IOP Conference Series: Earth and Environmental Science

Climate change factors increase ammonium, amino acids, DON and DOC in soil solution in a subarctic birch forest in northern Sweden

To cite this article: Biarne W Strobel *et al* 2009 *IOP Conf. Ser.: Earth Environ. Sci.* **6** 082017

IOP Conf. Series: Earth and Environmental Science **6** (2009) 082017 doi:10.1088/1755-1307/6/8/082017

P08.07

Climate change factors increase ammonium, amino acids, DON and DOC in soil solution in a sub-arctic birch forest in northern Sweden

Bjarne W Strobel(1), M Olsrud(2), R Giesler(3)
(1) Department of Basic Sciences and Environment, University of Copenhagen, Denmark
(2) Department of Biology, University of Copenhagen, Denmark
(3) Climate Impacts Research Centre, Department of Ecology and Environmental Science, Umeå University, Abisko, Sweden

Climatic changes are expected to be especially marked at high latitude ecosystems (IPCC, 2007) and global change factors, such as elevated CO2 concentrations and warming are likely to affect ecosystem functioning. Many high-latitude ecosystems are dominated by ericaceous dwarf shrubs; as heath vegetation or as under-storey vegetation in sub-alpine forests. Nutrient availability and functioning is strongly linked to the mycorrhiza association of plants in these plant communities that are dominated by ericoid and ectomycorrhiza plant associations. Global change factors, such as elevated CO2 concentrations and warming are suggested to enhance mycorrhiza activity and below-ground allocation of carbon. Elevated mycorrhiza activity may raise the degradation of labile organic N sources such as soluble peptides increasing the availability of amino acids and ammonium in the soil and potentially shift vegetation composition. An increased bellow-ground carbon allocation may also enhance soil concentrations of soluble organic carbon components such as carbohydrates and low-molecular weight organic acids. Here we investigated the effect of i) increased temperature, ii) increased atmospheric CO2 and iii) both factors in combination on soil concentrations of dissolved carbon and nitrogen components in a subarctic birch forest in northern Sweden. Fig. 1. Experimental site in Abisko, northern Sweden The experiment includes a warming and an elevated CO2 treatment in a one-way factorial design with four treatments. The experiment started in June 2000 and sampling was done after six growing seasons in September 2006. Four open-top chambers (OTC), with a footprint of approx 1.5 m2 were placed in each of six experimental blocks. Four treatments are randomly assigned to one of following four treatments: i) heated chambers with soil and air temperature elevated 5 °C above ambient using buried heating cables and infrared heating lamps; ii) CO2 chambers with CO2-enriched air blown in to double internal atmospheric CO2 concentrations; iii) combined heat and CO2-enrichment; iv) ambient control chambers identical to heat and CO2 treatments but receives no elevated CO2 or heat. The humus layer was sampled with 0.1 m diameter soil auger. Three to four samples were taken randomly in each plot and bulked into one composite sample. The soil solution was extracted using a centrifuge drainage technique within the same day of sampling. The soil solution was analysed for dissolved organic carbon (DOC), total and inorganic N, amino acids, carbohydrates and carboxylic acids. Ammonium increased significantly in the warming treatments but remained unaffected in the elevated CO2 treatment (Fig. 2a). Dissolved organic nitrogen tended to increase (treatment effect, p=0.083), especially in the warming treatment. The amino acids remained unaffected by the treatments. The warming and elevated CO2 treatments increased DOC concentrations between 22-47% expressed as µg DOC kg-1 soil (dw) (Fig. 2b), whereas no treatment effects were found for the carbohydrates and low-molecular weight organic acids analysed. The total amount of carbohydrates was equivalent to an average of 9.5±1.6% of the DOC. An increased temperature obviously promotes both mineralization of organic N and the formation of more DOC possibly as an effect of heterotrophic degradation of soil organic matter. The mechanism causing DOC to increase under elevated atmospheric CO2 is most likely linked to an increased below-ground C allocation. The absence of effect on the carbohydrates and low-molecular weight organic acids were, however, surprising since below-ground allocation of current photosynthates has been shown to affect both components. The combined effect of temperature and CO2 did not give any additive effects suggesting that not only production but also consumption of DOC is affected. The effects of global change factors are complex and more detailed studies are needed to understand the effect on organic carbon and nitrogen components in the high-latitude ecosystem.