Solutions from soils

The role of soils for climate change adaptation and mitigation

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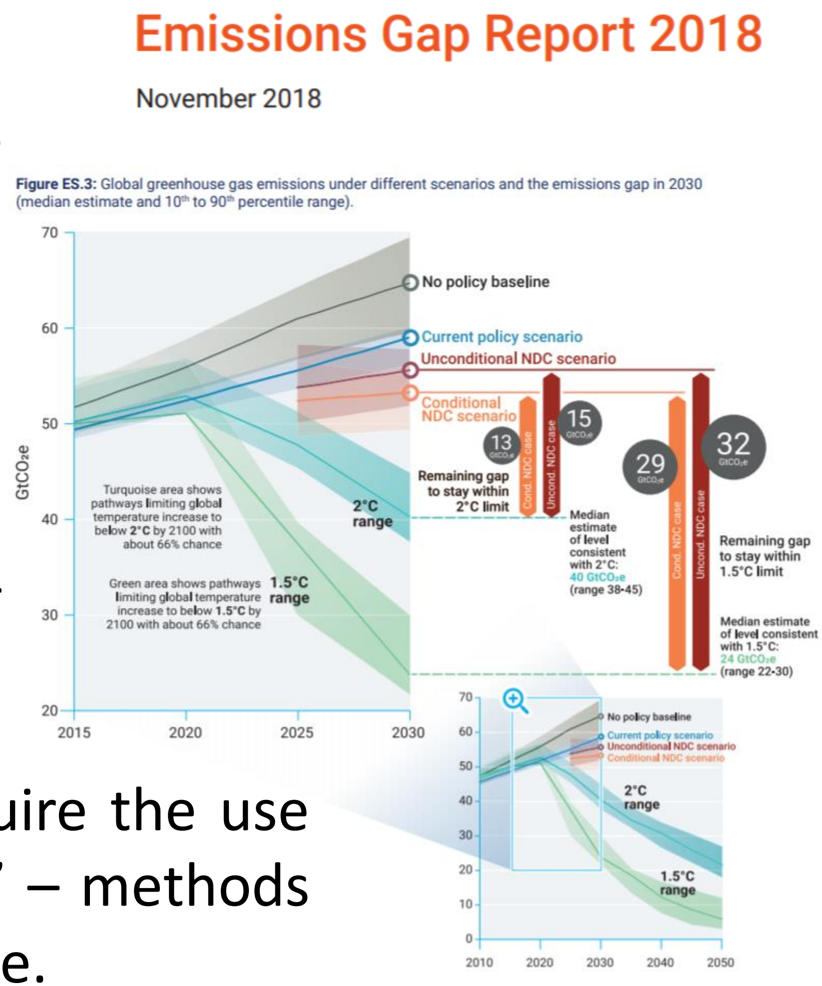
October 1st, 2019, Helsinki

Pledges for the Paris Agreement

- 128 countries include the Agriculture, Forestry and Land Use sector in their pledges

- By 2030, a gap of 13 billion tons CO_2eq prevents reaching the targeted +2℃ maximum global warming threshold (29 $GtCO_2$eq in the case of the 1.5 ℃ target)

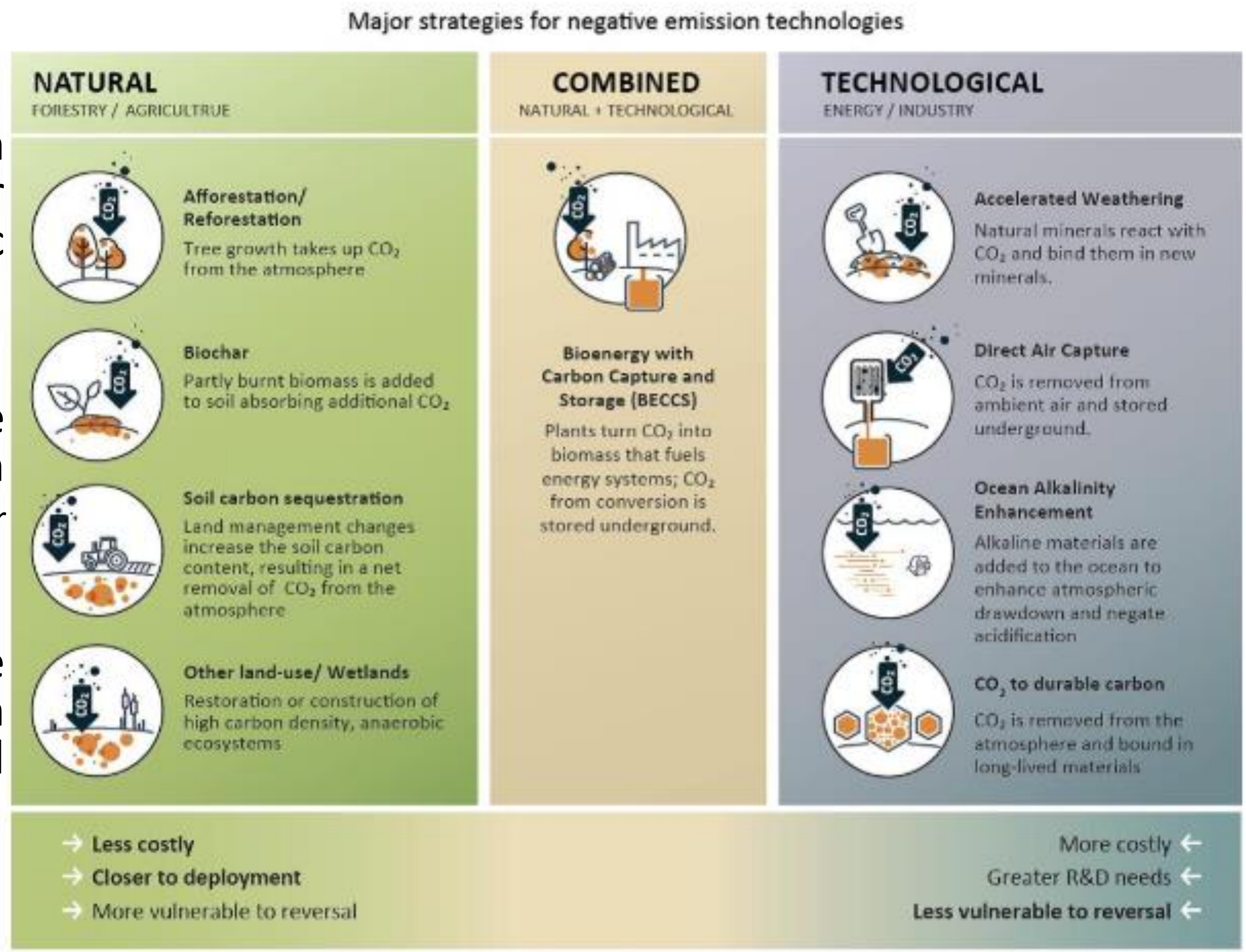


- Limiting warming to 1.5° C will require the use of “negative emissions technologies” – methods that remove CO_2 from the atmosphere.

[UNEP, 2018]

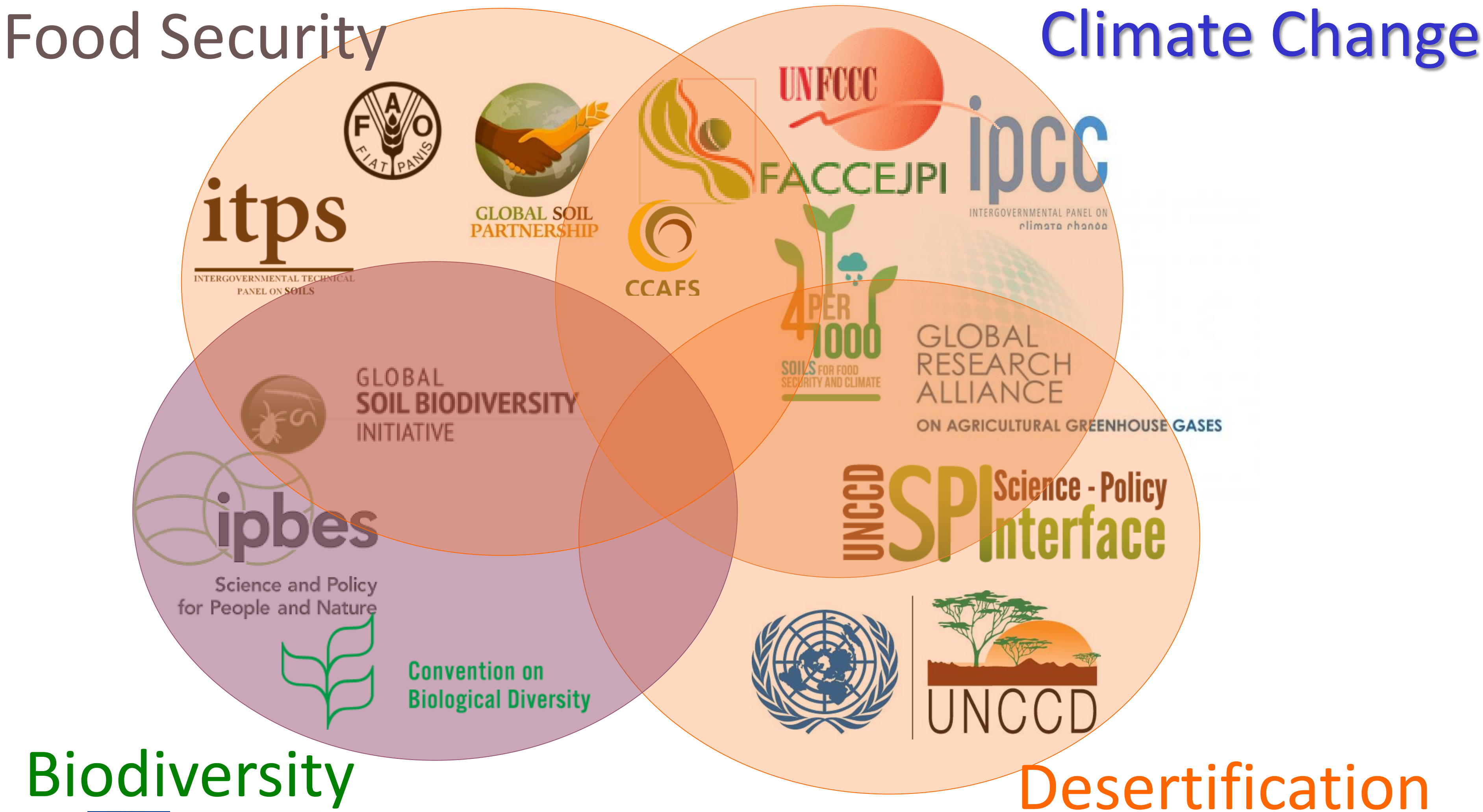
Soil carbon sequestration: a major mitigation option

- **2-3** times more carbon in soil organic matter than in atmospheric CO_2 *[IPCC, 2013]*
- **1.4** Gt C could be stored annually in <u>agricultural soils</u>, *[after IPCC, 2007, 2014]*
- **SOC seq** is among the cheapest methods with the greatest potential *[UNEP,2017]*



[Emission gap report UNEP, 2017]

Soil carbon as a cross-cutting theme between food security, climate change, desertification and biodiversity



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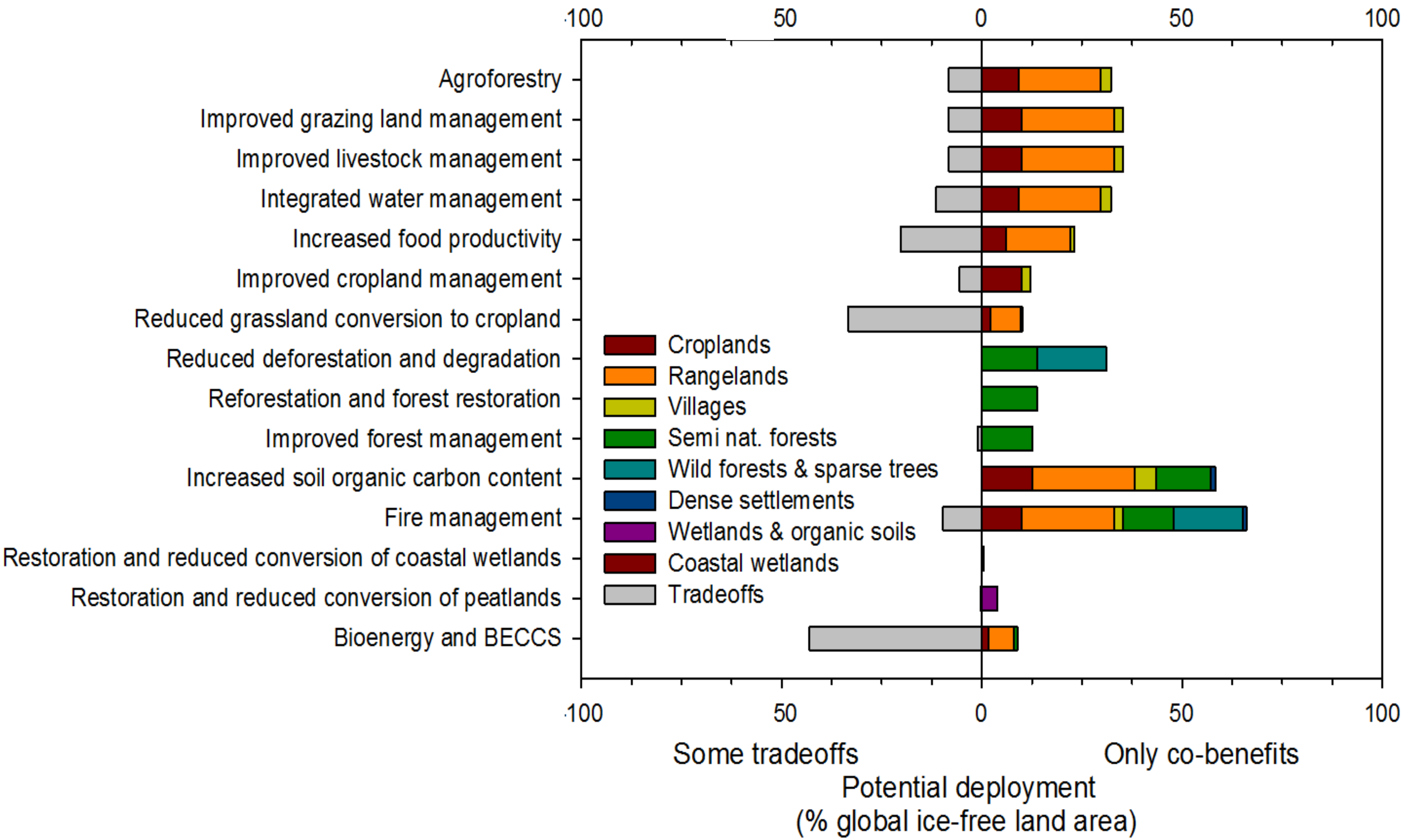
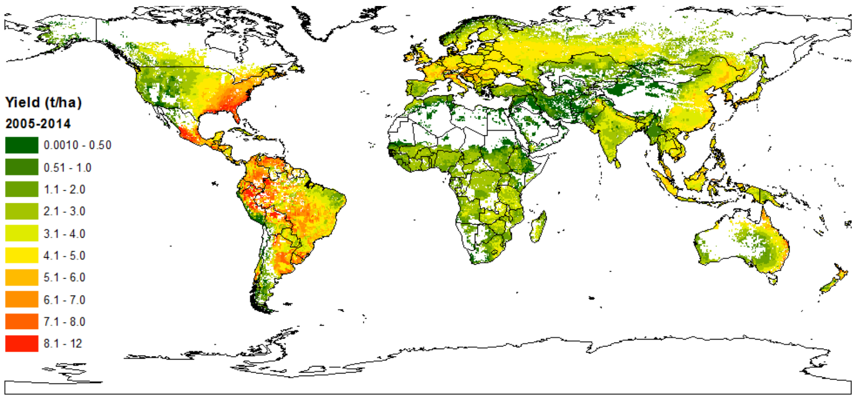
Potential global contribution of response options to mitigation, adaptation, combating desertification and land degradation, and enhancing food security



Land degradation lowers crop yields

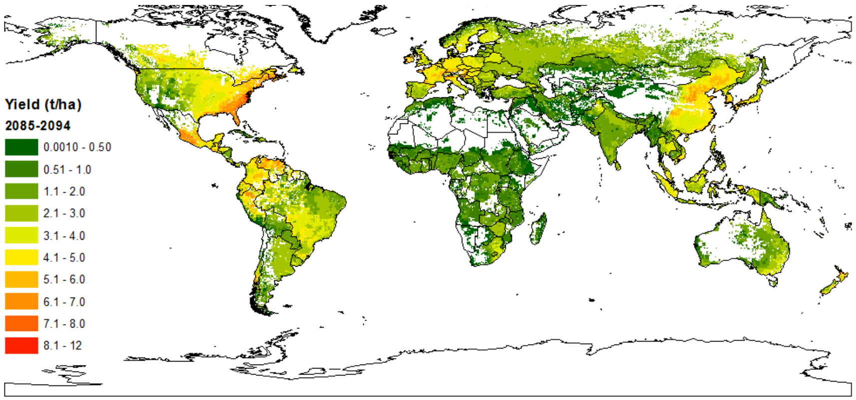
- 10% global crop yield loss by 2050 with land degradation *[ITPS, 2016]*

Maize Yield, conventional Tillage 2005-2014



HIGH YIELDS

Maize Yield, conventional Tillage 2085-2094



LOW YIELDS

Global EPIC model, dynamic soil, RCP 2.6: Example of Maize yields under conventional tillage for a 2° C global warming scenario *[Unpublished study by Balkovic, Havlik, Soussana et al.]*

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Agricultural practices for soil carbon sequestration

Integrated soil fertility management

Rangeland Management

Conservation tillage

Water management

Agroecology

Agroforestry

Organic fertilizers

With soil carbon sequestration, food security is little harmed, even for a 1.5°C global warming target

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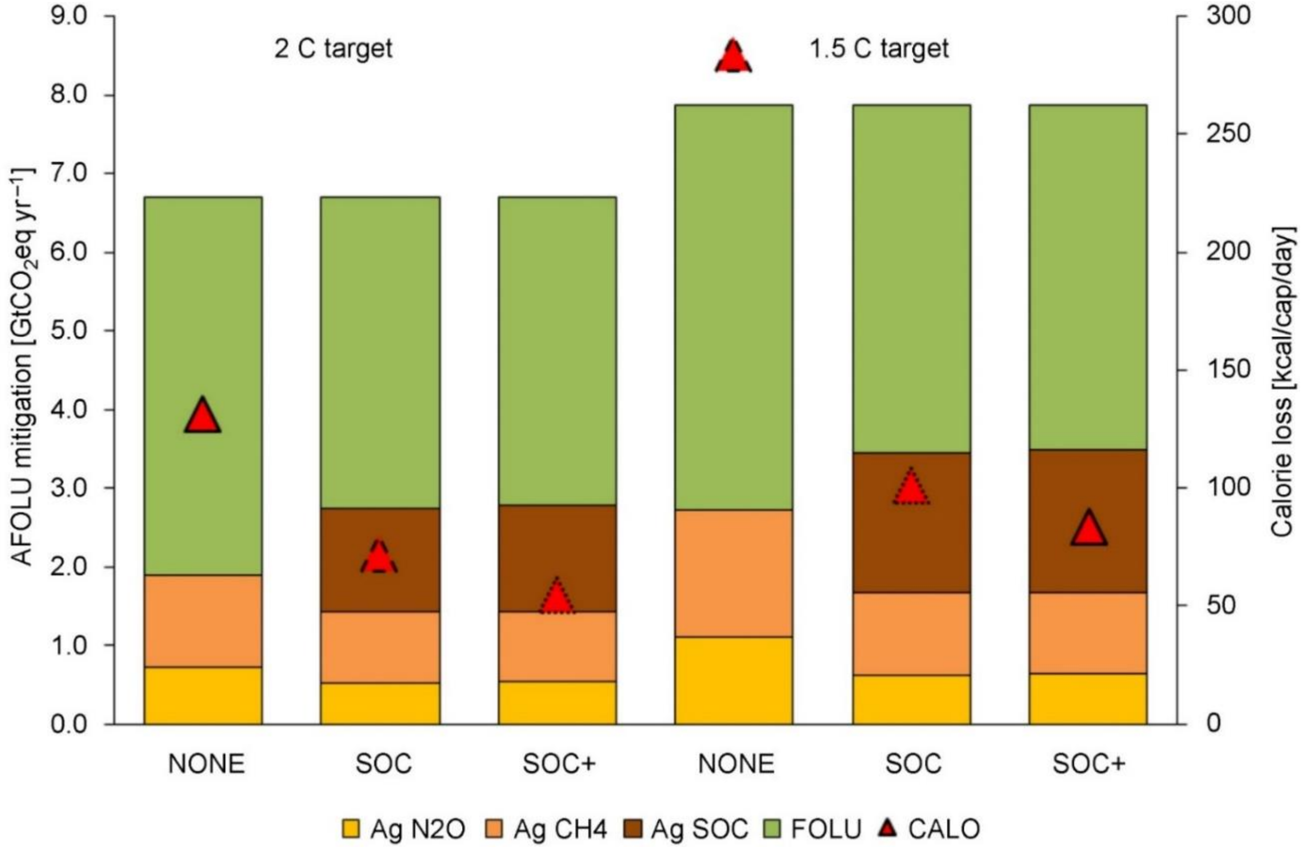

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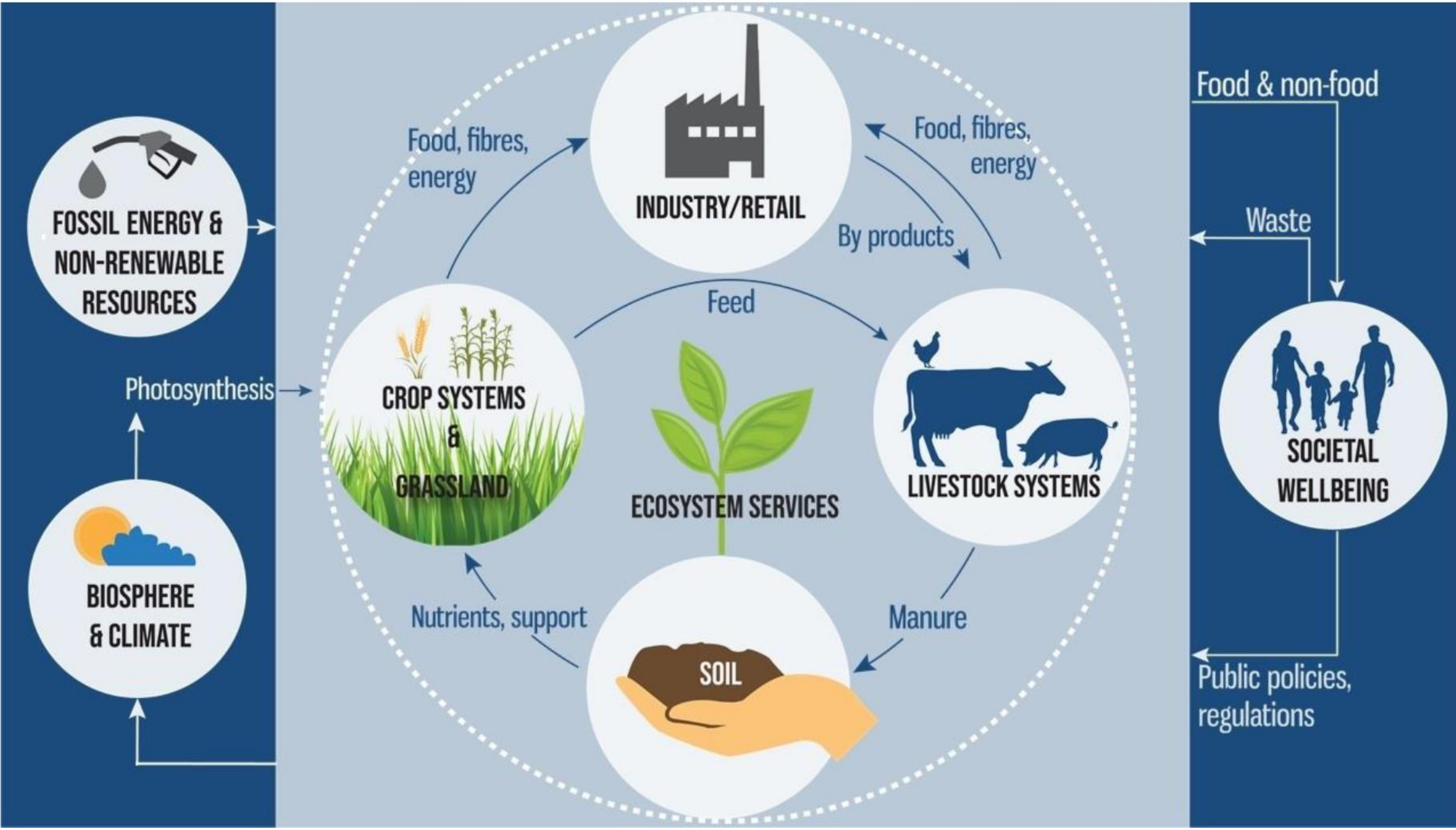
[Frank et al., Env. Res. Lett., 2017]

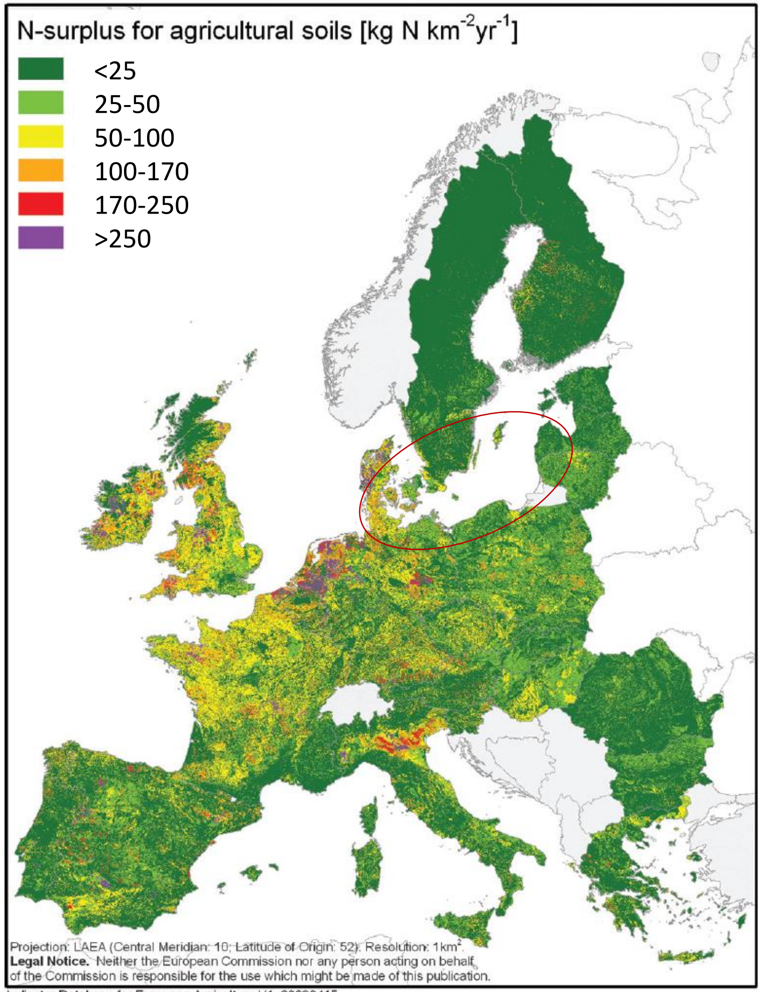
Circular bieconomy framework



(Animal Task Force, 2019)

Nitrogen surplus from European agricultural soils and soil organic carbon (SOC)

Potential to immobilize N by restocking SOC in intensive cropping systems



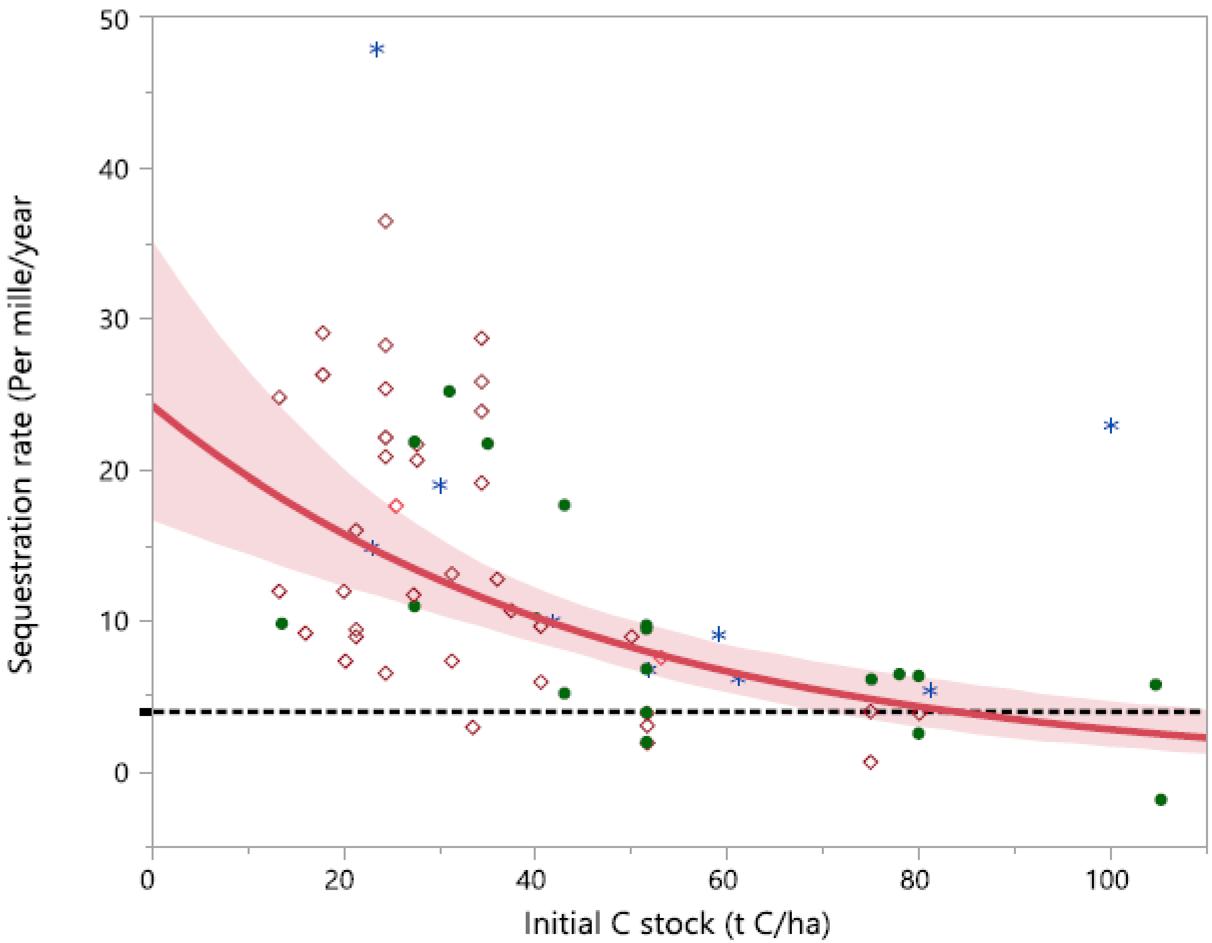
Indicator Database for European Agriculture V1_20090415

Fig. 3. Soil organic carbon prediction map which represents the present conditions simulated by the base model (background

(Yiginini & Panagos, SOSTEN, 2016)

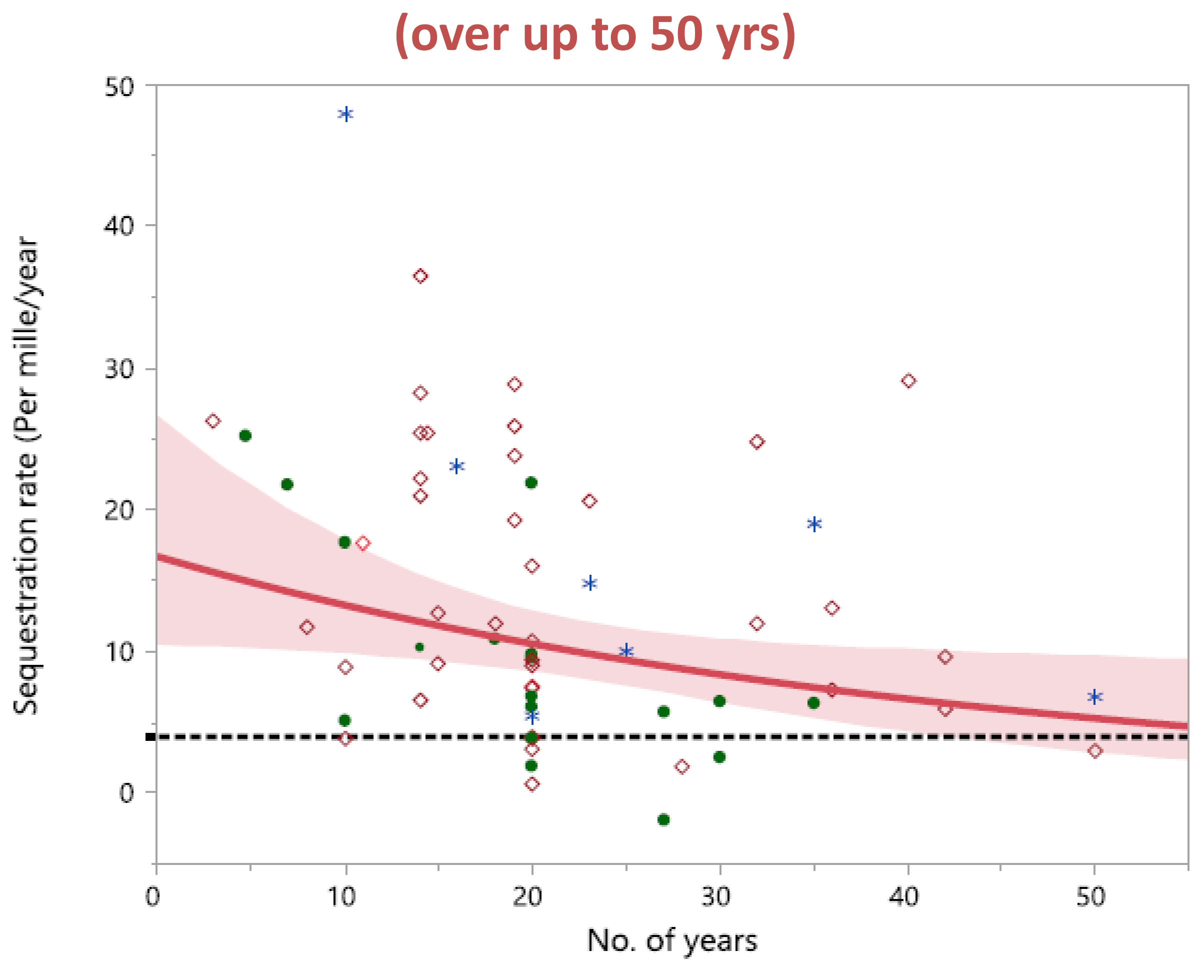
A 4 per 1000 SOC sequestration rate has often been exceeded in long-term arable field trials

..but the rate declines with initial SOC stock



(Minasny et al., 2016, Geoderma)

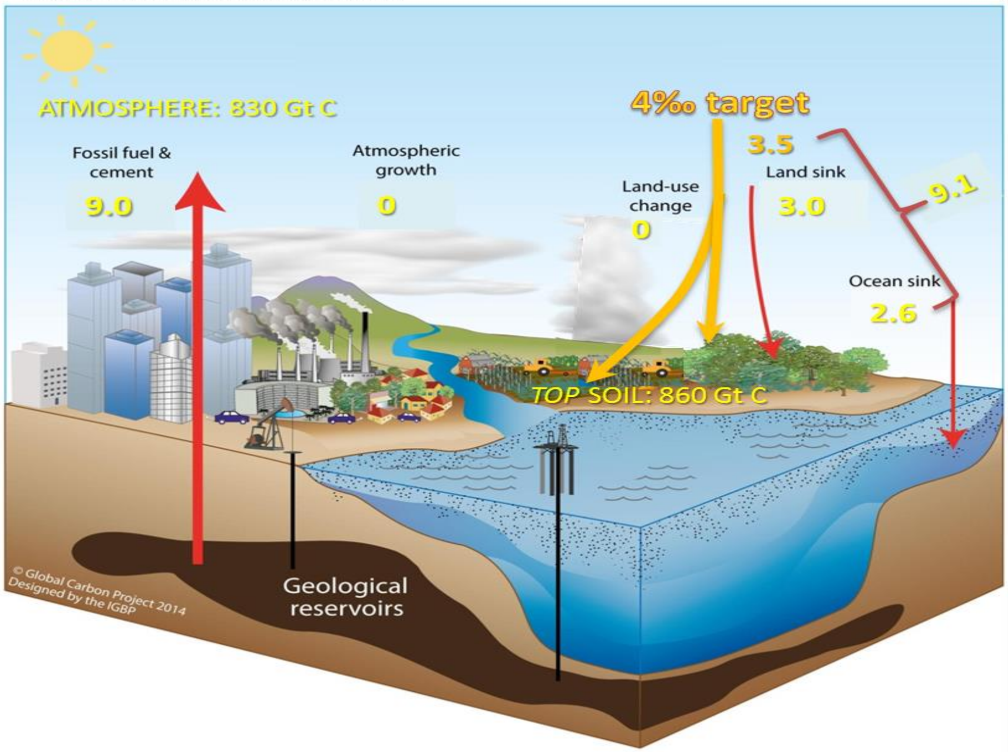
A 4 per 1000 SOC sequestration rate has often been exceeded in long-term arable field trials



(Minasny et al., 2016, Geoderma)

What means « 4 per 1000 » ?

Data: CDIAC/NOAA-ESRL/GCP



Stabilizing atmospheric CO_2
by a **large** soil carbon sequestration rate calculated over **top** soil (0-40 cm)

Strengthening the **current land carbon sink**

The 4 per 1000 target of 3.5 GtC/ yr is compatible with literature estimates:

- Agricultural soils
- Forest soils
- Desertified and salinized soils

An international initiative bringing together close to 40 countries and 250 organisations to accelerate agricultural soil carbon sequestration

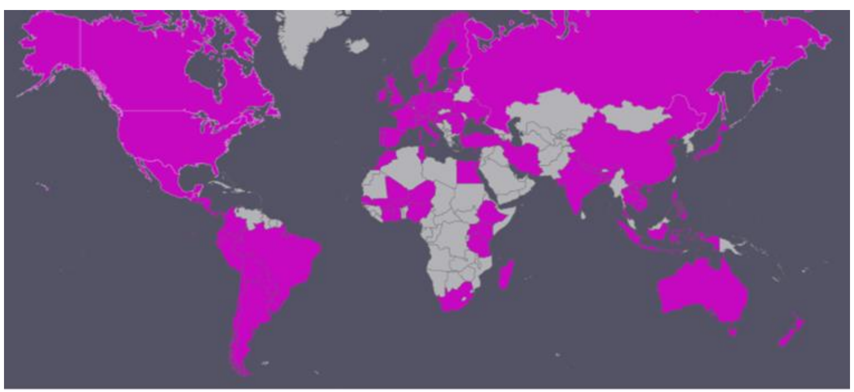
Limits of soil carbon sequestration

- Adoption of SOC sequestration measures will take time,
- SOC will increase only **over a finite period (30-50 yrs locally)**, up to the point when a new SOC equilibrium is approached,
- The **additional SOC stock will need to be monitored** and preserved by adapting land management practices to climate change,
- Soil phosphorus (P) and nitrogen (N) should be available (root symbioses could help) as well as organic carbon recycling
- Soil and water management need to be combined, especially in dry regions

CIRCASA

CIRCASA

- CIRCASA has **22 partners** including the research secretariats of **4p1000**, **GRA** and **FACCE-JPI**
- Together with these initiatives and with CCAFS-CGIAR, it has direct outreach to a total of **82 countries** accounting for **85% of the world's total research on soil C sequestration in agriculture**



Countries partners of CIRCASA, 4p1000, GRA, FACCE-JPI and CCAFS

Goals of CIRCASA Project

Develop **international synergies concerning research and knowledge transfer** on agricultural soil C sequestration at European Union (EU) and global levels.

1. Strengthen the international research community
2. Improve our understanding of agricultural soil carbon sequestration and its potential for climate change mitigation and adaptation and for increasing food production
3. Co-design a strategic research agenda with stakeholders
4. Create an International Research Consortium

Project results for policy

COP24 (Katowice, 2018) with 3 side-events

International Soil Carbon sequestration research: H2020 CIRCASA – Side event at the Pacific and Koronivia Pavillon.

Links between CIRCASA and the Global Research Alliance on agricultural greenhouse gases (GRA) and the "4 per 1000" initiative
How CIRCASA could contribute to the Koronivia program.

"Forests and Climate Policy under the Paris Agreement“, EU Pavilion.

Based on the latest IPCC special report on 1.5°C and on CIRCASA project

“4 per 1000 Initiative” Day in which the CIRCASA project stakeholders survey was presented.

CIRCASA

Project results for policy

The Koronivia Joint Work on Agriculture (KJWA) , Bonn, June 2019

Observer at the **Koronivia Soil Carbon workshop**, contributing to presentation by GRA and explaining CIRCASA aim and vision. Prof. Claire Chenu, INRA, delivered the introductory talk.

Side-event | Enhancing NDC ambition through soil organic carbon sequestration
on June 26 with CCAFS program of the CGIAR and Vermont U.
Presenting CIRCASA

Project results for policy

UNFCCC

Collective scientific submission to the KJWA **topic theme 2(c)** Improved soil carbon, soil health and soil fertility under grassland and cropland as well as integrated systems, including water management

The Koronivia Joint Work on Agriculture (KJWA)

Topic 2(c) Improved soil carbon, soil health and soil fertility under grassland and cropland as well as integrated systems, including water management

Signatories[1]*: *ABDN[2], AU-DCA[2] CAAS[2], CaSA Network, CATIE, CCAFS, CEA, CEIGRAM, CIAT[2], CIMMYT, CIRAD[2], CNRS, CSIRO[2], CSU[2], DORAS Center, FACCE-JPI[2], GDA, GRA[2], ICARDA, IIASA[2], INIA, INRA[2], IRD[2], IITA[2], ISRIC[2], MSU[2], NAFRI, NZAGRC[2], RUA, UNCCD (Sec. & SPI), University of Antananarivo[2], VAAS

As a group of research and higher education institutions and programs—hereinafter referred to as 'the Group'—, observers and non-observers to the UNFCCC, we welcome decision 4/CP23 and on the Koronivia Joint Work on Agriculture (KJWA), as well as the subsequent submissions by Parties, observers and non-observers to the UNFCCC, as well as the decisions FCCC/SB/2018/L1 and FCCC/SB/2018 L7 taken at SBSTA/SBI 48 and at SBSTA/SBI 49, respectively.

32 signatories [17 Institutions and programs members of the CIRCASA]

The Group also referred to a former collective scientific submission on **topic 2(a)** Modalities for implementation of the outcomes of the five in-session workshops on issues related to agriculture and other future topics that may arise from this work.

CIRCASA

Project results for policy

CIRCASA members contributing to Chapter 6:

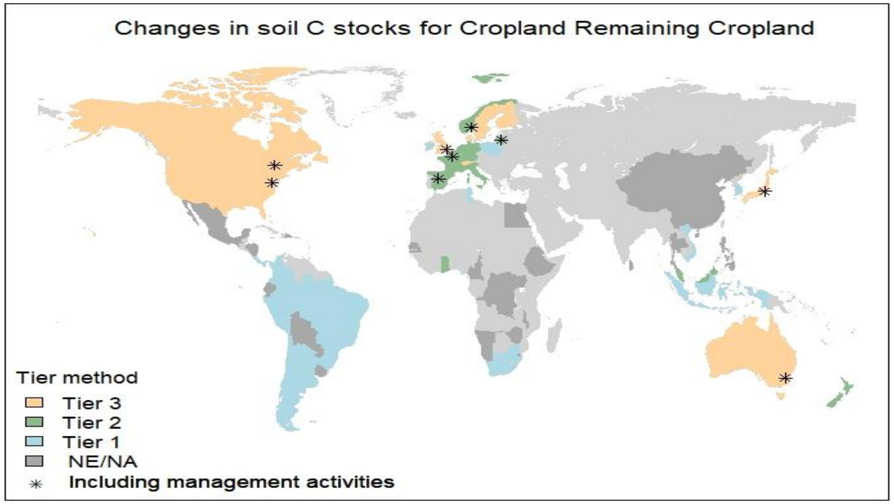
Prof. Pete Smith, Coordinating Lead Author
Dr. Jean-Francois Soussana, Lead Author
Dr. Cristina Arias Navarro, Contributing Author

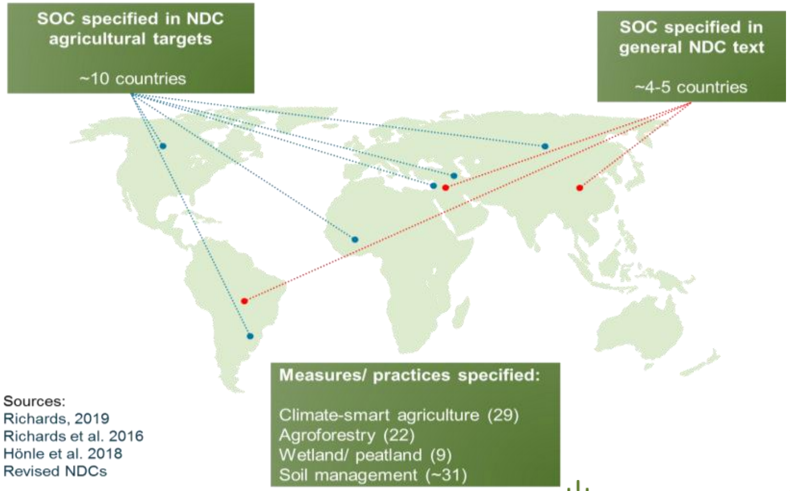
Forthcoming, 2 – 6 August 2019
50th IPCC Session, Geneva, Switzerland.

Chapter 6. Interlinkages between Desertification, Land Degradation, Food Security and GHG fluxes: synergies, trade-offs and Integrated Response Options

Project results for policy

Soil carbon in national GHG inventories, NDCs for Paris agreement and Land Degradation Neutrality in UNCCD





ISRIC's 250 soil carbon map is used by UNCCD LDN

Vision

Frontiers science

Unlocking the potential of soils through systemic research connecting functions, dynamics and biodiversity

Technological innovation

An international monitoring system of agricultural soil carbon stock change and associated GHG emissions

Capacity building

Online Collaborative Knowledge

Research Alignment

International Research Consortium governance, funding and work plan

Socio-ecological systems change

Knowledge based transformation of agricultural value chains and rural landscapes

Soil organic carbon monitoring

Two ways to assess soil organic carbon stock change

Changes in soil organic carbon stocks

- Selection of the baseline period and of the reference land use scenario
- Direct measurements of changes in soil carbon stock over a time period
- 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

Soil carbon balance (inputs -outputs)

- Soil carbon stock change is estimated from the balance of incoming and outgoing carbon fluxes
- Selection of the best calculation/modeling method

Soil organic carbon balance in a cropland

Photosynthetic C

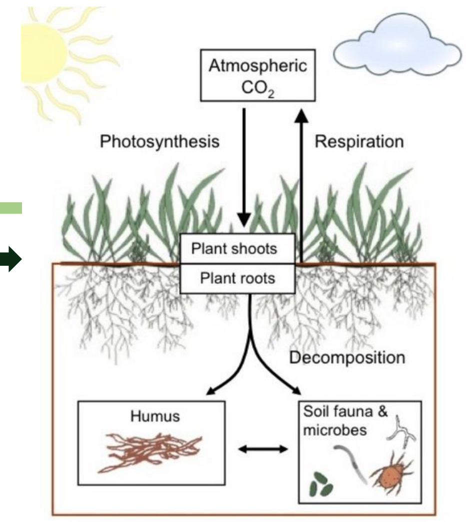
- Remote sensing

Primary plant productivity

- Harvested C (e.g. harvest index)

Harvests

Organic fertilizers



Soil carbon input

+ Organic fertilizer C

Soil carbon balance

- Soil respiration, C leaching (modeling)

For baseline conditions and for changes in land management

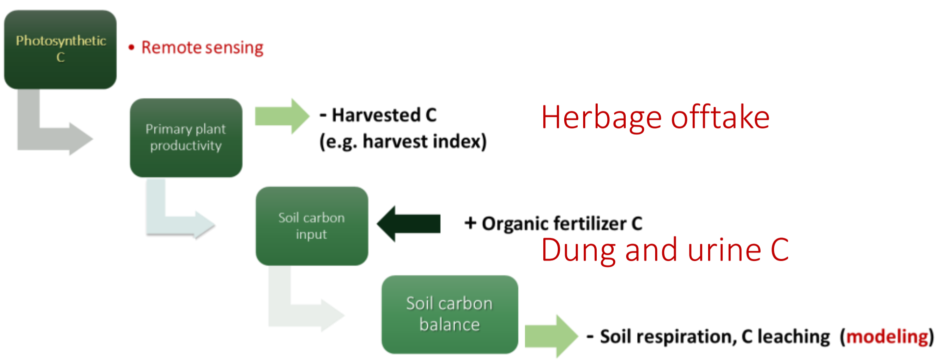
INRA SCIENCE & IMPACT

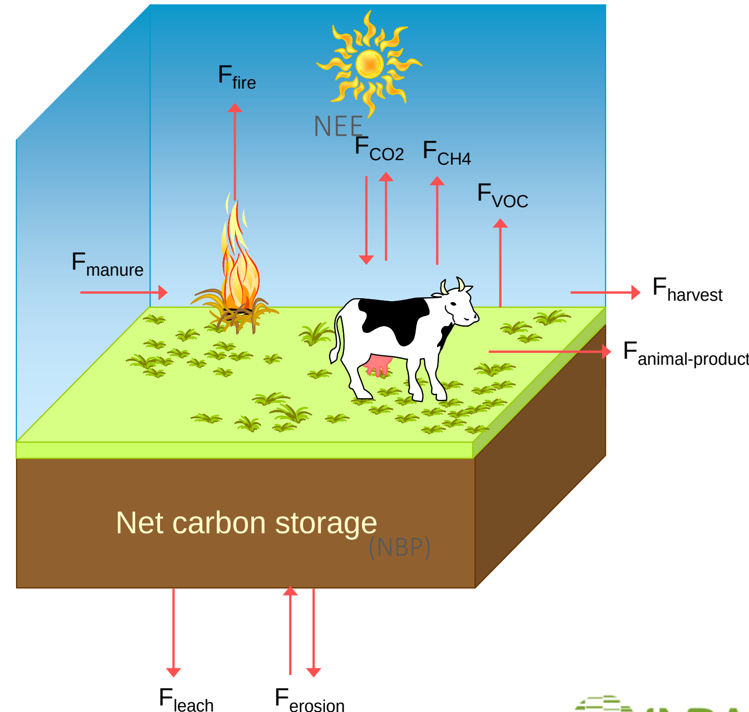
Soil organic carbon balance in a pasture

Measurements at eddy covariance flux sites
Simplified carbon balance :

$$NBP = (NEE - F_{CH4\text{-}C}) + (F_{manure} - F_{harvest} - F_{animal\text{-}products}) - F_{leach}$$

(Soussana et al. 2010)





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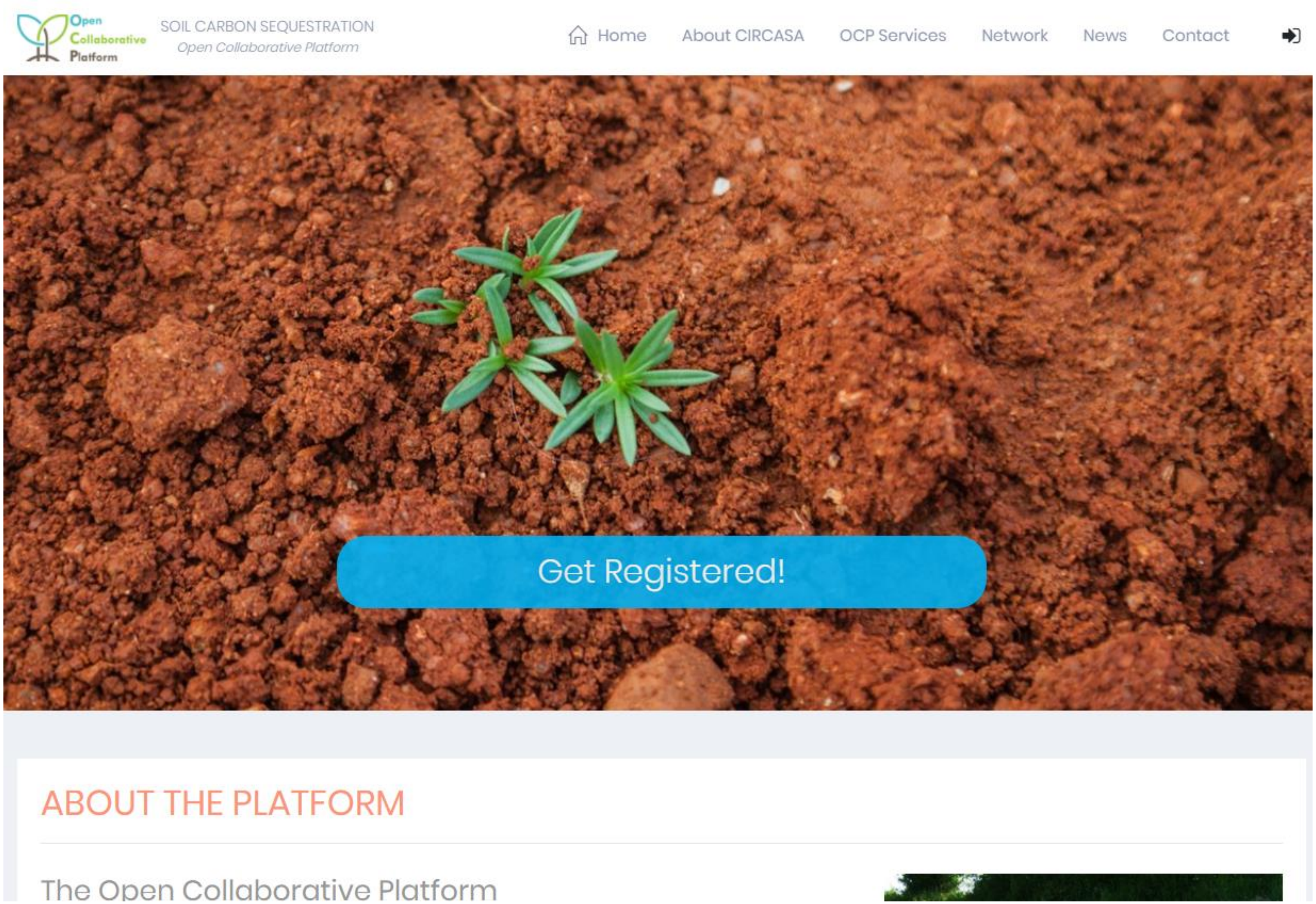

Thank you for your attention!

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This project has received funding from **the European Union's Horizon 2020** research and innovation programme under grant agreement No **774378**