Soil macroaggregates: the hotspots determining emission or mitigation of greenhouse gases according to the management system adopted

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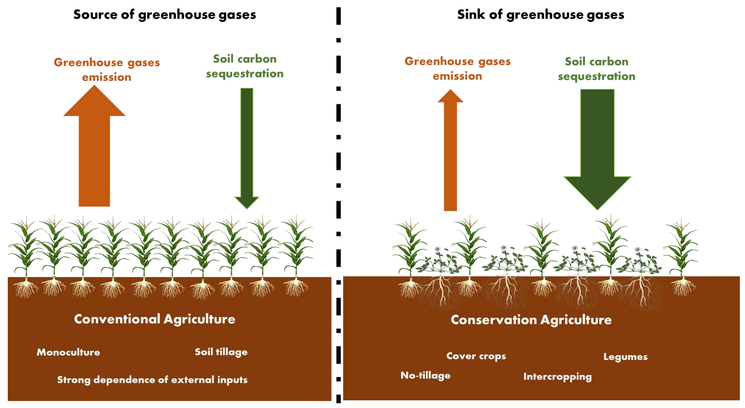
Introduction



Objectives

We address GHG emissions at the microscale level to identify potential hotspots and determine the influence of tillage and cropping systems on such emissions.

Material and Methods

Soil: clay-loam Acrisol

Two tillage systems : **Conventional tillage (CT)** vs **no-tillage (NT)**

Two cropping systems: **oat/maize (O/M)** and **oat+vetch/maize+caupi (OV/MC)**

Aggregates classes: **large macroaggregates, small aggregates and microaggregates**

Water content: **40 % and 70 %**

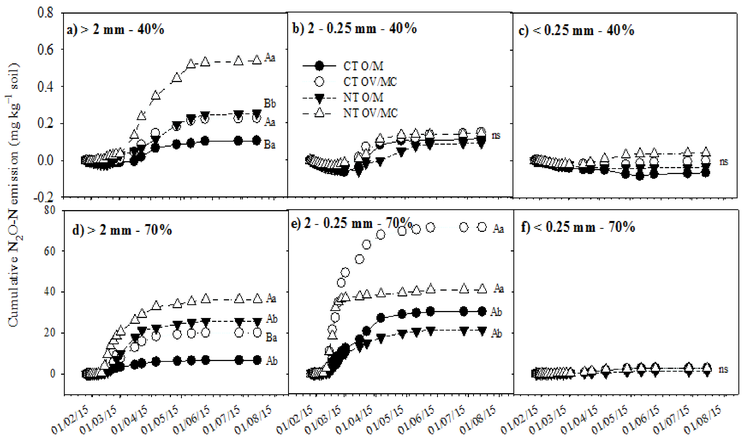
Evaluation of emission of N_2O and CH_4, and the C concentration

No-tillage (NT) vs Conventional tillage (CT)

Without vs with legume cover crops

Incubation of 3 aggregate classes

Cumulative N_2O-N emission



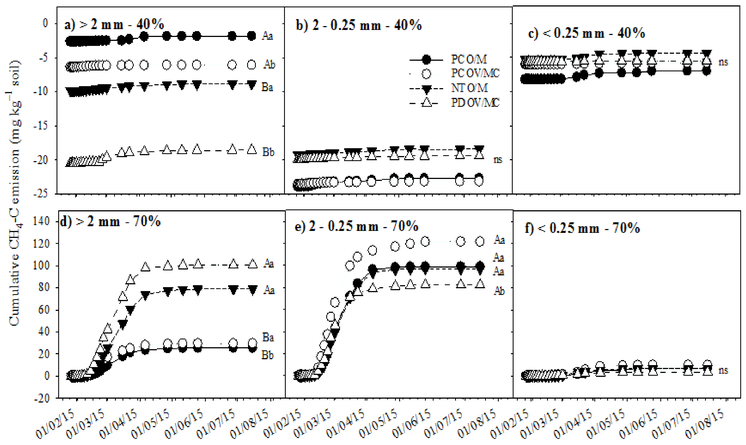
Under 40% of water content:

In large macroaggregates, N_2O-N emission was three times greater under OV/MC compared to O/M, and NT increased two times N_2O-N emission in relation to CT.

Under 70% of water content:

In large macroaggregates, N_2O-N emission increased two times in NT in relation to CT, and it was 80% greater in OV/MC than in O/M.

Cumulative CH_4-C emission



Under 40% of water content:

In large macroaggregates, greater influx in NT and OV/NC compared to CT and O/M.

Under 70% of water content:

In large macroaggregates, greater CH_4–C emission in NT and OV/MC compared to CT and O/M.

Net cumulative emission by kg of C

Tillage	Crops	$NCEC_{agg}$[2] (mg CO_2-Ceq. kg^{-1} SOC)			
		> 2mm	2 – 0.25 mm	< 0.25 mm	Whole
---------- 40 % ----------					
CT	O/M	-13.49 Bb	-63.34 Ab	-49.47 Aa	-727.19
	OV/MC	- 40.81 Aa	-96.41 Ba	-43.12 Aa	-
NT	O/M	- 40.33 Aa	- 91.83 Ab	-49.43 Aa	- 874.92
	OV/MC	-45.08 Aa	-155.93 Aa	-26.88 Aa	-
---------- 70 % ----------					
CT	O/M	3536.73	2696.46 Ab	232.54 Aa	18237.98
	OV/MC	4992.69	5892.90 Aa	222.52 Aa	47039.49
NT	O/M	3236.48	2520.42 Aa	210.30 Aa	29724.77
	OV/MC	3314.01	3296.47 Ba	257.21 Aa	44482.12

Uppercase letters compare averages of tillage systems within cropping systems in each class of aggregate. Lowercase letters compare averages of crop systems within tillage systems in each class of aggregate.

Under 40% of water content

For each kg of C accumulated in macroaggregates:

- greater C from atmosphere was up taken by NT than CT (83.29 vs. 53.51 mg CO_2-Ceq. kg^{-1} SOC, on average)
- greater C from atmosphere was up taken with than without (84.56 vs. 52.24 mg CO_2-Ceq. kg^{-1} SOC, on average) legume cover crops.

Under 70% of water content

- Only positive NCE was observed under 70% of water content
- In large and small macroaggregates under OV/MC, lower emission in NT compared to CT (3305.3 vs 5442.8 mg CO_2-C kg^{-1} SOC).

Conclusions

- Soil macroaggregates can be considered as a key element to a better understanding of GHG dynamic in the soil.
- By containing labile organic forms, soil macroaggregates are considered the hotspot of soil greenhouse emission/mitigation.
- Despite favoring N_2O emission, NT and legume cover crop lead to GHG mitigation by promoting CH_4 influx and C accumulation in soil macroaggregates.