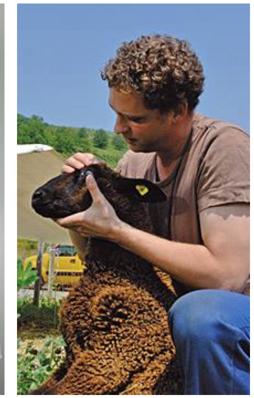
FiBL

EXCELLENCE FOR SUSTAINABILITY

Research Institute of Organic Agriculture
Forschungsinstitut für biologischen Landbau
Institut de recherche de l’agriculture biologique



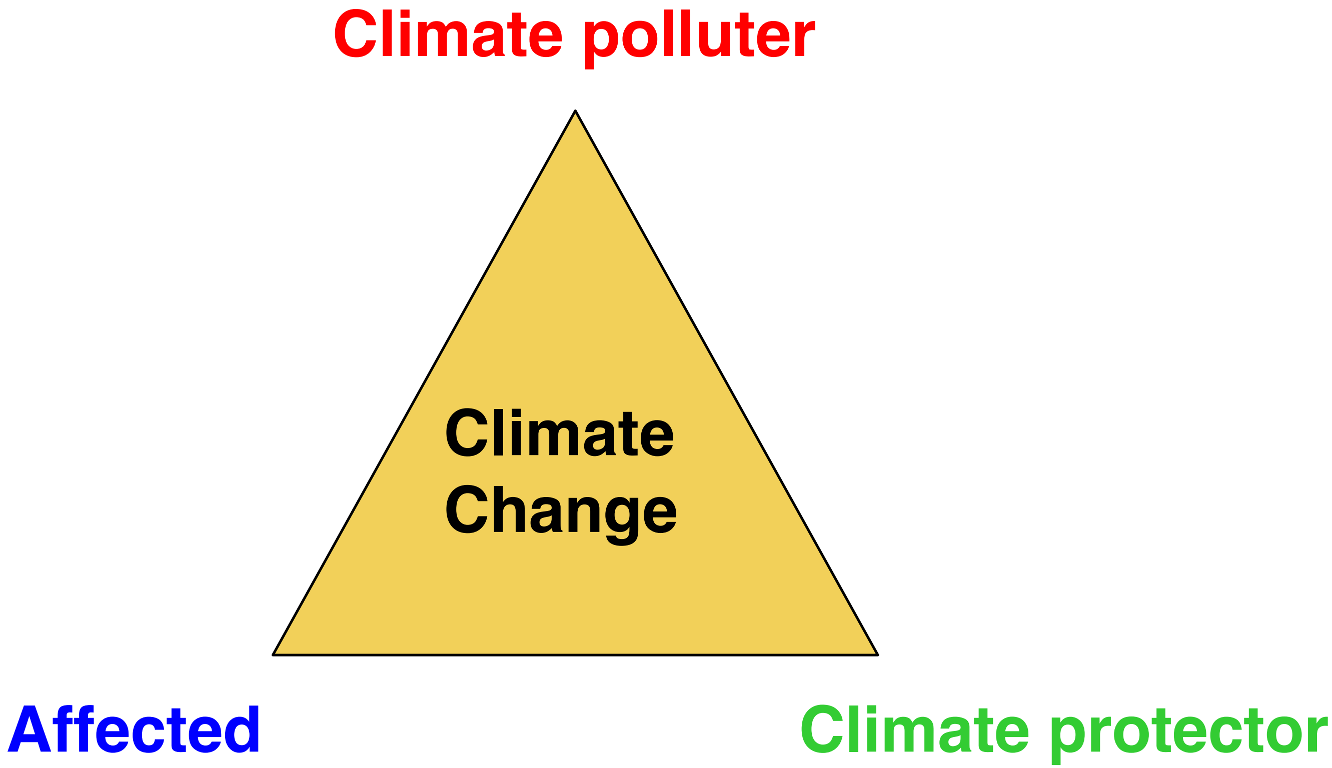
The climate relevance of organic farming systems – what do we know?

Andreas Gattinger

andreas.gattinger@fibl.org

Round Table on Organic Agriculture and Climate Change

The manifold role of agriculture regarding climate change



Organic Farming and Climate Change at FiBL Focus: Emission reduction

Information/Dissemination:
Bio-Sektor, Verbände, Betriebe

Scientific Basis:
- **Feldmessungen**
- **Reviews/Meta-Analysen**
- **Prozessmodellierungen**
- **Betriebserhebungen**

Process and system knowledge, Climate balance

Implementation:
- **Klima-Betriebsmodell**
- **SMART**
- **carbon-offset Methodologien**
- **politische Fördermassnahmen**

Contents

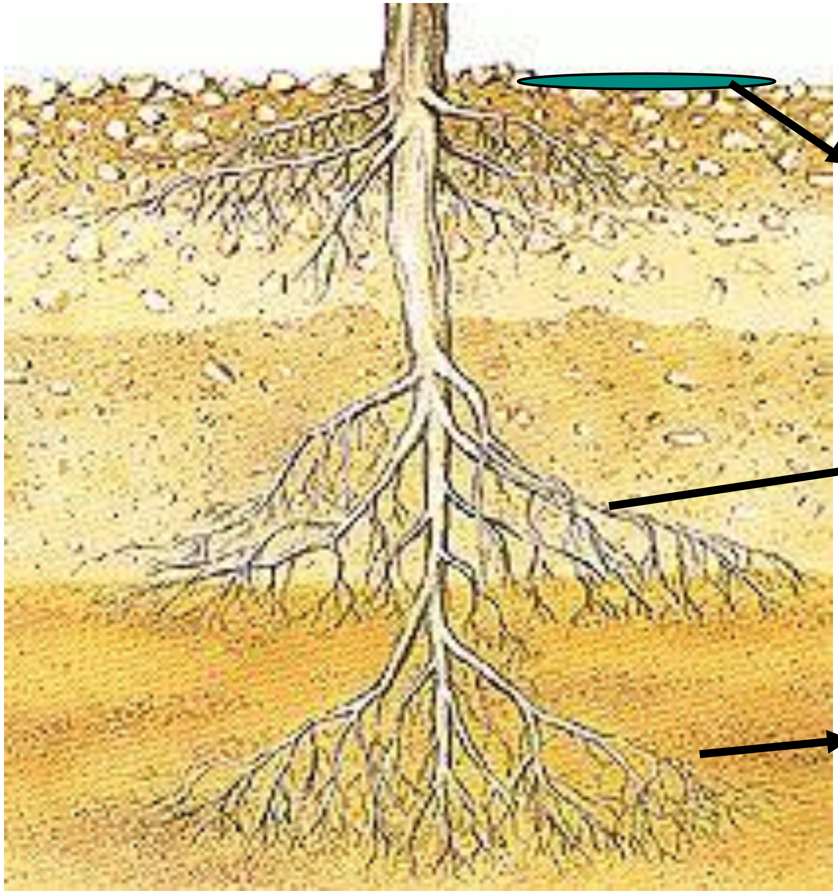
- More soil carbon in soils under organic management?
- Less GHG emissions from soils under organic management?
- GHG mitigation of organic crop production at global scale?

Contents

- More soil carbon in soils under organic management?
- Less GHG emissions from soils under organic management?
- GHG mitigation of organic crop production at global scale?

The concept of C sequestration in soil

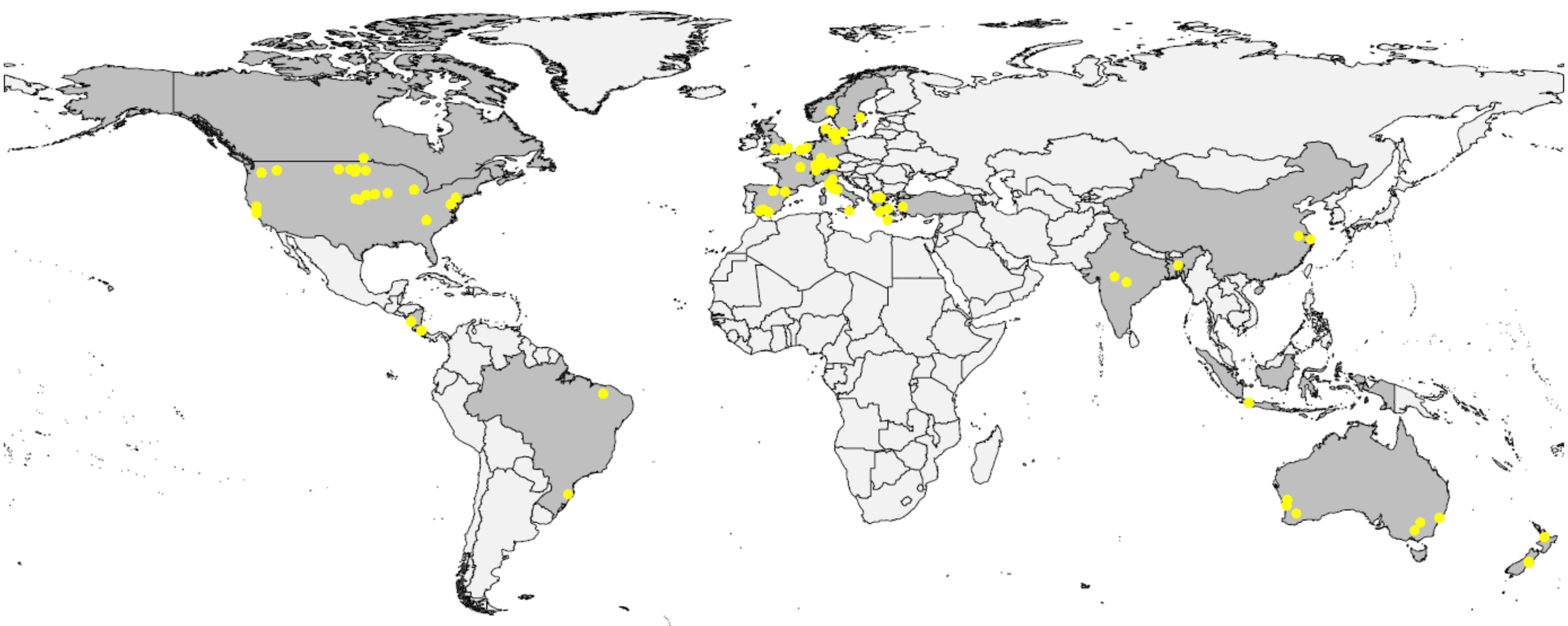
CO_2 –fixation via photosynthesis



Transformation into soil organic matter (Humus formation)

GHG mitigation through carbon storage in soils: organic vs. non organic

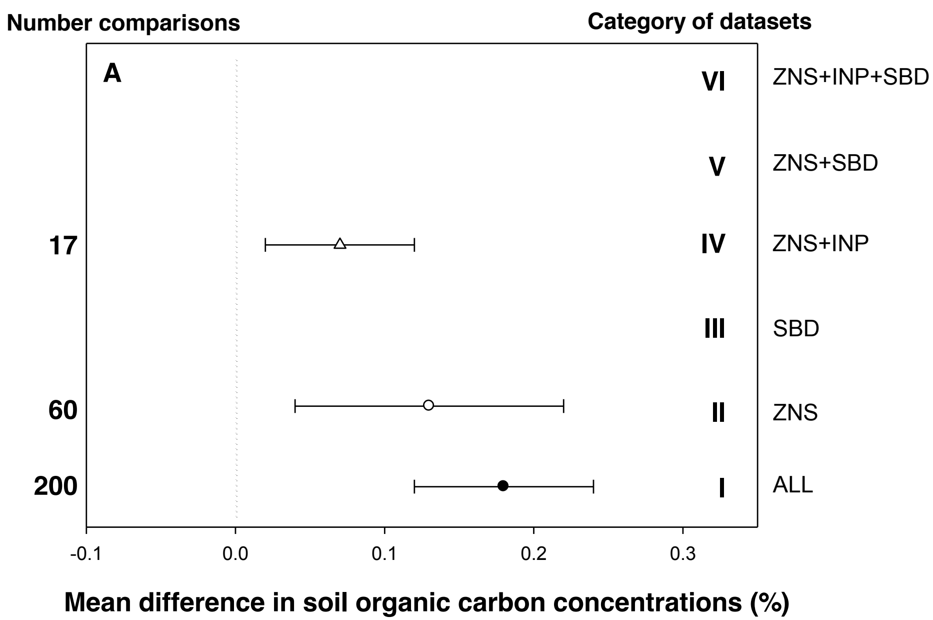
Geographic distribution of the system comparisons for meta-analysis

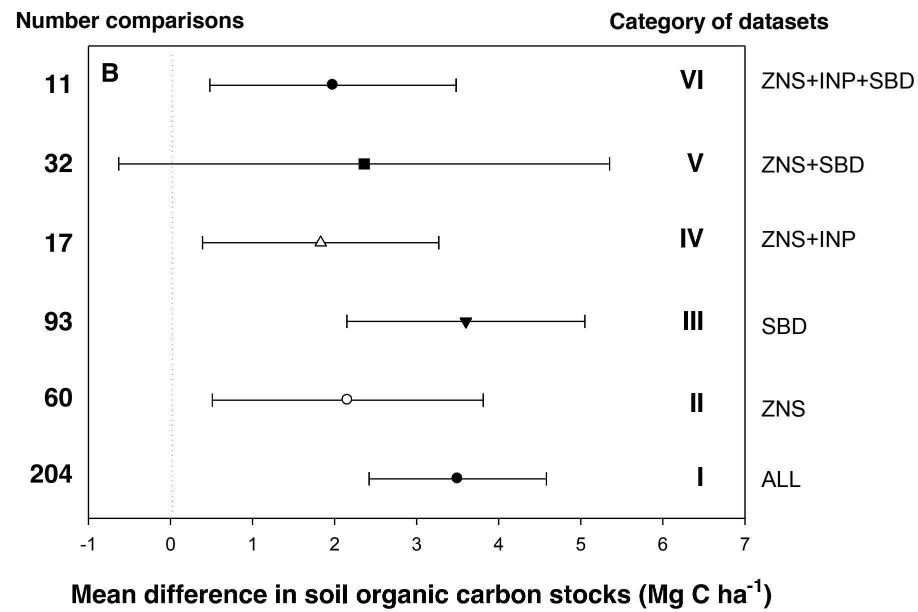


74 studies globally with up to 211 paired comparisons

Gattinger et al., PNAS, 2012

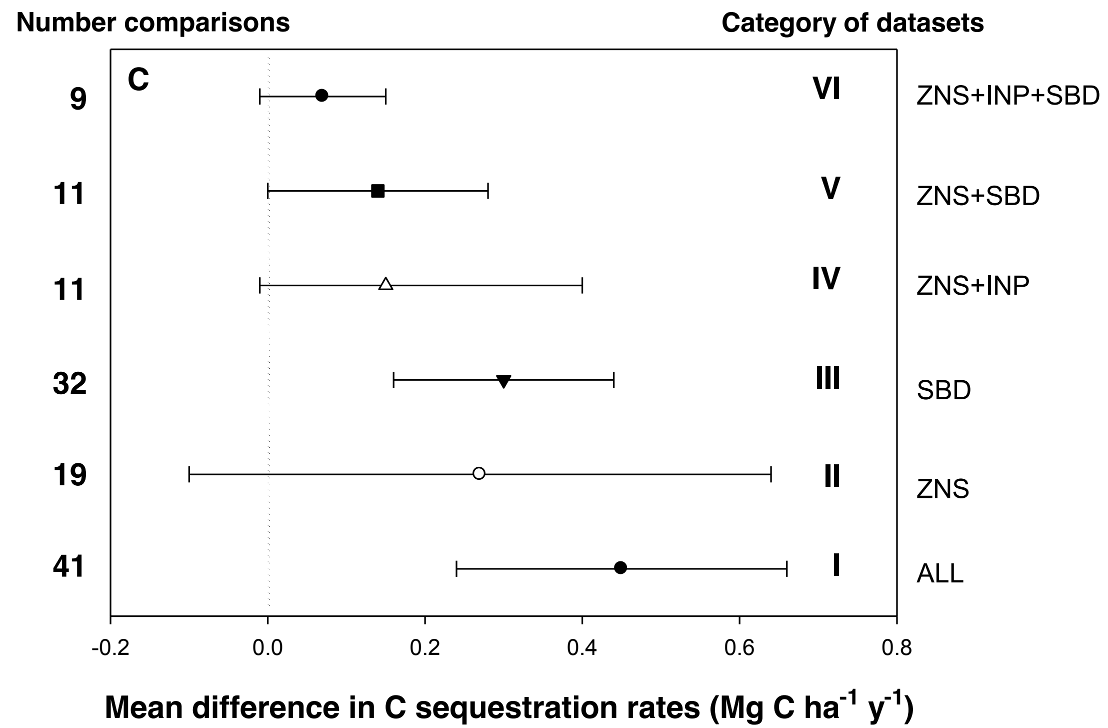
More carbon in organically managed soils?





Higher soil organic carbon concentrations (%) and stocks (t ha^{-1}) under organic farming management.

Is carbon sequestration possible within organic farming systems?

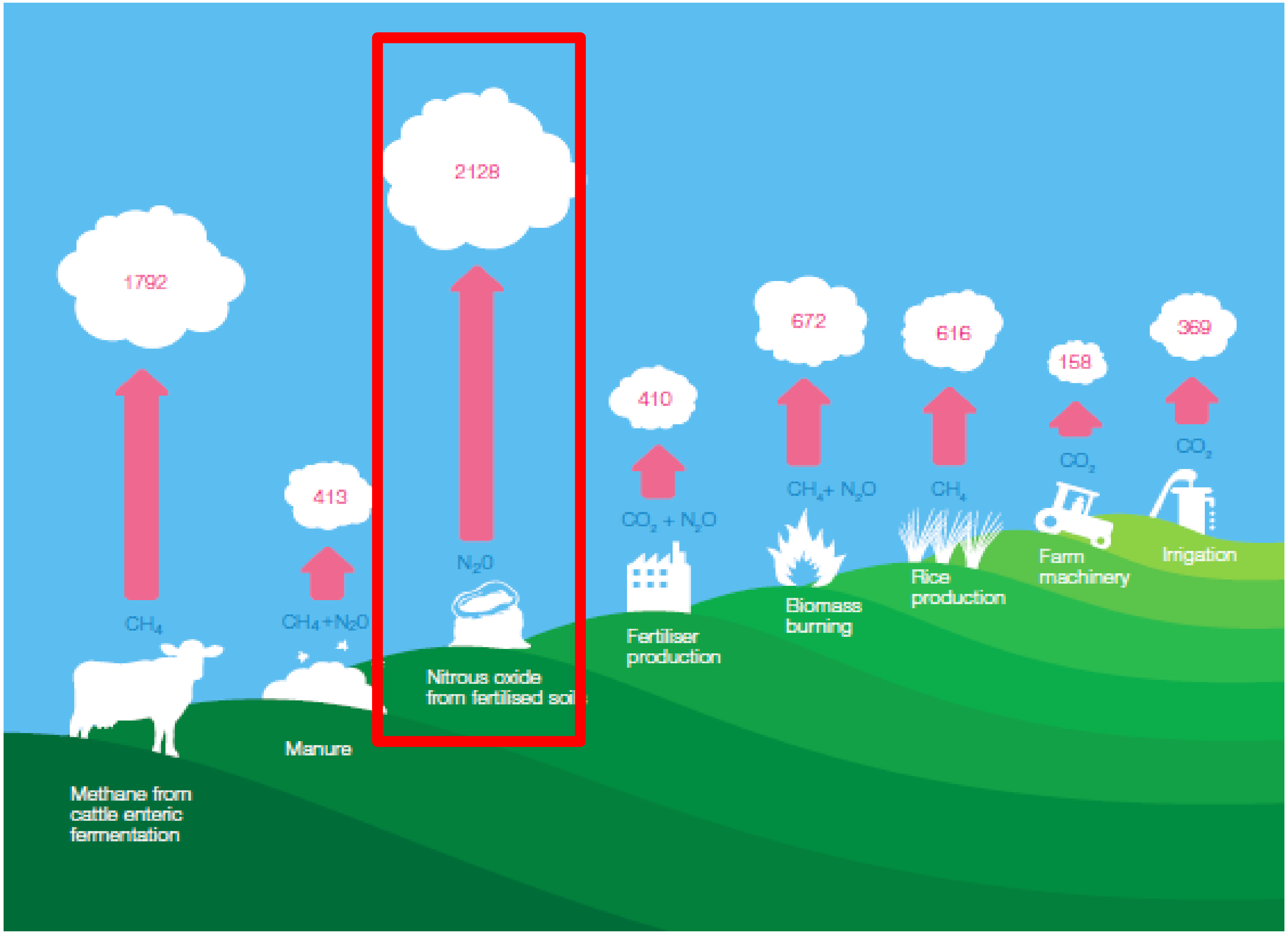


Yes, it is possible. Net sequestration of 450 kg C ha^{-1} y^{-1} (= 1.7 Mg CO_2 eq ha^{-1} y^{-1}) for all organic systems; the potential is lower for for zero net input systems (< 1.O ELU ha^{-1}): 70 – 270 kg C ha^{-1} y^{-1}.

Contents

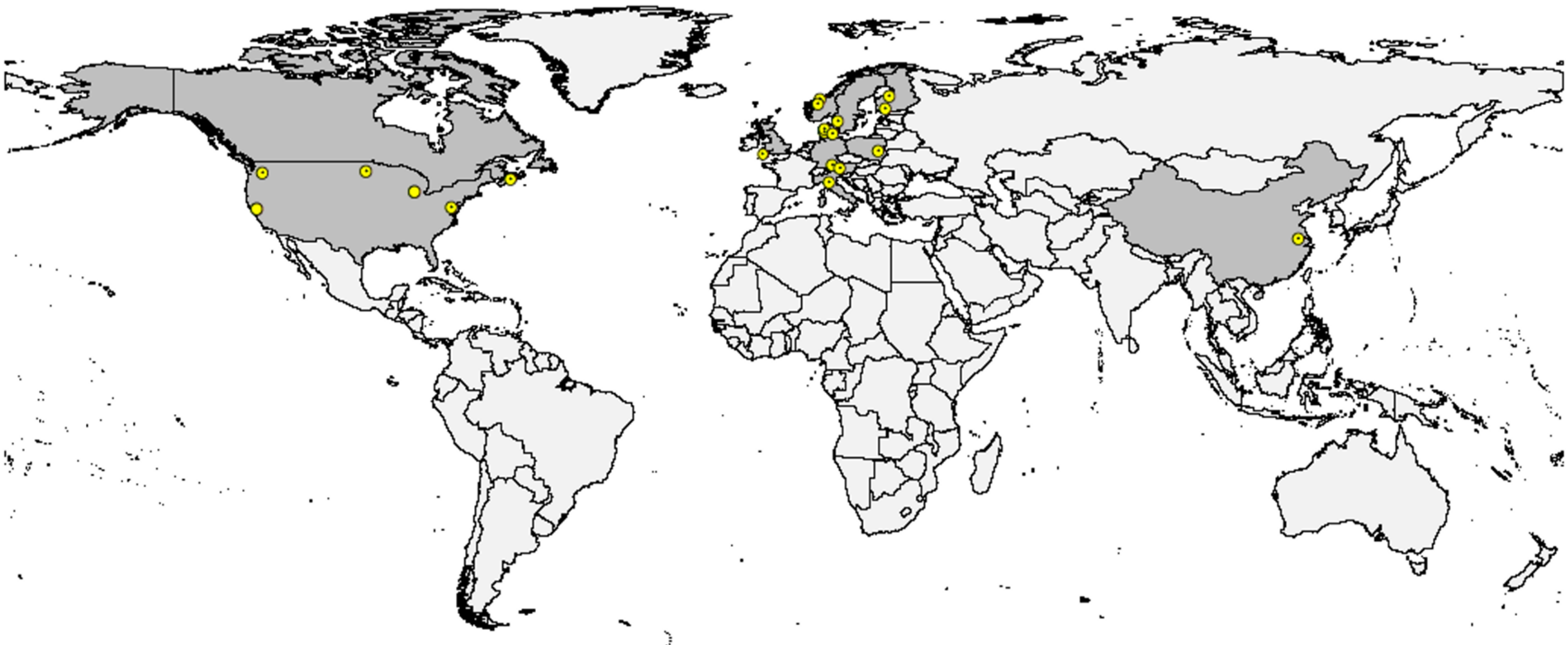
- More soil carbon in soils under organic management?
- Less GHG emissions from soils under organic management?
- GHG mitigation of organic crop production at global scale?

N2O emissions from agricultural soils



Bellarby et al. 2008

Meta study II: Soil-derived GHG fluxes (N_2O, CH_4) in soils under organic and non-organic management



18 studies globally with up to 98 paired comparisons

Skinner, Gattinger et al., STOTEN, 2014

Less N_2O from organically manaded soils?

	Area-scaled N_2O emissions ($kg\ N_2O\text{–}N\ ha^{-1}\ a^{-1}$)					Area-scaled GWP[d] N_2O emissions ($kg\ CO_2\text{-eq.}\ ha^{-1}\ a^{-1}$)					Yield-scaled GWP[d] N_2O emissions ($kg\ CO_2\text{-eq.}\ t^{-1}$ DM)				
Land-use	MD[a]	CI[b]	p	studies	comp.[c]	MD[a]	CI[b]	p	studies	comp.[c]	MD[a]	CI[b]	p	studies	comp.[c]
All (annual)[f]	−1.05	0.34	0.00	12	70	−492	160	0.00	12	70	42.4	33.1	0.01	7	25
Arable	−1.06	0.35	0.00	11	67	−497	162	0.00	11	67	41.1	34.2	0.02	6	23
Grassland	−2.33	5.40	0.40	2	3	−1091	2531	0.40	2	3	45.6	190.3	0.64	2	2
Rice-paddies	−1.38	2.22	0.22	1	3	−646	1040	0.22	1	3	−25.4	49.2	0.31	1	3
Overall[g]	−0.93	0.25	0.00	18	98	−434	118	0.00	18	98	30.7	28.9	0.08	8	30

[a] MD, Mean Difference under organic treatments; negative values mean less emissions compared to non-organic treatment.
[b] ±95%confidence interval (CI).
[c] Comparisons.
[d] Greenhouse Warming Potential (GWP).
[e] EF: Emission factor; total inputs: external inputs plus those from within the field e.g. N fixation and plant residues.
[f] All annual measurements excl. rice (arable & grassland).
[g] All landuse types excl. rice; annual and short time measurements.
[h] No data available for respective land-use type.

Related to area: ca. 0.5 t ha^{-1} yr^{-1} less CO_2 eq. in form of N_2O under organic management

Related to yield: ca. 0.05 t ha^{-1} yr^{-1} more CO_2 eq. in form of N_2O under organic management

Skinner, Gattinger et al., STOTEN, 2014

Less CH_4 from organically manaded soils?

	Area-scaled CH_4 fluxes (kg CH_4–C ha^{-1} a^{-1})					Area-scaled CH_4 fluxes (kg CO_2—eq. ha^{-1} a^{-1})[f]					Yield-scaled CH_4 fluxes (kg CO_2—eq. t^{-1} DM)				
Land-use	MD[a]	CI[b]	p	Studies	Comp.[c]	MD[a]	CI[b]	p	Studies	Comp.[c]	MD[a]	CI[b]	p	Studies	Comp.[c]
Arable	−0.10	0.15	0.01	3	8	−3.2	2.5	0.01	3	8	−2.10	2.33	0.08	2	5
Rice-paddies	9.37	8.19	0.00	1	3	950	415	0.00	1	3	128.3	26.1	0.00	1	3

[a] MD Mean Difference under organic treatments; negative values mean (higher) uptake, positive (higher) emissions compared to non-organic treatment.
[b] ±95%confidence interval (CI).
[c] Comparisons.

Only a few studies: in arable soils increased CH4 uptake under organic, but in riced paddies highest CH4 emission under organic management

FiBL www.fibl.org

Skinner, Gattinger et al., STOTEN, 2014

Contents

- More soil carbon in soils under organic management?
- Less GHG emissions from soils under organic management?
- GHG mitigation of organic crop production at global scale?

Thank you very much for your attention!

Further infos:
http://www.fibl.org/de/themen/klima.html
http://www.fibl.org/de/themen/nachhaltigkeit.html
http://www.organicandclimate.org