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## Tree-soil-water relations in a mature temperate forest under elevated CO<sub>2</sub>

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Extreme anthropogenic global change, such as increasing atmospheric carbon dioxide, can challenge long-lived organisms including trees. Carbon uptake by trees, during photosynthesis, is inevitably accompanied by leaf transpiration; elevated atmospheric CO<sub>2</sub> is, therefore, expected to reduce daytime plant water usage. The Free-Air Carbon-dioxide Enhancement (FACE) experiment at the Birmingham Institute of Forest Research (BIFoR) UK manipulates atmospheric CO<sub>2</sub> in a 150 year old mixed deciduous temperate forest. In the sub-project described here, we compare diurnal and seasonal plant-water dynamics from individual trees under treatment (elevated CO<sub>2</sub>) and control conditions. Response of Pedunculate oak (*Quercus robur*), as the dominant tree species, is reported for the initial three years of elevated CO<sub>2</sub>, enabling us to characterise whether the woodland is starting to adapt. Xylem sap flux measurement reflects tree water usage and has been used as a proxy for transpiration at stand scale in forest experiments. This project explores a modified sap flux analysis approach, enabling individual trees to be compared and responses to be scaled up to treatment patch level. It considers: inputs-outputs (e.g. precipitation, transpiration), water flow (e.g. xylem sap flux), temperature and radiation to see how tree-soil-water interfaces behave and change with increased CO<sub>2</sub>. Measurement methods include spot observations (phenology, porometry), and data-logged measures (e.g. of soil moisture and xylem flow). Initially sap flux and stomatal conductance are considered in comparison with previous reported studies of tree water use efficiency and estimations of water storage. By considering these key measurements driven by a tree-centred view the results provide valuable data to improve vegetation, soil and landscape models and increase understanding of trees in mature future- forest environments.