

Soil – atmosphere exchange of greenhouse gases under future climates



Douwes Dekker, N.G., Barba, J., Kourmouli, A., Mackenzie, A.R., Gauci, V., Pendall E., Yamulki, S, Ullah, S. (2022)

Question & Hypotheses

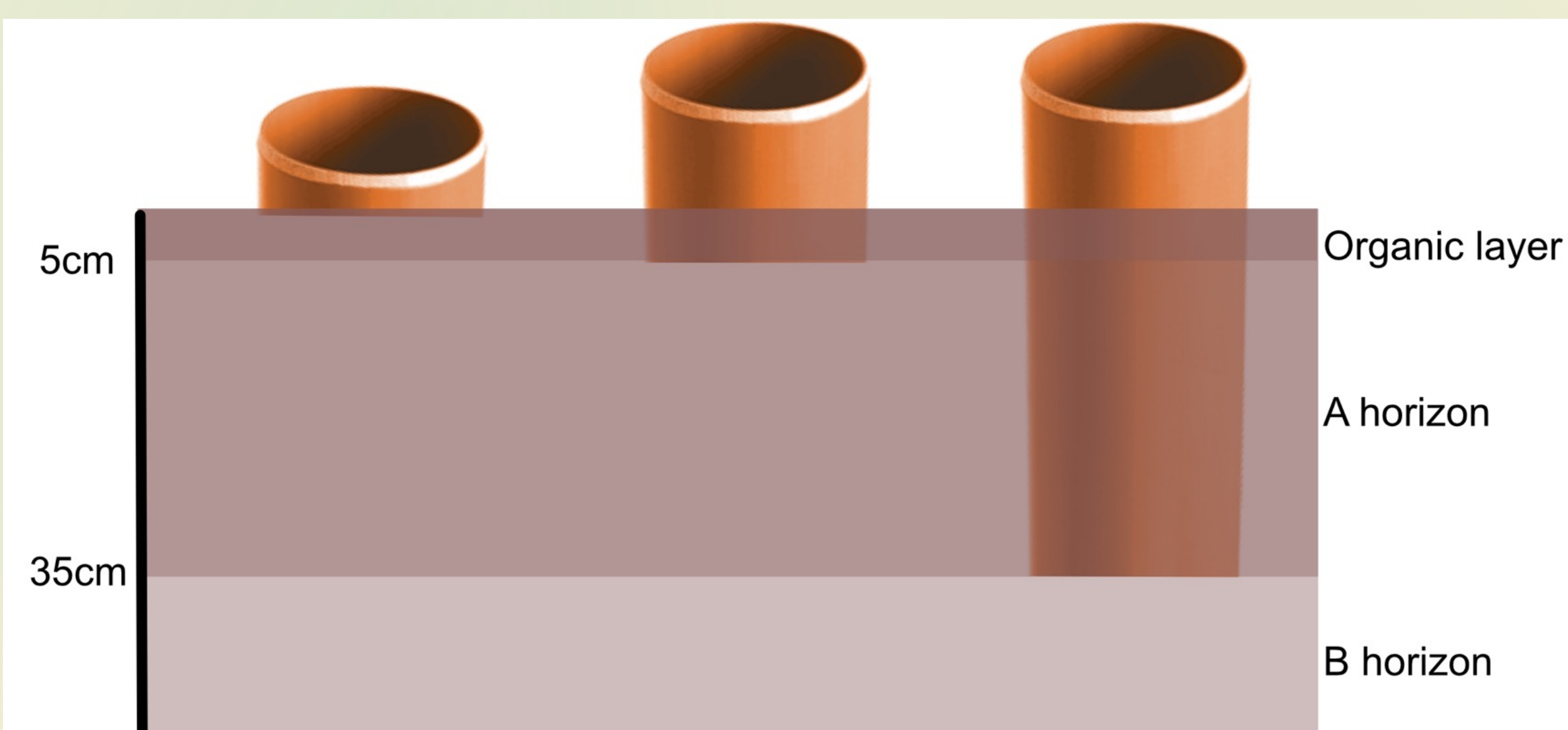
What happens to soil greenhouse gas emissions under elevated CO₂?

Increased carbon allocation belowground means increase in microbial activity and exp. Increase in respiration under elevated CO₂ (eCO₂); Potential increase in soil moisture due to reduced evapotranspiration; increased soil respiration;

Consider heterotrophic (microbes) & autotrophic (root) respiration from the soil;

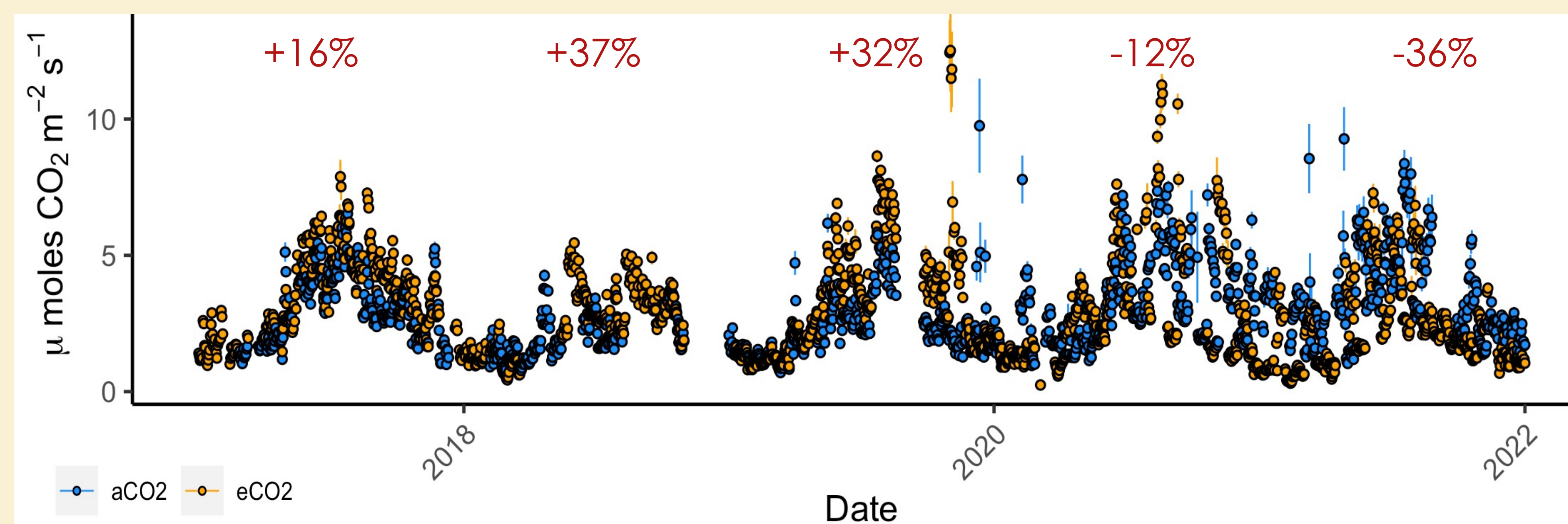
Key hypothesis: heterotrophic respiration will increase as a result of enhanced microbial activity and low evapotranspiration

Experimental set-up



Continuous measurements in the field, measuring CO₂ (results shown), N₂O and CH₄ fluxes (results not shown) from soil from heterotrophic and autotrophic respiration (figure) & PLFA analysis to consider shifts in the active micr. community (not shown)

Soil CO₂ respiration 2017 – 2021



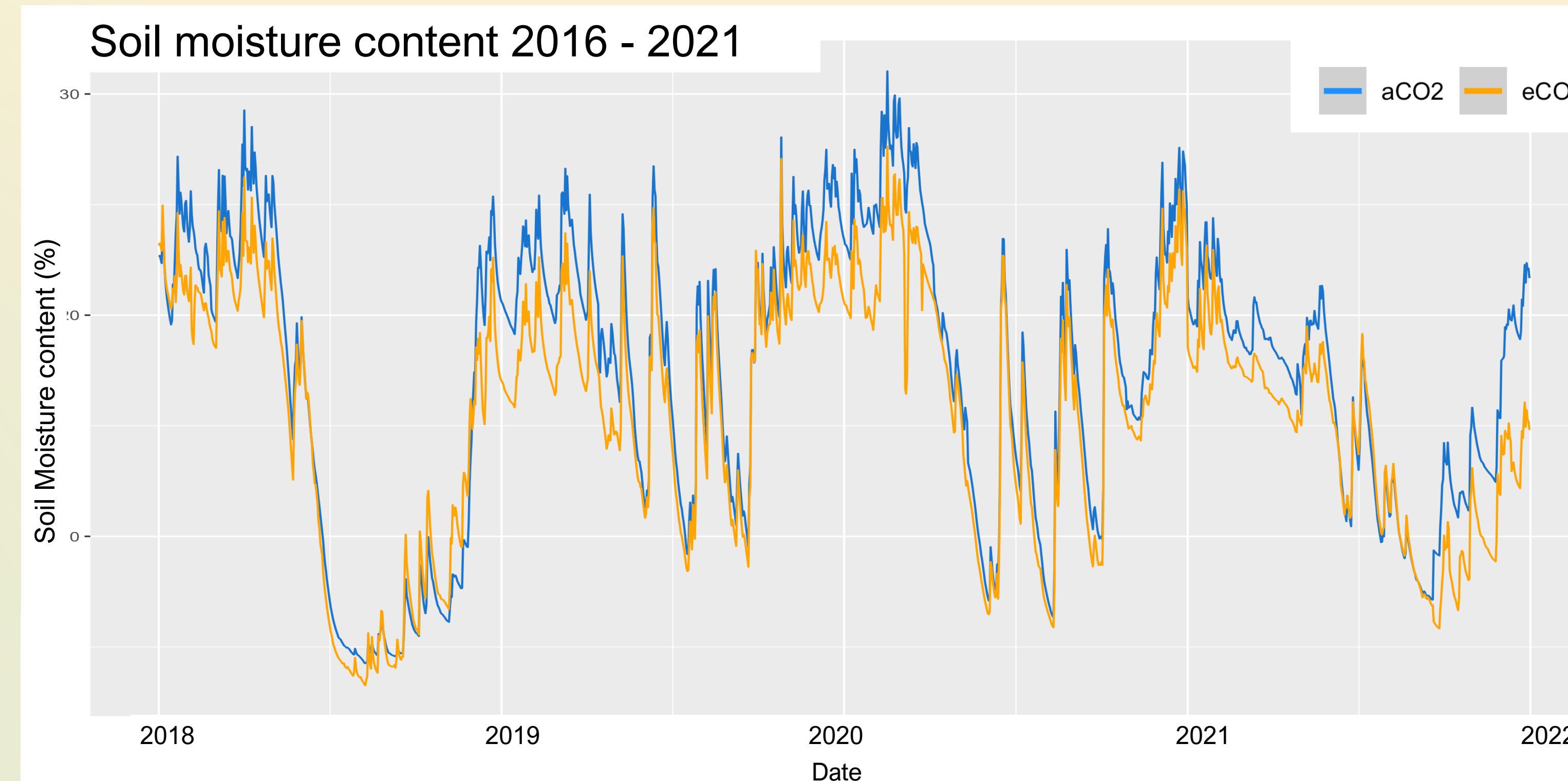
Discussion

Early findings showed a **strong positive** effect of eCO₂ on soil CO₂ emissions (Kourmouli et al., in prep);

Later years show a **slowing down** of this effect and even an **inversion** with higher reduced respiration in eCO₂ plots;

Peaks in emissions seem to line up with rainfall events (results not shown);

Soil moisture



Soil moisture **lower** in eCO₂ = the opposite of hypothesis (exp. reduced evapotranspiration);

Interactive effect of eCO₂ and soil moisture;

Soil temperature influences soil respiration but does not differ between treatments (results not shown).

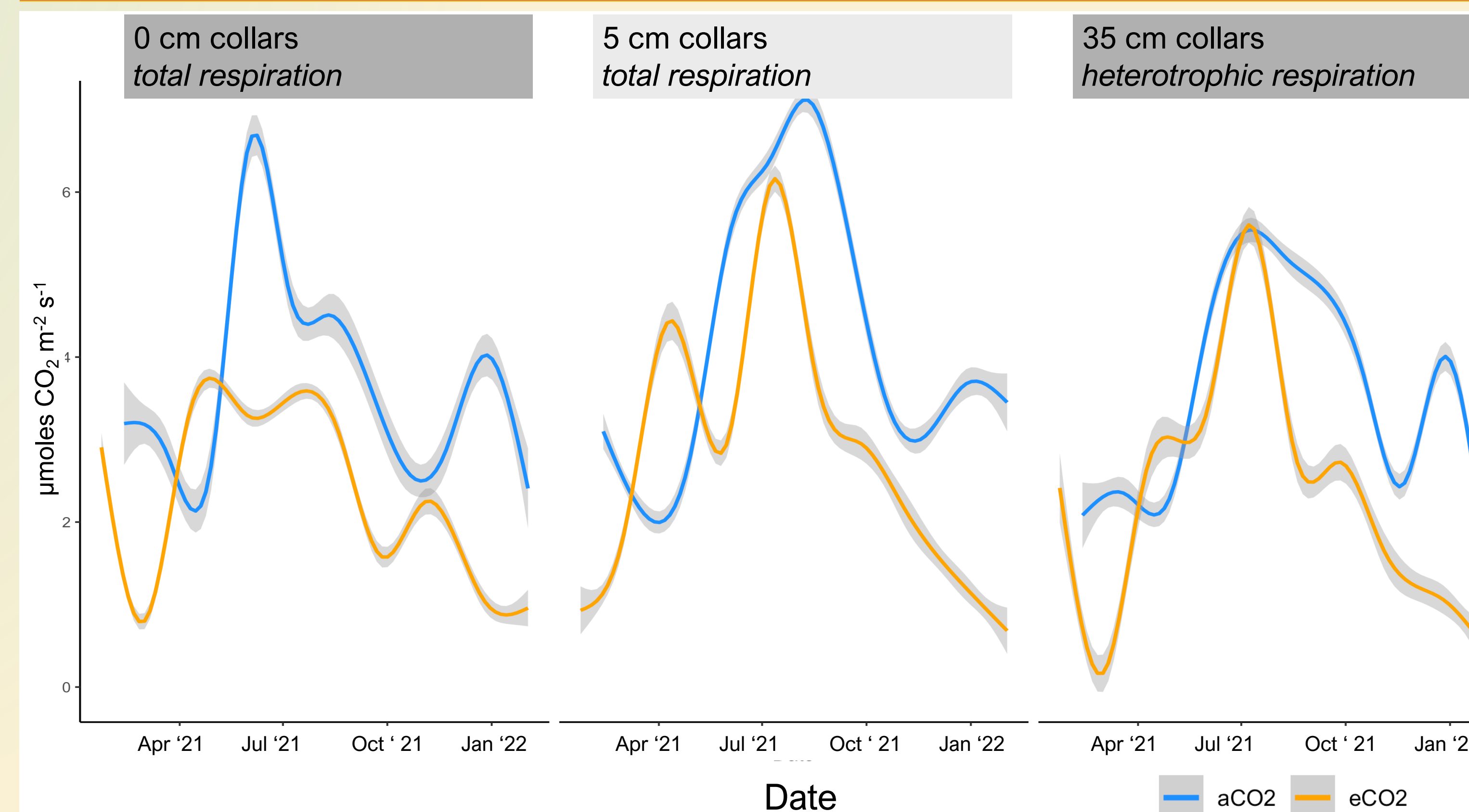
Take home messages

Understanding how higher CO₂ in the atmosphere down- and upregulates other greenhouse gas fluxes allows understanding the possibilities and limits of carbon storage in forests across the globe;

Considering the role of the microbial community will help understand what regulates these fluxes (PLFA analysis);

N₂O and CH₄ will be considered to account for all major greenhouse gases.

Heterotrophic vs. autotrophic respiration (2021)



@ndouwesdekker

nxd934@student.bham.ac.uk