Does soil organic matter stoichiometry varied with agricultural practices on the long-term?

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Does Soil Organic Matter Stoichiometry Varied with Agricultural Practices On The Long Term?

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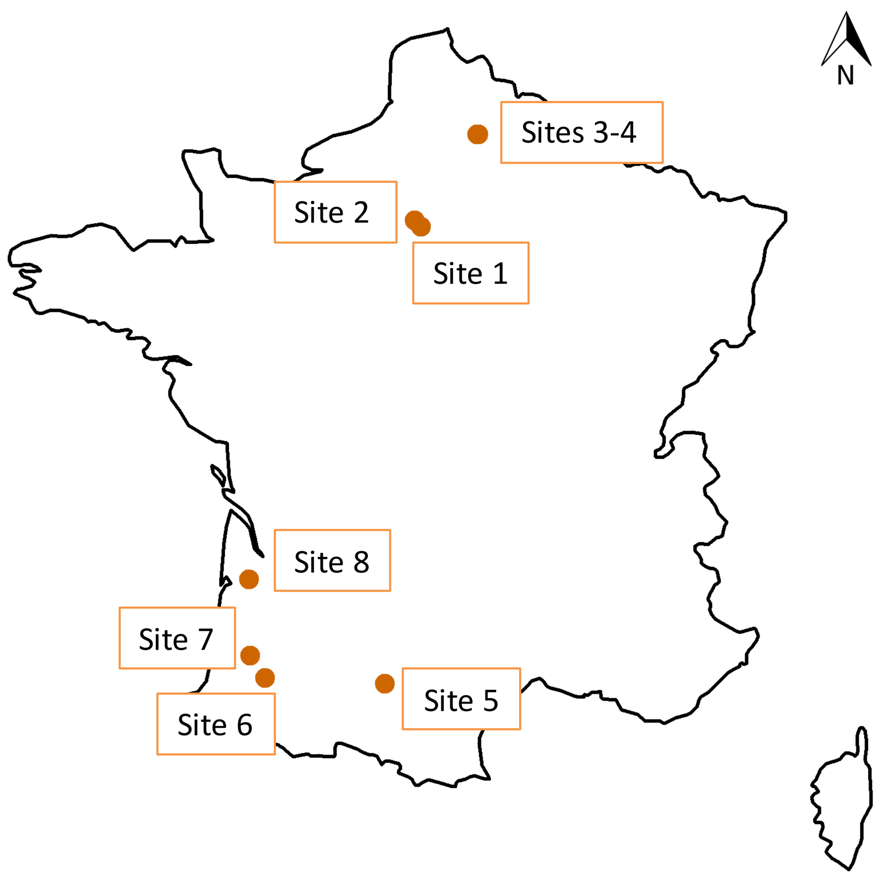
Aim

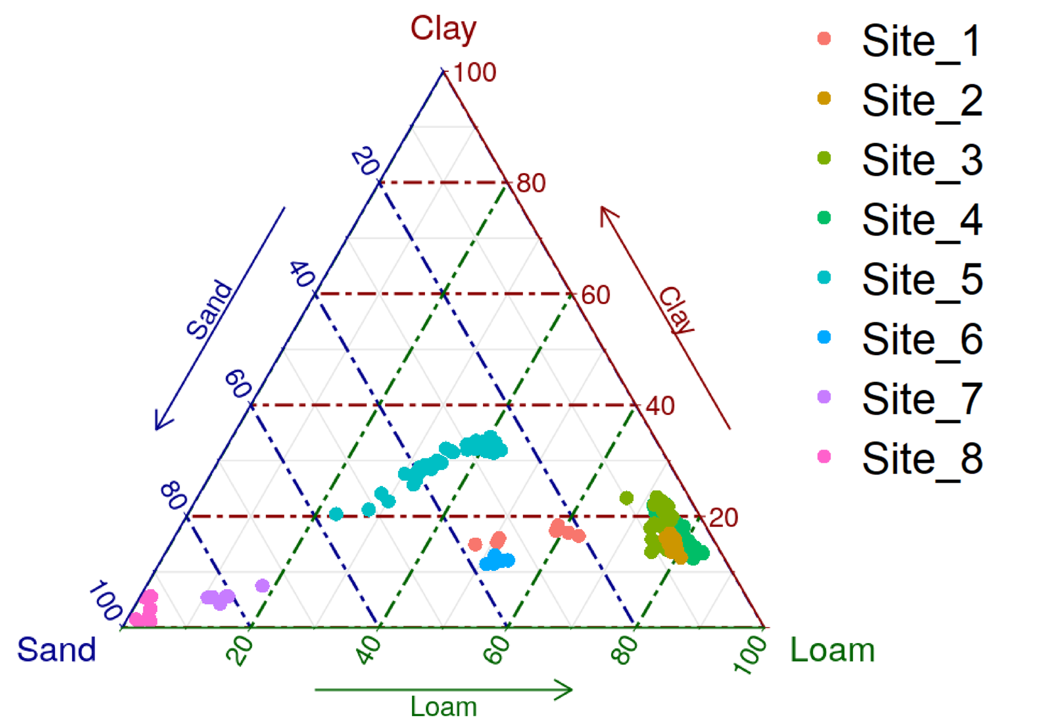
Soil stoichiometry constraints may limit the impacts of agroecological practices to increase nutrient recycling and foster C storage in cropped soils (*Bertrand et al. 2019*). However, little is known about the long term impact of agricultural practices on soil stoichiometry. Our aim is to analyse long-term (8-49 yr) field experiments in France including several treatments with contrasted N and/or P budgets.

Methods

We compiled and completed a dataset of long-term (8-49 yr) field experiments in France.



Site	Name and duration	Tested agricultural practices
1	La Cage 1998-2014 (16 years)	4 arable cropping systems: conventional, low input, conservation agriculture, organic farming
2	SOERE QualiAgro 1998-2013 (15 years)	Organic waste products (4 types) * N fertilisation (2 rates) Wheat-maize rotation
3	SOERE ACBB 2009-2015 (6 years)	4 treatments: conventional, reduced tillage, crop residue removal, reduced N fertilisation Arable cropping system
4	Biomass & Environment 2006-2016 (10 years)	Crop type (perennials vs annuals) * N fertilisation (2 rates)
5	Auzeville 1969-2017 (48 years)	P fertilization (superphosphate): 0, 11, 22 and 33 kg P ha^{-1} yr^{-1} Arable cropping system
6	Mant 1975-1992 (17 years)	P fertilization (superphosphate): 0, 27, 79 kg P ha^{-1} yr^{-1} Continuous irrigated maize
7	Tartas 1972-2004 (32 years)	P fertilization (superphosphate): 0, 44, 96 kg P ha^{-1} yr^{-1} Continuous irrigated maize
8	Pierroton 1995-2015 (20 years)	P fertilization (superphosphate): 10, 15, 20, 40, 80 kg P ha^{-1} yr^{-1} Continuous irrigated maize



Calcul of the balance of C, N and P in (kg *X* ha^{-1}) in all sites

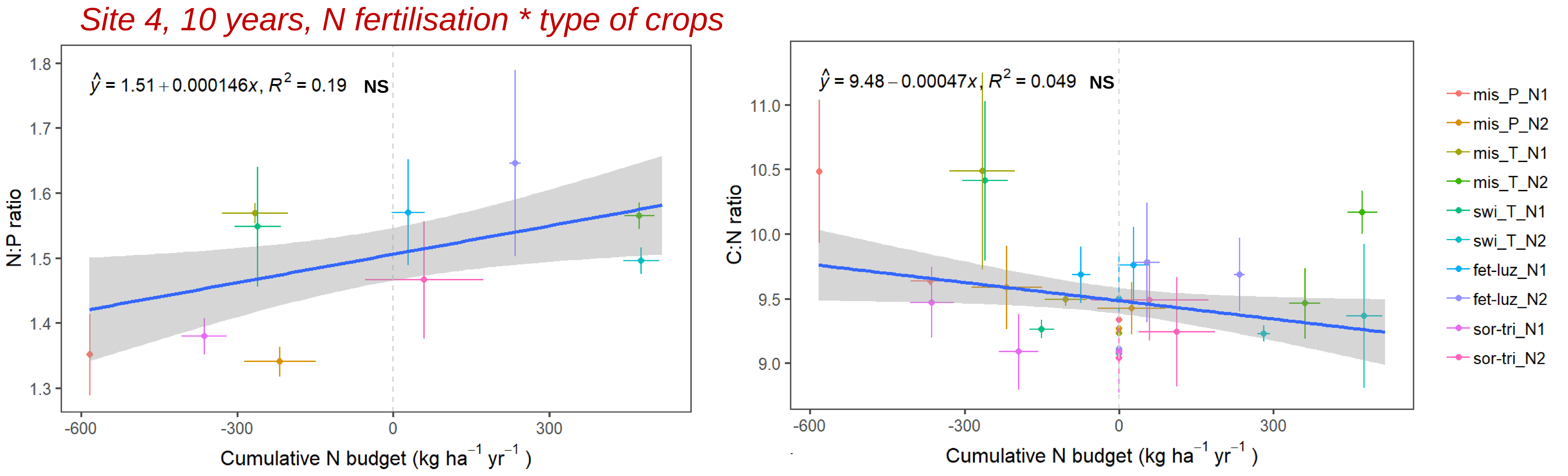
$$X_{\text{cumulated budget}} = \sum_{i=1}^{n}(X_{input} - X_{export})i \qquad X_{input} = X_{fert} + BNF + X_{deposition}$$

With X_{export} = exportations at harvest; X_{input} = amount of fertilizers (mineral or organic).

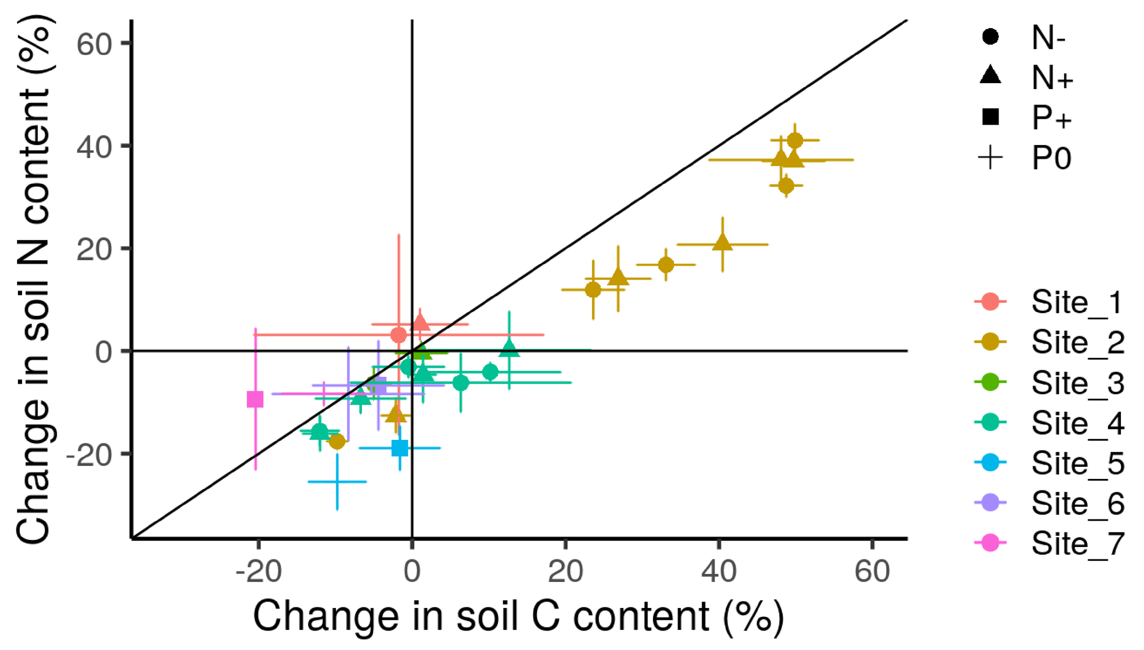
For N, atmospheric deposition ($X_{deposition}$) (http//www.emep.int/mscm_ydata.html) and N fixation by leguminous (BNF) (Anglade et al. 2015) were taken into account.

Results

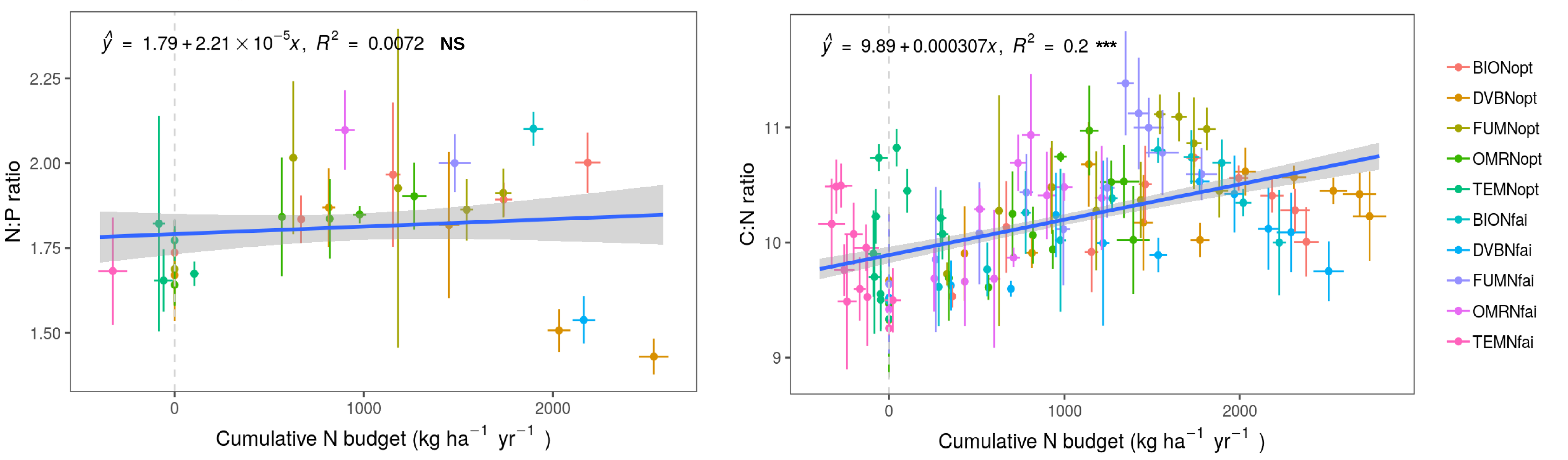
*Site 4, 10 years, N fertilisation * type of crops*

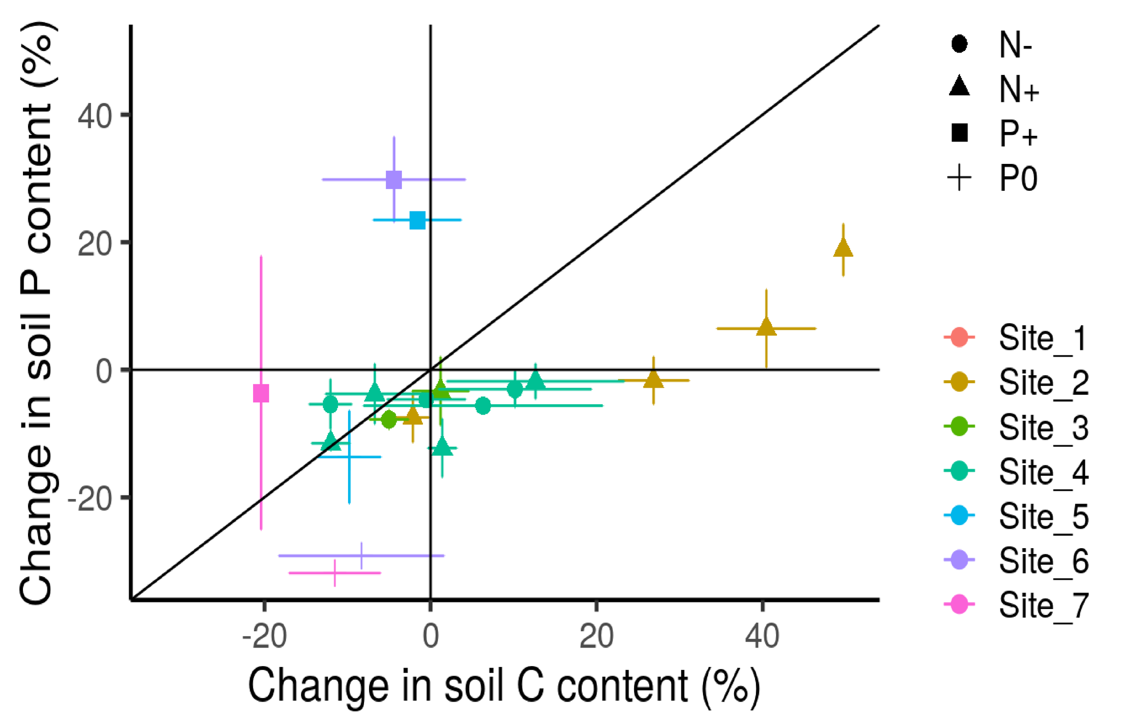


Changes in soil C, N and P contents between initial and final dates

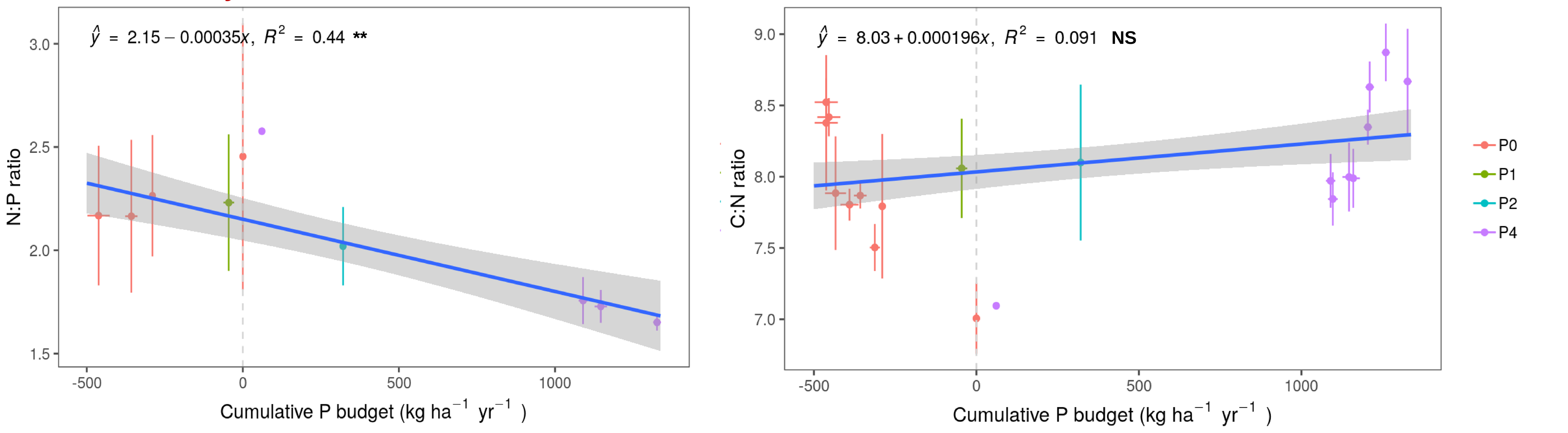


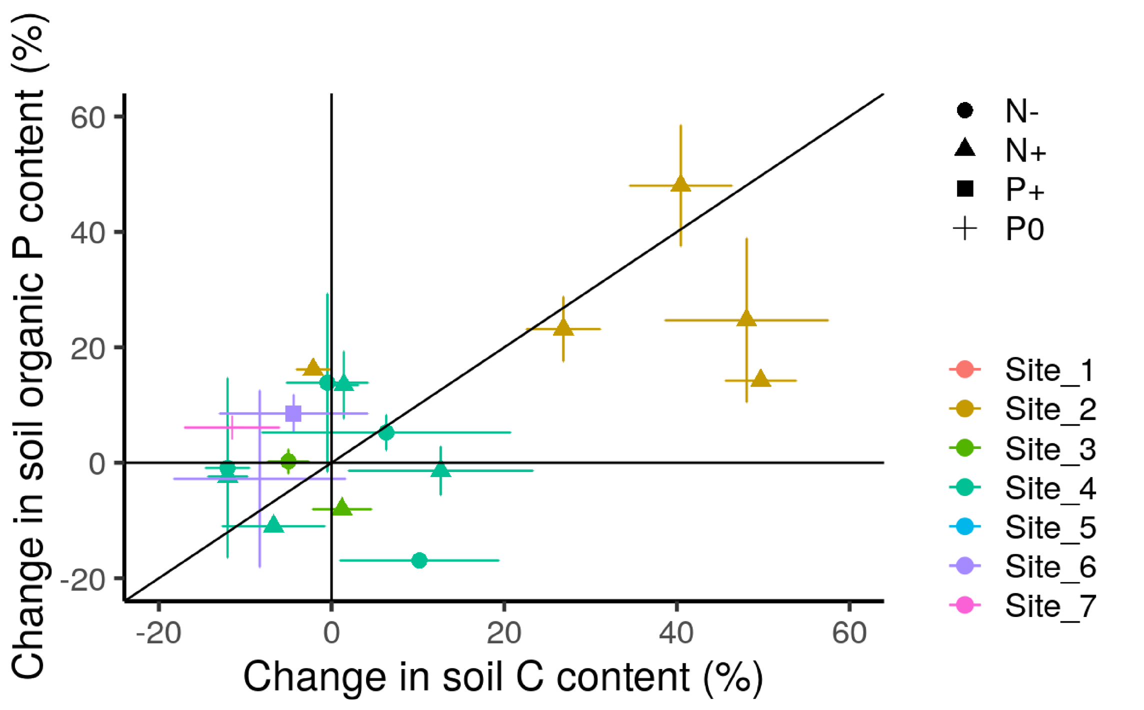
*Site 2, 15 years, N fertilisation * organic amendments*





Site 5, 48 years, P fertilisation





Take home messages

The site has a stronger effect on soil C, N and P contents than practices. Soil C:N ratios were very constrained and not influence by the different agricultural practices, even after 48 years. The N:P and C:P ratios (data not shown) were more flexible. However, the forms of P considered modify the relationships with soil organic C. Organic P is more strongly correlated with organic C underlining the role of soil heterotrophic microorganisms. Such high level of stoichiometry constraint implies that N and P will be necessary to store C in soils.

References: - Bertrand et al. (2019) Stoichiometry constraints challenge the potential of agroecological practices for the soil C storage. A review. Agronomy for Sustainable Development. In Press

- Anglade et al. (2015). Relationships for estimating N2 fixation in legumes: incidence for N balance of legume-based cropping systems in Europe. *Ecosphere*, *6*(3), 1-24.