From branch to forest to globe:

how does woody tissue distribution and turnover change under elevated CO_2?

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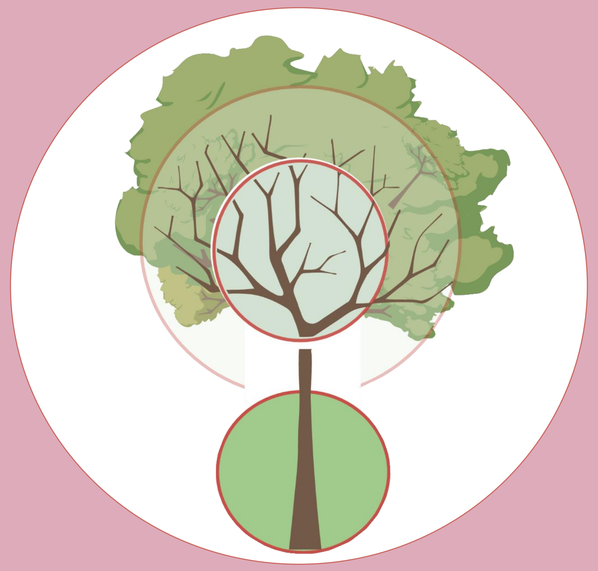
Introduction

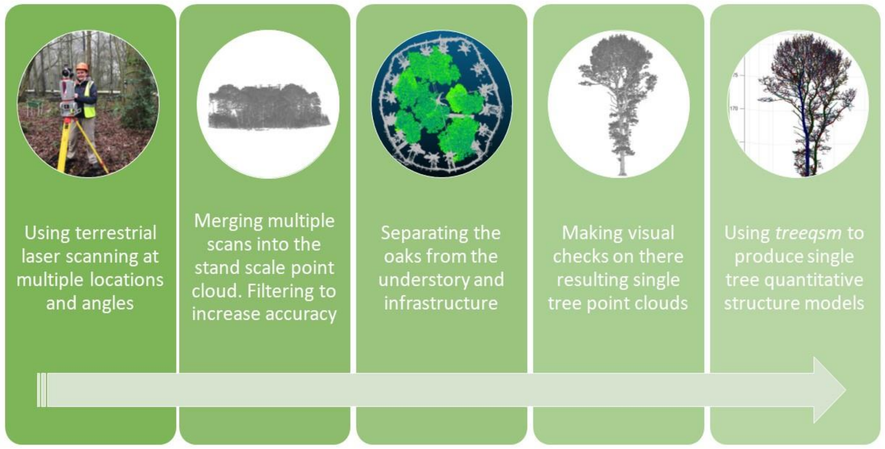
The fate of carbon following increased photosynthetic activity under elevated carbon dioxide (eCO_2) is still uncertain in mature forests. Existing models have forecasted a substantial fraction of the additional carbon to be stored in wood. And while this emphasizes the importance of the existing global forest sink, our knowledge on woody carbon dynamics remains incomplete.

While trunks are typically the main focus in forest research due to their accessibility and longevity, the branches and finer wood compartments of trees, which tend to have shorter lifespans, are often overlooked. Their regular and irregular removal from the canopies of global forests pose a further level of complexity to how the forests of the future will retain the additional carbon. Explore the progress in breaking open the black box of woody carbon dynamics working at two Free Air Carbon Enrichment (FACE) facilities.

Methods

Using terrestrial laser scanning to determine woody distribution in the canopy, while transect inventories and litter traps observe turnover.





Walking trough a digital forest? Explore the pointcloud of BIFoR FACE! SCAN ME:

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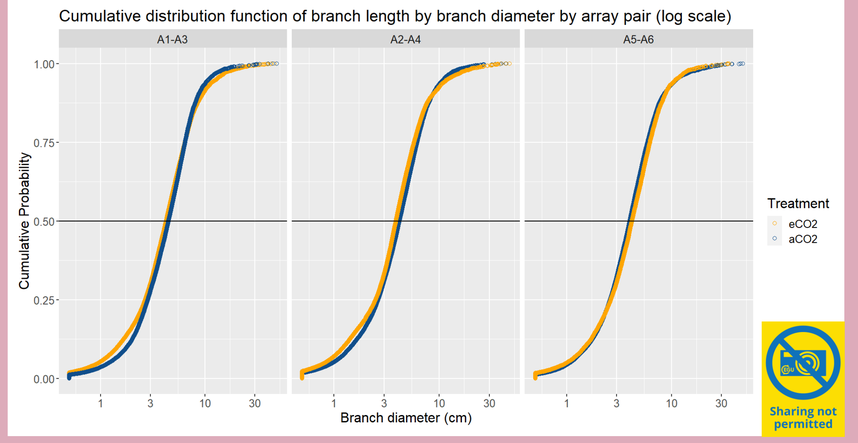
Preliminary results

In the canopy of eCO_2 Oak trees a larger fraction of total length is represented in the smallest branches, up to 3 cm in diameter in the figure below, compared to the aCO_2 trees. This could mean more canopy expansion driven by the increased photosynthesis activity, although the signal strength varies between the array pairs.



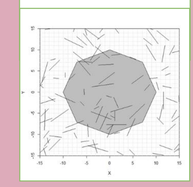
Next steps – turnover at 2 FACE facilities and climates

Knowing how woody tissue is distributed in the canopy is only part of the research question of this project. To understand how frequently a compartment size, and thus carbon, is removed from the canopy, line transects were placed and monitored at monthly intervals at both the BIFoR FACE and EucFACE sites (Sydney, Australia).

With the sub-sample observations of fallen woody debris (A), it's possible to model the stand-scale turnover frequency (B). This will contribute to a further understanding of woody tissue dynamics. Additionally, it will provide an opportunity to determine the impact of environmental drivers such as wind, alongside the treatment effect of eCO_2.

A

B



Tree icon made with Biorender.com