FINNISH METEOROLOGICAL INSTITUTE

Science behind Carbon Action

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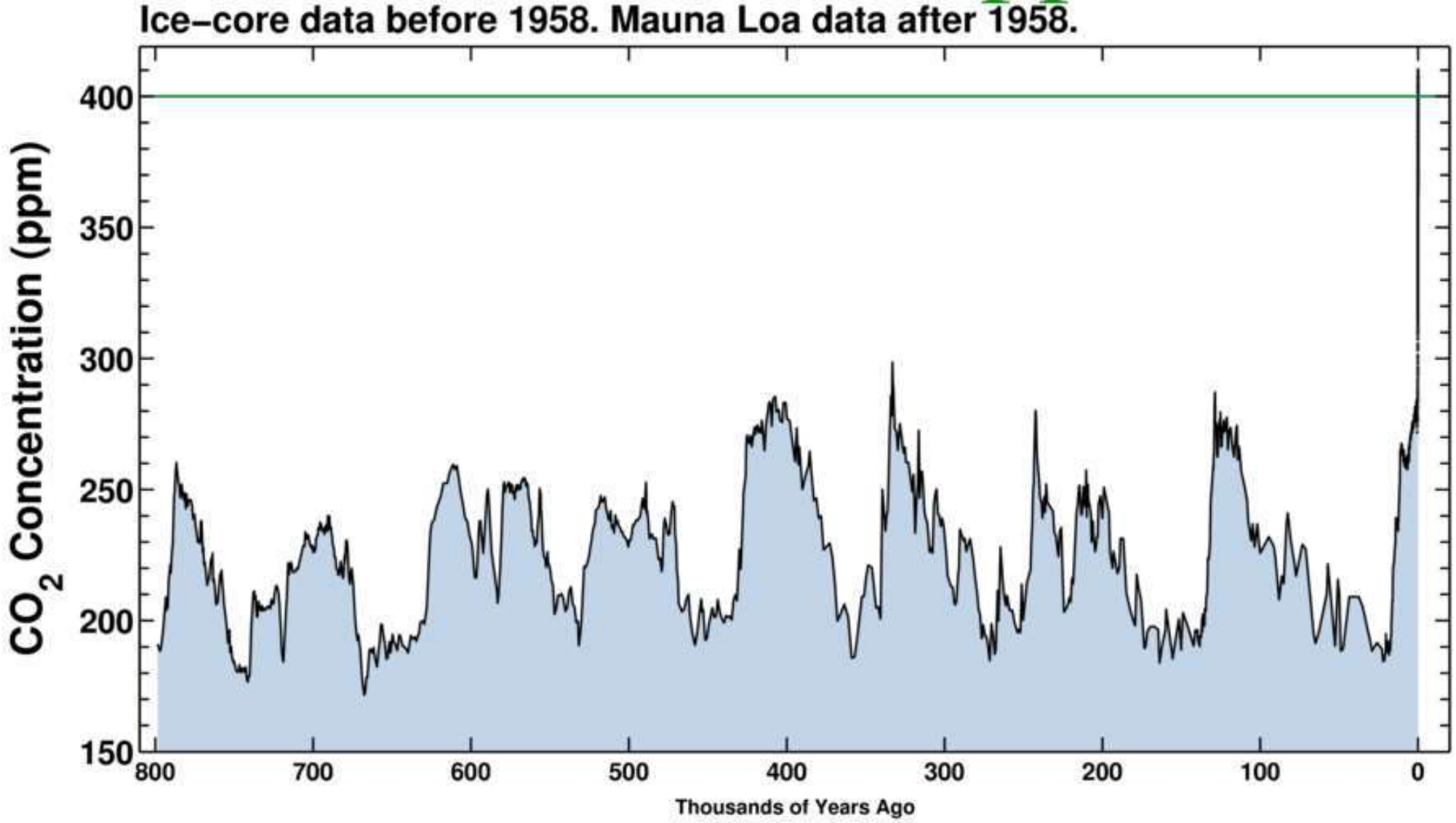
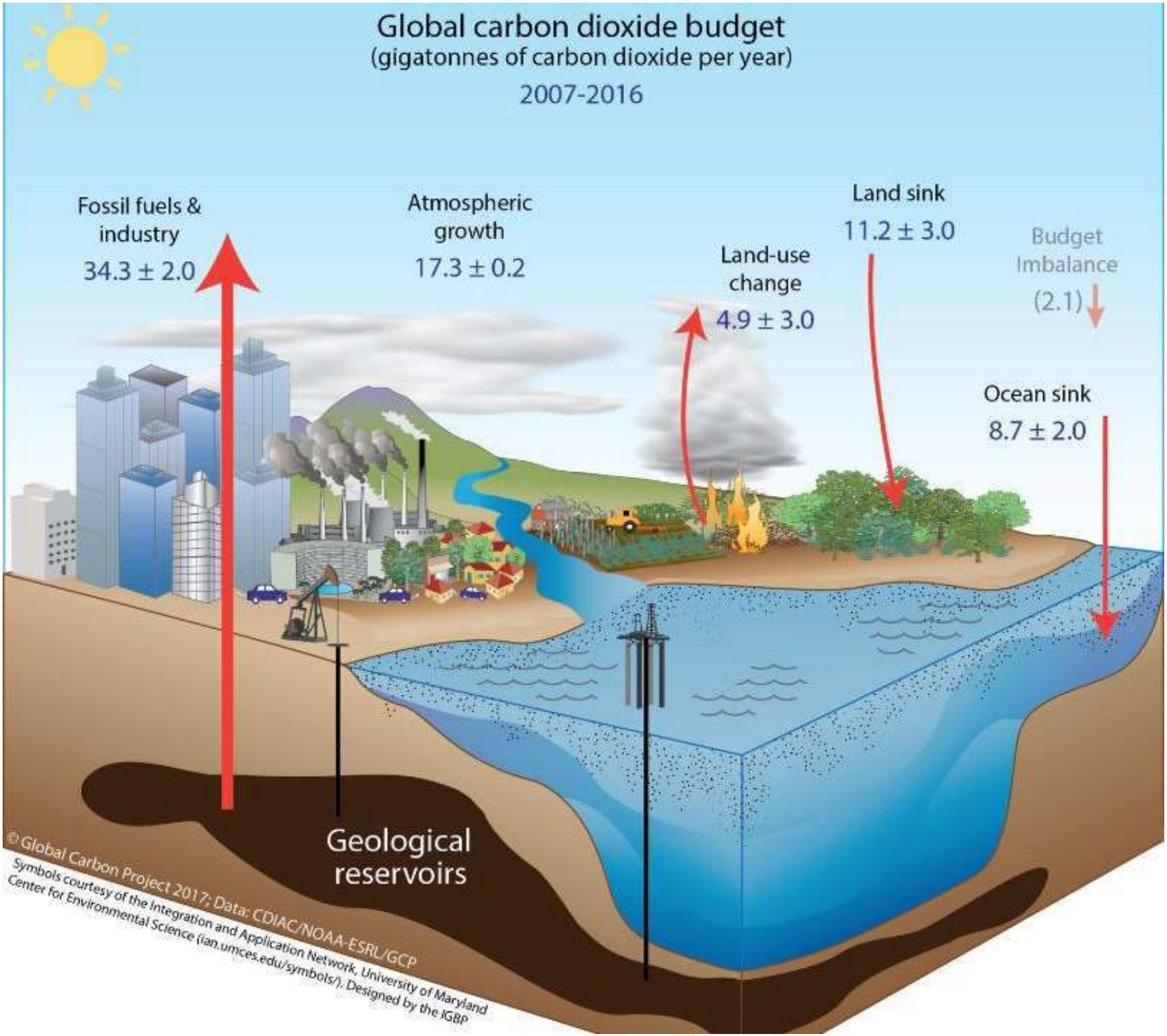
1. Why Carbon action?
2. What kind of scientific research in Carbon Action?

Latest CO_2 reading
May 19, 2018

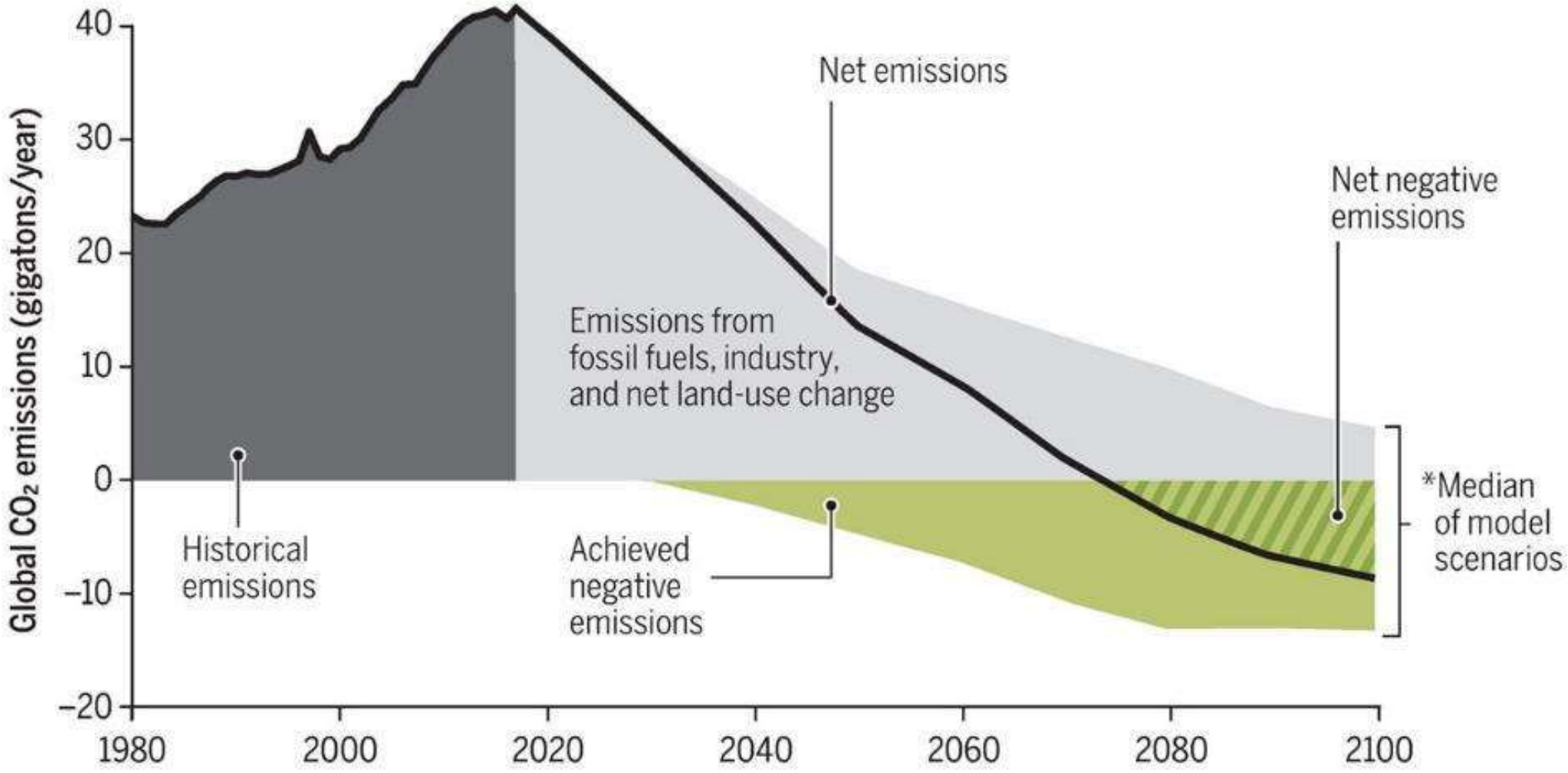
412.24 ppm




Global carbon dioxide budget
(gigatonnes of carbon dioxide per year)
2007-2016
Fossil fuels & industry
34.3 ± 2.0
Atmospheric growth
17.3 ± 0.2
Land-use change
4.9 ± 3.0
Land sink
11.2 ± 3.0
Budget Imbalance
(2.1)
Ocean sink
8.7 ± 2.0
Geological reservoirs
© Global Carbon Project 2017; Data: CDIAC/NOAA-ESRL/GCP
Symbols courtesy of the Integration and Application Network, University of Maryland Center for Environmental Science (ian.umces.edu/symbols/). Designed by the IGBP

A global unwinding

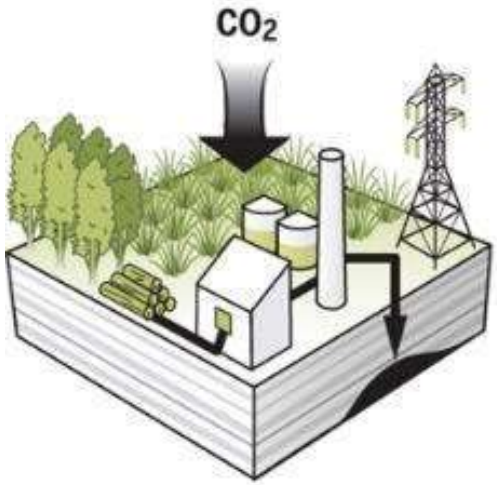
In order to prevent the world from warming more than 2°C, models count on the fast development of NETs. But many scientists question whether they can be scaled up in time.



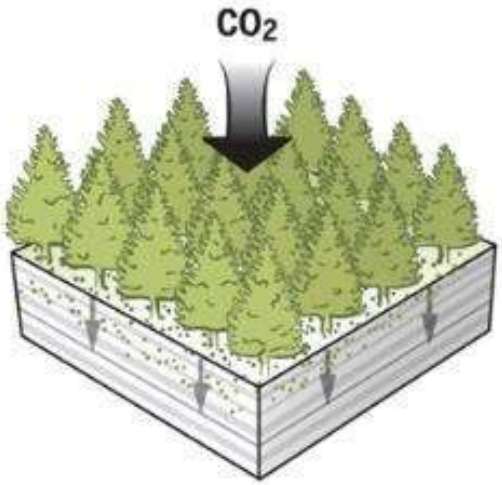
*Median values at 10-year time steps of 18 scenarios evaluated by six models using shared socioeconomic pathways assessed in the next report of the Intergovernmental Panel on Climate Change.

Rosen. 2018. Science.

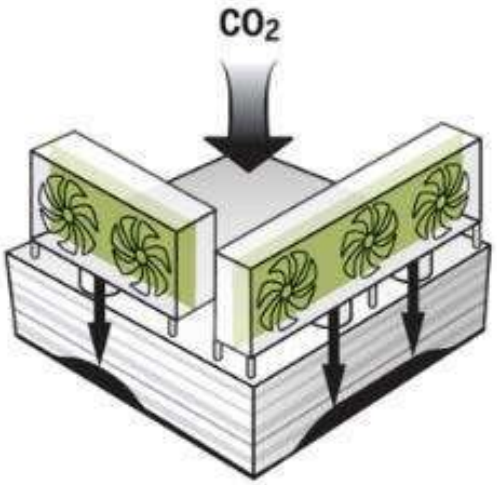
Six ways to pull CO_2 out of the air



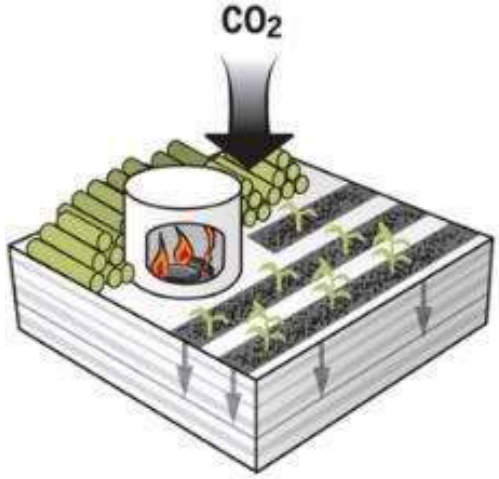
BECCS
Fast-growing plants are harvested and burned to make energy. Exhaust carbon is captured and piped underground.



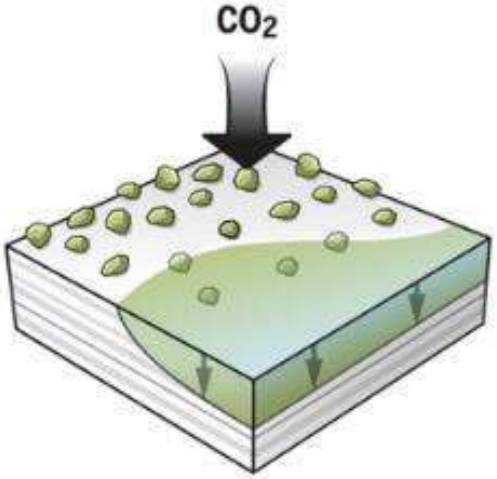
Forestation
Planted trees capture CO_2 as they grow. The carbon remains sequestered as long as forests are not cut down.



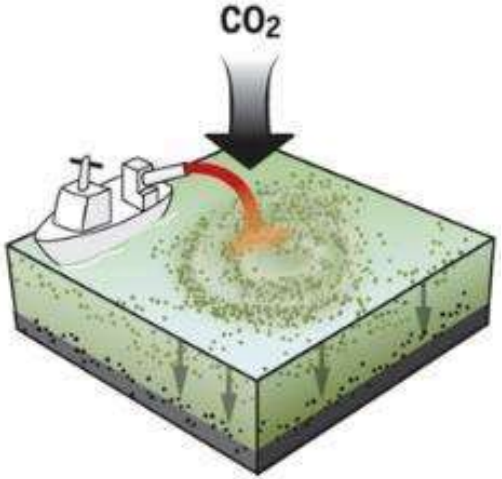
Direct air capture
CO_2 in air selectively "sticks" to chemicals in filters. Filters are reused after releasing pure CO_2, which can be stored underground.



Biochar and soil sequestration
Charring biomass stores carbon in soil by making it resistant to decomposition. Altered tilling practices also enhance CO_2 storage.

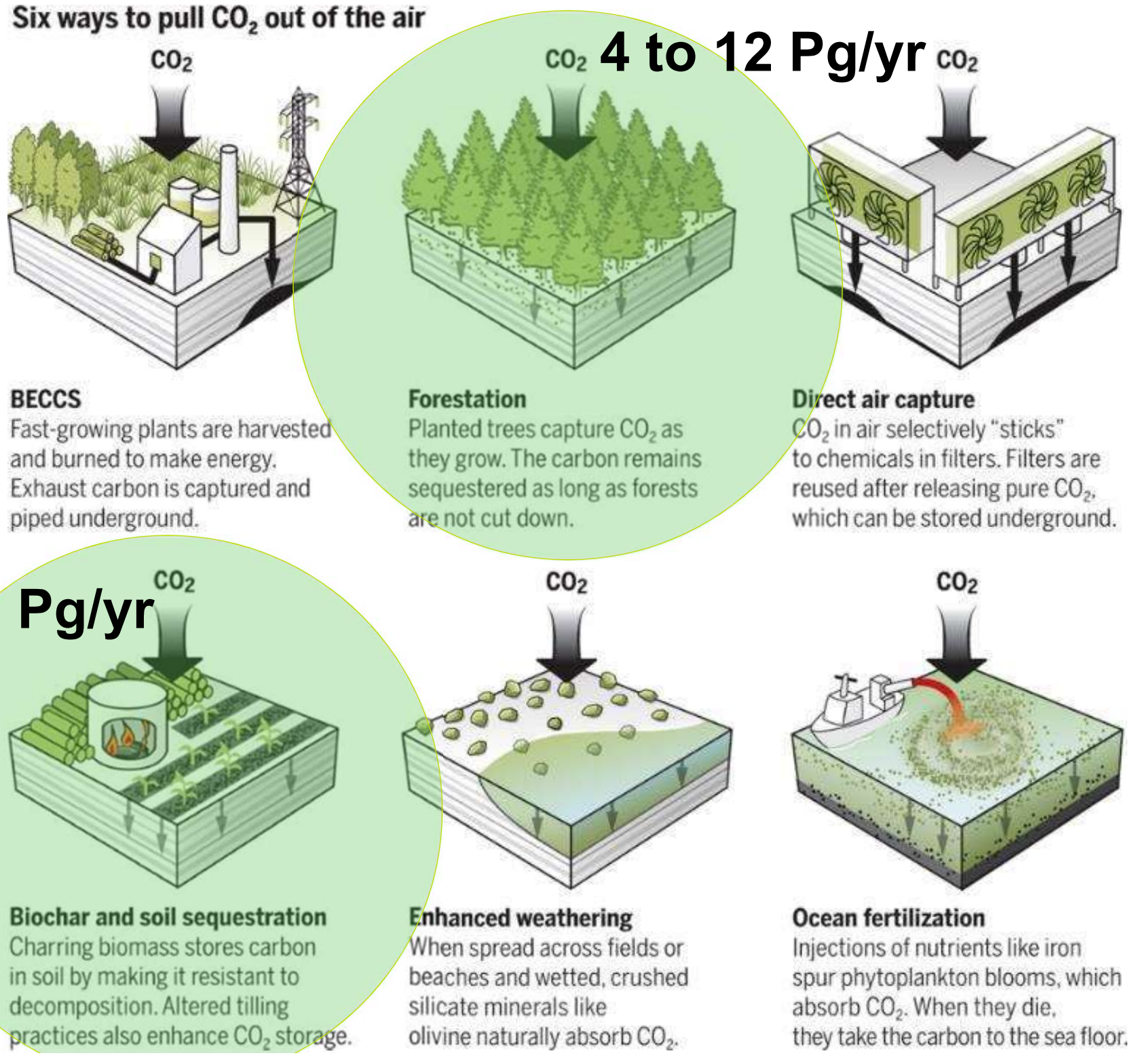


Enhanced weathering
When spread across fields or beaches and wetted, crushed silicate minerals like olivine naturally absorb CO_2.



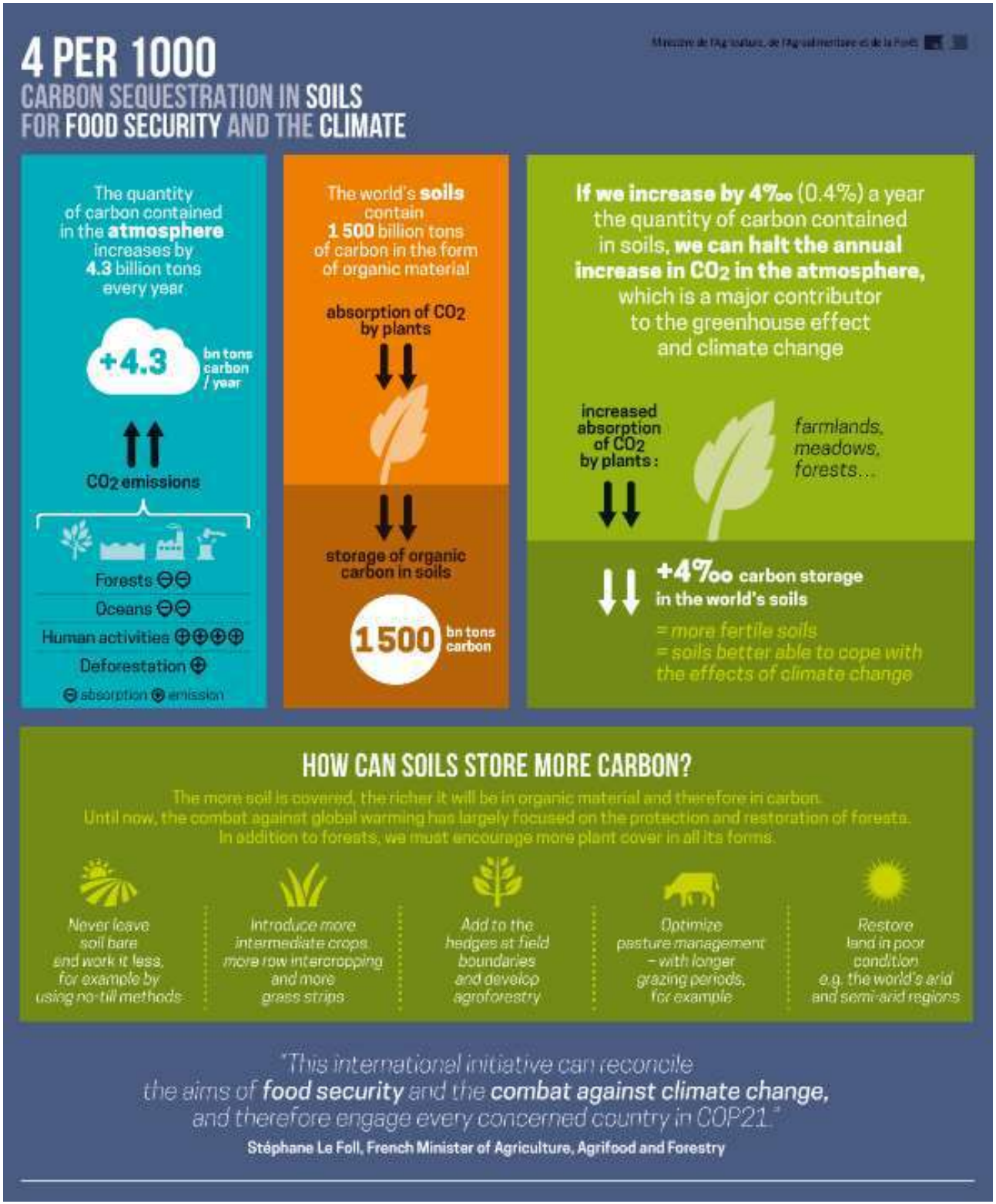
Ocean fertilization
Injections of nutrients like iron spur phytoplankton blooms, which absorb CO_2. When they die, they take the carbon to the sea floor.

Rosen. 2018. Science.



Rosen 2018
EASAC 2018

= Ca. 17 Pg CO2


4 PER 1000
CARBON SEQUESTRATION IN SOILS
FOR FOOD SECURITY AND THE CLIMATE
The quantity of carbon contained in the atmosphere increases by 4.3 billion tons every year
+4.3
bn tons carbon / year
CO2 emissions
Forests
Oceans
Human activities
Deforestation
absorption
emission
The world's soils contain 1 500 billion tons of carbon in the form of organic material
absorption of CO2 by plants
storage of organic carbon in soils
1500
bn tons carbon
If we increase by 4‰ (0.4%) a year the quantity of carbon contained in soils, we can halt the annual increase in CO2 in the atmosphere, which is a major contributor to the greenhouse effect and climate change
increased absorption of CO2 by plants :
farmlands, meadows, forests...
+4‰ carbon storage in the world's soils
= more fertile soils
= soils better able to cope with the effects of climate change
HOW CAN SOILS STORE MORE CARBON?
The more soil is covered, the richer it will be in organic material and therefore in carbon.
Until now, the combat against global warming has largely focused on the protection and restoration of forests.
In addition to forests, we must encourage more plant cover in all its forms.
Never leave soil bare and work it less, for example by using no-till methods
Introduce more intermediate crops, more row intercropping and more grass strips
Add to the hedges at field boundaries and develop agroforestry
Optimize pasture management – with longer grazing periods, for example
Restore land in poor condition e.g. the world's arid and semi-arid regions
"This international initiative can reconcile the aims of food security and the combat against climate change, and therefore engage every concerned country in COP21."
Stéphane Le Foll, French Minister of Agriculture, Agrifood and Forestry

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Climate-smart soils

Science and technology

Basic research on soil–plant processes

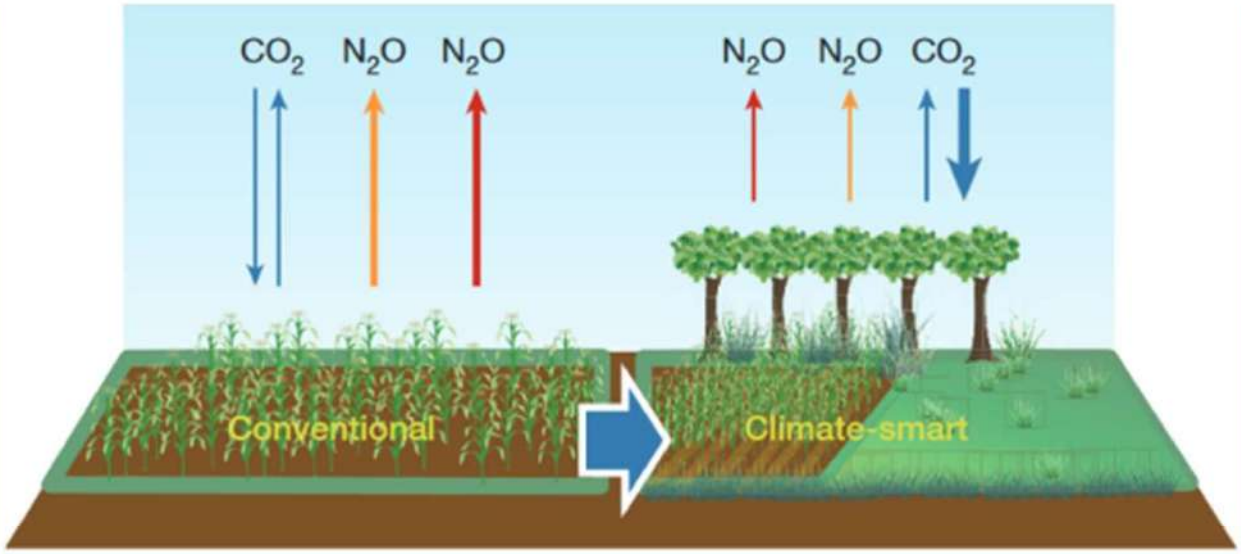
Research measurement networks

Soil monitoring networks

Advanced greenhouse gas networks

Remote sensing

Spatial databases and model integration



Practices

Reduced tillage

Biochar

Land restoration

Improved crop rotations

Organic amendments

Nutrient management

Cover crops

Agroforestry

Implementation

National and international greenhouse gas mitigation programme

Greenhouse gas offset and ecosystem service markets

Agricultural product supply chain management

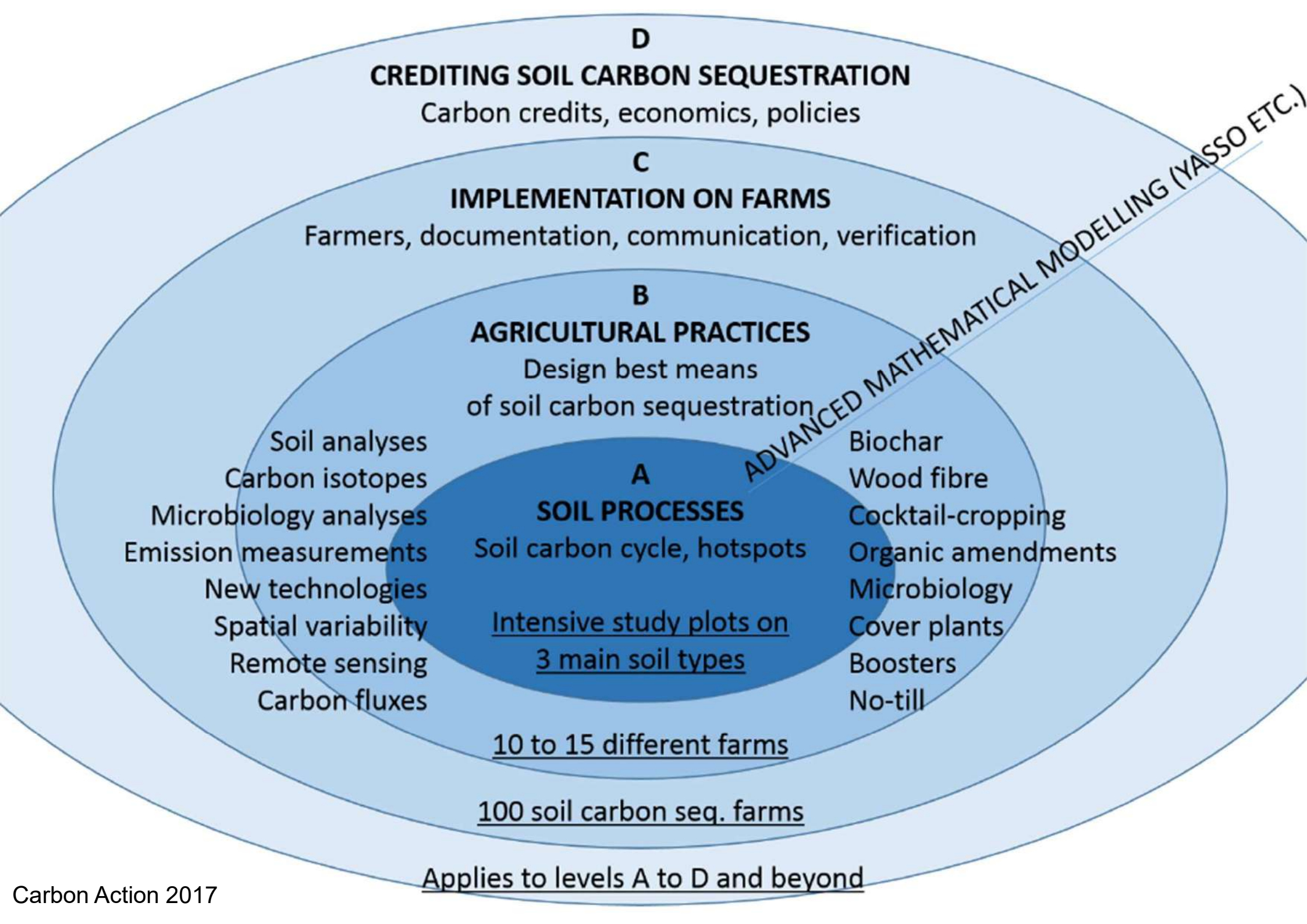
Decision-support systems

Land-user engagement

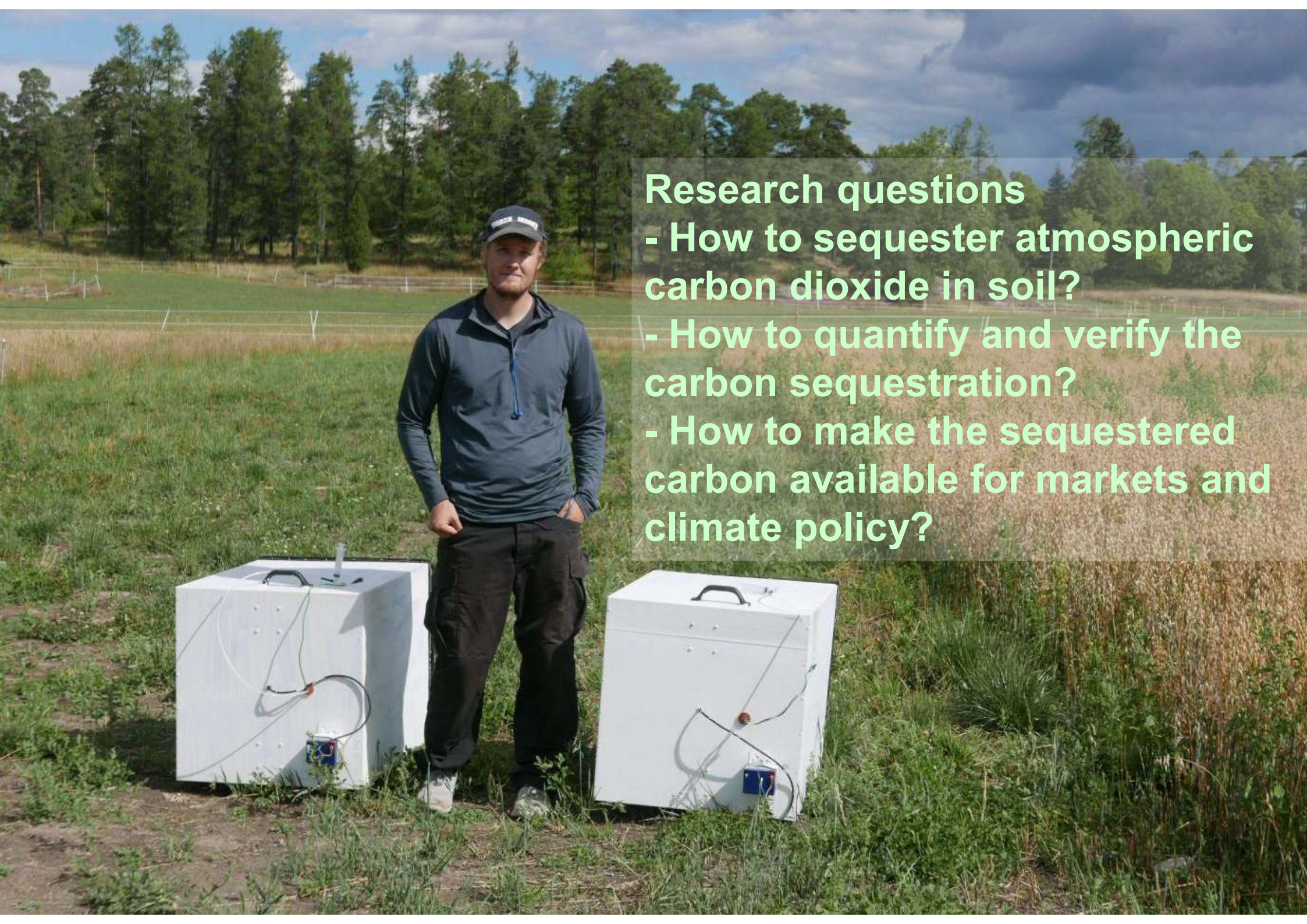
"*Expanding the role of agricultural soil GHG mitigation will require an integrated research support and implementation platform*"

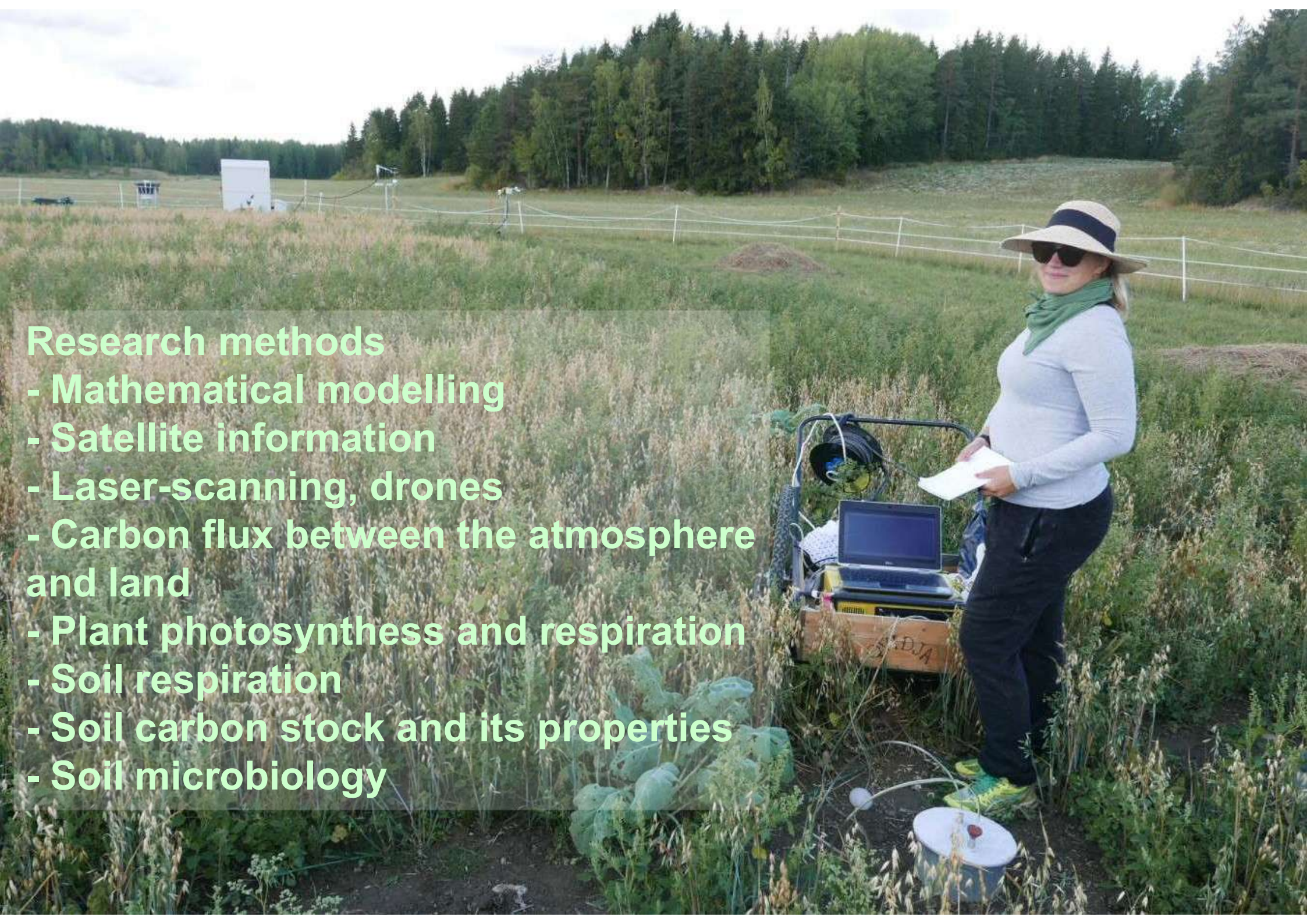
Paustian et al. 2016. Nature.


CARBON
ACTION
CLIMATE - SOIL - BALTIC SEA



Carbon Action 2017


Research questions
- How to sequester atmospheric carbon dioxide in soil?
- How to quantify and verify the carbon sequestration?
- How to make the sequestered carbon available for markets and climate policy?

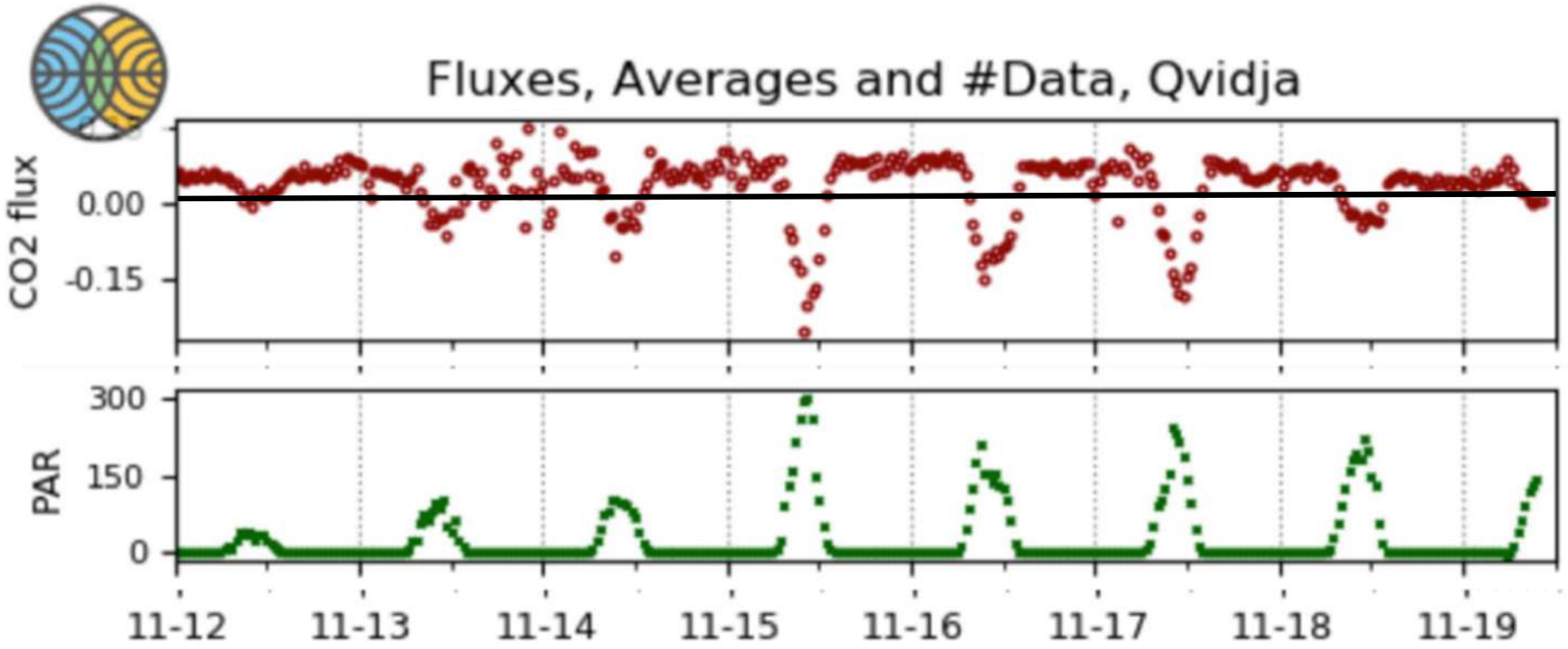

Research methods
- Mathematical modelling
- Satellite information
- Laser-scanning, drones
- Carbon flux between the atmosphere and land
- Plant photosynthess and respiration
- Soil respiration
- Soil carbon stock and its properties
- Soil microbiology

Quantification system of carbon sequestration

- Quantification system of carbon sequestration is needed for making the carbon units available for markets and climate policy

- Scientifically valid, generally approved, reliable and quantitative estimates for ordinary farms

Carbon balance of a Finnish grass field over a week

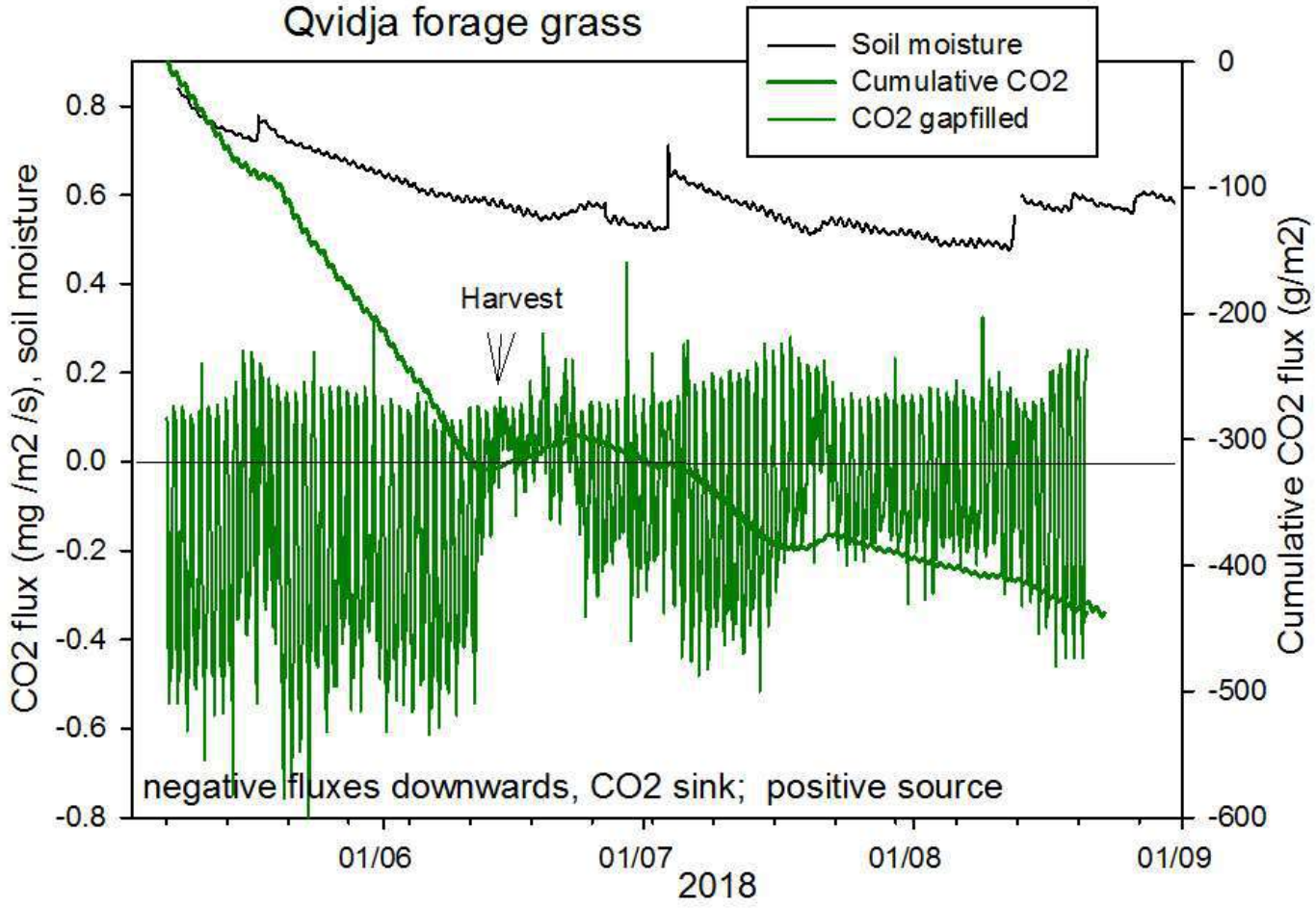


Source

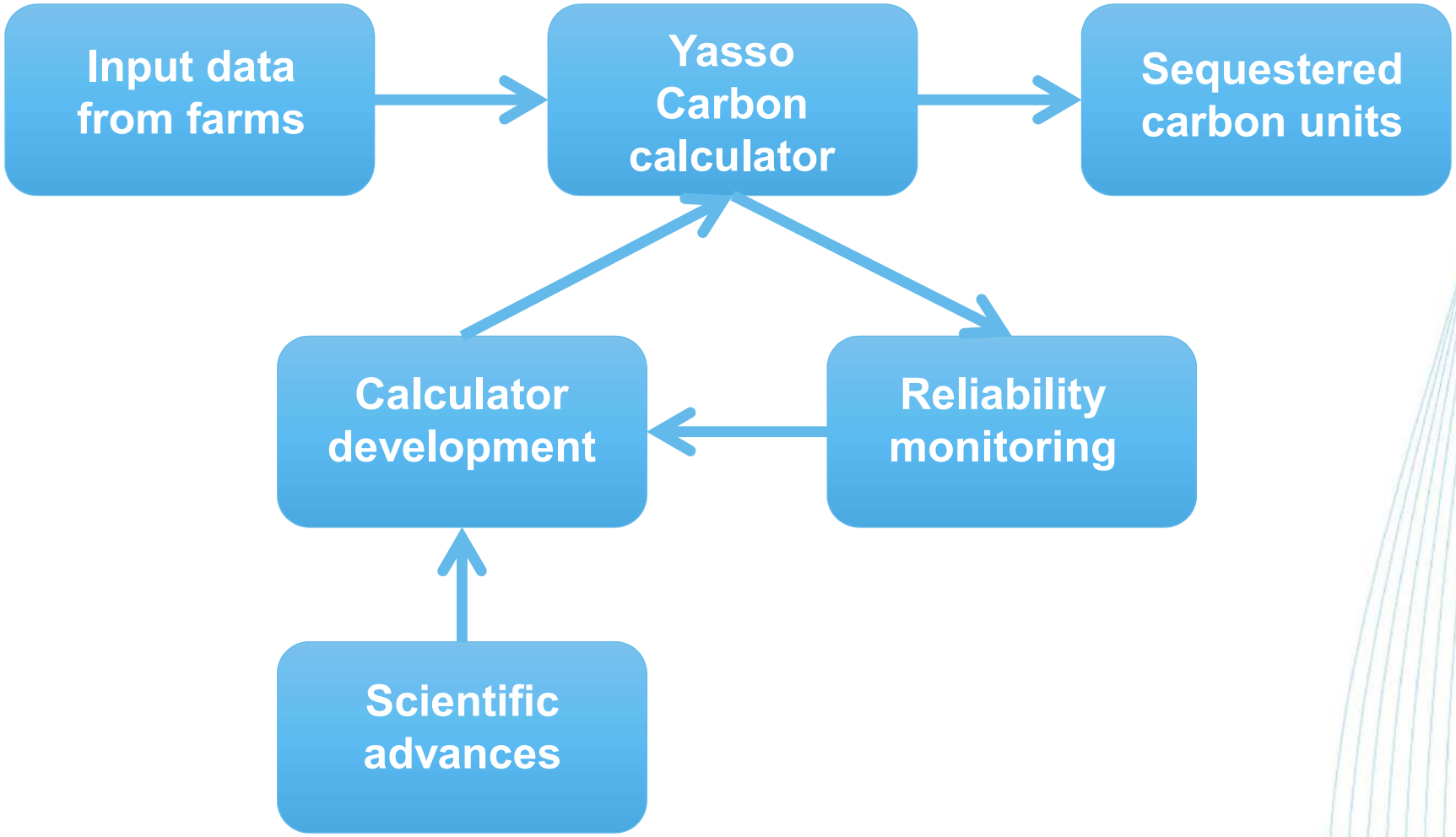
Sink

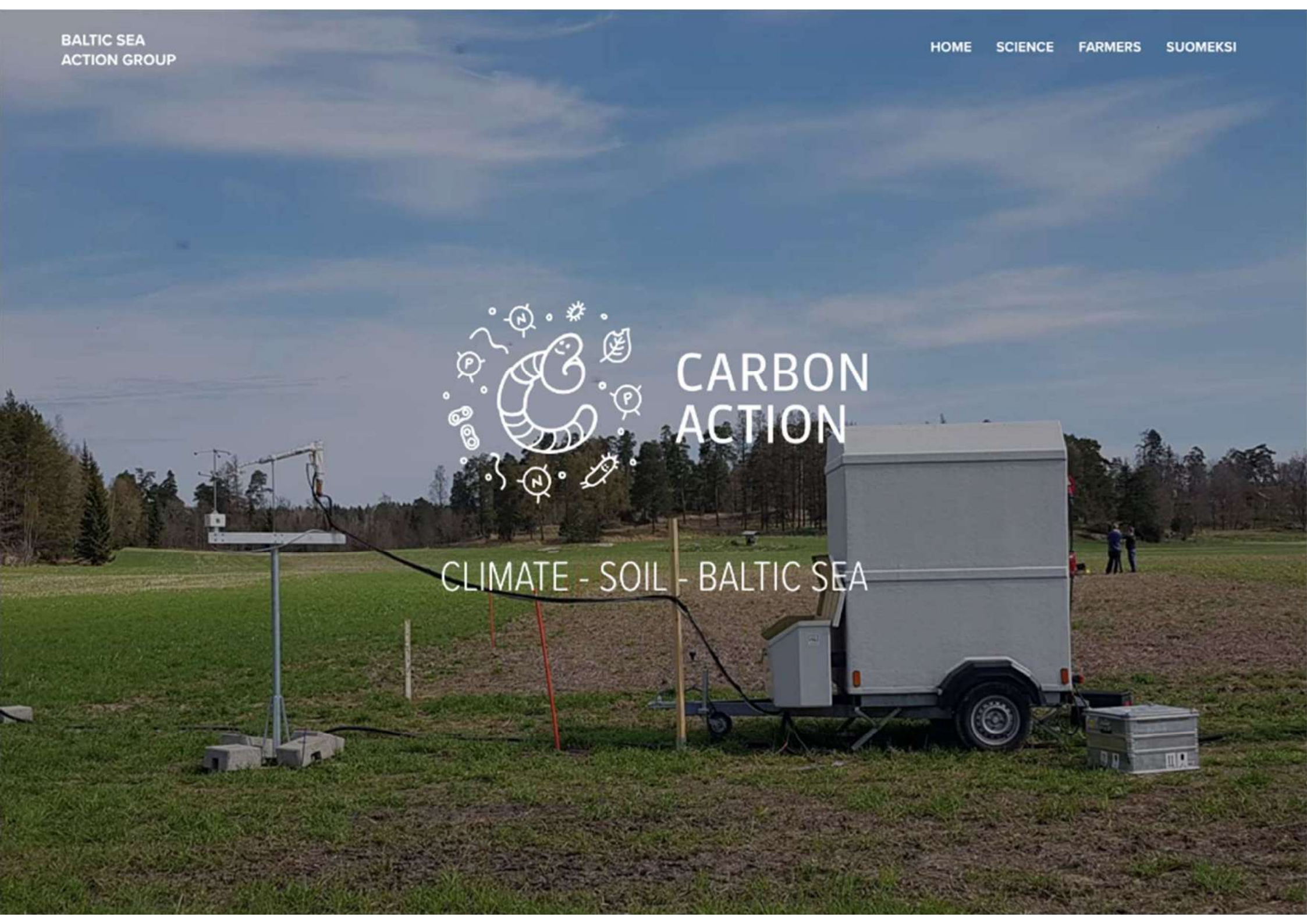
Radiation

Carbon sequestration of a Finnish grass field



Quantification system of carbon sequestration





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