Project no. GOCE-CT-2003-505540

Project acronym: Euro-limpacs

Project full name: Integrated Project to evaluate the Impacts of Global Change on European Freshwater Ecosystems

Instrument type: Integrated Project

Priority name: Sustainable Development

Deliverable No. 316
Paper on the experimental response of DOC to climate change (Task 5.1)

Due date of deliverable: 09 February 2009
Actual submission date: 09 February 2009

Start date of project: 1 February 2002
Duration: 5 Years

Organisation name of lead contractor for this deliverable: NERC

Project co-funded by the European Commission within the Sixth Framework Programme (2002-2006)

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Version 1
Introduction

This deliverable takes the form of a paper published in Soil Biology and Biochemistry, describing research undertaken at the Clocaenog climate manipulation experiment to examine the effects of summer drought on DOC production. The paper focuses on the role of the phenol oxidase enzyme as a control on DOC production, and shows that moisture limitation during droughts reduces soil phenol oxidase activity, with an accompanying decrease in DOC concentrations. Following re-wetting, an accumulated pool of degradable organic matter is decomposed, with increased phenol oxidase activity and elevated soil solution DOC concentrations. The experiment reproduces the widely observed pattern of reduced DOC concentrations in surface waters during droughts, followed by large post-drought pulses on re-wetting, and suggests that this altered seasonal pattern will become more prevalent under climate change if droughts become more frequent or severe. High autumn DOC pulses, in particular, have significant economic and health implications associated with the treatment of highly coloured water. A further assessment of DOC response to 9 years of experimental climate manipulation at Clocaenog is currently in preparation (Sowerby et al., in prep.)


[http://dx.doi.org/10.1016/j.soilbio.2008.01.004](http://dx.doi.org/10.1016/j.soilbio.2008.01.004)
Abstract
Extracellular phenol oxidases play an important role in the soil carbon cycle. The effects of a field-scale summer drought manipulation on extracellular litter and soil phenol oxidase activity, soluble phenolic compounds and dissolved organic carbon concentrations were examined for an upland Calluna heathland on a peaty podsol in North Wales. Litter and organic soil phenol oxidase activity was found to be positively correlated with moisture content. Thus in shallow organic soils, which are sensitive to drying during periods of low rainfall, drought may inhibit soil phenol oxidase activity as a result of water limitations. The release of soluble phenolic compounds and DOC from the droughted plots was found to be lowered during the drought period and elevated outside of the drought period. It is hypothesized that these changes may be a result of the reduced ability of extracellular phenol oxidases to process recalcitrant polyphenolic material under drought conditions. A drying incubation carried out with litter and soil cores from the same site suggests that extracellular phenol oxidase activity displays an optimal moisture level. This reconciled the observed water limitation of phenol oxidase activity at the heathland experimental site with previously observed stimulation of phenol oxidase activity by water table drawdown in deeper peats.