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# Carbon Certification : lessons learned from the French standard “Label Bas Carbone”

Jean-François Soussana- INRAE

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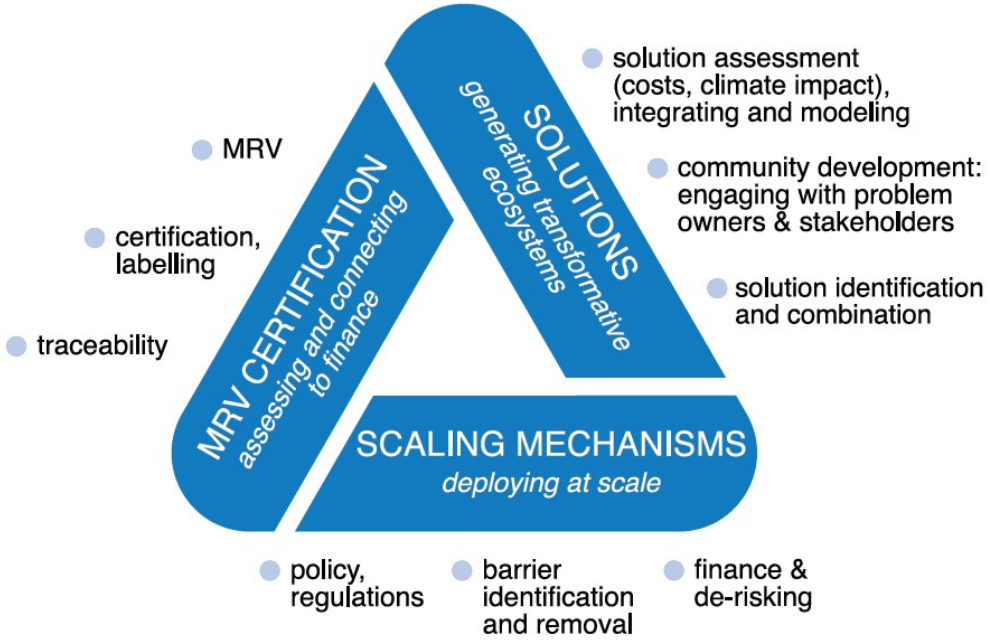
The Soil Carbon Farming network
SCARF

I4CE INSTITUTE FOR CLIMATE ECONOMICS

4 POUR 1000
LES SOLS POUR LA SÉCURITÉ ALIMENTAIRE ET LE CLIMAT

# Context of the webinar: the EIT Climate-KIC Carbon Farming project

The EIT Climate-KIC "**Carbon Farming**" project

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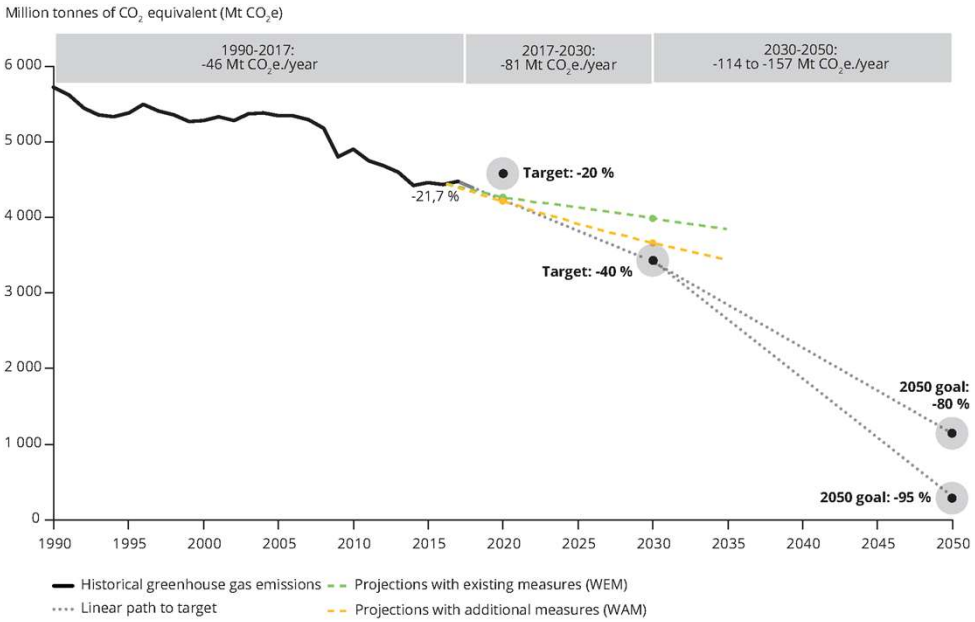
## Context of the workshop: the EIT Climate-KIC Carbon Farming project

- The **SCARF (S**oil **CAR**bon **F**arming) network is developed within the EIT Climate-KIC "**Carbon Farming**" project
- Currently counts 20 European members

# The challenge of emissions reduction

**Greenhouse gas emission trend projections and target**




***Source : European Environment Agency (EEA), European Comission***

- Global GHG emissions in 2018 : 55.3 billion tons of CO2 (Gt CO2 eq) *source*

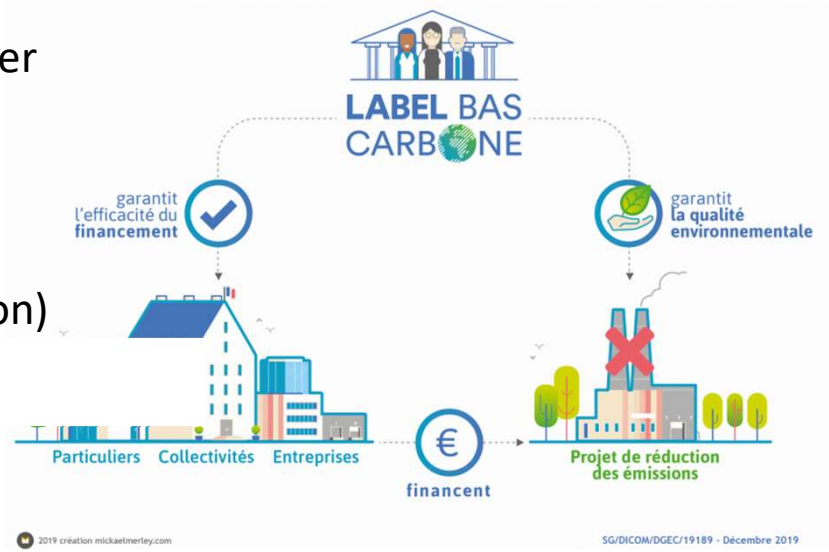
- EU territory (27 Member States) emissions in 2018 : 3.5 Gt CO2 eq of GHGs, a 23% decrease compared to 1990 *source*

**The additional effects of planned measures reported by Member States illustrate the need to do even more!**

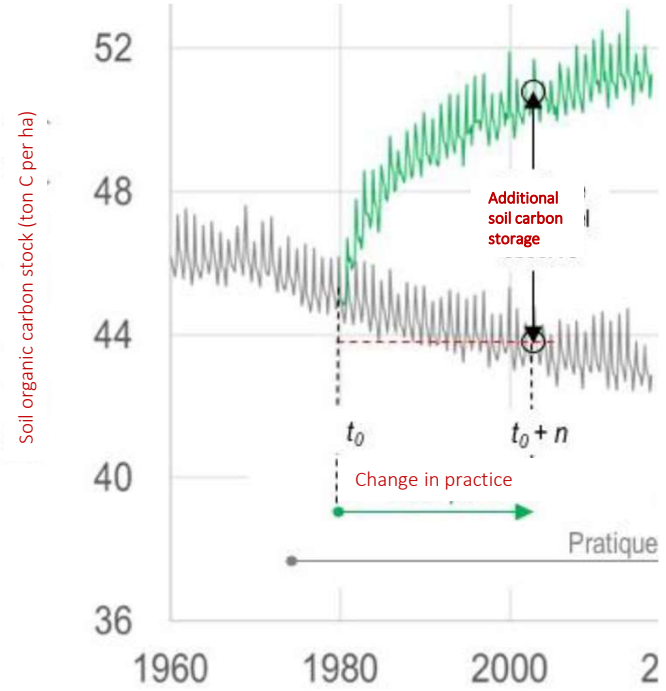
**→ Soil carbon storage is part of the solution**

# The French low carbon label : an incentive opportunity

- Created and entered in force in November 2018
- Local GHG emission reduction projects (avoided emissions+ carbon sequestration)
- Certified credits by the Ministry of Ecological Transition



# Baseline and additional soil carbon storage




Pellerin and Bamière. Stocker du carbone dans les sols français, INRA, 2019

- In France, the mean baseline for soil organic carbon stocks is uncertain:

| | |
|---|---|
| Crops : | -0.33 to +0.09 % per year |
| Permanent grasslands: | +0.06 to +0.25 % per year |

# How can we reflect on the French standard?

**What are the lessons learned in France with the Low carbon label development and in terms of Monitoring, Reporting and Verification?**

# How can we reflect on the French case for domestic schemes?

## Agenda :

- **Feedbacks and recommendations for the development of carbon certification in the agricultural sector in Europe (I4CE)**
- **The French Label : Label Bas Carbone (MTES)**
- **Recommendations for estimating and certifying the change in soil organic carbon stock (INRAE - Gécica Yogo)**

**First question session – 20 min**

- **The cropland method (Arvalis- Helene Lagrange)**
- **The NIVA project and how to link NIVA with the models and tools recommended in the Label Bas carbone (INRAE-CESBIO-Eric Ceschia)**

**Second question session – 20 min**

- **Conclusion (INRAE and I4CE)**

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# Feedbacks and recommendations for the development of carbon certification in the agricultural sector in Europe

**Carbon certification : lessons learned from the French standard**

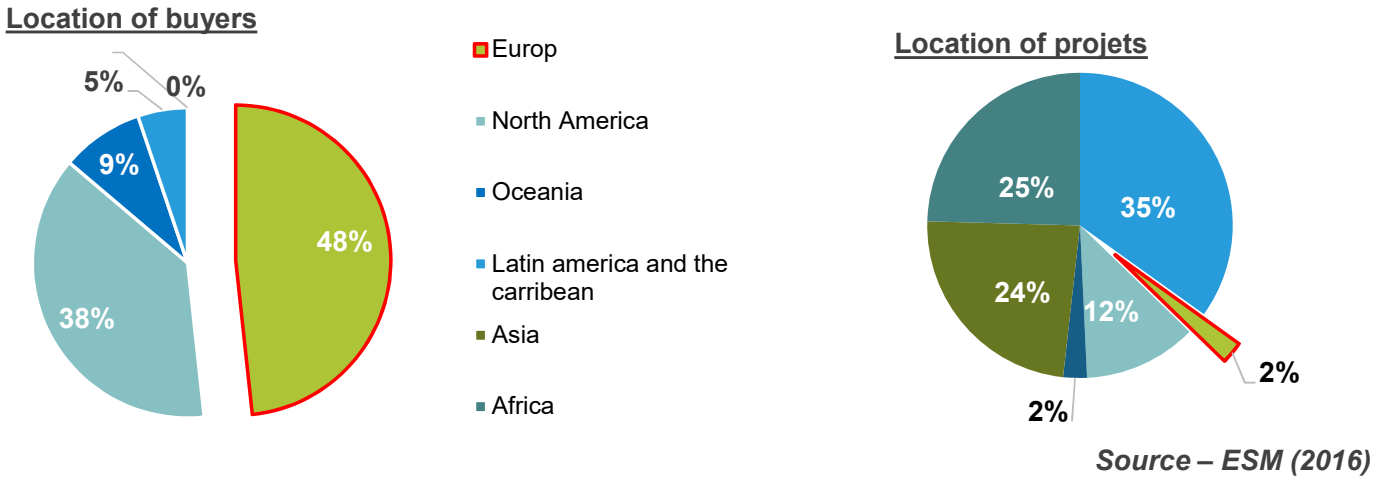
June 2nd 2021

# Institute for Climate Economics (I4CE)

- Non profit association
- Initiative from
- A think tank that provides public and private decision-makers with independent expertise on economic and financial issues related to the energy and ecological transition.
- Contributed to the creation of the French Carbon Standard (Label Bas Carbone)

# European context for carbon projects

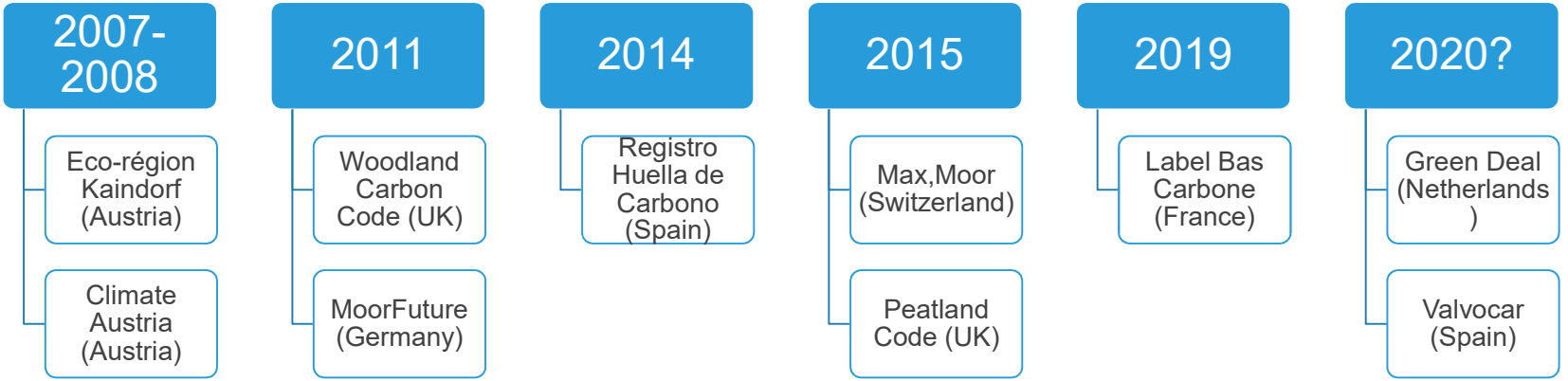
- Historically, a high demand for carbon projects from European buyers, but very few local carbon projects




*Source – ESM (2016)*

# European context : development of domestic carbon standards

- Since 2010's….




- Most projects from LULUCF sector, but very few from agriculture (in 2018)
  - Afforestation : 90% (UK)
  - Renewable energy : 4% (Austria)
  - Peatland restoration : 2% (UK, Switzerland, Germany)

  - Label Bas Carbone especially focuses on forestry and agriculture.

# Tomorrow, the creation of a European carbon certification framework

**Prefiguration study for the creation of a European Framework for Removals**

- Natural and technological sinks

- Review of existing mechanisms for the certification of carbon removals
  - Compliance and voluntary standards from various geographical scale
- Assessment of technological and nature-based solutions for carbon removals.
  - Carbon potential, permanence issues, readiness…
- Organization of expert workshops
- Development and assessment of options to design EU CRC mechanism
  - Propose certification rules, governance and scope options…

- **Expected in 2023**

# Why this workshop?

- Provides a few insights from the French carbon experience
  - To the Carbon Farming partners and other actors working on result-based payments for the land-use sector in Europe
  - To the participants to the SCARF network
  - To feed the work of the EC about the creation of a European carbon standard

- Explain what has been done in France and discuss what could be useful in other contexts

# Carbon methodology: carbon measurement (modeling) and quality criteria

## Measurement and diagnosis :

**Equations modeling the emissions of an activity**

- How to measure carbon and deal with uncertainty ?
- Lots of models available with different levels of precision/uncertainty (tier 1, 2, 3)
- Need to sort out tools' robustness in coherence with expected objectives

## Certification rules :

**Move from an estimate of emissions at a given time to an estimate of the emissions reductions allowed by the project**

- How to define the baseline scenario (counterfactual)?
- How to demonstrate the project's additionality?
- How to manage the risk of non-permanence?

## Transaction and claims rules

**How to finance emissions reductions and what to claim**

- What is the legal status of emissions reductions and certified sequestration?
- What can buyers claim?
- How is it accounted for by the host country?
- …

Diagnosis tools to provide robust carbon evaluation of an activity

Contribution to collective effort to reach carbon neutrality

Defined by the standard to help financing and ensure credibility

# A few messages to expect from today ?

- **Carbon certification : no need to reivent the wheel**
  - Already lot of expertise internationally, and more recently in Europe with domestic standards.
  - Build from existing tools to help scaling carbon payments in the agriculture sector, in order to save both time and money and to ensure the commitment of the actors already involved in these approaches in the future.

- **Finding the right scale for MRV tools application and take into account local specificities**
  - Need to find a balance between relying on a common tool which will give better clarity to the framework, especially to buyers, and or building on the existing local frameworks and tools already used by stakeholders.

- **Diversity of tools and methodologies but need for a common scientific background**
  - There is a profusion of models and methodologies to estimate emission reductions and carbon sequestration in the agricultural sector
  - Need to scientifically asses them and make sure carbon methodologies are robust constantly adapted to the latest scientific knowledge

# A few messages to expect from today ?

- **Not letting uncertainty deter action**
  - There will always be uncertainty linked to carbon measurement, especially wihtin the land-use sector (measures, non-permanence risk…)
  - This has to be taken into account but must not prevent action (no regrets strategies)

- **Find an acceptable balance between MRV precision and costs**
  - Evaluating emission reductions in the agricultural sector is complex but standards and methodologies can find a proper balance between precision and costs, to have a credible methodology but still accessible to project developers.
  - Carbon certification needs to be applicable to small-scale projects (Europe)
  - On-site measurement and soil sampling are not always necessary to estimate carbon sequestration
  - Tools like the discount principle (applied to uncertainty, information asymmetry…) can help find this balance

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# Thank you for your attention !

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# LABEL BAS CARBONE

## Rewarding actors fighting climate change at the local level

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Julien VIAU – Head of Carbon Markets Unit
French Ministry of Ecological transition

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# Agenda

I. Context
II. Functioning of the Label
III. Methods and Projects
IV. Financing

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# I. Context

- Current climate change mitigation actions are insufficient to achieve the 1.5-degree target.
  - Need to support in emission reduction and carbon sequestration efforts, especially in **diffuse sectors** (agriculture, forestry, transport, building, recycling/reuse…)

- Contribution to the implementation of the **French National Low-Carbon Strategy** by :
  - Promoting the emergence of **local actions** that benefit the climate and the dissemination of **good practices**
  - Mobilizing **innovative financing** for climate action from various stakeholders (companies, public bodies, citizens…)

- Certification tool that guarantees **environmental quality**
  - Additional **emission reductions and carbon storage**
  - **Co-benefits** (biodiversity, social…) neutral or positive

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❖ Resulting from a R&D project Voluntary Carbon Land Certification (VOCAL) aimed at developing a French framework for certifying voluntary emissions reductions (2016)

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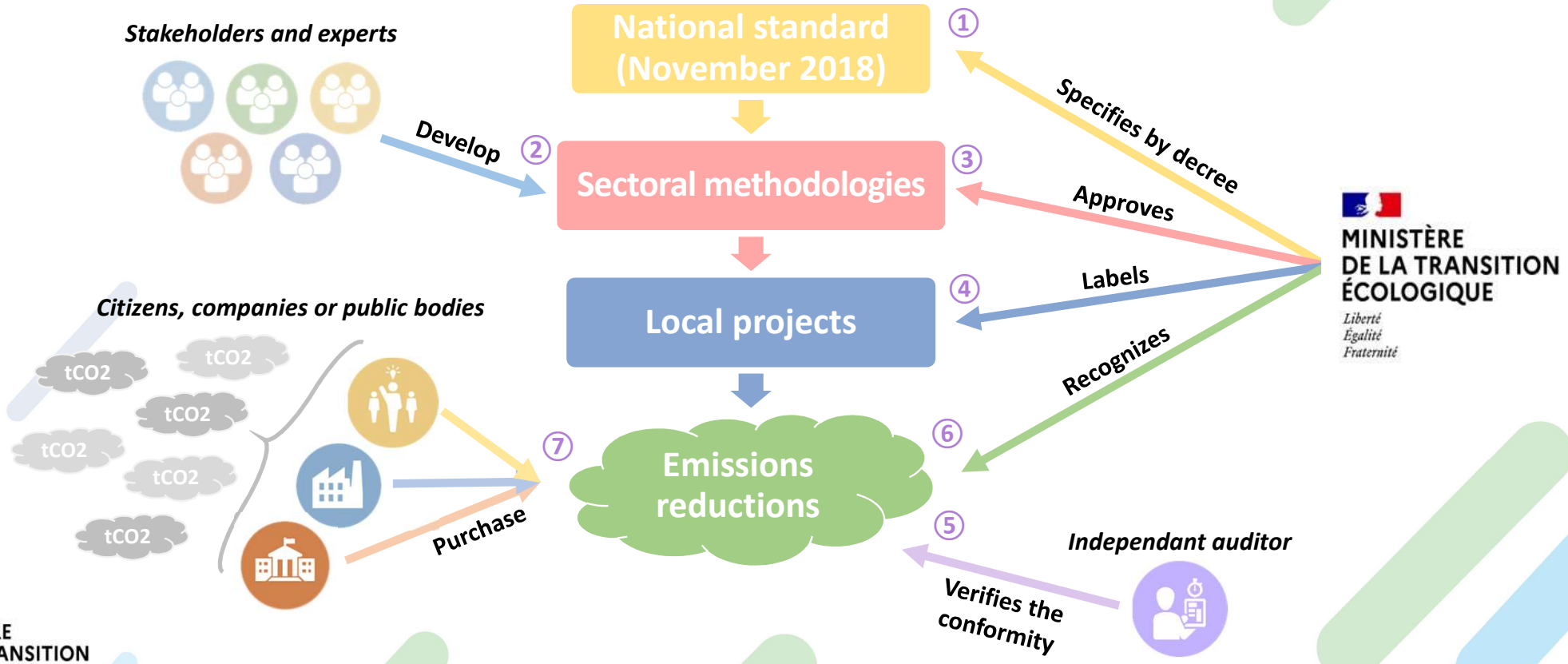
# II. Functioning of the label

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- **The scheme is open to all types of investors (public or private, national or foreign) but projects must be located in France (mainland or oversea)**

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# II. Requirements and safeguards

- Emission reduction are **monitored accurately** (discounts may apply) and **verified by an independent and qualified auditor,** according to modalities specified in the method.

- **Additionality** is assessed relative to a **baseline scenario**, determined in the method :
  - ✓ Likely situation in the absence of labelling
  - ✓ **Regulatory requirements** and **common practice**
  - ✓ **Incentives provided by other instruments** than the label

→ Only emissions reductions that go beyond the baseline scenario are recognized

- Taking into account the **risk of non-permanence** and of **release of carbon**, by applying discounts

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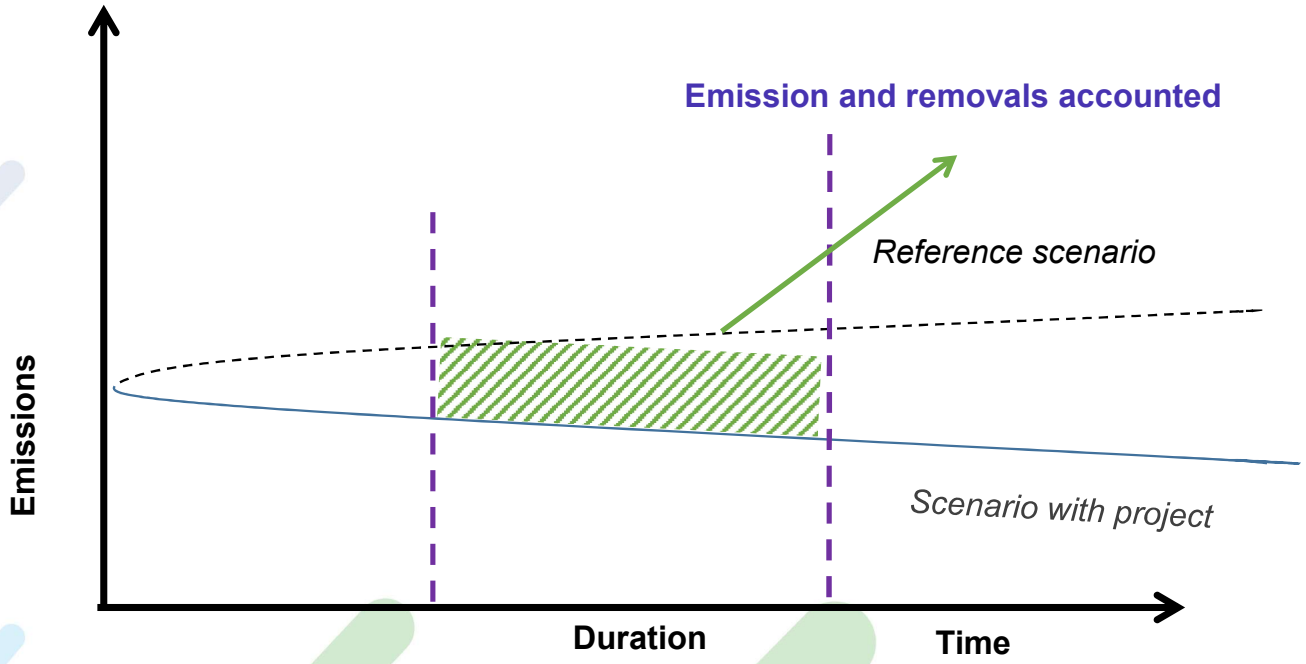
# II. Reference scenario and additionality

- **A project that reduce more emissions or remove more carbon in comparison with a reference scenario**

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# II. Scope of emissions and removals

- **Emissions avoided** and **removals** are included but calculation are separate

- Possibility to include scope 2 and 3 of GHG emissions of the projects if the methodology is robust (ex: emission factor of the production of synthetic fertilizer)

- **By default** only Emissions reduction during the duration of the project

- For Carbon removal in biomass, possibility to include anticipated removal
  - => Need to ensure that the project is managed with a long term perspective
  - => Use of a discount for non permanence risk

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# II. How to manage uncertainty

- Need to find a balance between MRV cost and robustness
- Use of discount (ex: -10%/-20%) for specific part of the calculation

- Discounts are used for :
  - In case of uncertainty of the datas
  - In case of uncertainty of the relevance of parameters
  - To deal with **non permanence** of emissions reduction or removals

- Discounts are applied depending of the methodology and the project
  - Ex: In Forest project, discounts level linked with the risk of forest fire depend of the region in France

- A methodology can include different options depending of the quality of the data/parameters

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# II. Verification and inspection

- **An independent auditor** need to valid the report of emissions reduction

- The report include the final estimation of emissions reduction and how the action have been implemented

- Depending of the methodology
  - Use registers and document (invoices, permits…)
  - On site inspection in some case
  - In depth examination of random site for a collective project

- Preferable to use available datas, use of remote data collection or sampling possible, but not yet implemented

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# III. Methodology = toolbox

- A methodology tailored to the projects / sectors
- A toolbox to implement projects under the “Label Bas Carbone”
  - Projects eligibility
  - Duration of the project
  - How to determine the reference scenario
  - Methods to assess additionality of the project
  - The specific calculation to estimate GHG emissions reduction and removals, with parameters to use
  - The application of discounts
  - Modalities to verify emissions
  - All forms and elements to apply

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# III. Methodologies

6 methodologies have been approved

- **Forest :**
- Afforestation
- Reforestation after fire, storm or sanitary disease
- Saplings selection

- **Agriculture :**
- Orchards plantation
- Sustainable management of hedges
- Crop-lifestock and lifestock farming

Methodologies under development

- **Agriculture**: cattle breeding and field crops, agroforestery, hedges, methanisation, soil carbon
- **Forests:** continous cover sylviculture, forest management scaling-up
- **Circular economy**: recycling, reconditioning of electronic devices
- **Wetlands**: improved protection of mangroves, of seagrass
- **Building**: reuse of building materials, use of bio-based materials
- **Transport**: use of local co-working space, freight transport

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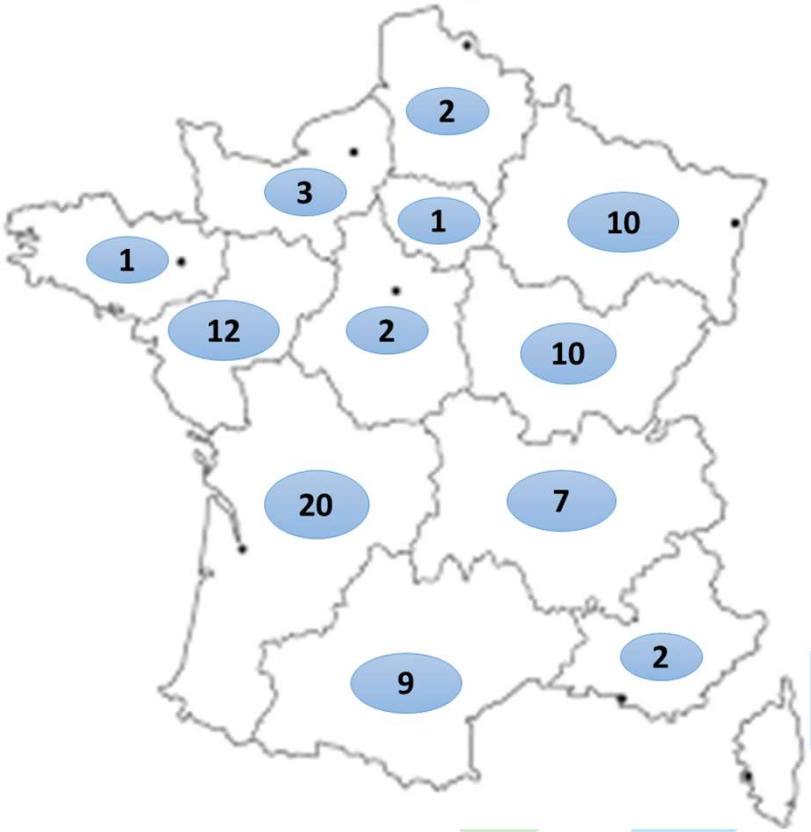
# III. Projects : 88 certified projects (May)

- **87 forest projects** are labeled
  - Corresponds to **130 000 tCO2**
  - Corresponds to 600 ha
- **+ 1 collective agriculture project** is labeled
  - a collective project of **300 farms**
  - Corresponds to **140 000 tC02**
- **73 projects** are currently under examination

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# III. Transparency and communication

- Stakeholders and civil society are involved in the development of the methodologies
- Creation of a **working group** with the **stakeholders** and **civil society**, consulted during the appraisal of methodologies and the implementation of the label
- All methodologies are publicly available
- Dedicated **website** and **registry**: lists of approved methodologies, labelled projects and recognized emissions reductions

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# Thank you !

www.ecologique-solidaire.gouv.fr/label-bas-carbone

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# Recommendations for estimating and certifying the change in soil organic carbon stock

Gécica YOGO, INRAE

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The Soil Carbon Farming network
SCARF

# How to monitor soil carbon sequestration ?

*Two ways to assess soil organic carbon stock change*

**Changes in soil organic carbon stocks**

- Implies measurements of changes in soil carbon stock over a time period

**Soil carbon balance (inputs -outputs)**

- Implies taking into account incoming and outgoing carbon fluxes

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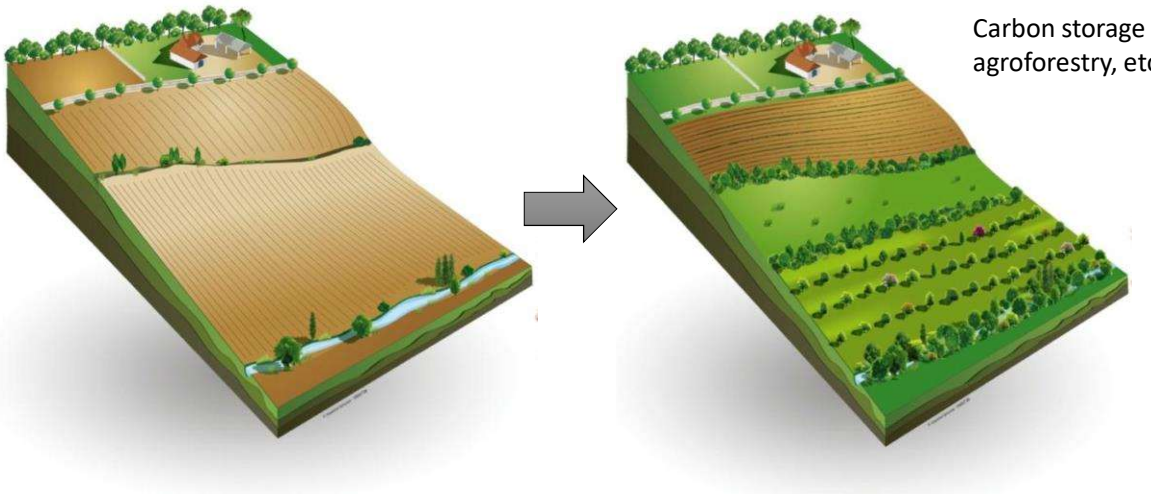
# How to monitor soil carbon sequestration ?



Illustrations: Arbre et Pays

Carbon storage practices : cover crops, agroforestry, etc.

**Changes in soil organic carbon stocks**

- Selection of the **baseline period** and of the **reference land use scenario**
- The change in C stock is given by the difference between the reference scenario and the scenario with a change in land use or land management

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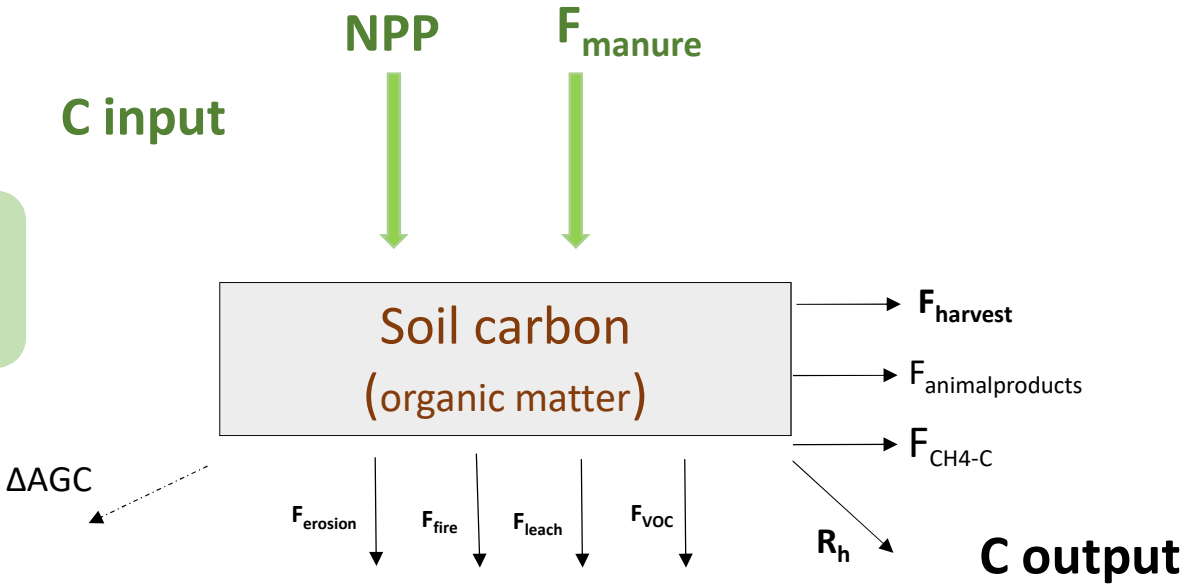
# How to monitor soil carbon sequestration ?

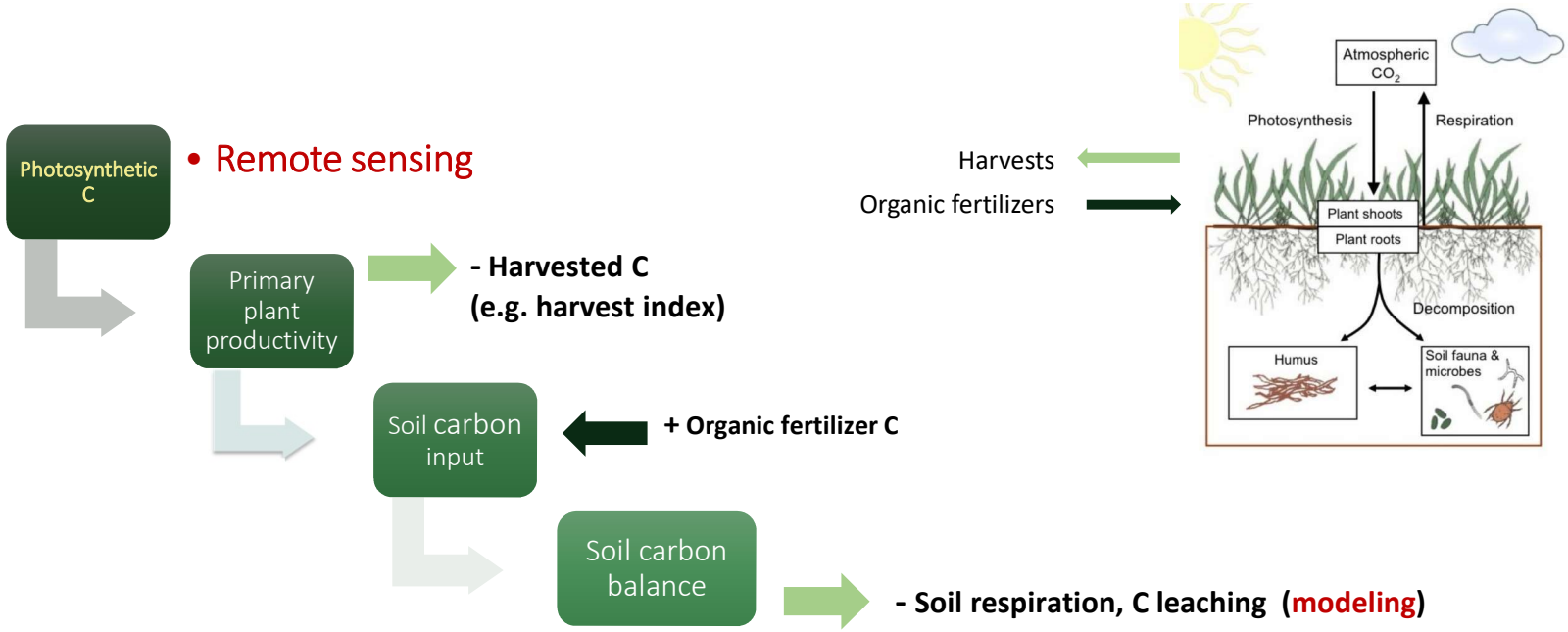
**Soil carbon balance (C inputs – C outputs)**




ECB = NPP - Rh + Fmanure - Fharvest - Fanimal-products−FCH4-C - Ferosion+Ffire+Fleach+FVOC

*Adapted from Soussana et al., 2017*

# Soil organic carbon balance in a cropland




For baseline conditions and for changes in land management

# Lessons from a French project funded by ADEME


- A benchmark of methodologies, tools and available data for carbon balance assessment taking soil carbon into account

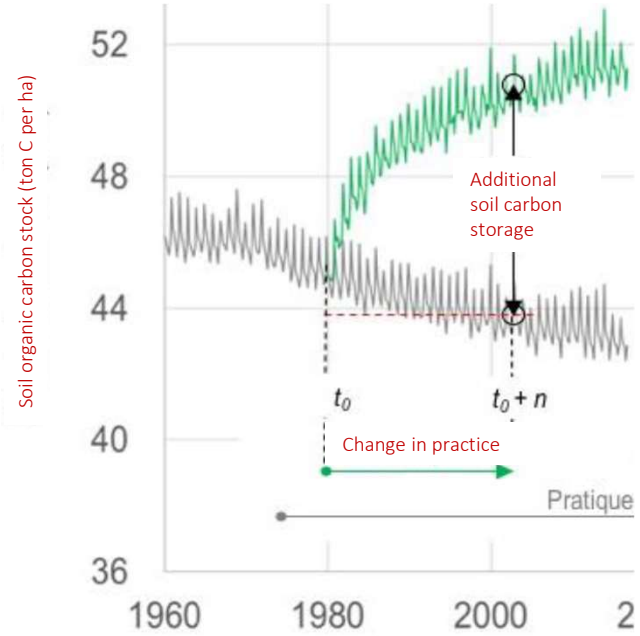
- Recommendations
  - ✓ to establish the storage potential
  - ✓ three recommended monitoring options focused on croplands
  - ✓ to account for model sensitivity to input data (example of AMG model)

French version available : https://hal.inrae.fr/hal-03212854

English version coming soon

# Lessons from a French project funded by ADEME

## Recommendations to establish the storage potential




Pellerin and Bamière. Stocker du carbone dans les sols français, INRAE, 2019

Building on the results of the national 4p1000 study, the CarsolEl meta-model

-> orders of magnitude at farm level

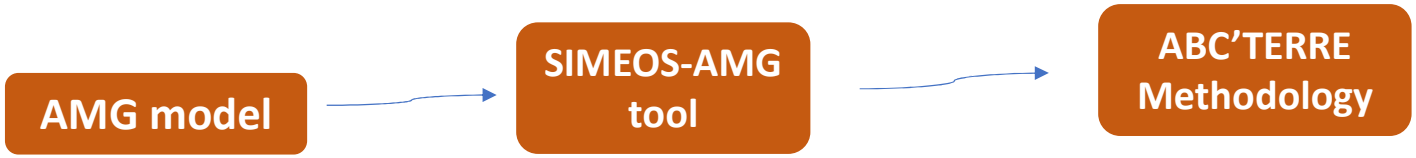
-> guidelines for the choice of practices

Link to the 4p1000 study:
https://data.inrae.fr/dataverse/etude4pour1000

# Lessons from a French project funded by ADEME

## Three recommended monitoring options focused on croplands

**Option 1**




- SIMEOS-AMG (carbon stocks estimates)
- Repeated 3 to 6 year typical rotations

Full GHG budget -> IPCC EF + Agribalyse (or Ecoinvent if necessary)

**Simple option with the use of a locally calibrated tool with AMG model and residue measurement in the case of cover crops**

# Lessons from a French project funded by ADEME

## Three recommended monitoring options focused on croplands

**Option 2**

**SAFY-CO2 for C balance at ecosystem level**

**Spatial scale:** plot scale ( or even 10m)
**Temporal scale :** daily

- Take into account the effect of cover crops, weeds, regrowth on carbon balance components
- No soil C module (no uncertainty related to input data)
- No need for technical itinerary data except*.

*Export of straw and organic amendments not detectable by the satellite

- No simulation for future climate (only diagnostic mode)
- No soil C module ( impact on the capacity of the model to simulate correctly the medium/long term balance?)

*PhD Thesis Veloso, 2014 ; Pique et al., 2019*

# Lessons from a French project funded by ADEME

## Three recommended monitoring options focused on croplands

**Option 3**

**Coupling SAFY-CO2 / AMG**

**-> Better biomass estimation with the satellite = better carbon input to the AMG model**

**-> Currently under test within a EIT Climate-KIC project « Carbon Farming »**

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# Lessons from a French project funded by ADEME

## Recommendations to take into account the models sensitivity to the input data (example of the AMG model)

**C stock estimates in absolute value** : each scenario ( with and without change of practice) is simulated separately

- Very high sensitivity of the simulated stock to the initial stock value
- High sensitivity for soil data like pH, C/N and stable carbon fraction

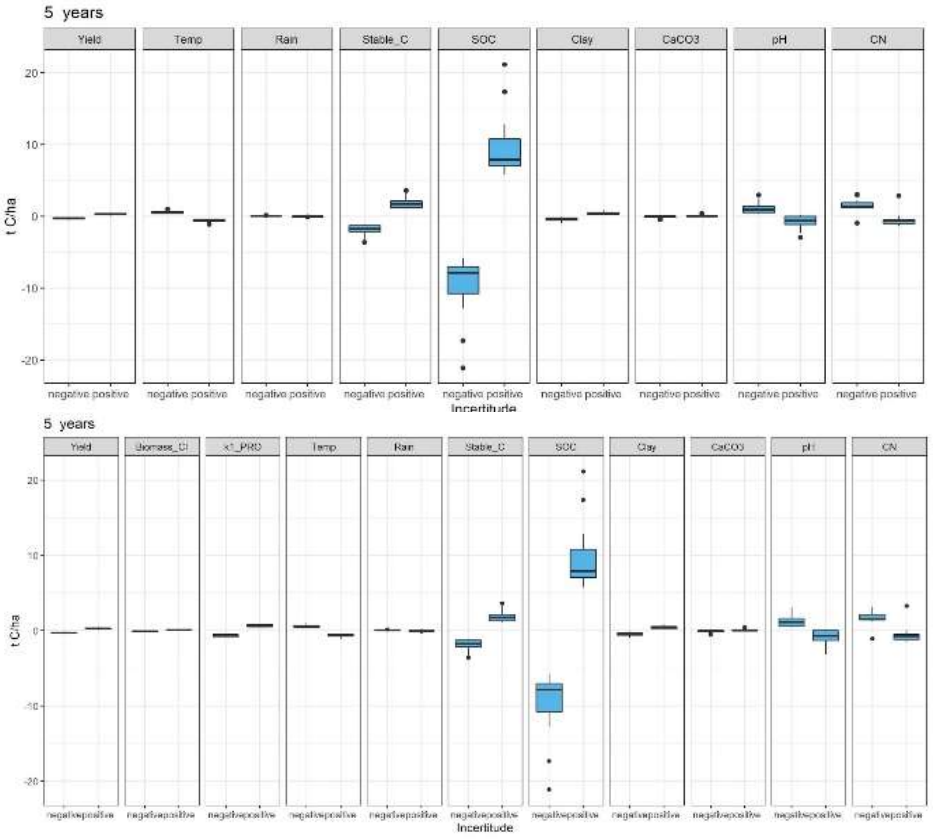


**Figure 2**. Sensitivity analysis of final soil C stock after 5 years for 2 practice scenarios: without (high) and with (low) intermediate crops and PROs applications. Influence of the relative uncertainties (negative bound, positive bound) of the input variables and parameters of the AMGv2 model on the C stock. Each box shows the variability of the results for the 12 sites analyzed. The final stock is highly dependent on the initial stock (high sensitivity to the SOC variable).

# Lessons from a French project funded by ADEME

## Recommendations to take into account the models sensitivity to the input data (example of the AMG model)

**C stocks estimates as a differential** : the evolution of the difference between two scenarios is simulated

→Reduced sensitivity of the simulated stock to the initial stock value

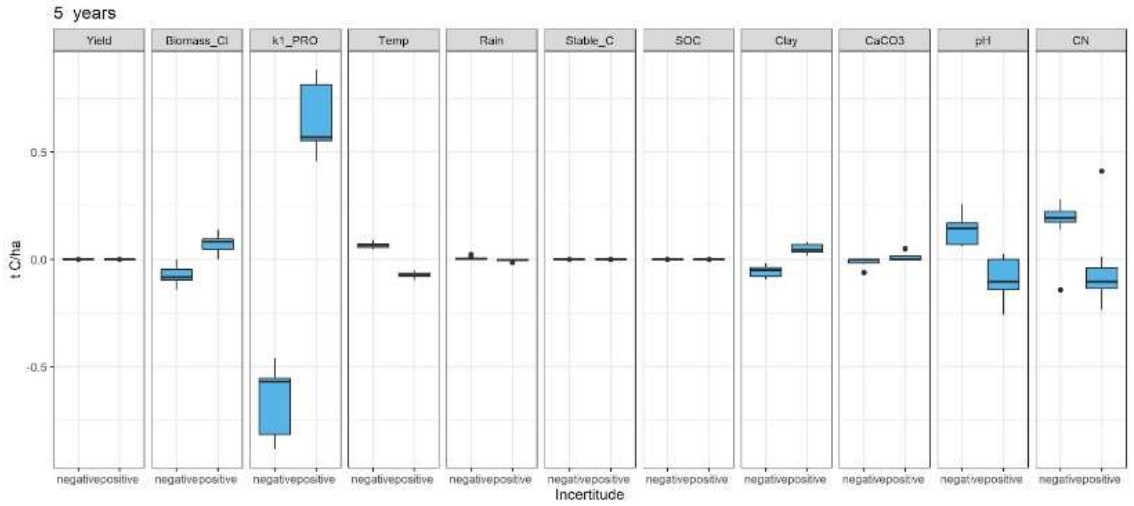


***Figure 3.*** *Analyse de sensibilité du stockage de carbone après 5 ans résultant de l'application de pratiques stockantes (C.I. et PROs, différence entre les deux scénarios de pratiques). Influence des incertitudes relatives (borne négative, borne positive) des variables d'entrées et paramètres du modèle AMGv2. Chaque boîte figure la variabilité des résultats pour les 12 sites analysés*

# Lessons from a French project funded by ADEME

## Recommendations to take into account the models sensitivity to the input data (example of the AMG model)

| **Input parameters or variables** | **A) The effect of uncertainties on the 5-year C stock differential** | **A) Recommendations for data acquisition for a carbon stock differential** |
|---|---|---|
| Initial carbon stock | Low | Regional data with at least one representative soil analysis of the plot |
| Fraction of stable C | | |
| Rainfall | | |
| Temperature | Medium (high in the longer term) | Measurements in the immediate area of the site |
| pH, clays, CaCO3, C/N ratio | Medium (high in the longer term) | Representative soil analysis at the plot level |
| **Biomass from cover crops** | **High** | **Estimation by remote sensing calibrated on the ground** |
| **Amount of carbon in organic waste products and their stability (K1_PRO)** | **high** | **Precise measurements** |

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# Lessons from a French project funded by ADEME

Recommendations to take into account the models sensitivity to the input data (example of the AMG model)

- **Prioritize the simulation of a differential (reference vs. stocking practices)**

With AMG model, the RMSE is reduced by 30% compared to a simulation of absolute C stocks (Levavasseur et al., 2020, H. Clivot, personal communication)

- **Whatever the trend (C storage/loss) in comparision to the baseline scenario, the simulation of a differential values the farmer's effort and supports the maintenance of stocks already acquired.**

# Lessons from a French project funded by ADEME

## Additional recommendations

A range of « carbon calculators » are in development to provide MRV solutions as part of the value chain in the voluntary C market.

/!\ Need for scientifically validated methodologies that confirm the quantity of carbon stored, with an associated uncertainty, in particular those with few to no soil measurements

/!\ Need to encourage the permanence of carbon storage practices through long-term contracts and significant discounts in case of interruption.

/!\ Need to support farmers who have been using these practices for a long time to maintain them.

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Climate-KIC is supported by the EIT, a body of the European Union

# Thank you for your attention!

wendtwoin.yogo@inrae.fr

LinkendIn, Twitter : Gécica YOGO

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# First Q&A session – 20 minutes

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# Five minutes break – 5 minutes

LABEL BAS CARBONE
Grandes Cultures

**Webinar 2021-06-02: Carbon labelling**
**Lessons learned from the French label (Label Bas Carbone)**

# The field crops method

ARVALIS
Institut du végétal

**Hélène LAGRANGE**
**Member of the drafting Committee**
**for the LBC field crops method**

# Our organization to write the field crops method

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Grandes Cultures

✓ A large involvement of stakeholders: from users to scientific experts

**Monitoring committee**

AGPM, AGPB, FOP, CGB

**Drafting committee**

ARVALIS Institut du végétal, Terres Inovia, ITB, ARTB, agrosolutions

**Notification to the ministry**

**in March 2020**

**→ Submission in Dec 2020**

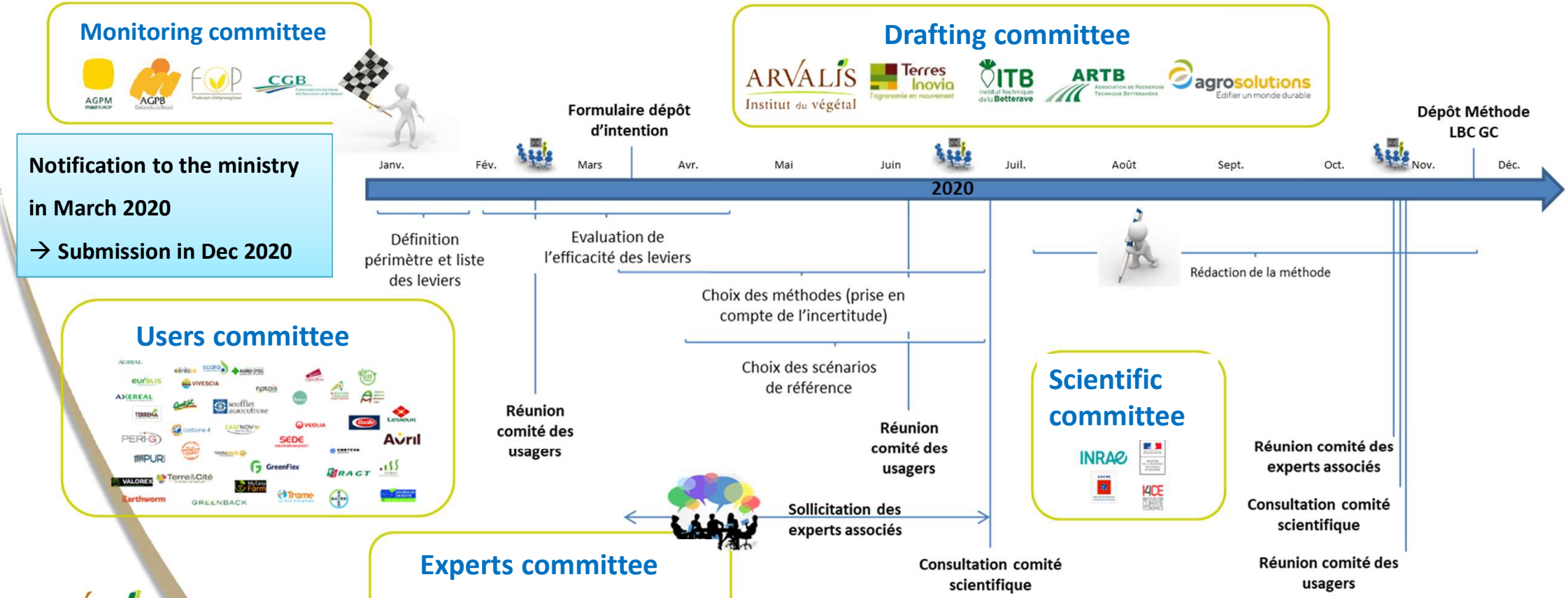
**Users committee**

**Experts committee**

INRAE, Gemas, CRISTAL UNION, acta

**Scientific committee**

INRAE, KACE

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# The field crops method describes all these points:

LABEL BAS CARBONE Grandes Cultures

## III. Methodology = toolbox

- A methodology tailored to the projects / sectors
- A toolbox to implement projects under the "Label Bas Carbone"
  - Projects eligibility
  - Duration of the project
  - How to determine the reference scenario 3
  - Methods to assess additionality of the project
  - The specific calculation to estimate GHG emissions reduction and removals, with parameters to use 2
  - The application of discounts
  - Modalities to verify emissions
  - All forms and elements to apply

+ perimeters and levers 1

MINISTÈRE DE LA TRANSITION ÉCOLOGIQUE
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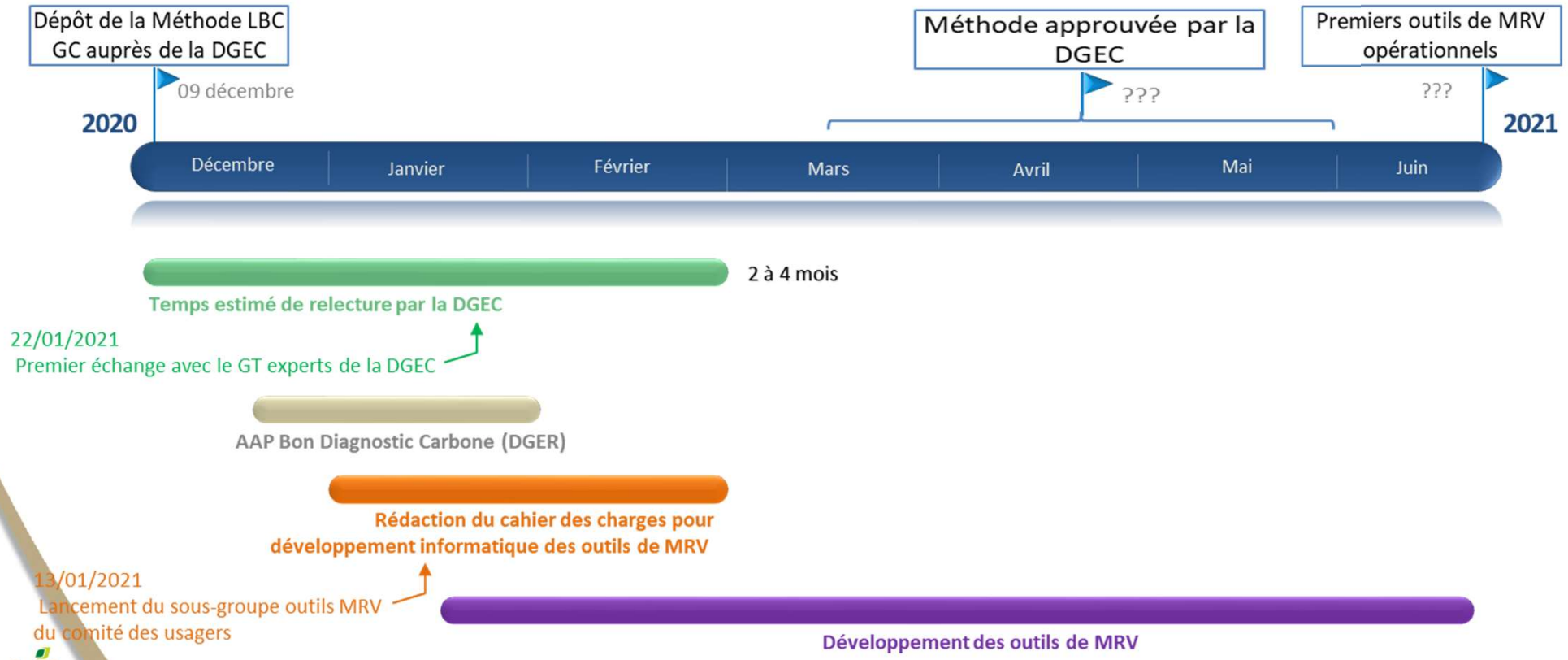
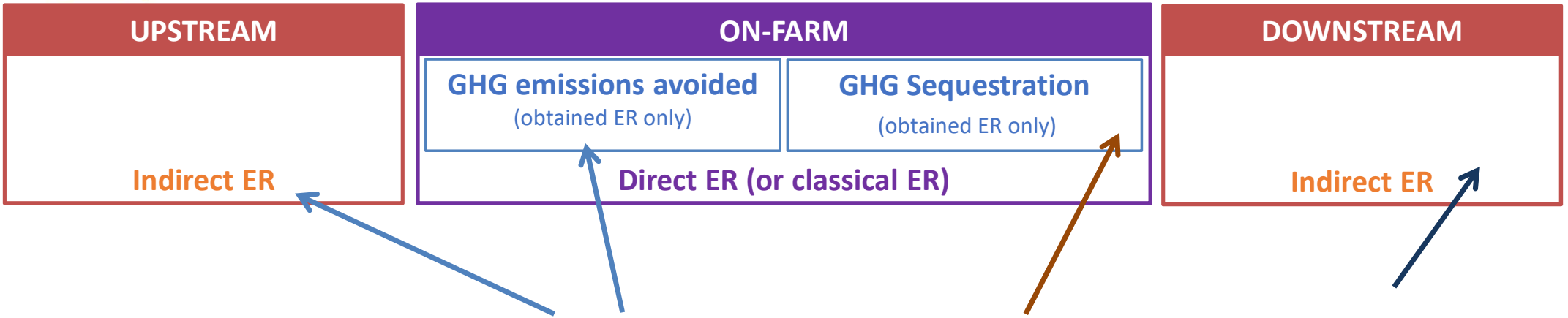
# Déploiement à venir



# Accounted emission reductions




$$Emission\ Reductions = ER_{emissions} + ER_{SOC\ storage} + (ER_{downstream})$$

- ✓ The computation is done at farm scale on cropping systems and storage/drying buildings

# Accounted emission reductions

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Grandes Cultures

✓ The eligible levers can be chosen for each project:

## UPSTREAM

- Purchase of fertilisers (production)
- Purchase of fuel for fertilisers
- Purchase of fuel for irrigation
- Purchase of fuel for storage or drying buildings

Indirect ER

## ON-FARM

### GHG emissions avoided

- Reduce the amount of mineral nitrogen applied on crops
- Improving the efficiency of nitrogen application and plant uptakes
- Introduce legumes into rotation or crops/varieties with lower nitrogen requirements
- Direct emission of CO2 through engines

### GHG Sequestration

- Increase the amount of biomass returned by cover crops
- Increase the restitution of crop residues to the ground
- Increase applications of organic fertilisers or organic amendments
- implantation or lengthening the temporary & artificial grasslands in rotations

Direct ER (or classical ER)

## DOWNSTREAM

- Reduction of GHG emissions from harvests storage by storage agencies

Indirect ER

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# How emission reductions are calculated?

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$$\textbf{Emission Reductions} = RE_{emissions} + RE_{SOC\ storage} + (RE_{downstream})$$

The most up-to-date scientific references are used for calculations.
They have been proved to be :

- Adapted to field crop contexts
- Adapted and validated for French contexts
- Available to be used by anyone
- Compatible with data obtained from farmers

✓ ***ER GHG emissions:***
***Equations on the basis of recognised references:*** *international (IPCC 2019) and (OMINEA 2020, GESTIM, GESTIM+, ACV MAFOR, Hénault et al. 2020....)* ***for adaptation to the French context***

✓ ***ER SOC storage:***
***Estimation of SOC storage by using humic assessment models*** *(via AMG, STICS, AqYield)*

✓ ***ER downstream activities :***
***Equations*** ***with the farm production data and published national references*** *(Ademe, Interpros, Feedtables, Inies)*

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# How emission reductions are calculated?

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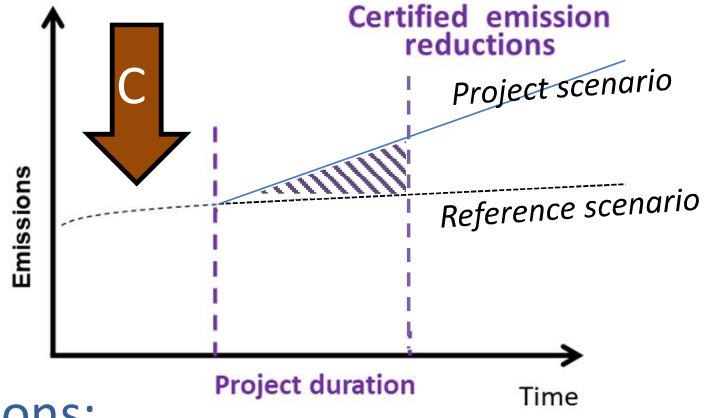
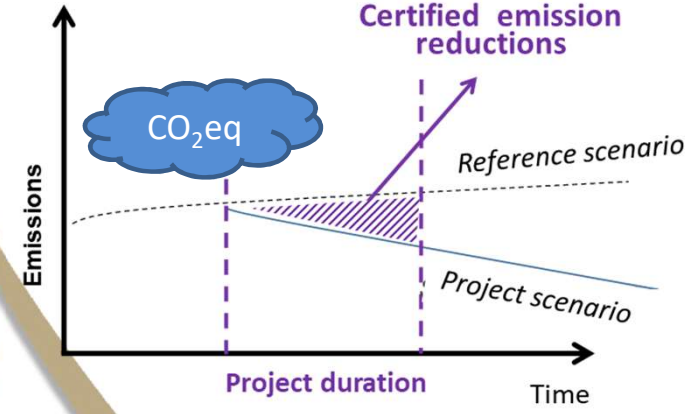
✓ For each cropping systems SOC storage **AND** GHG emissions have to be calculated:

ER SOC storage:




ER emissions:

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✓ ***Compulsory to calculate both as soon as one lever is chosen***

***Why?***

*for example:*

- *a lever storing more SOC could be the increase of biomass restitution to the soil by cover crops.*
- *A way to reach this goal could be the nitrogen fertilisation on cover crops.*
- *But more fertilisers would also mean an increase in GHG emissions.*

*The project has to check that :*

$$ER_{emissions} + ER_{SOC\ storage} > 0$$

# Collection of data adapted to the farm constraints

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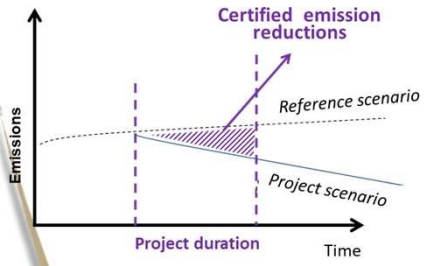
✓ The method is adapted to reach as many farmers as possible:

- Two types of references can be used depending on the kind of data available on the farm:
  - "Specific reference" : use real data from the farm (the 3 years before project)
  - "Generic reference": a database made up from French statistics and surveys on farms; at the department level




- The required data can be collected from different ways: from the most precise to average values from French databases (ex: fuel consumption, input data for SOC storage models)

✓ This is possible thanks to the discounts:

Precise data will be rewarded (low discount)

Less precise data will still be workable with higher discount applied to the project

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# References also available for co-benefits

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✓ Estimation of other impacts and co-benefits of the projects

## Pressure on resources and air or water quality

- ✓ Amount of nonrenewable (or low) resources
- ✓ Soil quality
- ✓ Air quality
- ✓ Water quality

**A set of indicators proposed**

- ✓**Soil erosion in medium- or high-erosion hazard zones**
- ✓**Non-renewable energy consumption**
- ✓**Ammonia emissions** (air quality)
- ✓**Risks of nitrate leaching** (water quality)

## Biodiversity

- ✓ Aerial biodiversity (cultivated or uncultivated areas)
- ✓ Underground Biodiversity

**A set of indicators combined**
**if the stakeholder wants to follow biodiversity**

## Socio-economic and societal impacts

- ✓ For the producer
- ✓ For the territory
- ✓ For society

**Several indicators to choose according the local challanges**

✓ *To highlight additional services provided by the climate projects*

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# Conclusion

- A broad consortium gathered with among the best specialists working on SOC storage, GHG emissions and co-benefits and stakeholders
- The most up-to-date and reliable references used
- The references and the models are adapted to the contexts (field crops, France)
- The projects will be made up with farmers, fitting for their own farms


# The NIVA project and how to link NIVA with the models and tools recommended in the Label Bas Carbone

**Eric Ceschia, INRAE Senior scientist**

G. Pique, T. Wijmer, L. Arnaud, A. Al Bitar, R. Fieuzal from CESBIO,
E. De La Roche from ASP,
G. Marchand, D. Laurent from IGN

NIVA
NEW IACS VISION IN ACTION

June 2nd , 2021

SCARF Webinar | Carbon labelling : lessons learned from the French label (Label Bas Carbone)

# Context: indicators for the NIVA project

- **Discussion with key stakeholder (European Commission) based on a preliminary selection of 13 candidate indicators**

- **Priority : 3 indicators for the CAP**
  - **Carbon storage => climatic change**
  - Nitrate Lixiviation => water quality
  - Biodiversity


- **Indicators may be computed at various TIERs,**
  - **TIER 1 : easily feasible but less accurate**
  - **TIER 2 : better result but more difficulties to get**

  } Empirical approaches

  - **TIER 3 : best results, less operational**

  } Modelling approach

# C budget : what are we talking about ?

- It represent a change in soil organic carbon stocks between two dates (yearly, crop rotation, decades),

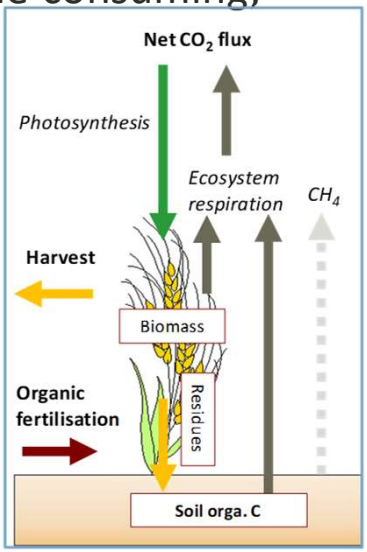
- How to assess it:

  – Soil sampling ? ➔ very time consuming, very expensive or inaccurate (10000 samples/plot to detect a few % change in Corg in 3 years),

  – Soil modelling oriented approaches (AMG, RothC, DayCent…) require many input data : management, accurate measurement of the biomass returned to the soil and accurate/recent soil analysis ➔ time consuming, expensive,

  – In/out carbon fluxes approaches with a focus on biomass Production/restitution to the soil (crop modelling driven by remote sensing observations ➔ SAFYE-CO2 model)

- Cropland Carbon budget is mainly driven by the biomass returned to the soil (Moureaux et al. 2008…) !!!



# Carbon budgets indicators : principle

- Are calculated for each cropping year (at 10m/plot level), but can be summed over several years (crop rotation),

- 3 TIERS (Bockstaller et al, 2021):
  - TIER 1 ($CO_2$ fluxes) and TIER 2 (C budget) are based on empirical approaches and can be applied to most crops species except rice,
  - TIER 3 is based on the SAFYE-CO2 crop model assimilating LAI derived from Sentinel 2 data ➔ allows other indicators to be calculated (biomass, yield, $CO_2$ fluxes, evap/transp…) but only for 4 crops species (wheat, sunflower, maize and rapeseed) + cover crops at this stage.

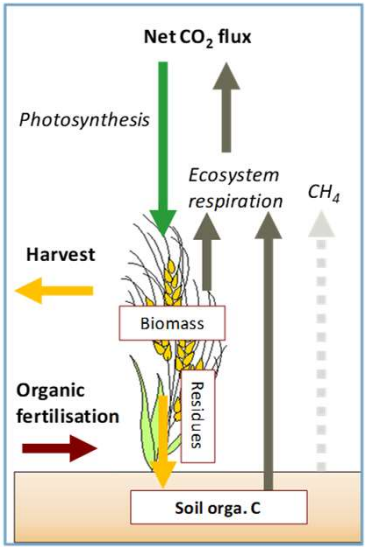
- A similar conceptual approach:

TIERs 2 & 3

C budget = Net $CO_2$ flux – C harvested + Org. manure

TIER 1

Farmer's data (FMIS)



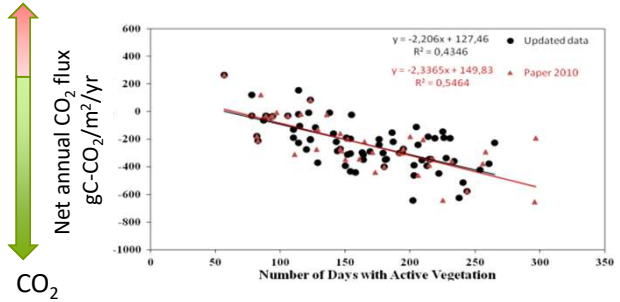
# Carbon indicator Tier 1 : principle

- Objective: estimate empirically the net annual $CO_2$ flux at parcel level
  - The net annual $CO_2$ flux is related to number of days of vegetation
  - Method valid only on arable land for 13 family crops

$CO_2$ release

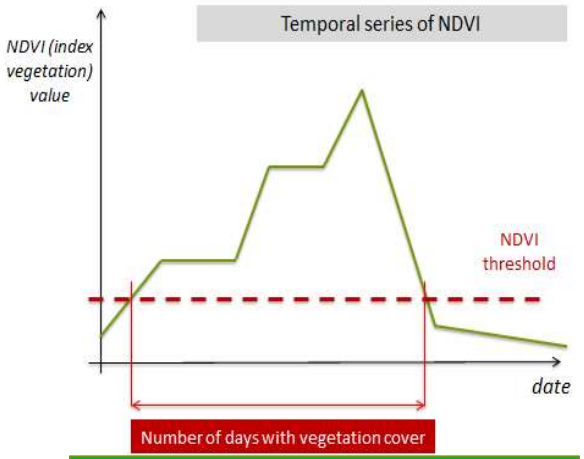
$CO_2$ fixation

*Based on Ceschia et al. (2010)*

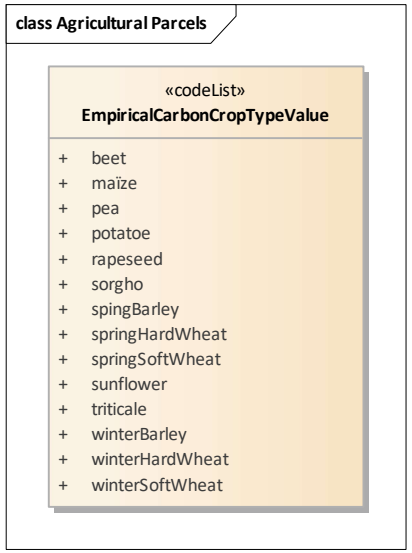



Simple relation between number of days with active vegetation and $CO_2$ flux : validated on additionnal/recent data

*Araya et al. (2017)*




Apply threshold on NDVI profile to get number of days with active vegetation

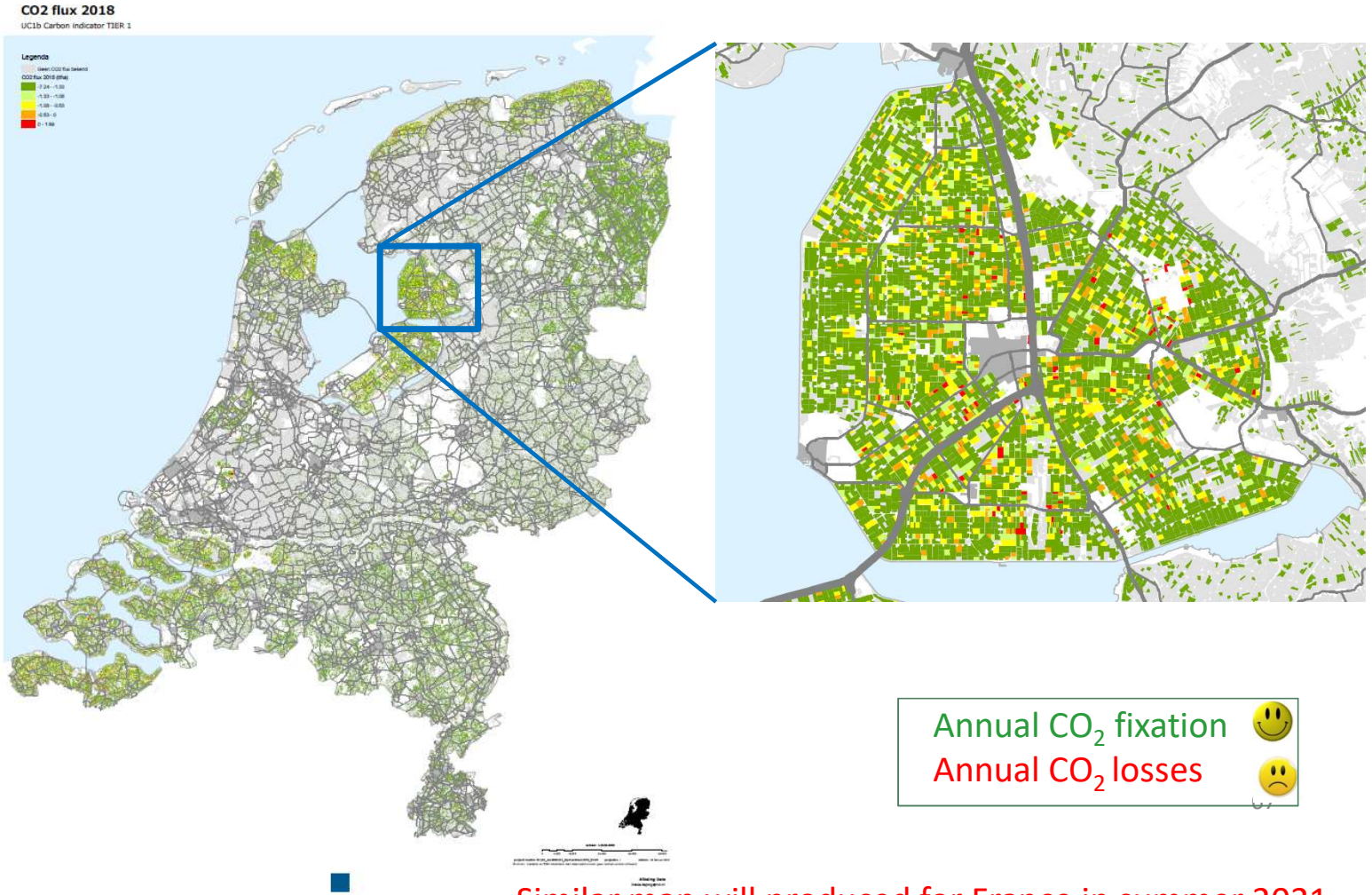



Concerned crop families

# Carbon Tier 1 : Testing results

Ministerie van Economische Zaken en Klimaat

Net annual $CO_2$ fluxes of croplands in Netherlands (2018)



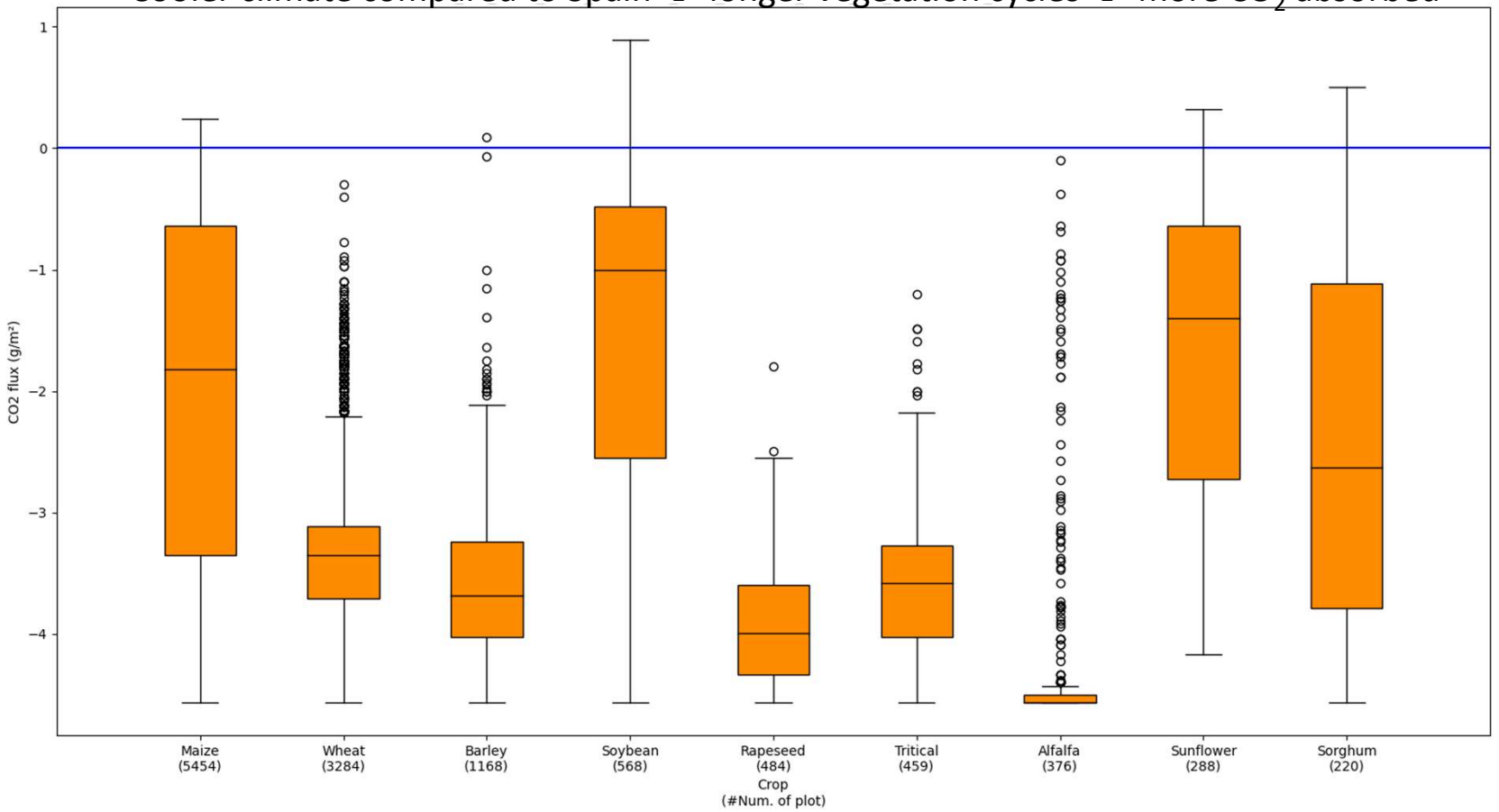

Annual $CO_2$ fixation

Annual $CO_2$ losses

Similar map will produced for France in summer 2021

# Tier 1 : Ain Department test results

Cooler climate compared to Spain ➔ longer vegetation cycles ➔ more $CO_2$ absorbed




More $CO_2$ absorption in Ain Compared to Spain (fluxes are more negative)

Winter crops (long veget. cycles) are fixing more $CO_2$ than summer crops (as expected)

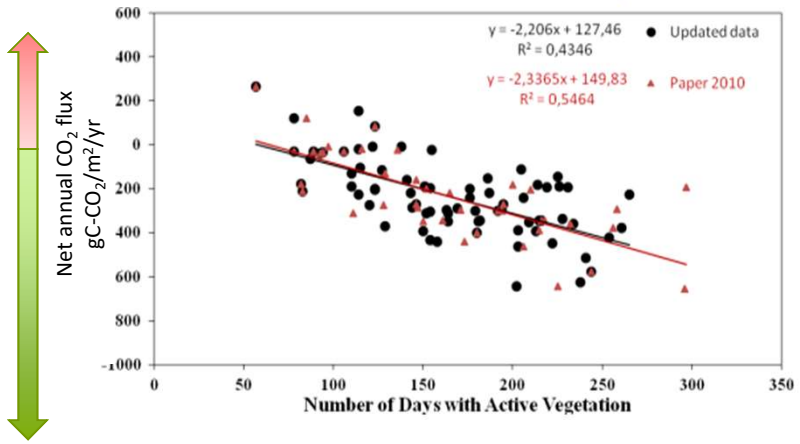
# Carbon indicator Tier 2 : principle

➢ Empirical approaches: plot level/annual

TIER 2 C budget = TIER 1 Net $CO_2$ flux + C harvested – Org. fertil.

Farmer's data (FMIS)

$CO_2$ release




$CO_2$ fixation

*Based on Ceschia et al. (2010)*

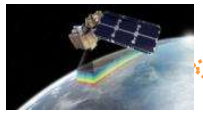
- What do we need to know from the farmers ?

- C harvested:
  - yield (grain t/ha)
  - eventually the amount of straw/cover crop exported (t/ha),

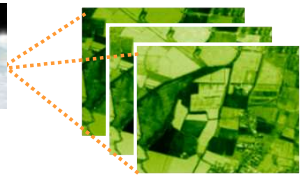
- Are organic amendments applied ? If yes:
  - type of amendment,
  - amount (t/ha).

# Carbon indicator Tier 3 : principle

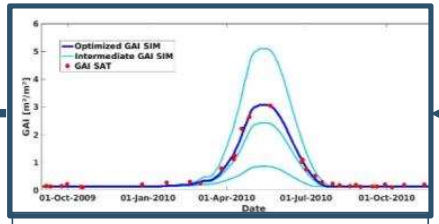
➢ TIER 3, modelling approach: SAFY-CO2



Sentinel 2



$m^2$ leaves/$m^2$ soil




Calibration of phenological & photosynthetic efficiency parameters

Crop maps

Crop param

SAFYE-$CO_2$

*Pique et al. (2020 a, b, c)*

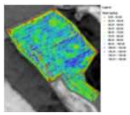
Leaf Area Index

Soil & climatic data (e.g., ERA-5)

Rg,T°C, P

Biomass, Yield,

Validation with farmers & regional stat. for yield

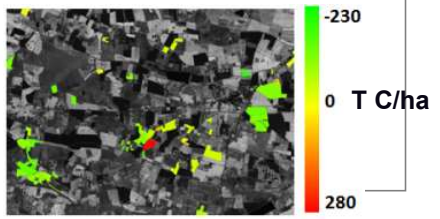



International flux stations networks

ICOS INTEGRATED CARBON OBSERVATION SYSTEM

$CO_2$ fluxes, ETR

C budgets

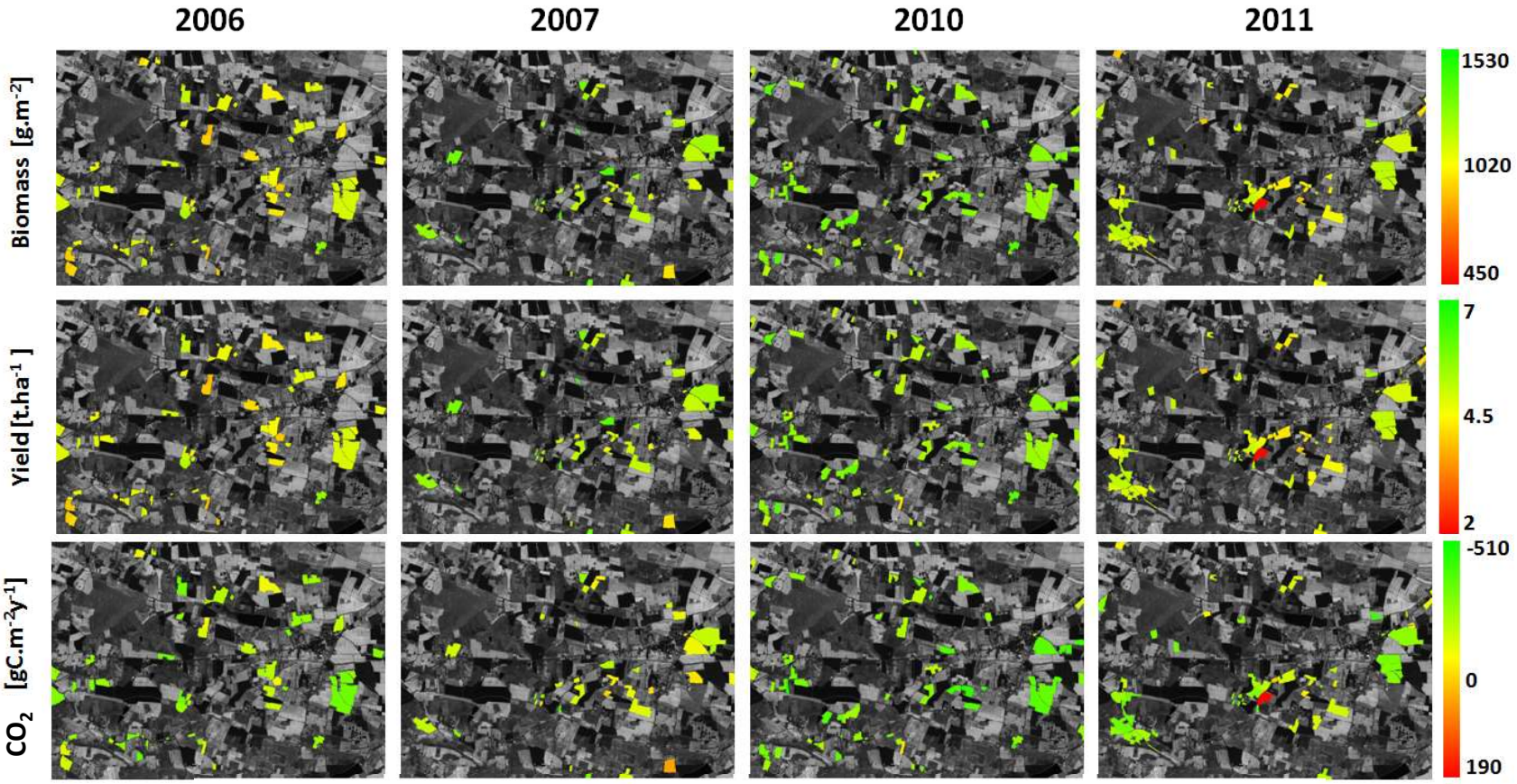



FMIS

Straw export? Organic Fertil ?

# SAFYE-CO2 simulations

Winter wheat (Veloso, 2014)




Monitoring of cover crop heterogeneous development based on Sentinel 2 satellite data (vegetation appears in red)

# Carbon budgets tools

**Level of readyness**

- Tested in 4 MS
- Tested in France
- To be developped

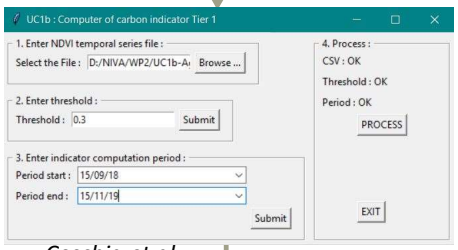
LPIS

Sentinel 2

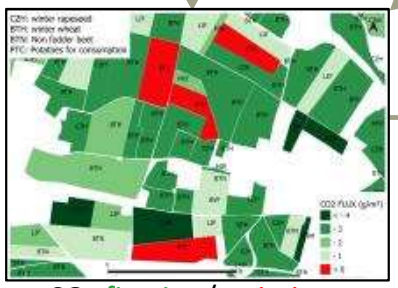
Meteo. data

Soil map

SEN4CAP (NDVI)




*Ceschia et al. (2010) updated*



$CO_2$ fixation/emission

TIER 1 plot map (net $CO_2$ flux)

AgriCarbon-EO

Image processor

NDVI

Prosail (Jacquemoud et al. 2009)

LAI

SAFYE-CO2 (Pique et al. 2020 a&b)

TIER1 calculator

FMIS Interface

TIER2 Calculator

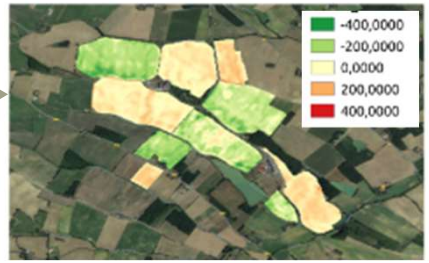
Soil module (e.g. AMG)

TIER 2 plot map (C budget)

FMIS (straw, orga. amendments)

API

Pixel scale C budget ($gC.m^{-2}$)



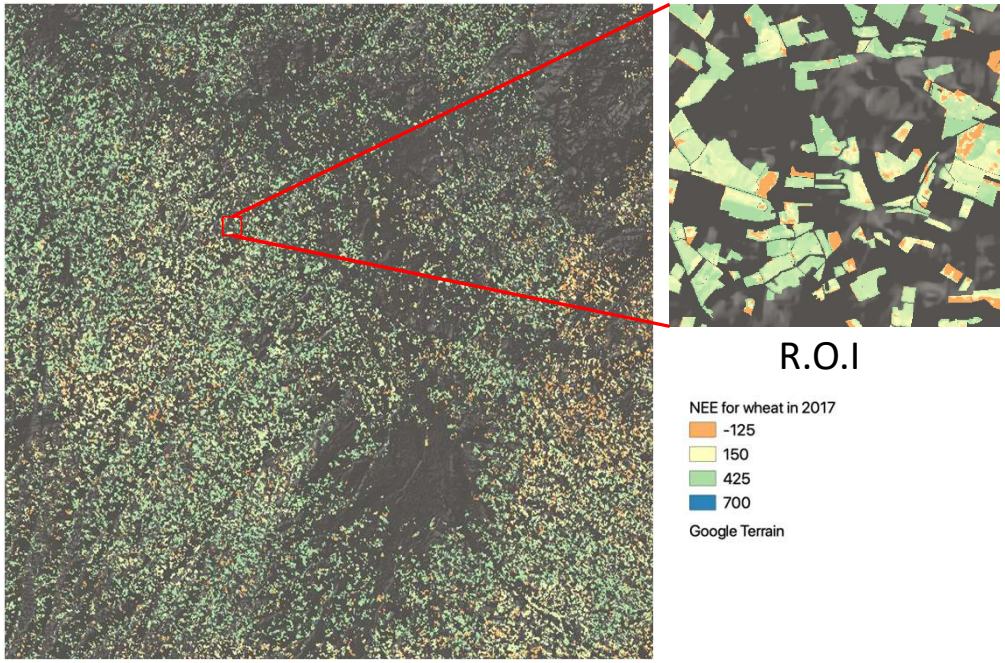

+ uncertainties

TIER 3 pixel map (C budget)

# Tier 3 : application over a Sentinel 2 tile

- AgriCarbon-EO currently tested in France,

Net annual $CO_2$ fluxes for straw cereals in South West France



Whole Tile (31TCJ)

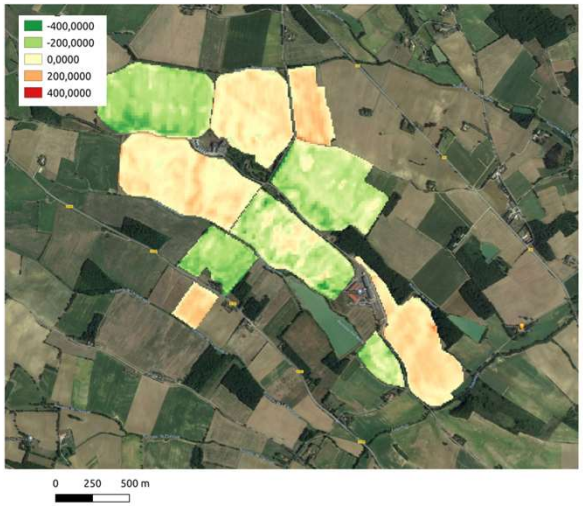


R.O.I




Cover crop biomass ➔ C storage

High Resolution C budget maps for cover crop/maize/wheat crop rotations




- Method compliant with Verra's Certified Carbon Standard VCM0042.

# Conclusions

➢ 3 Carbon indicators at pixel/plot scale based on HR EO data for agri-environmental monitoring and for the C market/Low Carbon Label in agriculture (huge demand) ; TIER2 & 3 require farmer's data (accessibility, consent…),

➢ They are compliant with the CAP monitoring approach base on EO data and are developed in open source,

➢ TIER 1 could easily be implemented everywhere thanks to the IACS data + the Sentinel data. Operational tool ➔ core service at short term ?

➢ TIER 2 still under development & requires access to the FMIS ➔ calculated at the state level ? ➔ will depend on the objectives/efforts of the European MS,

➢ TIER 3 (model) offers higher levels of accuracy, more indicators (yield, ETR) but also needs additional data (FMIS, pedoclimatic data) ➔ still requires some research (parametrise new crops, analyse transposability…),

➢ In the future, AgriCarbon-EO could be used in combination with farm level GHGbudget tools (e.g. SIMEOS-AMG) for more accurate C budgets estimates.

# Thanks for your attention

Sensagri

HORIZON 2020

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Agence de l'Environnement et de la Maîtrise de l'Energie

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ETABLISSEMENT PUBLIC DU MINISTERE DU DEVELOPPEMENT DURABLE

BAG'AGES

NIVA
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# Second Q&A session – 15 minutes

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# Conclusion

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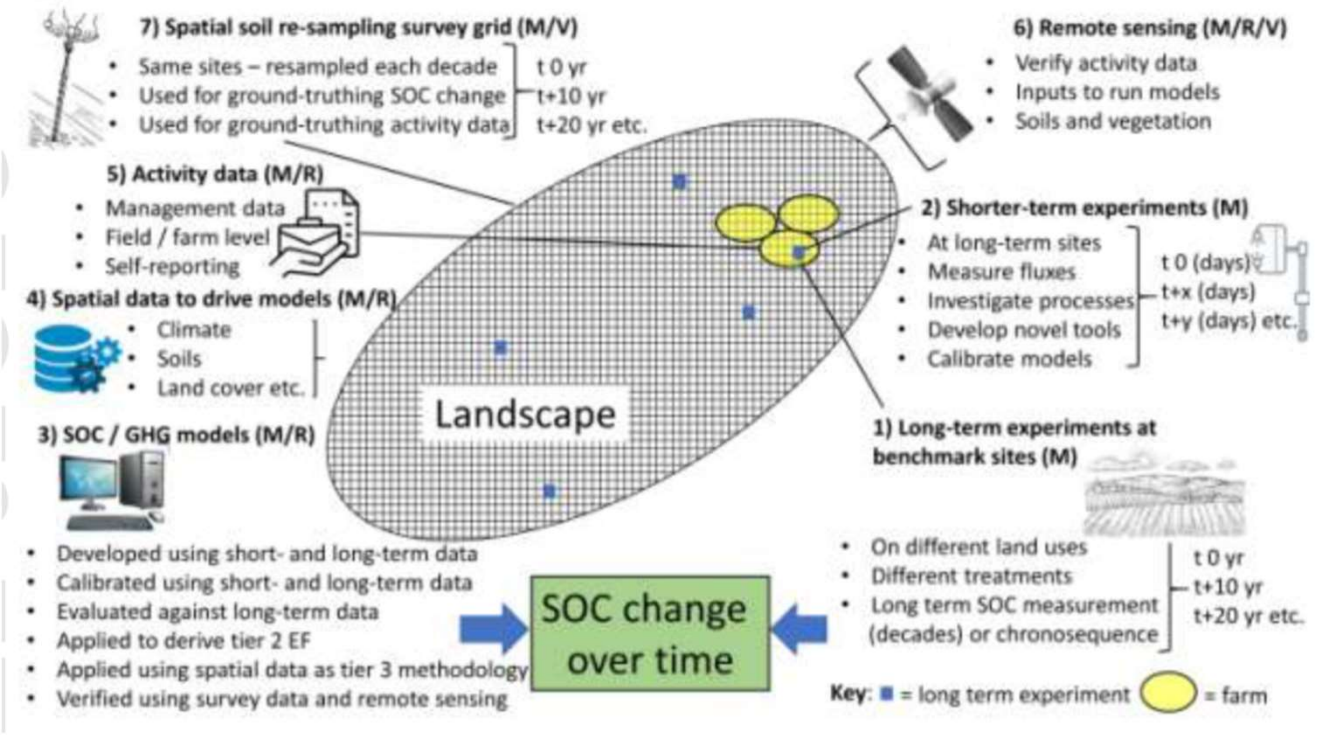
I4CE INSTITUTE FOR CLIMATE ECONOMICS

## Could we base Monitoring, Reporting, Verification (MRV) on flux estimates of soil C balance?

**Towards an international infrastructure for soil C monitoring, reporting and verification?**

# Combining data for international scale monitoring of soil carbon




(Smith, Soussana et al., Global Change Biology, 2019)

## Carbon Certification : lessons learned from the French standard (Label Bas Carbone)

**Thank you for your attention!**