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Abstracts

Carbon flux from decomposing wood and its dependency on temperature, wood N_2 fixation rate, moisture and fungal composition in a Norway spruce forest

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Globally 40-70 Pg of C are stored in coarse woody debris on forest floor. Climate change may reduce the function of this stock as a C sink in the future due to increasing temperature. However, current knowledge on the drivers of wood decomposition is inadequate for detailed predictions. To define the factors that control wood respiration rate of Norway spruce and to produce a model that adequately describes the decomposition process of this species as a function of time, we used an unprecedentedly diverse analytical approach, which included measurements of e.g. respiration, fungal community sequencing and N_2 fixation rate. Our results suggest that climate change will accelerate C flux from deadwood in boreal conditions, due to the observed strong temperature dependency of deadwood respiration. At the research site, the annual C flux from deadwood would increase by 27% with the projected climate warming. The second most important control on respiration rate was the stage of wood decomposition.. Wood decomposition process was best described by a Sigmoidal model, where after 116 years of wood decomposition mass loss of 95% was reached. Our results on deadwood decomposition are important for C budget calculations in ecosystem and climate change models. We observed for the first time that the temperature dependency of N_2 fixation, which has a major role at providing N for wood-inhabiting fungi, was not constant but varied between wood density classes due to source supply and wood quality. This has significant consequences on projecting N_2 fixation rates for deadwood in changing climate.

Wood degradation by white rot basidiomycetes and production of simple phenolic compounds

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White rot fungi degrade and mineralize lignin through secretion of strong oxidative ligninolytic enzymes, preventing accumulation of deadwood organic matter. Due to the specific structures, different lignolytic enzymes has different mechanism in lignin degradation/oxidation, producing many natural secondary metabolites, including phenolic compounds (PC). PC in soil may regulate nutrient cycling in forest ecosystems by controllingthe pool and form of nutrients available for trees. This work explores the PC produced at different times by nine main decay fungal species, belonging to *Heterobasidion* and *Armillaria* genera, before and after their inoculation and growthon silver fir (*Abies alba* Mill.) sawdust, as axenic culture system, under controlled conditions. A total of 81 samples (three replicates for each fungal species and other three replicates kept as a control) were analysed usinghigh-performance liquid chromatography coupled to a hybrid quadrupole-orbitrap mass spectrometer.EighteenPC, includingsimple phenols, alkylphenyl alcohols, hydroxybenzoketones, hydroxycinnamaldehydes, hydroxybenzaldehydes, hydroxyphenylacetic acids, hydroxycinnamic acids, hydroxybenzoic acids and hydroxycoumarins were detected. In particular, coniferyl alcohol, ferulic acid, p-coumaric acid, acetovanillone, vanillic acid, etc. showed a decreasing trend during degradation process, by contrast an accumulation trend was observed for protocatechuic acid, syringic acid and scopoletin. These results suggesteddifferent strategies of silver fir lignin degradation by selected fungal species. PCA revealed a good differentiation between PC and the activity of nine fungal species along the three times of silver fir sawdust degradation. The nine fungal species have different climate requirements which imply different PC production under different global warming scenarios.

B7p: PHYSIOLOGICAL AND BIOGEOCHEMICAL RESPONSE OF FOREST ECOSYSTEMS TO CLIMATE CHANGE AND AIR POLLUTION

The effect of elevated carbon dioxide on leaf-level physiology in a mature temperate woodland

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Anthropogenic carbon dioxide (CO_2) is the main greenhouse gas driving change in the Earth's climate. Rising CO_2 is expected to stimulate photosynthesis, but limited studies have been conducted on mature or temperate forests. It is uncertain how mature temperate forest ecosystems may respond to the future CO_2 emissions and what interacting environmental factors may influence this. This experiment has been conducted at the Birmingham Institute of Forest Research Free Air Carbon Enrichment Experiment (BIFoR-FACE). BIFoR-FACE is set in a mature oak (Quercus robur L.) woodland and provides additional CO_2, to 30 m diameter experimental plots, to simulate the future atmospheric conditions in 50 years' time (+150 ppm). Instantaneous gas exchange measurements have been conducted in the second year of CO_2 fumigation (2018) in the upper canopy of *Q. robur* trees, from bud burst (June) to leaf fall (October). This study used a paired plot design (n = 3) of elevated CO_2 (eCO_2) (550 ppm) and ambient control plots (aCO_2) (400 ppm). Measurements were taken using a Li-6800 portable photosynthesis machine (LICOR) to calculate leaf-level rates of photosynthesis (A), stomatal conductance (gsw) and intrinsic water use efficiency (iWUE) across the growing season. The results suggest an average of +24% increase in photosynthesis, seasonally variable decrease in gsw and increase in iWUE under eCO_2 conditions. The effect of eCO_2 varied depending on the prevailing seasonal and diurnal fluctuations in environmental variables, such as light and water availability. This data will help understand, and contribute, to the accurate modelling of canopy physiological responses to eCO_2 for mature temperate forest ecosystems.