Greenhouse gas emissions from soils under future climates

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1. Why is this important?

◊ Globally forests captures one third of the carbon (C) that humans emit[2].

◊ Under future climates with elevated atmospheric carbon dioxide (eCO_2), the potential of forests for C capture is predicted to increase.

◊ An increase in C capture can stimulate soil nutrient cycling and microbial activity. The balance between soil water stores versus tree demands might change under eCO_2.

⇒ Thus a question arises if changes in belowground C allocation, nutrient transformations and moisture content will result in enhanced greenhouse gas (GHG) emission from forest.

2. Fluxes of greenhouse gasses from forest soils

◊ Soil fluxes include carbon dioxide (CO_2), nitrous oxide (N_2O), and methane (CH_4)

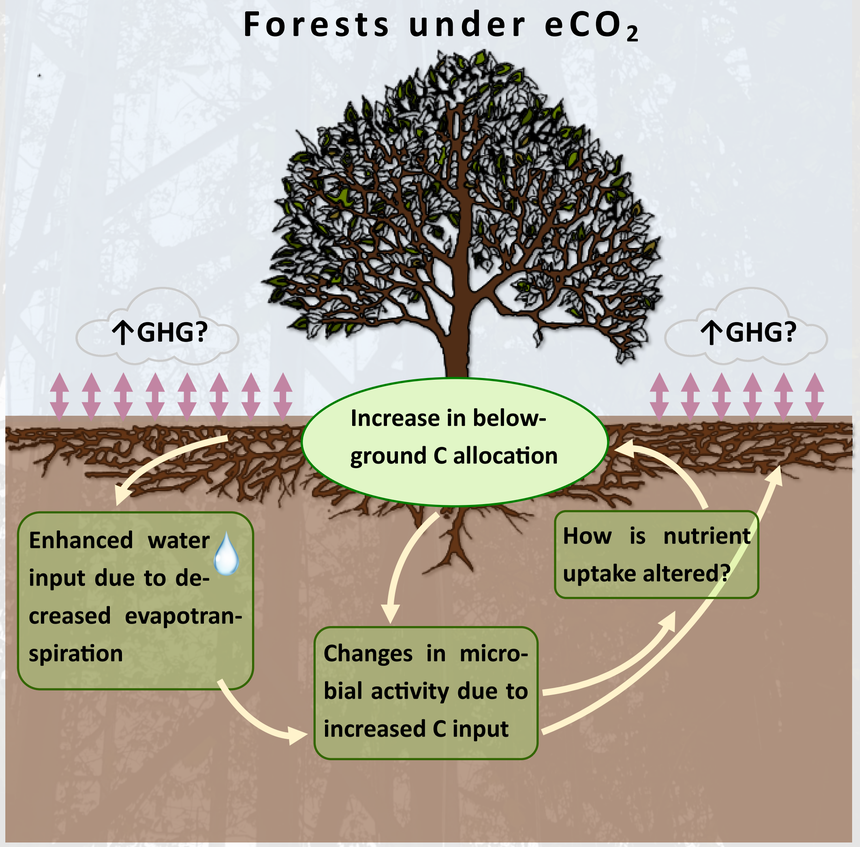
◊ CO_2 fluxes from soils are both autotrophic (roots) and heterotrophic (microbes) and of N_2O and CH_4 are mainly heterotrophic coupled with chemolithotrophic CH_4 consumption

◊ Fluxes are more informative than pools

3. Hypotheses

◊ The complexity and interactions of greenhouse gas producing and consuming processes in regulating the fluxes are poorly understood. Thus this study will focus on disentangling the controls of fluxes.

◊ Enhanced input of C and changes in soil microbial activity and moisture will enhance greenhouse gas emission from forests under eCO2.



4. Field and laboratory work

◊ Determine in situ continuous greenhouse fluxes under eCO_2 fumigation at BIFoR-FAC using automated flux analysers (LiCoR and Picaro)

◊ Characterise relevant soil properties and changes in microbial community functions/profiles through Phospholipid Fatty Acid (PLFA) assays that affect greenhouse gas fluxes

◊ Using isotopes, compare soil CH_4 fluxes and their controls in BIFoR-FACE and EucFACE to assess the impact of forest types (dry vs mesic/wet) on CH_4 fluxes.

⇒ At EucFACE

5. Expected outcomes

◊ Field fluxes and their controls will be explored

◊ Autotrophic and heterotrophic respiration will be partitioned

◊ Control of CH_4 flux across ecosystems: wet temperate in the UK vs. dry eucalyptus forest in Australia

◊ Understanding how CO_2 down– and upregulates other GHG fluxes

◊ Allows understanding the possibilities and limits of carbon storage in forests across the globe

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The Forest Edge Doctoral Scholarship Programme

[2]Pan, Yude, et al. "A large and persistent carbon sink in the world's forests." *Science* 333.6045 (2011): 988-993

Images: https://www.hiclipart.com

[1]About the author: A PhD student funded by the Forest Edge Doctoral Program.

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