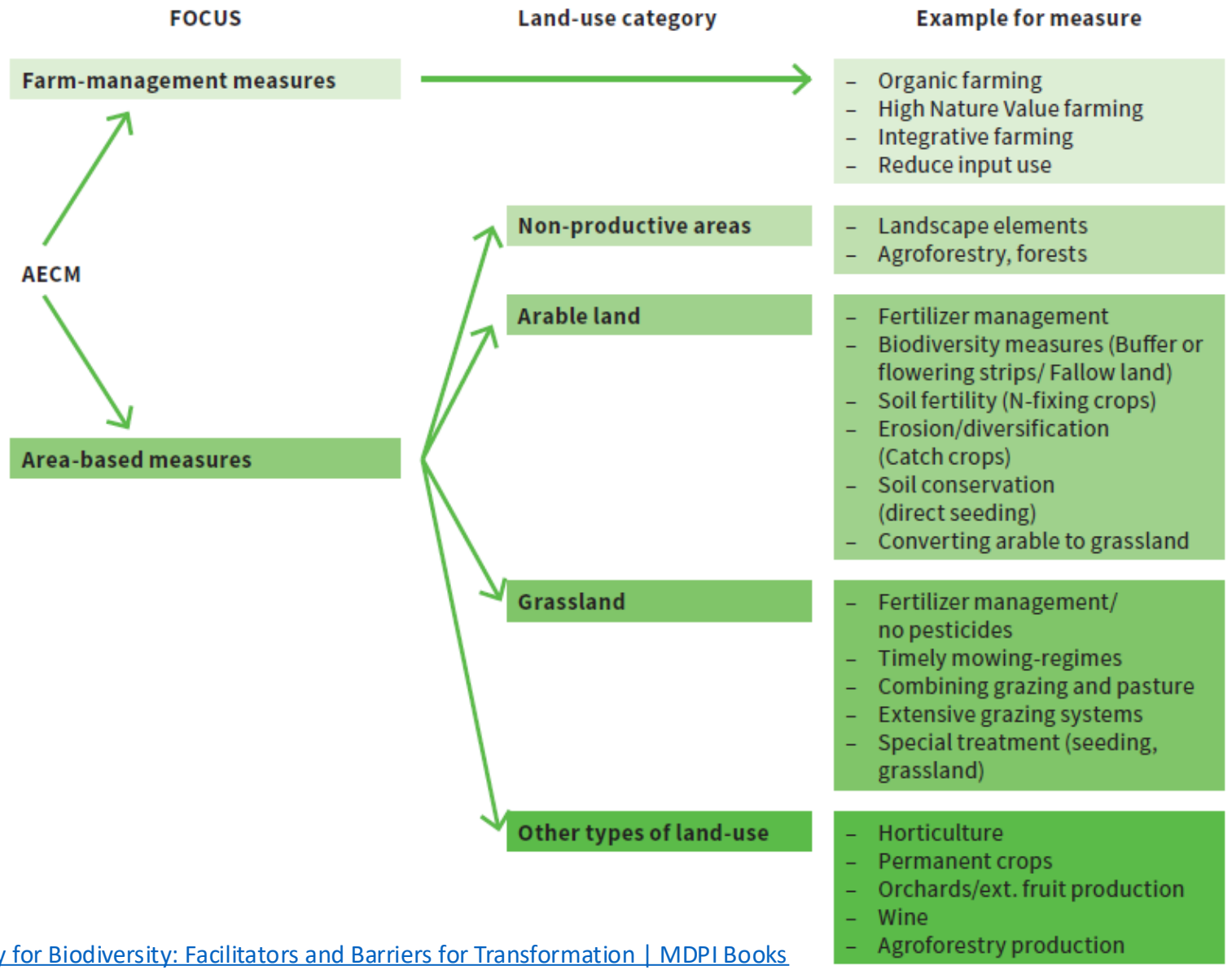
	Component	Tier 1	Tier 2	Tier 3
	Tier method	Stock-change equation using default parameters	Stock-change equation using country-specific parameters	Dynamic models and/or repeated measurements
	Factors / Parameters	Default IPCC values: SOC_{REF}, F_{LU}, F_{MG} and F_I	Country-specific: SOC_{REF}, F_{LU}, F_{MG} and F_I	Model parameters and dynamically represented input variables
	Management classification	Broad classes (e.g., tillage, input level)	Higher-resolution management classification encouraged	Explicit management representation
	Main data requirements	Soil type, land use, management classes	Country-specific soil, management data, climate	High-resolution soil monitoring and management data
	Spatial stratification	Climate + soil type + management system	More detail land and management stratification	Detailed spatial stratification (depending on the model or measurement approach)

What can IACS/LPIS/GSA tell us?

	WHERE? Parcel / location	Geographic location and parcel boundaries	
	HOW MUCH? Area	Area of parcels	
	WHAT? Land use / crop	Declared land use and crop types (e.g., arable land, permanent crops)	
	WHEN? Annual information	Annual data (from declarations, coverage varies by country)	2022 2023 2024
	HOW MANAGED? Management practices	Though CAP-linked information (e.g., GAECs, AECMs, Greening)	

The same IACS/LPIS/GSA data can support all three Tiers. All three Tiers require complementary datasets (to varying degrees)

Examples of Agri-Environmental and Climate Measures



Translate into:

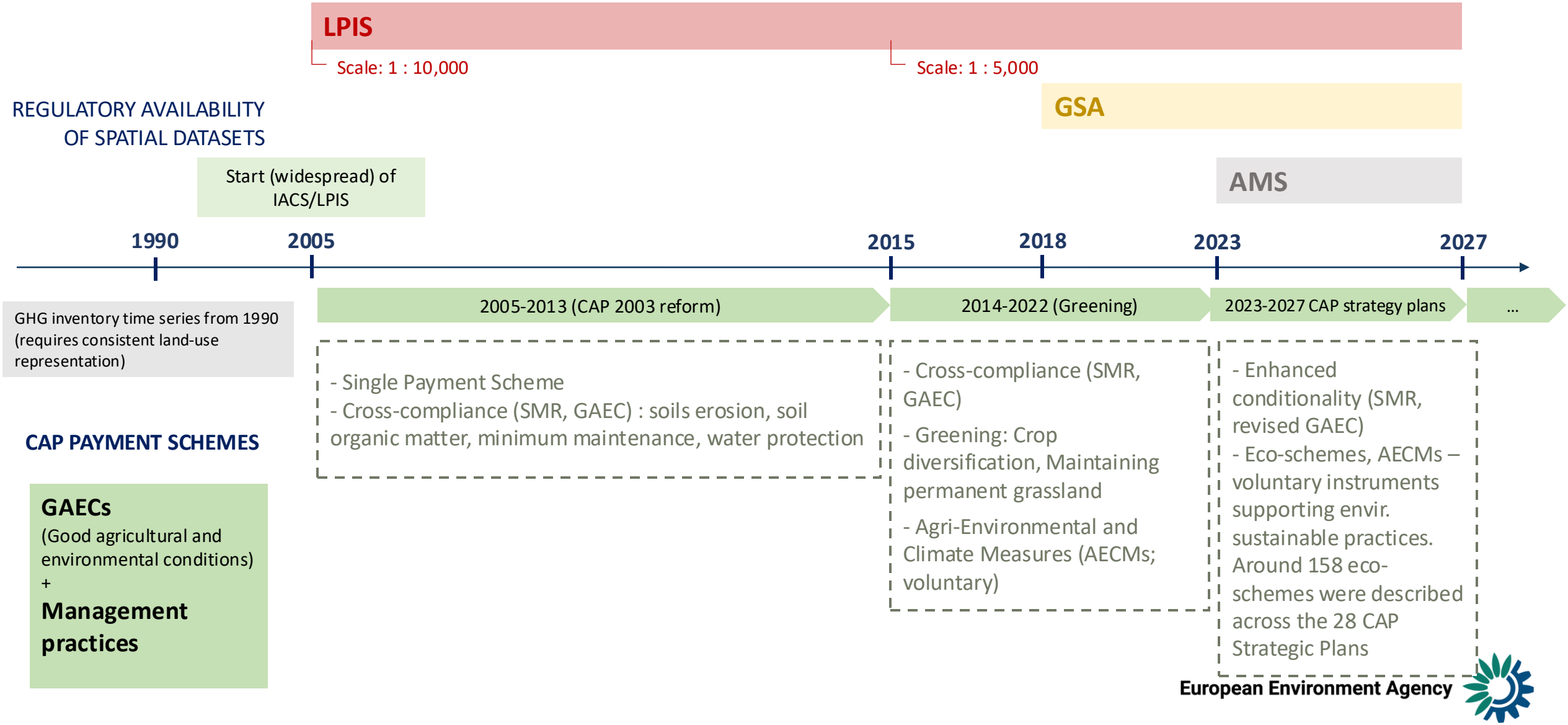
F_{MG}

F_I

Agricultural Policy for Biodiversity: Facilitators and Barriers for Transformation | MDPI Books

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Successive CAP reforms: Data availability over time (simplified)





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Country experiences

Country experiences — Tier 1 and Tier 2

Slovenia
Romania
Greece
Austria (CS carbon stock change)

Slovenia, Romania and Greece:

- IPCC Tier 1 default stock-change factors (2006 and 2019)
- The IACS/LPIS/GSA is used in combination with other spatial datasets to support identification and verification of Cropland and Grassland areas

Slovenia:

Information from AECMs, livestock manure nitrogen inputs and soil maps is also used to support management classification:

- Regularly tilled arable land
- Reduced tillage
- No-till
- Medium input
- High input with organic manure
- High input without organic manure

Romania:

LPIS is combined with CORINE Land Cover. Information from agricultural payment measures is considered to evaluate management factors/classes:

- Conventional tillage
- Conservation/zero tillage
- No-till
- High input without manure
- Medium input

Greece:

LPIS as a supplementary source for land representation, particularly to identify set-aside land.

CORINE Land Cover, EUROSTAT agricultural statistics and soil maps is used to determine management practices

Slovenia. 2026 National Inventory Document (NID). | UNFCCC
Romania. 2026 National Inventory Document (NID). | UNFCCC
Greece. 2026 National Inventory Document (NID). | UNFCCC

Country experiences — Austria

The five management groups are subsequently further stratified according to tillage practices and the level and type of organic inputs resulting in 24 combinations.

Detailed information is available for selected years (e.g. 2002 and 2016), while data for the intermediate years are interpolated.

CS carbon stock change parameters:

Type of information	Intervention	Source of data
Management type	Cropland with organic farming	CAP AECM 70-02
Management type	Cropland with limitation of yield-increasing inputs (without mineral fertiliser and pesticide use – except organic products)	CAP AECM 70-03
Management type	Cropland with environmentally sound management (started 2007, incl. N reduction obligations, changed 2015)	CAP AECM 70-01
Management type	Cropland with direct seeding and seeding on mulch incl. strip till	CAP AECM 70-07
Management type	Cropland with no measures	Estimated

Impact factor type	Impact factor	Levels	Source of data
Management	Tillage	No tillage, reduced tillage, full tillage	FSS, AECM measure
C input	Cover crops	Cover crops as intermediate crops, cover crop as evergreen systems, no cover crops	AECM measures, IACS data
C input	Manure	With and without manure	IACS data
C input	Crop residues	Crop types with low or high crop residues input	IACS data

Factor value type	Level	2006 IPCC default (cool, temperate, moist regime)	Applied revised country specific factors
Land use (FLU)	Long-term cultivated	0.69	0.93
Tillage (FMG)	Full tillage	1.00	1.00
	Reduced	1.08	1.00
	No-Tillage	1.15	1.09
Input (FI)	Low	0.92	0.95
	Medium	1.00	1.00
	High-without manure	1.11	1.05
	High with manure	1.44	1.11

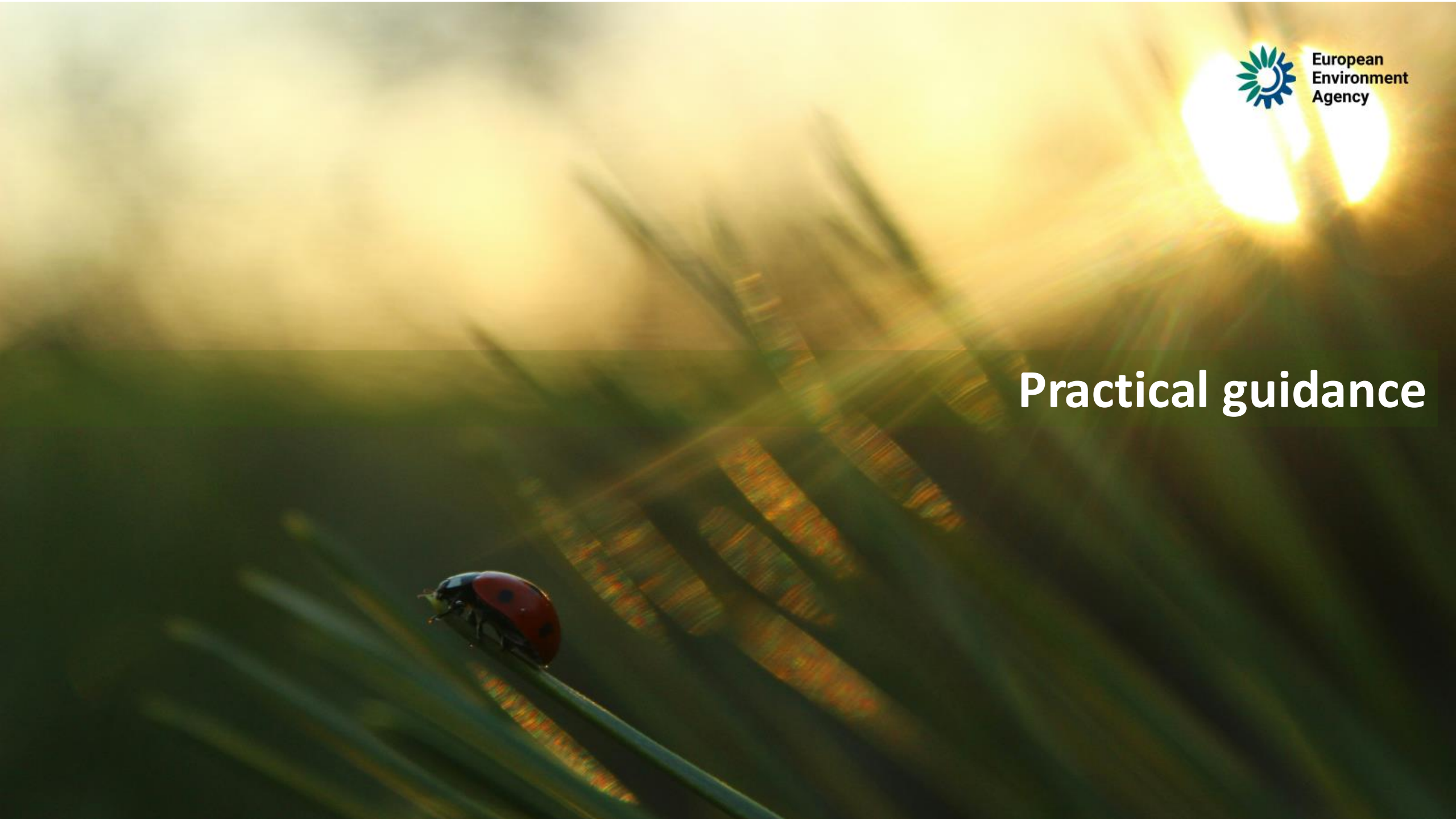
Austria. 2026 National Inventory Document (NID). | UNFCCC

Country experiences — Tier 3

Denmark – C-TOOL; Germany – RothC; Netherlands – RothC; Finland – Yasso07; Sweden – ICBM

Model + LPIS/IACS/GSA + Complementary datasets

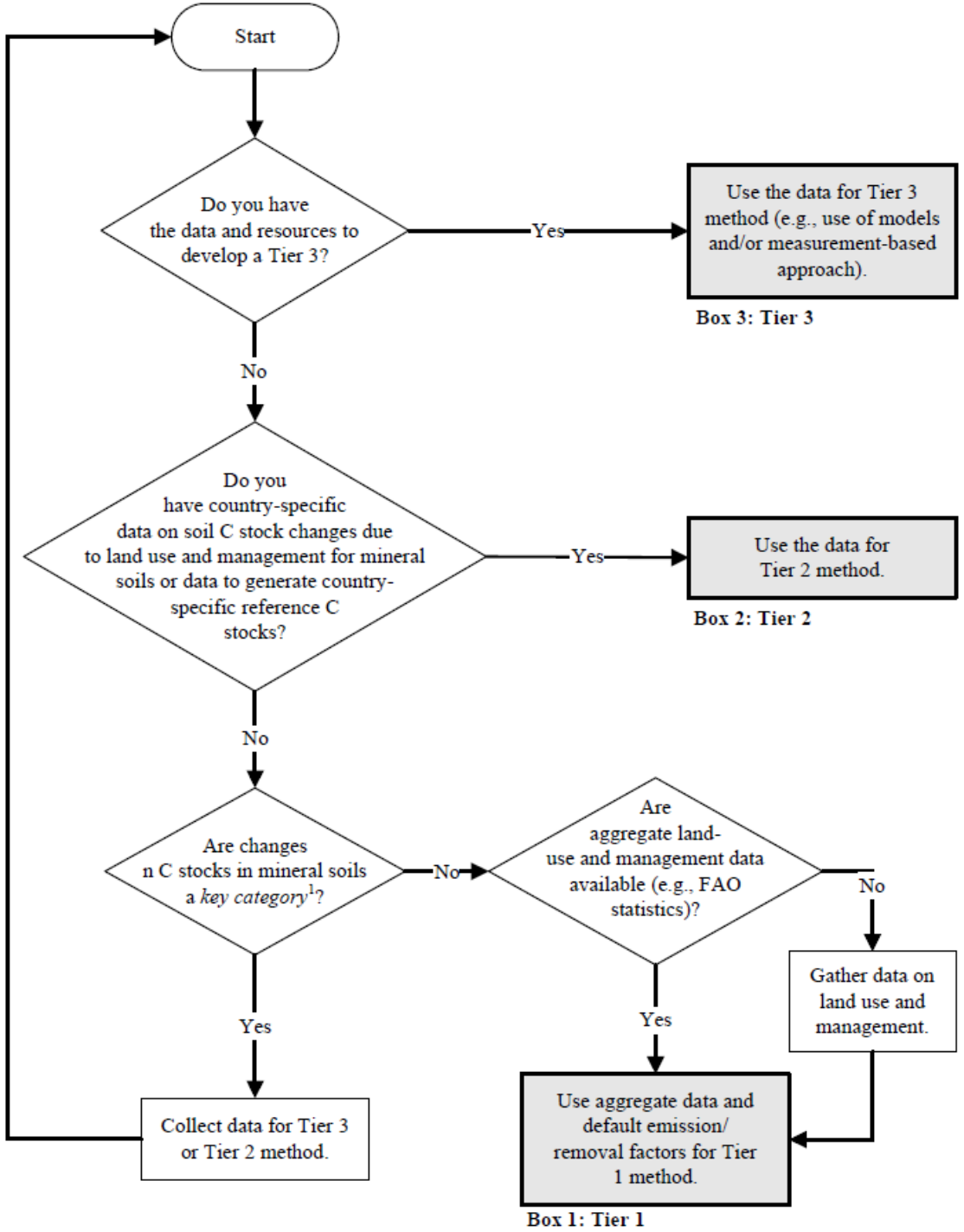
Role of IACS/LPIS/GSA	Complementary datasets
• Supports land representation or land-use change identification • Helps to distinguish mineral and organic soils • Crop areas and types as model inputs • 'Greening and Eco-scheme' measures	• *Agricultural statistics* • Crop yields • Manure, organic fertilizers and residue inputs and straw removal • Farm locations and manure application • Soil maps • Climate data • Field measurements • …

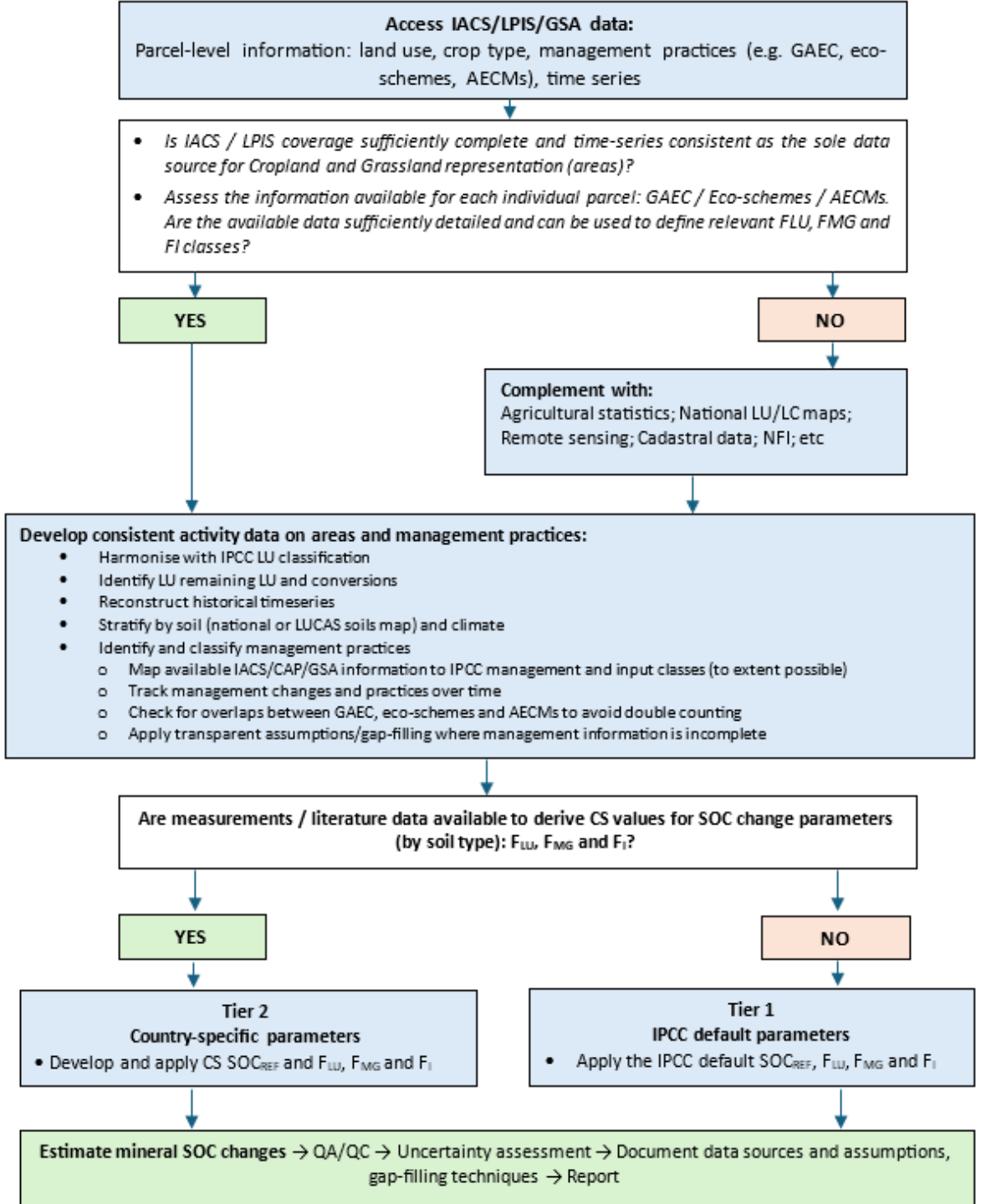

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Practical guidance

Practical workflow – Tier(s)

Assessing IACS/LPIS/GSA data for SOC estimation

- Do the data cover all relevant Cropland and Grassland areas?
- Are consistent historical data available?
- What land-use, crop and management information is available?
- Can the available information be linked to IPCC land-use and management classifications?
- Are SOC models used or planned, and are the necessary technical skills and resources available?
- …





Practical workflow - Tier 1/2

Step 1: Assess IACS/LPIS data availability and coverage

Step 2: Assess available management information from GAEC requirements, eco-schemes and AECMs, etc

Step 3: Identify complementary data needs

Step 4: Assess the availability of CS SOC parameters

NO – apply the IPCC defaults

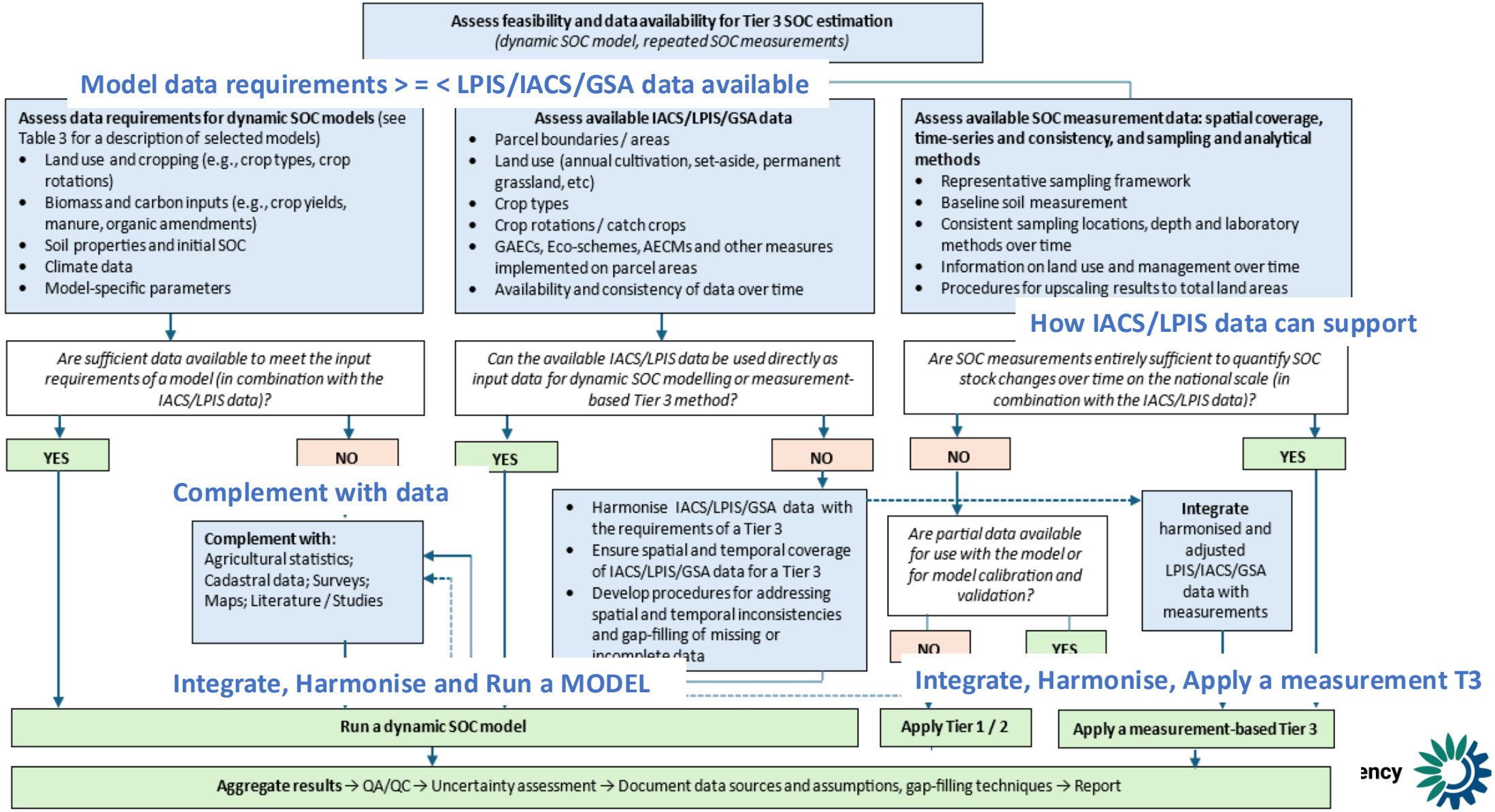
Step 5: Estimate SOC stock changes

TACCC quality principles

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Practical workflow - Tier 3

TACCC quality principles





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Conclusions and key takeaways

Conclusions and key takeaways

- **IACS/LPIS/GSA provides valuable data for LULUCF inventories**: Spatially explicit information can support SOC estimation in Cropland and Grassland (F_{LU} parameter)
- **CAP-linked information can support management classification**: GAECs, AECMs, Greening measures may help identify relevant F_{MG} and F_I, but requires additional efforts to interpreter the information and validate
- **IACS/LPIS/GSA can support all three IPCC tiers:** the implementation of the information depends on level of aggregation and/or details
    - **Integration with complementary datasets is crucial**: agricultural statistics, soil surveys, national studies and so on are needed to address data gaps and improve SOC estimates
- **Historical consistency remains a challenge**: Changes in CAP requirements, data coverage and reporting practices require harmonisation, reconstruction of entire timeseries and transparent assumptions


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Thank you!

References:

Photo credits:

- Agriculture in Spain – Wikipedia