NARO

APEC WS ＠Trujillo
17 August 2024

Modelling soil carbon for domestic GHG inventory, NDCs, and decision-support tool

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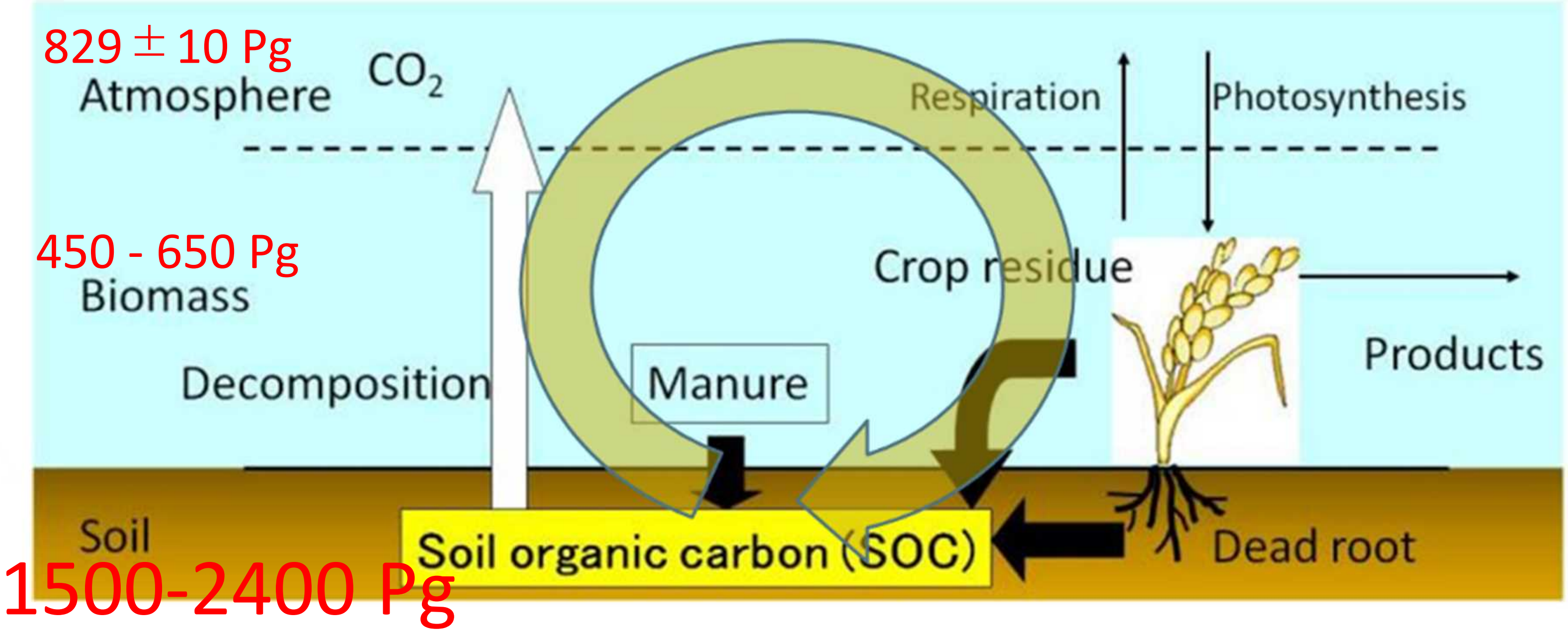
Soil carbon (C) sequestration & climate change mitigation



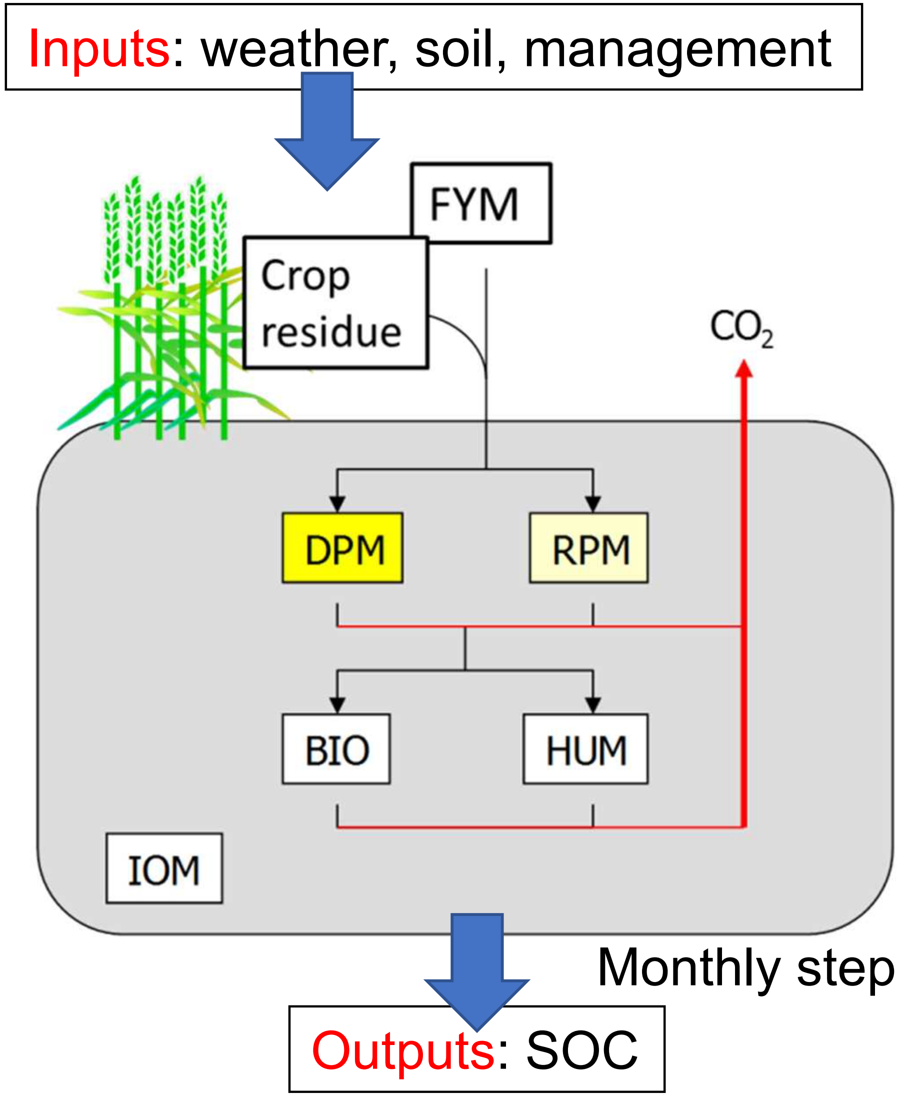
- "Carbon" accumulated as dark-colored "soil organic matter": Important index of productivity
- Size of soil C pool is huge.

"The 4 per 1000 initiative" for soil C sequestration

Storing C in soils has huge potential to mitigate increase in atmospheric CO_2 and contribute to sustainable food production

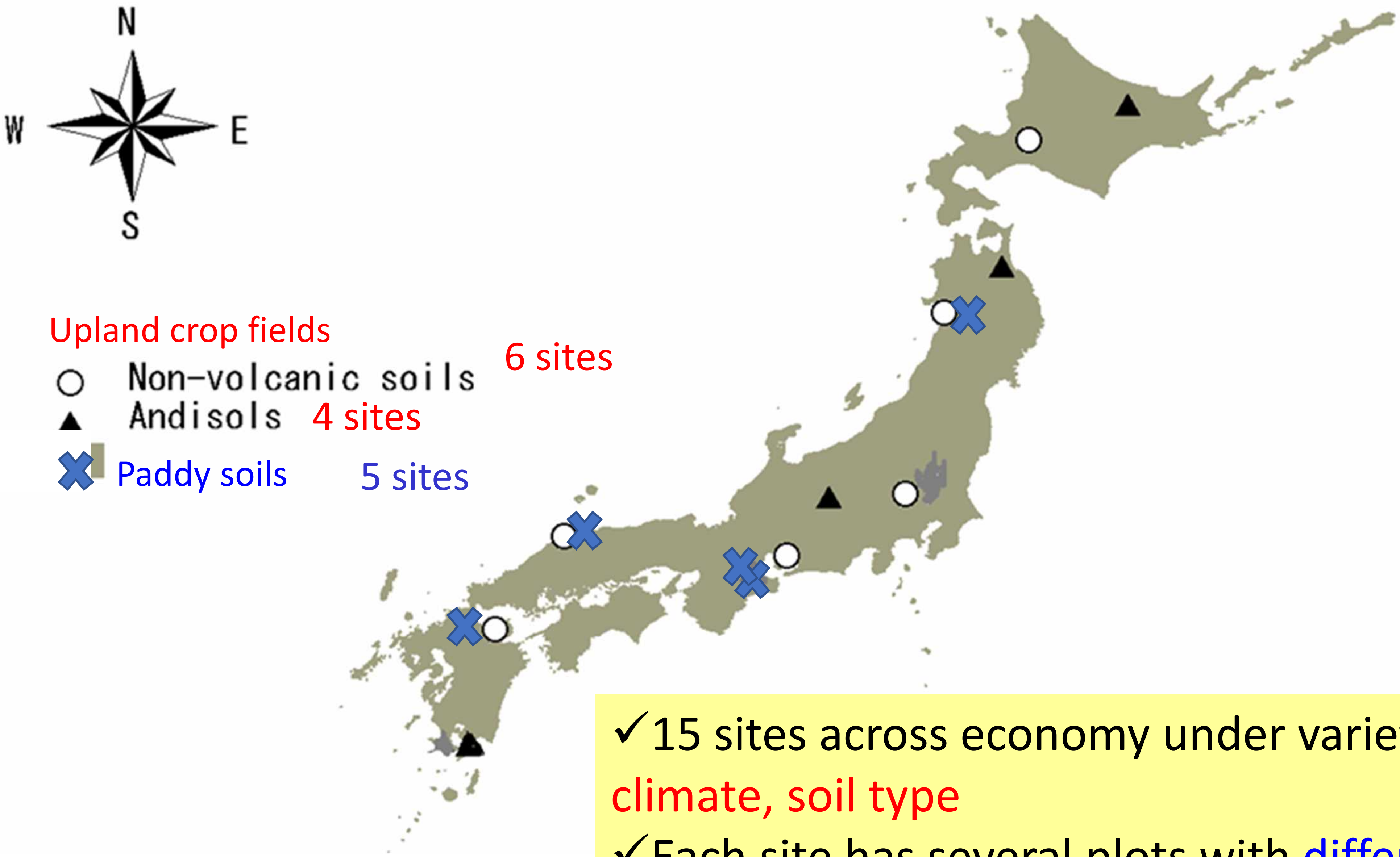
Soil C model: useful tool for future prediction and spatial evaluation

Rothamsted Carbon (RothC) model



- One of widely used soil C models developed in UK.
- Simpler structure has advantage for model modification
- Not validated in Japan

Long-term experiments for model validation



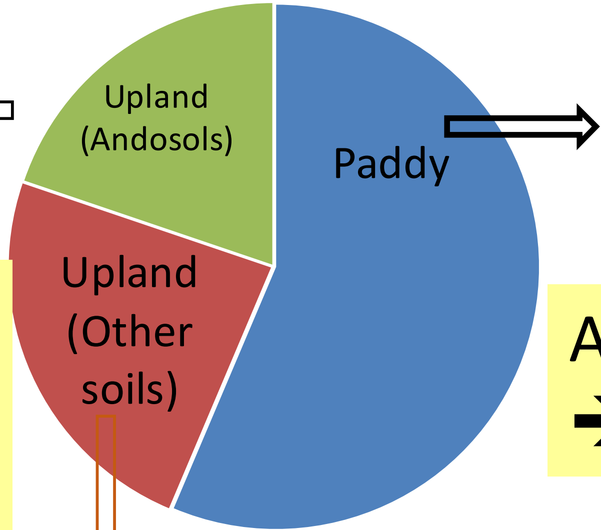
✓15 sites across economy under variety of climate, soil type

✓Each site has several plots with different management (NPK, manure, straw, etc.)

Validation and modification of the RothC: Japanese version

Andosols

Arable soils: ~500 million ha



Paddy soils

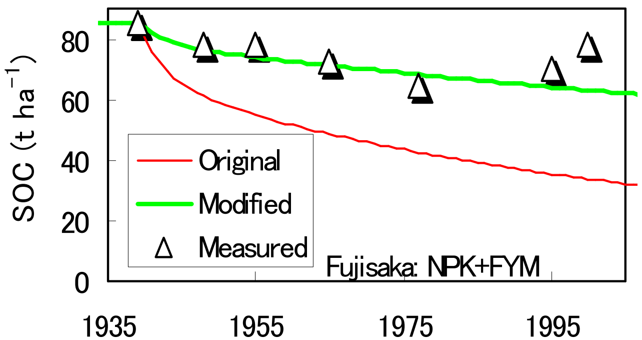
Stable humus with active Al
➔Slow decomposition of "HUM" pool

Anaerobic condition
➔Slow decomposition

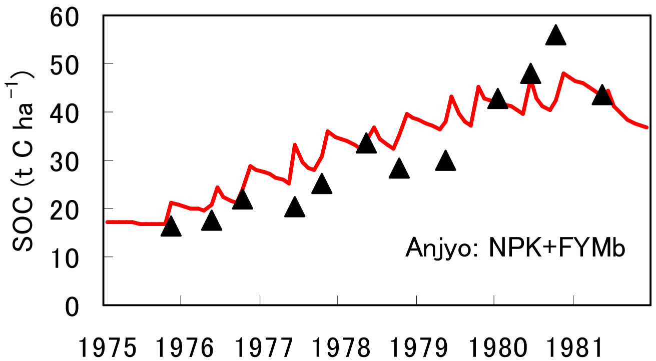
Modified model

Original RothC: successful

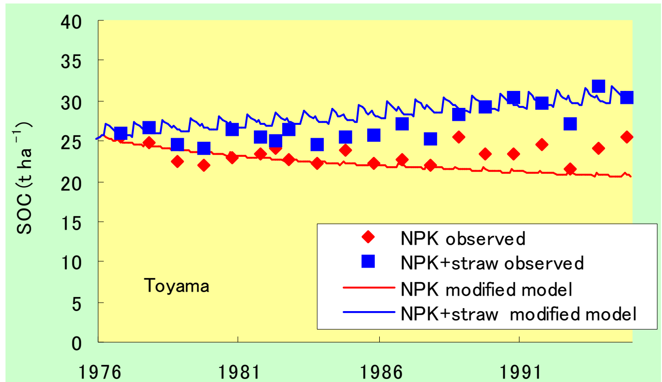
Modified model



(Shirato et al., 2004)



(Shirato & Taniyama, 2003)

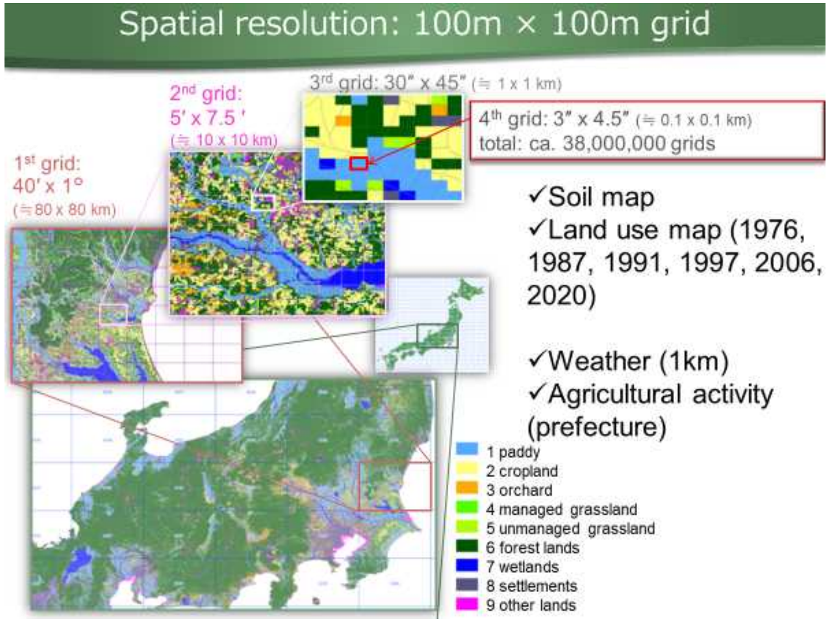


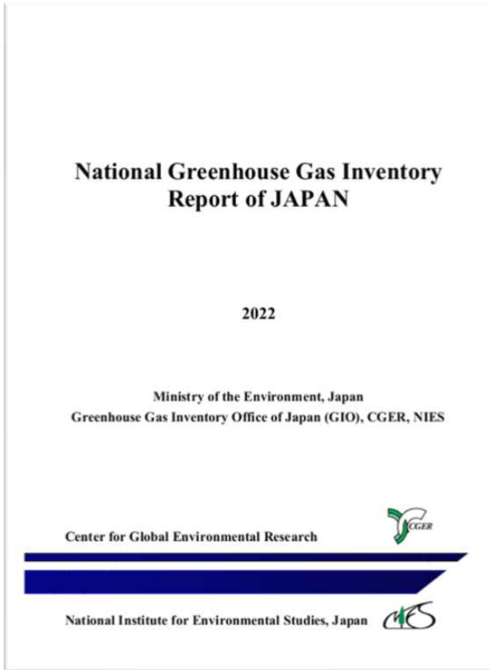
(Shirato & Yokozawa, 2005)

➔Economy-level soil C calculation system by using 3 versions

Japan uses soil C model for GHG inventory and NDC

- IPCC tier 3 method (modelling): Effective for taking more detailed environmental conditions into account
- Used for developing NDC (future projection)





- Models are effective also to consider trade-off

Trade-off: need to evaluate total Global Warming Potential (GWP)

e.g. Increase C inputs to soils

Soil C increase
(CO_2 decrease)

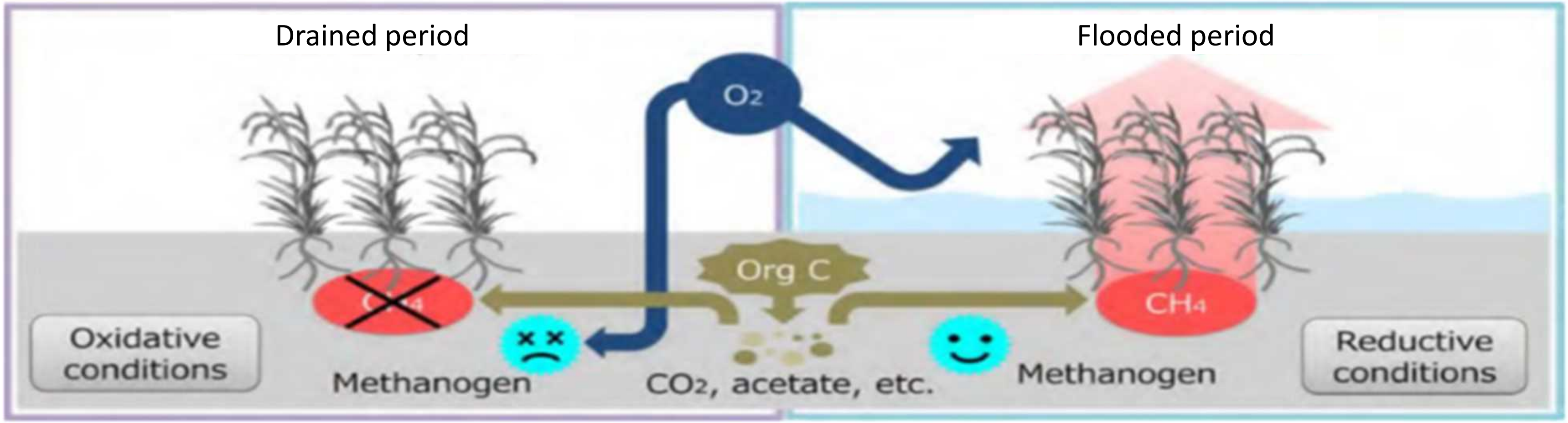
Trade-off

Total GWP?

CH_4 and N_2O
increase

- Evaluating total GHGs (GWP) considering “Trade- off”.
- GWP (CO2=1, CH4=25, N2O=298)

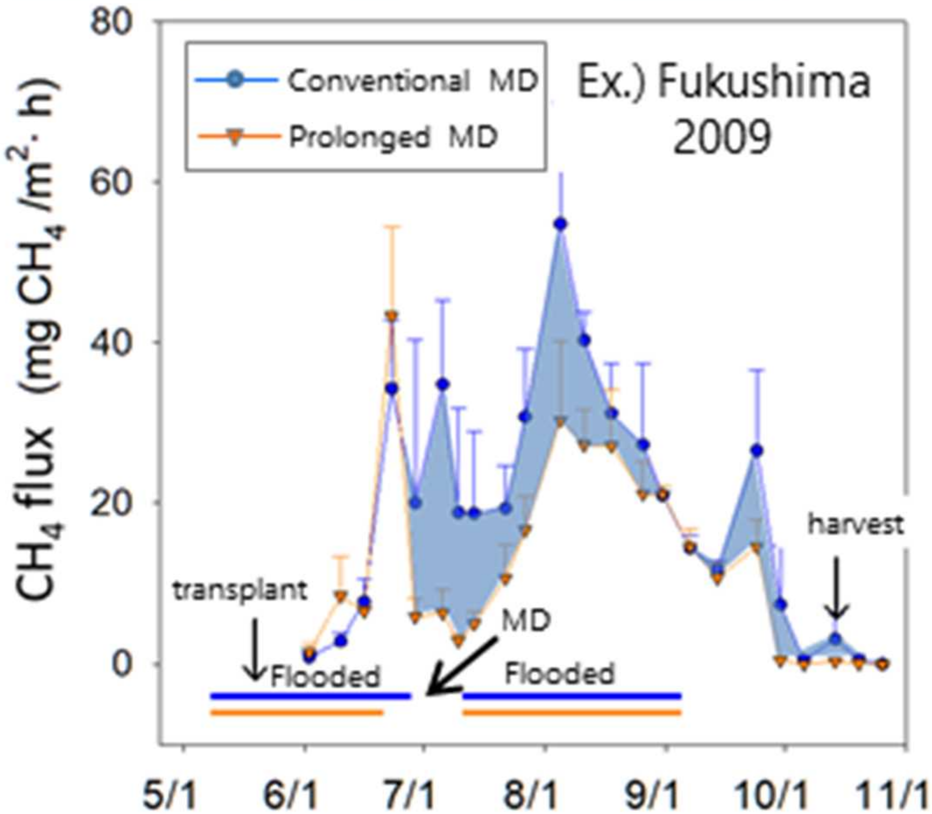
GHG mitigation from paddy field by water management



Mid-Season drainage (MD) in Japan

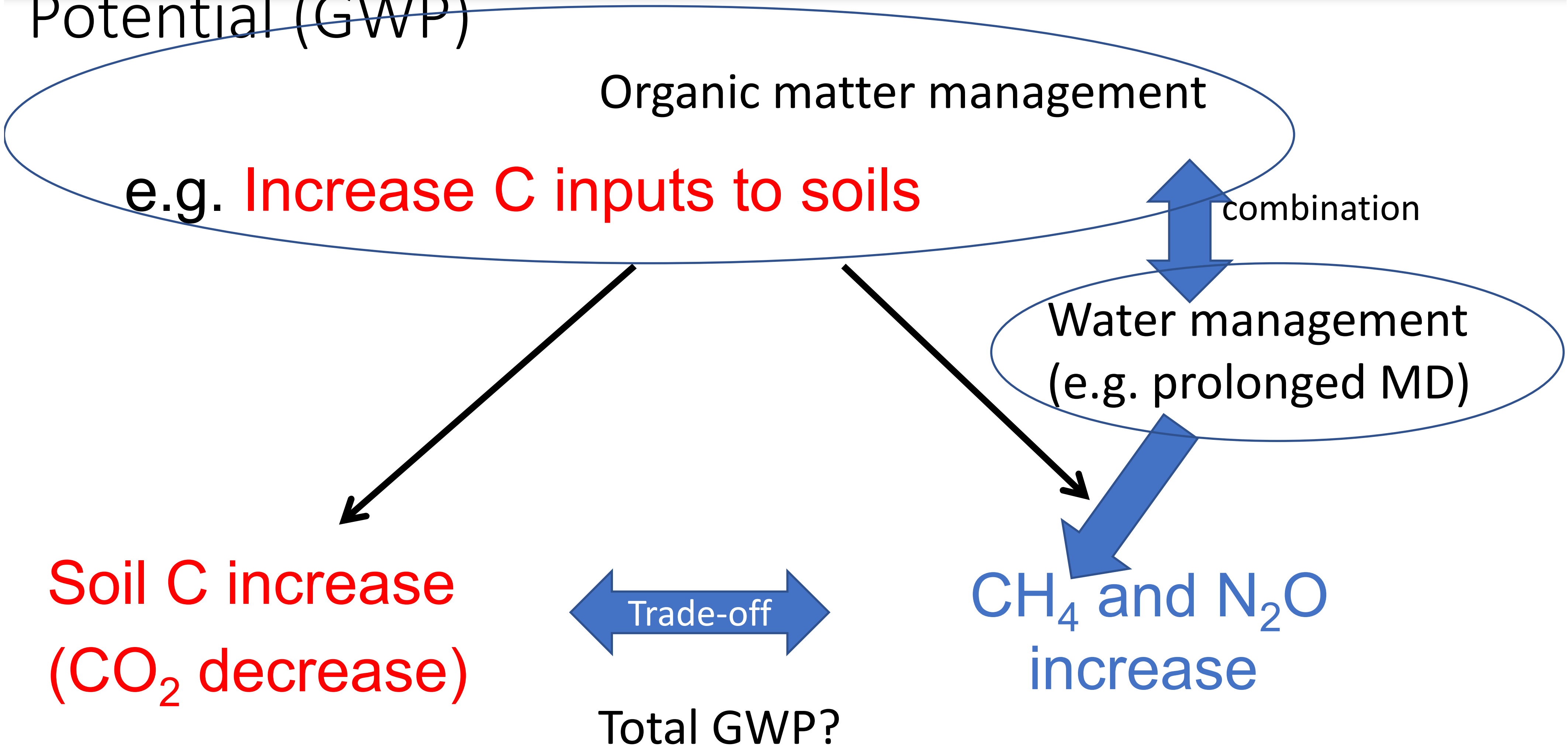
Drain water for 1~2 weeks

Prolonged MD (1 week longer than conventional) can reduce 30% of CH_4 emission without negative effect on yield.



Ito et al. (2011)

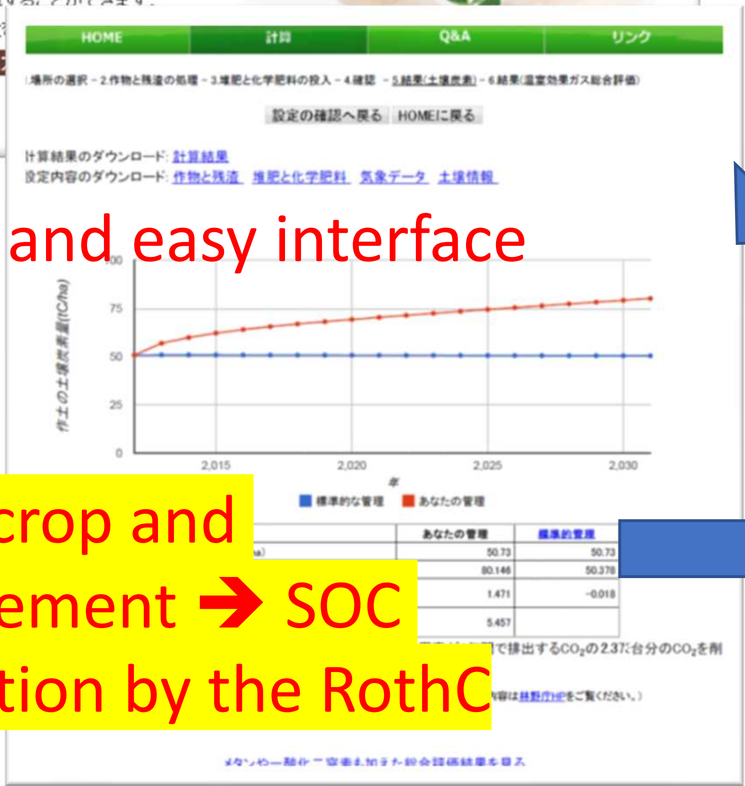
Trade-off: need to evaluate total Global Warming Potential (GWP)



- Evaluating total GHGs (GWP) considering “Trade- off”.
- GWP (CO2=1, CH4=25, N2O=298)

Web-based decision-support tool visualizing soil C and GHGs emission

Click on map to get weather and soil data of the field



Simple and easy interface

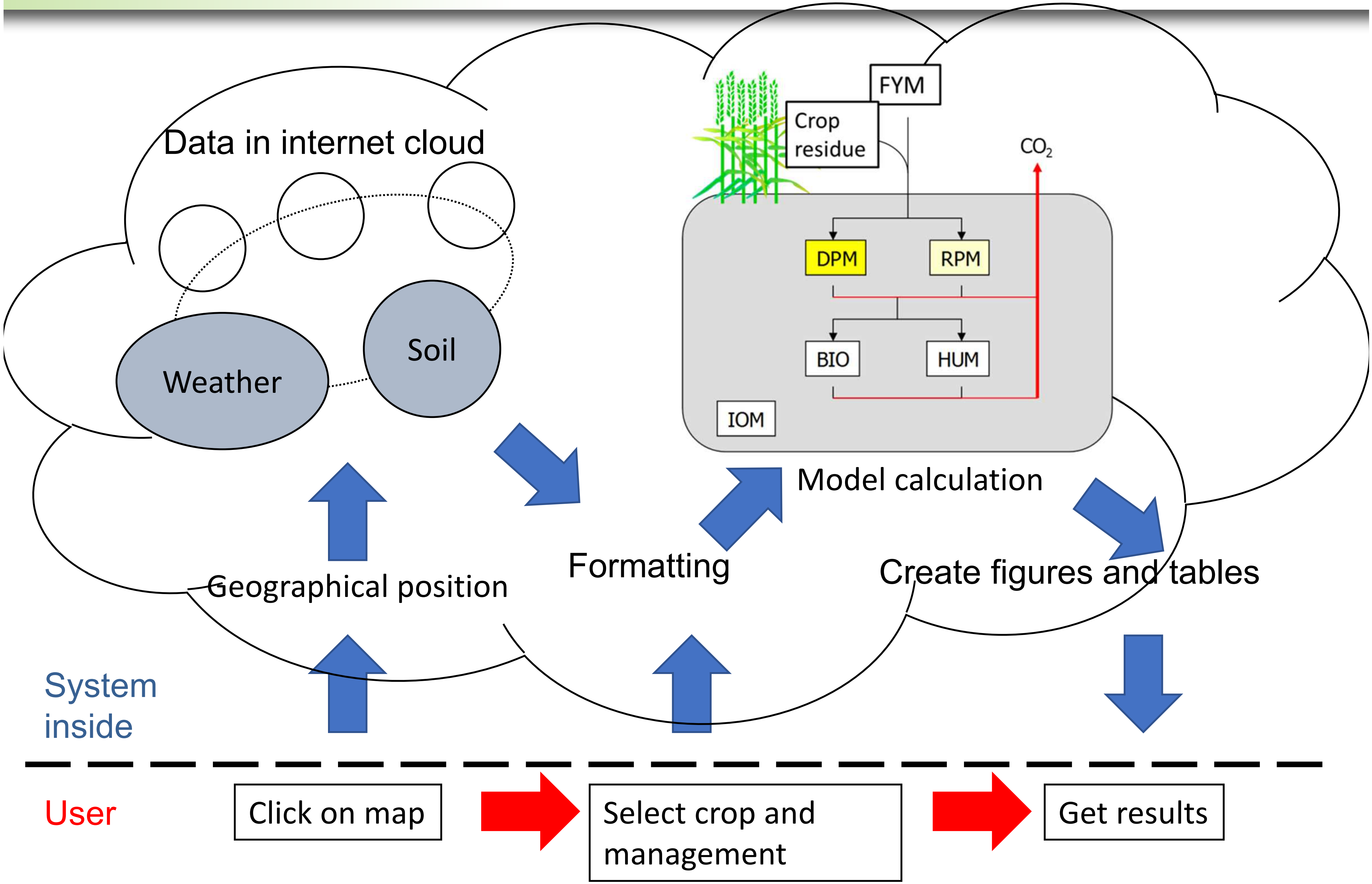
Select crop and management ➔ SOC calculation by the RothC

	あなたの管理	標準的管理
土壌炭素の増減によるCO₂(tCO₂/ha/年)(プラスが排出。マイナスが吸収)	-3.34	0.5
メタン(g-CH₄/m²/年)	10.00	10.00
CO₂換算(tCO₂/ha/年)	3.40	3.40
N₂O(kg-		0.07
CO₂換		0.20
うち化学		0.02
CO₂換算(tCO₂/ha/年)	0.05	0.05
うち堆肥由来(kg-N₂O/10a)	0.08	0.01
CO₂換算(tCO₂/ha/年)	0.23	0.03
うち作物残渣由来(kg-N₂O/10a)	0.04	0.04
CO₂換算(tCO₂/ha/年)	0.11	0.11
化石燃料由来のCO₂(tCO₂/ha/年)	2.02	2.02
合計(tCO₂/ha/yr)(プラスが排出。マイナスが吸収)	2.47	6.12

Total GWP calculation, too

https://soilco2.rad.naro.go.jp/

How it works



Data in internet cloud
Weather
Soil
FYM
Crop residue
CO_2
DPM
RPM
BIO
HUM
IOM
Model calculation
Geographical position
Formatting
Create figures and tables
System inside
User
Click on map
Select crop and management
Get results

Asian Network of long-term experiments

Highlight the importance of long-term field monitoring

ALTENA
Asian Long-Term Experimental Network for Agriculture

Since 2017


NARO-MARCO International Symposium

Soil Carbon Sequestration: needs and prospects under the 4 per 1000 initiative

✓Tuesday, February 28, 2017 10 am - 5 pm
✓Tsukuba International Congress Center (Ibaraki, Japan)

Program

[Keynote]
10:10 Claire CHENU
Chair of Soil Science, AgroParisTech/INRA, FRANCE
Background and current status of 4 per mil initiative, Current understanding of soil C sequestration in agricultural lands and future directions

10:55 Minggang XU
Deputy Director General, IARRP, CAAS, CHINA
Soil carbon sequestration in arable land of China based long-term field experiments

11:20 Suphakarn LUANMANEE
Director, DOA, MOAC, THAILAND
Effect of long-term fertilizer application and cropping management on changing of soil properties

11:45 Srinivasa Rao CHERUKUMALLI
Director, ICAR-CRIDA, INDIA
Long-term field experiments in India: current status & future directions

1:30 Hideo KUBOTERA
CARC/NARO, JAPAN
Long-term field experiments with organic matter application in Japanese paddy and upland fields

1:50 Shoji MATSUURA
NIAES, JAPAN
Long-term field experiments for soil carbon monitoring in Japanese grasslands

2:10 Yasuhito SHIRATO
NIAES, JAPAN
Validation and modification of soil carbon models against long-term experiments in Japanese agricultural soils

2:30 Jagadeesh YELURIPATI
The James Hutton Institute, UK
Analysis of factors controlling soil organic matter dynamics as affected by management practices: A model inter-comparison study

3:30 Akihiko ITO
NIES, JAPAN
Soil carbon modeling and climate change: knowledge gaps

4:00 Mayumi YOSHIMOTO
NIAES, JAPAN
MINCERnet: International research network to support the fight against heat stress of rice

4:20 Summary and Discussion (led by Rota WAGAI, NIAES, JAPAN)

✓Register Online
https://pursue.dc.affrc.go.jp/form/fm/naro192/soilc
FREE AND OPEN TO THE PUBLIC

More information:
Institute for Agro-Environmental Sciences, NARO
NARO-MARCO Symposium Office E-mail: marco@ml.affrc.go.jp

- Most of studies published on long-term field experiments are from Europe and north America.
- Not many from Asia. Networking long-term experiments in Asian economies can add new value.
- Enormous variation in climate, soil type, and cultural practices.

Summary

- Soil C model is useful: plot scale validation and modification ➔spatial evaluation and future prediction➔ NIR and NDC
- Important to consider Trade off (e.g. soil C vs. CH4)
- Visualization of soil C and GHGs: web-based decision support tool by using models.
- Primary data (e.g. long-term field experiments) are basis for all above.

Soils can save the earth!