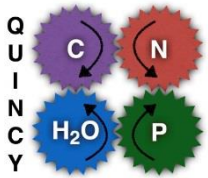

Quantifying the effects of **in**teracting nutrient **cy**cles on terrestrial biosphere dynamics and their climate feedbacks

Project-ID 2014-CoG-647204

DFG

Elevated CO_2 increases plant growth but reduces soil C storage under N limiting conditions

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Summary

Question

1) Do plants allocate 'new' C into nutrient acquisition and if so, 2) how big is the nutrient gain for the C investment?

Aims

- Quantify whole plant C allocation and soil C allocation and their changes with eCO_2
- Quantify plant N uptake mechanisms

Methods

- **Mesocosm experiment** with 64 European beech trees
- Ambient vs. elevated CO_2
- Continuous $^{13}CO_2$ atmosphere
- ^{15}N-labelled root litter in ingrowth cores: root vs. hyphal N uptake
- ~ 5 months duration

Conclusions

YES, plants allocated more C belowground,

BUT they did not gain significantly more N.

+ High variability between individuals!

+ Total C storage was not enhanced under eCO_2.

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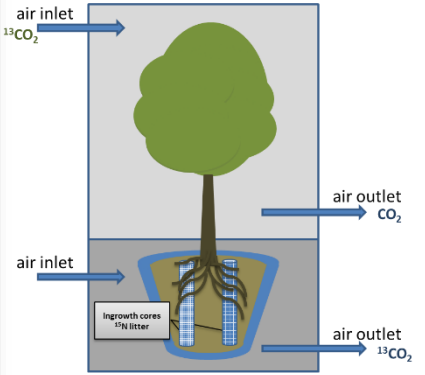
Method: ^{13}C-^{15}N eCO_2 mesocosm experiment

Experiment

- 64 ***Fagus sylvatica* L.** saplings planted in forest top soil **plus** 16 bare soils
- **Elevated and ambient CO_2 levels** (390/ 560 ppm).
- **Continuous $^{13}CO_2$ atmosphere**
- **N uptake quantification** via ^{15}N-labelled root litter in ingrowth cores AND ^{15}N dilution
- June – November 2016



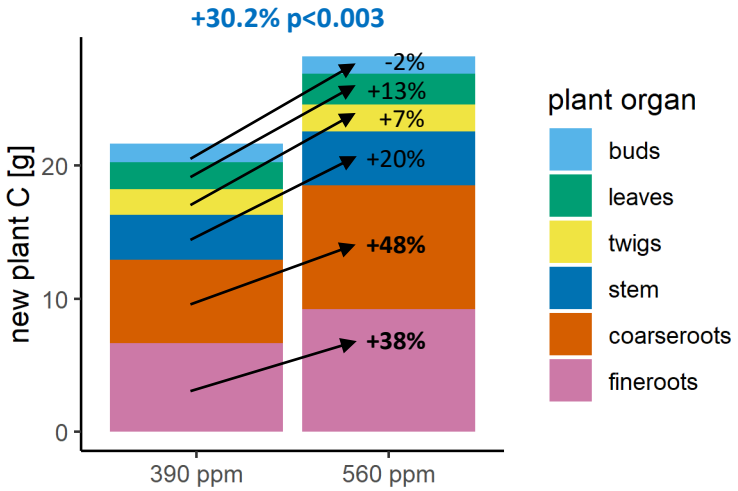
Analyses

- *During* the experiment: **Gas fluxes** (GPP, R_s)
- *After* the experiment: **destructive harvest**: biomass (dry mass, elemental analyses, isotopes), soil (elemental analyses, PLFAs, isotopes)

Plant C allocation*

** C allocation (measured as 'new' C) was quantified by analyzing the isotopic composition of all plant compartments and mass balance*

New plant C

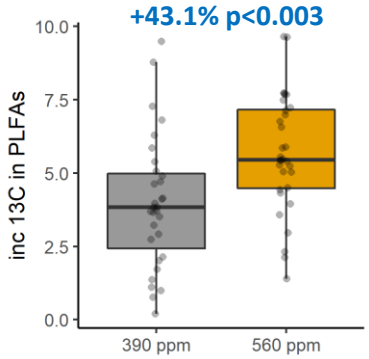


- Under eCO_2, we found **strong increases of 'new' C allocation to roots** in contrast to lower increases to other plant organs and a moderate increase in plant growth (+7%).
- eCO_2 induced a **shift in C allocation patterns towards belowground resource investment** from 57% of new C in roots under aCO_2 to 64% under eCO_2.

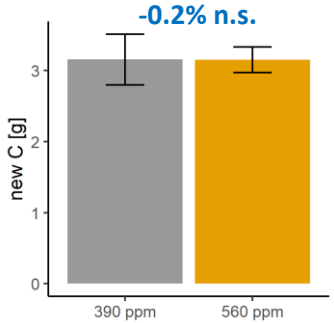
Belowground C allocation

Microbes → **Soil** → **Soil C priming effect?**

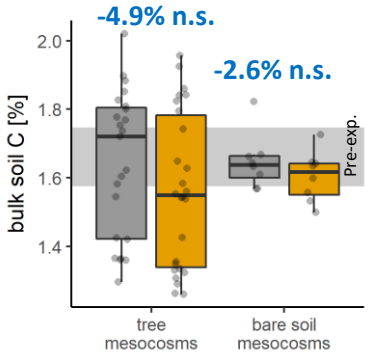
- Strong increase in ^{13}C label in microbial biomass under eCO_2



- Despite substantial positive eCO_2 effects on belowground **plant C** allocation, no significant change in new **soil C** was found.



- A small decrease in soil C was found after 5 months of plant growth under eCO_2.

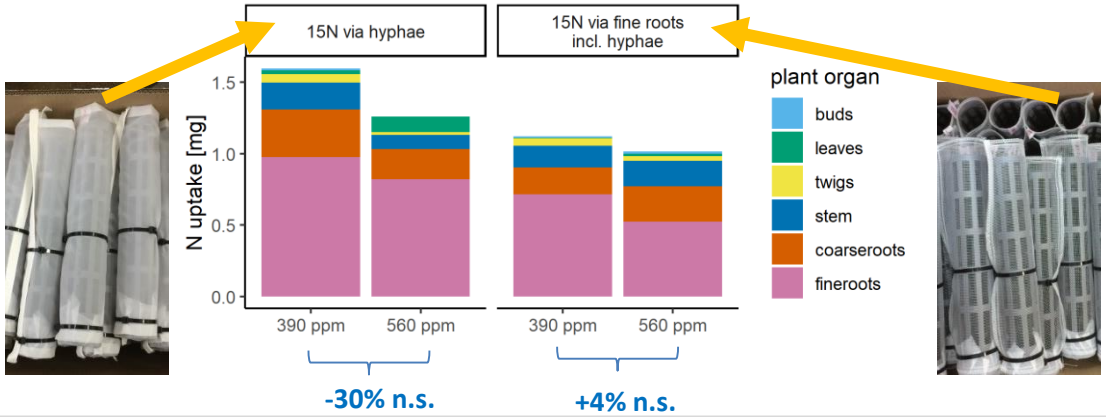


Conclusion 1: These results suggest plant C investments into nutrient acquisition.

Plant N uptake*

** N uptake was quantified by analyzing the isotopic composition of all plant compartments **outside** of the ingrowth cores and mass balance*

- Low recovery of ^{15}N from labelled litter in plant organs **except fine roots**
- We **did not find significant differences** for
  - N uptake between eCO_2 and aCO_2
  - N uptake between hyphal uptake and fine root uptake

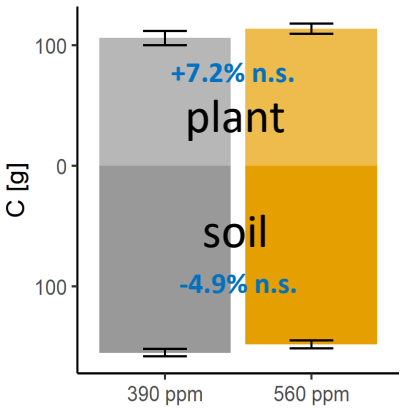


Conclusion 2:
We did not find evidence for increased plant N uptake.

Total C balance

Question:

How does increased C allocation to roots and soil affect total C pools?



- In these mesocosms, more **C was stored in soils** than in plants.
- Moderate increase in plant growth under eCO_2 resulted in **more plant C storage** under eCO_2.
- Under eCO_2, C storage shifted slightly towards plant C.
- The increase in plant C was balanced by a small decrease in soil C, resulting in **no differences in C storage between aCO_2 and eCO_2**.

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