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Soil – atmosphere exchange of greenhouse gases under future climates

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This research investigates the cascading effects of elevated carbon dioxide (eCO₂) fumigation of a mature temperate forest, with a particular focus on the fluxes of greenhouse gases (GHG) nitrous oxide (N₂O), methane (CH₄) and carbon dioxide (CO₂). A field experiment was performed at the Birmingham Institute of Forest Research Free Air Carbon dioxide Enrichment facility (BIFoR FACE), where an oak dominated mixed mature woodland has been under eCO₂ since 2017. Fluxes were quantified in situ using the Licor 8100A – an infrared gas analyser measuring total soil respiration (R_s) as CO₂, and a Picarro greenhouse gas analyser (G2508), measuring N₂O and CH₄. Preliminary data from 2019 – 2021 have been analysed and are built on an earlier dataset from 2017-2018, and the role of soil temperature and soil moisture is considered. With more carbon allocation belowground, we expect an increase in microbial activity and consequently larger R_s. Overall, R_s was higher under eCO₂ in 2017-2018; however, in years 2019 to 2021, the absolute difference in respiration between eCO₂ and control plots gradually decreased and even switched in 2021, with a slight increase in R_s for control plots compared to eCO₂ plots. Moreover, annual fluxes of N₂O and CH₄ were detectable and in general we observed N₂O emission and CH₄ consumption. My presentation will discuss R_s and N₂O and CH₄ fluxes and highlight the role of eCO₂ as well as environmental and soil conditions that regulate the GHG fluxes, allowing us to compute the net global warming potential of forests under future climates.