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From branch to forest to globe: how do tree choices regarding growth affect forest response to elevated CO2 levels?

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Anthropocene impact on atmospheric carbon has led to increased efforts to better understand the carbon cycle in terrestrial vegetation. Forests and their natural ability to assimilate carbon dioxide (CO_2) from the air have increasingly been incorporated into climate change mitigation policies. The increase in global CO_2 levels has also been shown to cause photosynthetic enhancement, although the extent of this CO_2-fertilization effect varies across vegetation type, age, species and the availability of other resources. An important knowledge gap for the projected mitigation function of (future) forests is the currently unknown fate of this additional carbon as a result of the increased photosynthetic activity [1]. Woody biomass is still thought to harbour a substation fraction of the unaccounted for carbon [2] and by including smaller woody compartments to the well-represented stem diameter datasets this research project aims to provide more details to the standing and turned over woody biomass inventories. The branch and twig compartments might detach faster from trees pre-mortality under elevated CO_2, increasing the turn-over rate of carbon within forest stands where this has previously gone unnoticed. To determine the choices of trees regarding growth under future CO_2 levels observation will be collected in two second-generation Free Air CO_2 Enrichment (FACE) facilities: BIFoR FACE, in Staffordshire UK and EucFACE in Sydney Australia. By making stand scale inventories using Terrestrial Laser Scanning (TLS) for standing biomass and line transects along with litter traps for fallen woody tissue, the fluxes of newly grown wood under eCO2 versus wood exposed to long term ambient concentrations can be compared. With additional comparisons between the two facilities, subsequent environmental factors and weather events to follow so that predictive carbon budget models can be improved. The increased CO_2 concentrations at these sites reach the levels estimated to be the global ambient in 30-40 years. In the current phase of this research project, the datasets resulting from the first fieldwork campaign and pipelines for array scale TLS analysis and turnover expansion factors are constructed.

References

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