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Drought effects on soil C dynamics - ***DRYSOM***

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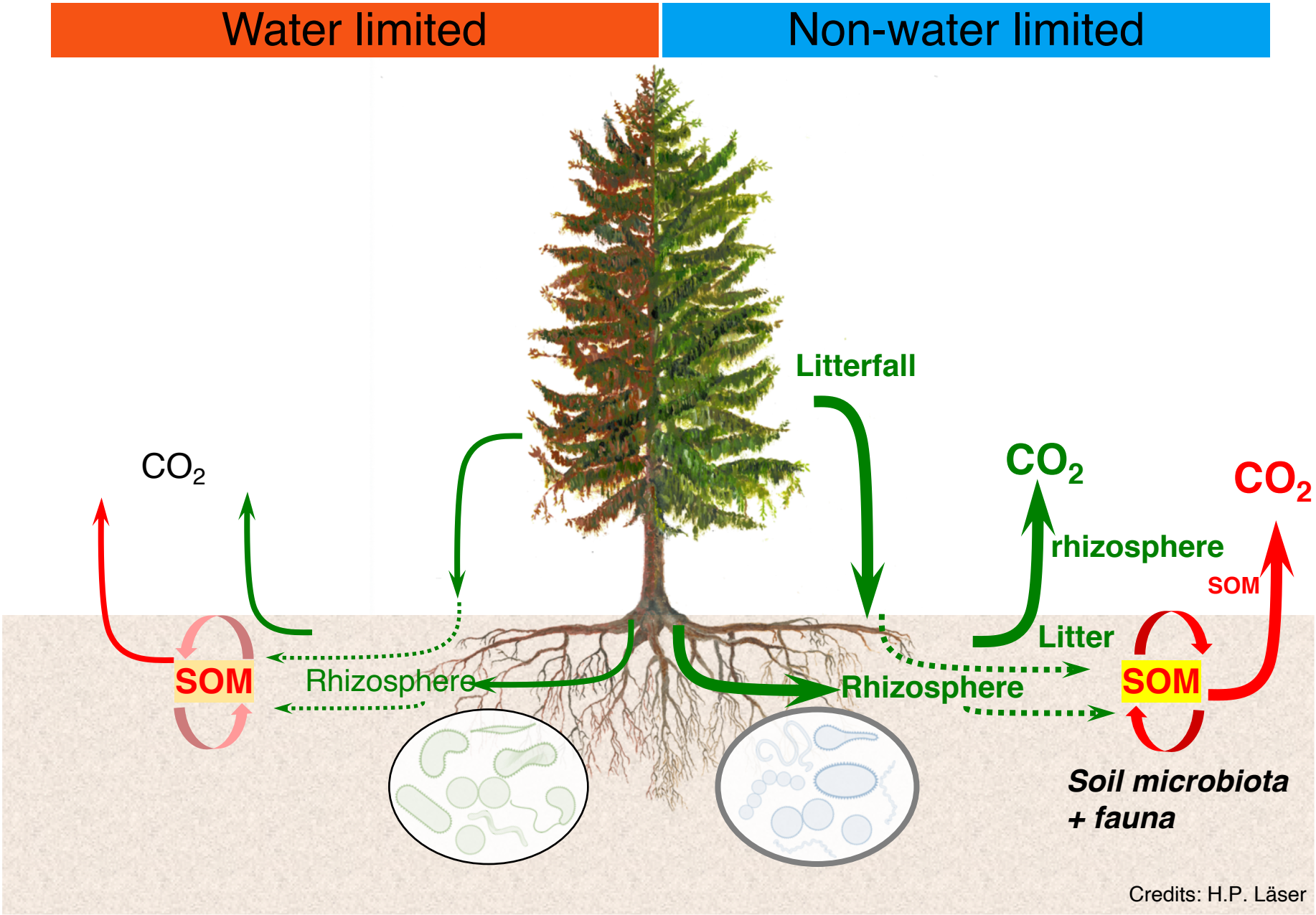
Forest Soils and Biogeochemistry WSL

Pfynwald Workshop, WSL -17.09.2020

How does repeated drought affect:

1. **SOM pool** sizes and composition?
2. **C inputs** from roots and mycorrhizas / **C outputs** from soil organic matter (SOM)?
3. **SOM origin**: root- *vs*. shoot-derived, microbial *vs*. plant-derived?


Water limited
Non-water limited
Litterfall
CO_2
CO_2
CO_2
rhizosphere
SOM
Litter
SOM
Rhizosphere
Rhizosphere
SOM
Soil microbiota
+ fauna
Credits: H.P. Läser

How does repeated drought affect:

1. **SOM pool** sizes and composition?

Aim:

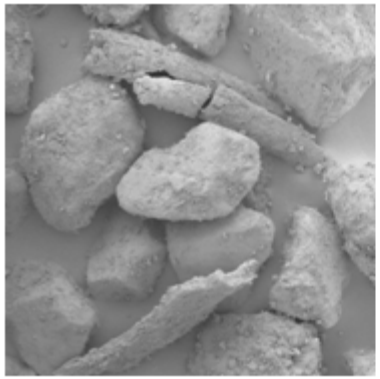
- Estimate **soil C stocks** changes
- Determine effects on **SOM pools and their composition (fractions)**

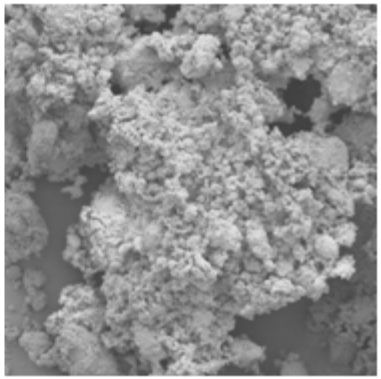
Hypothesis:

total soil C stocks: ↓ C inputs ↓ SOM mineralization

↑ unprocessed «POM» ↓ mineral-associated OM

POM



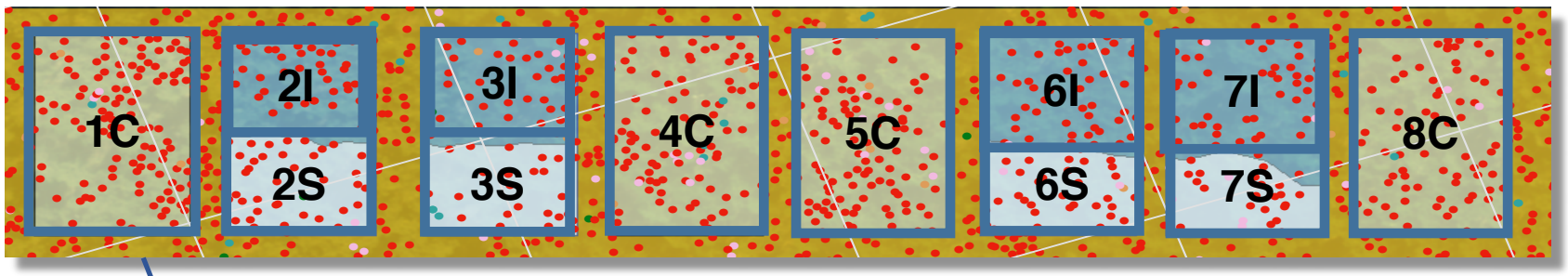


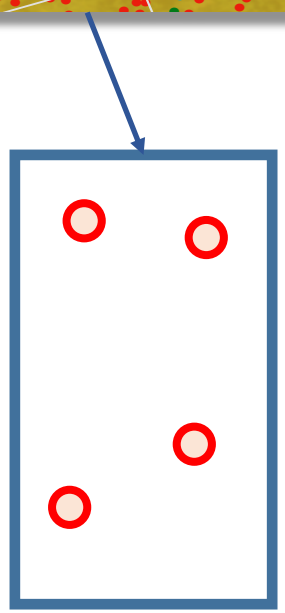
MAOM

How does repeated drought affect:

1. **SOM pool** sizes and composition?

Soil sampling, Nov. 2019: re-sampling after 8 (total 16) years.





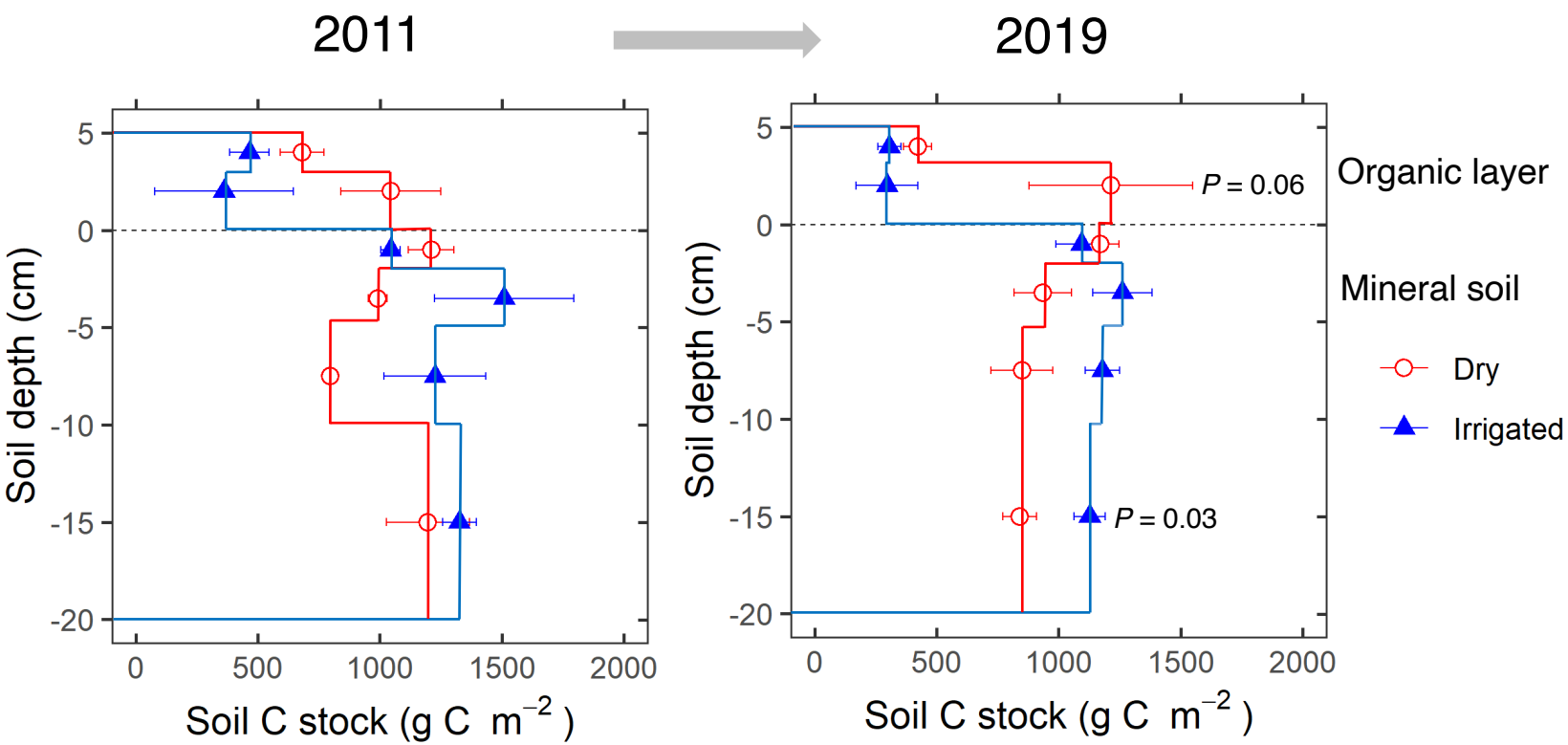
Same method as in 2011:

4 pits per plot (including the Stop Irrigated): Organic layers (L, F) + mineral soil (0-2, 2-5, 5-10, 10-20 cm)

Total 48 pits

AL 109
5.10

Soil Organic Carbon Stocks

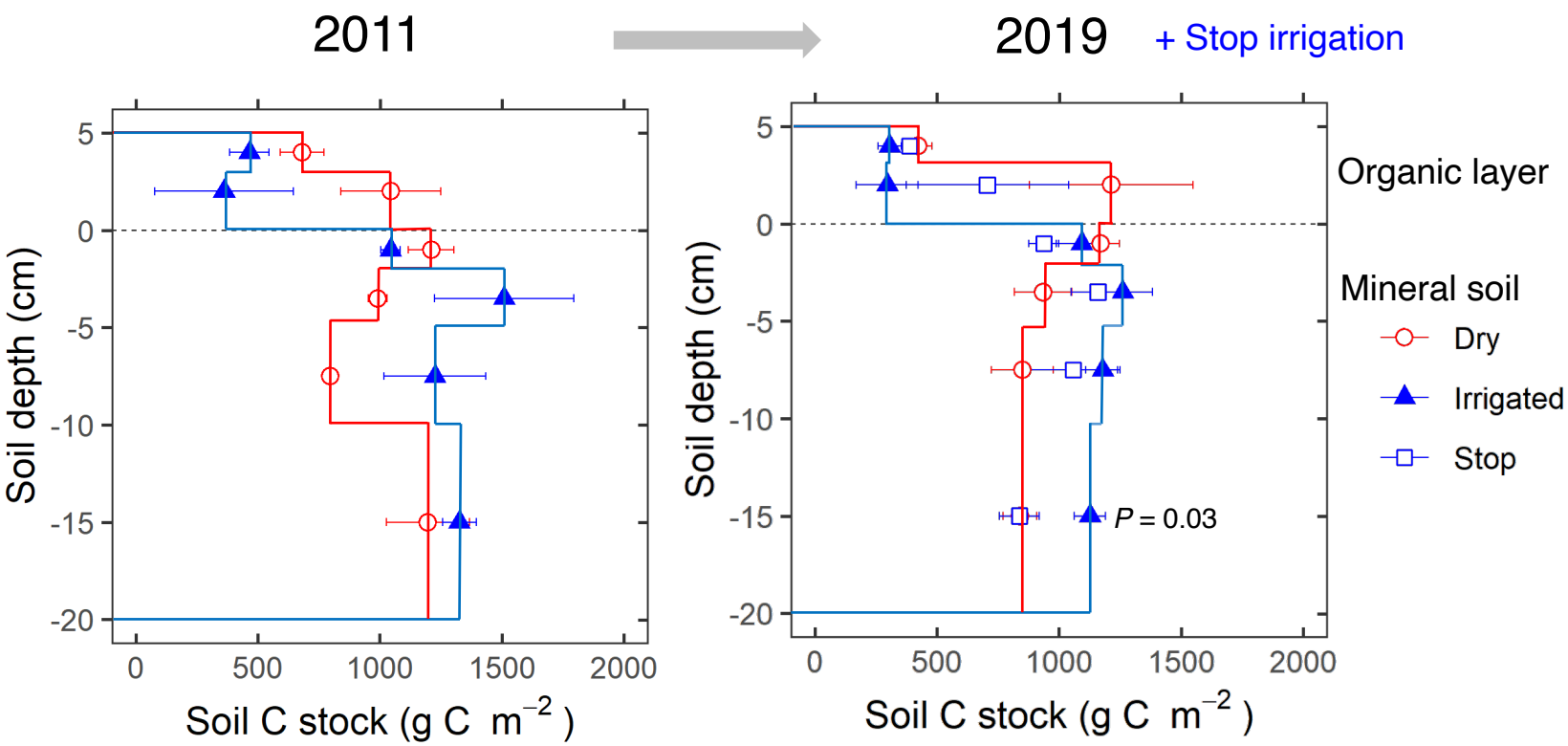


$P_{\text{treat x depth}} < 0.02$

$P_{\text{treat x depth}} = 0.005$

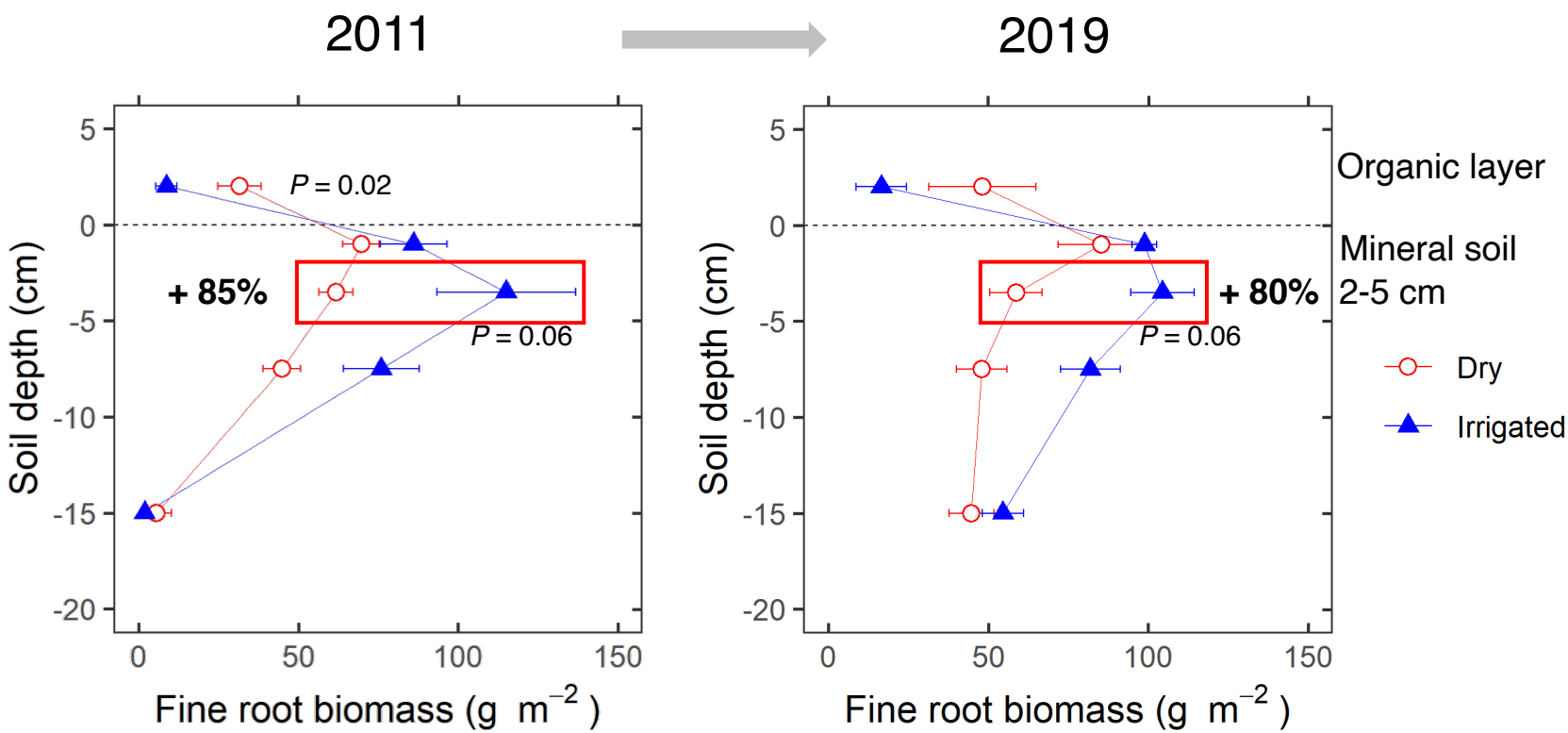
No difference in total SOC stocks P_{treat} = n.s.
n = 4 plots per treatment.

Soil Organic Carbon Stocks



Stop irrigation: back to Dry?

Root biomass

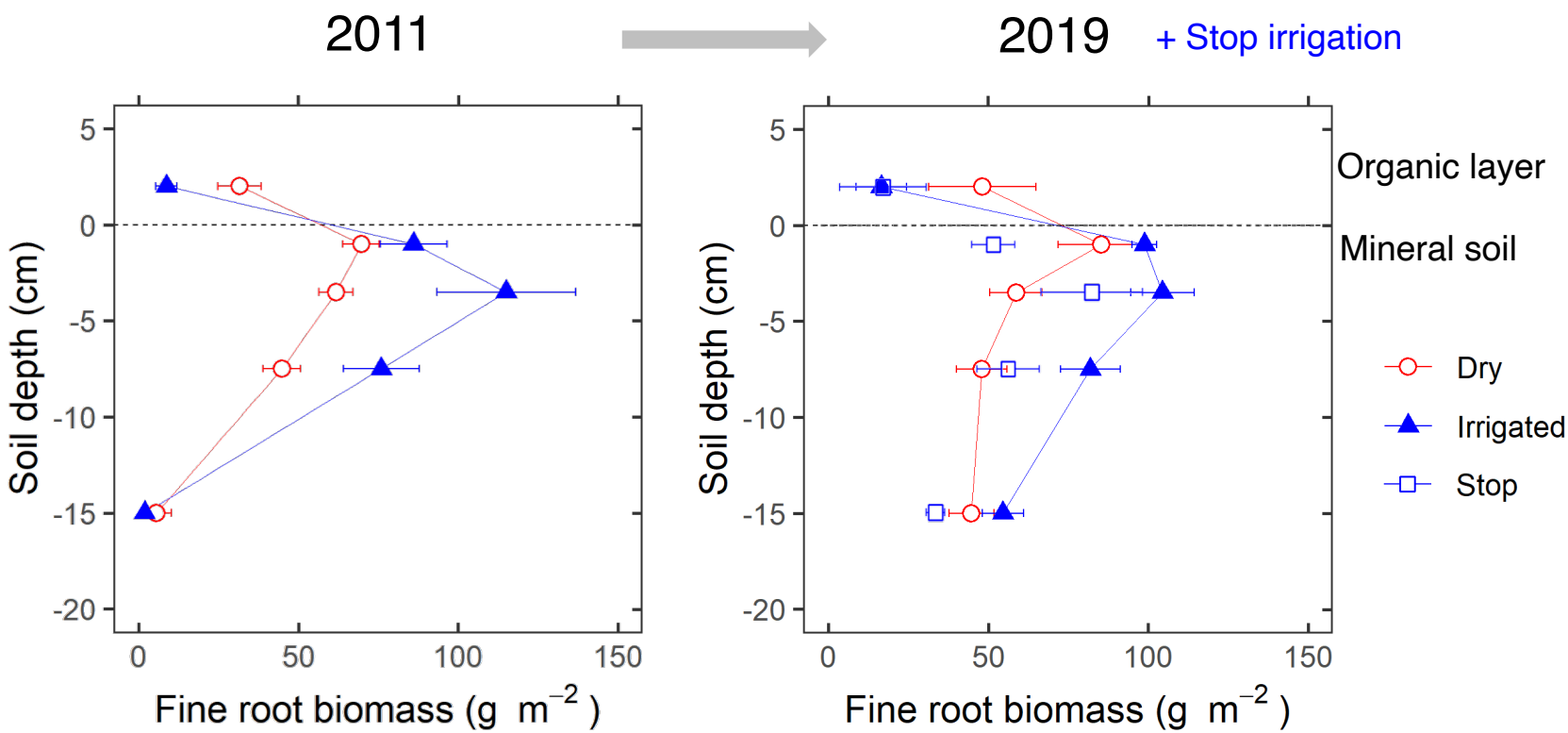


$P_{\text{treat x depth}} < 0.004$

$P_{\text{treat x depth}} < 0.02$

No difference in total fine root biomass, P_{treat} = n.s.
n = 4 plots per treatment.

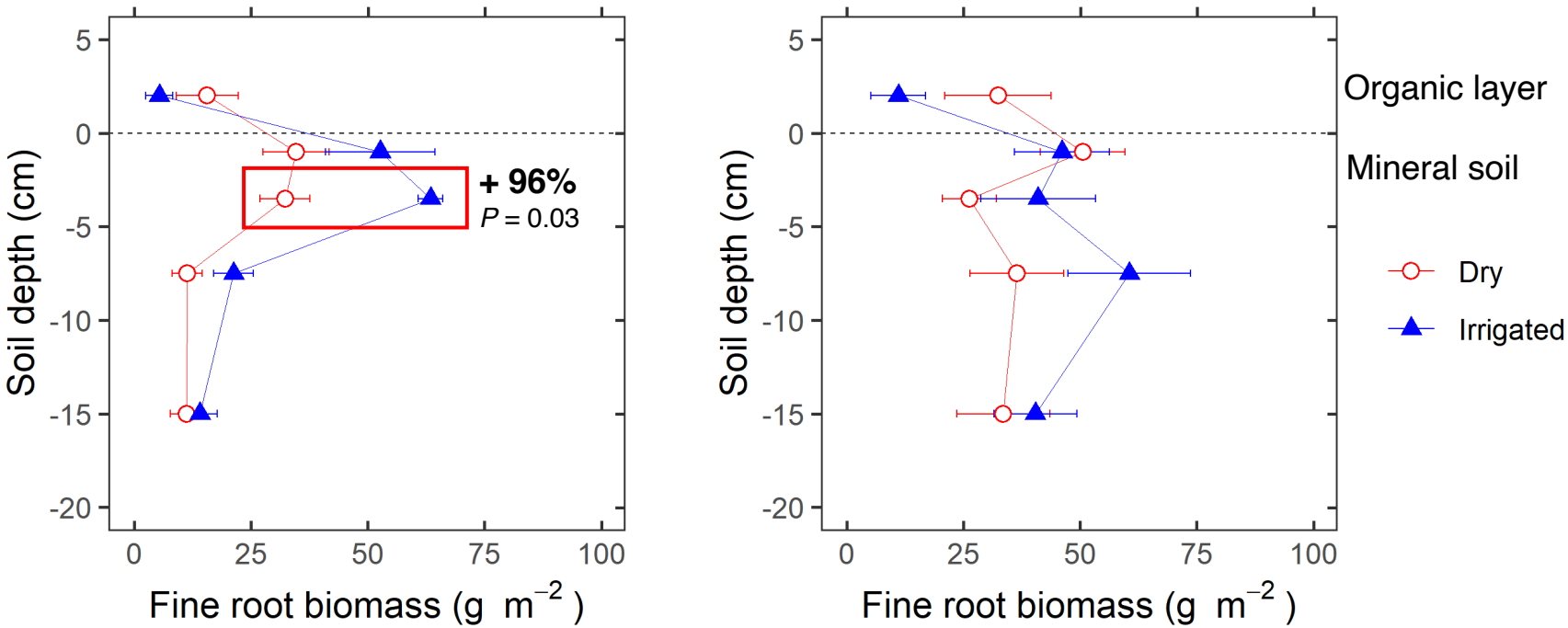
Root biomass



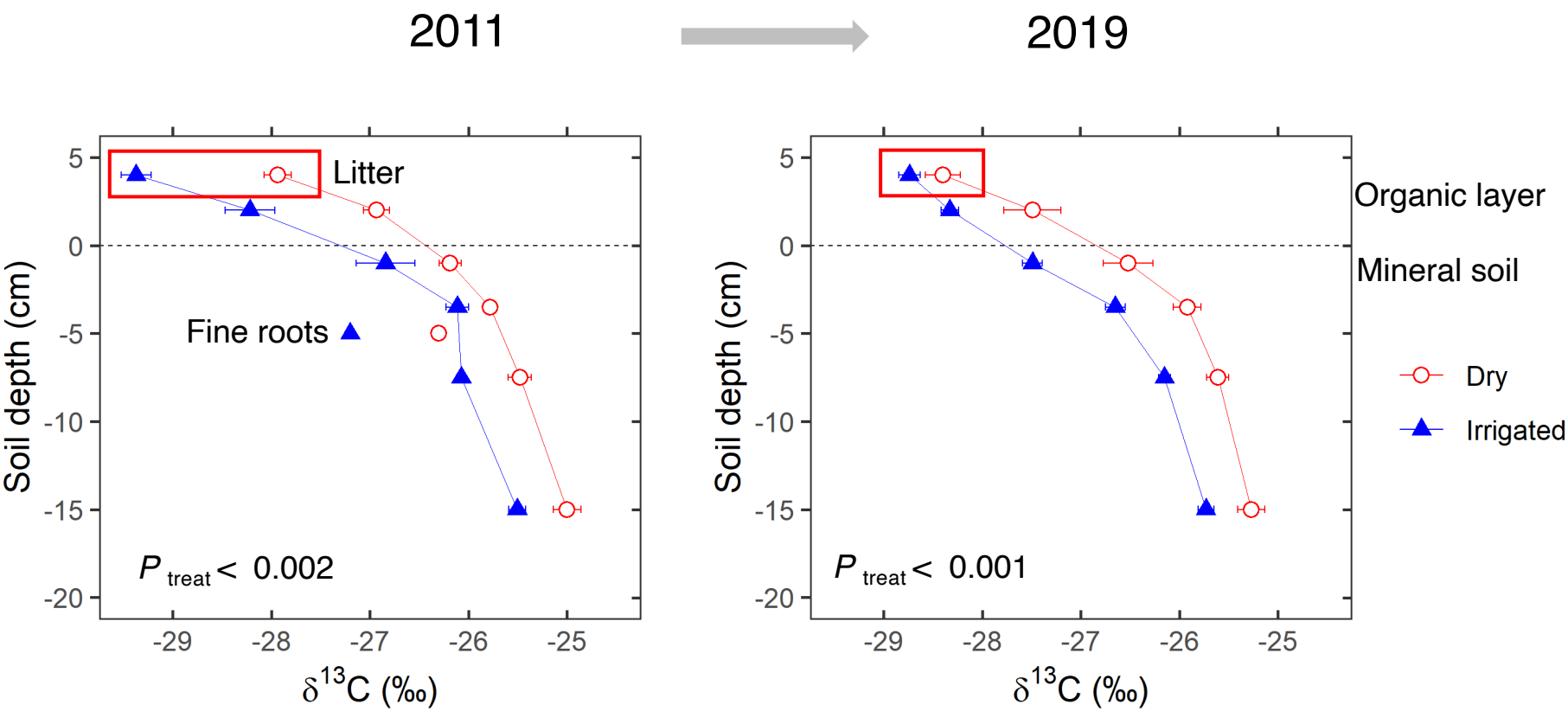
Root biomass

2019

Pine roots *vs.* **Other** species



^{13}C abundance in SOM



Toward similar ^{13}C signature in litter, e.g. due to a new equilibrium in water content?

How does repeated drought affect:

2. C inputs from roots and mycorrhizas /
C outputs from "old" soil organic matter?

Aim:

- Quantify C inputs from roots and mycorrhizas and old C losses
- Relate these changes to microbial communities

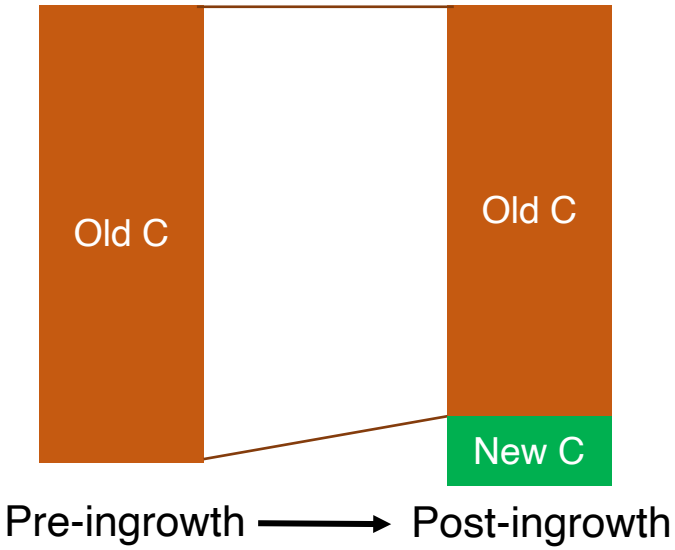
Hypothesis:

↓ *C inputs from roots and mycorrhizas*

↓ *old soil C losses "priming effect"*
→ *impact on soil microbiota*

How does repeated drought affect:

DROUGHT

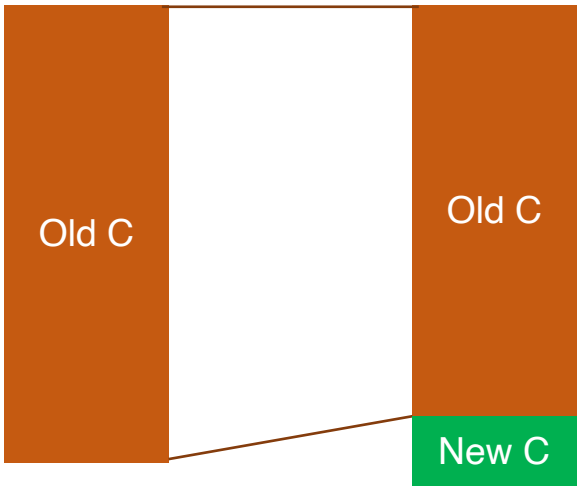


C4 soil, δ ^{13}C - 12 (‰)

Root or litter
δ ^{13}C - 26/-29 (‰)

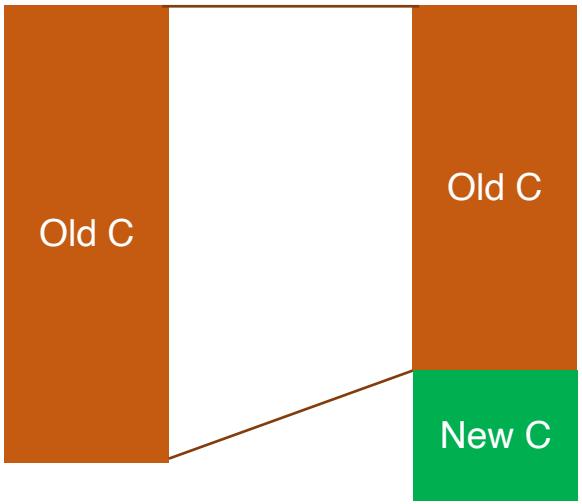
How does repeated drought affect:

DROUGHT



Pre-ingrowth → Post-ingrowth

IRRIGATION

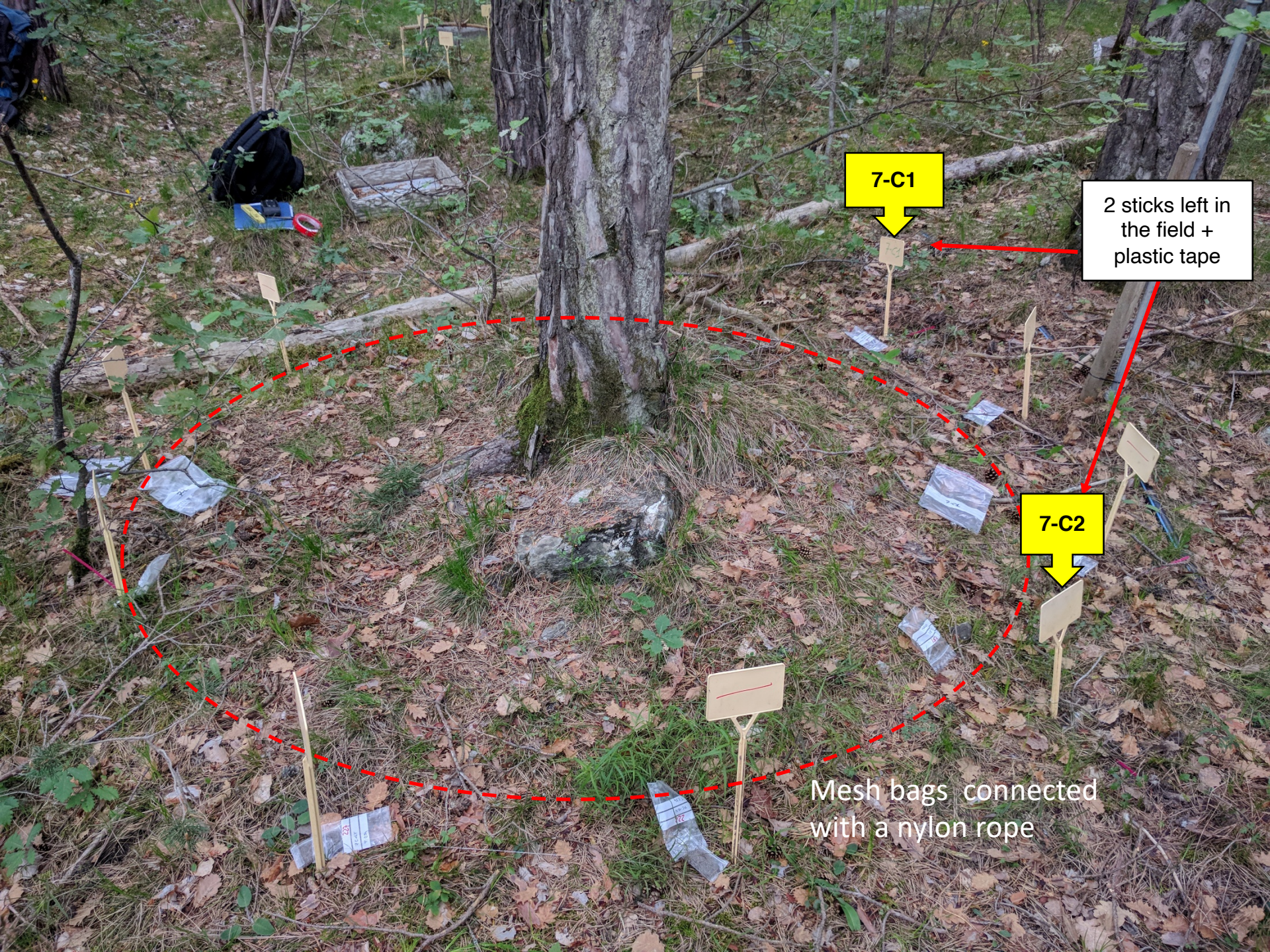


Pre-ingrowth → Post-ingrowth

C4 soil, δ ^{13}C - 12 (‰)

Root or litter
δ ^{13}C - 26/-29 (‰)

Mesh bags installation in Pfynwald (May 2020)


7-C1
2 sticks left in the field + plastic tape
7-C2
Mesh bags connected with a nylon rope

How does repeated drought affect:

3. SOM origin

Aim:

- Determine **prevalent SOM origin** by analysis of biomarkers, root- vs. shoot-derived (suberin and cutin), microbial vs. plant - derived (long-chain n-alkanes) or ^{2}H

Hypothesis:

↓ *root-derived SOM with drought*

↓ *microbial-derived SOM*

THANK YOU!

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