"Nutrient availability could constraint forest ecosystem response to global change in Europe"

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NUTRIENT AVAILABILITY COULD CONSTRAINT FOREST ECOSYSTEM RESPONSE TO GLOBAL CHANGE IN EUROPE

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Abstract

In Europe, the combined effects of the global enrichment in atmospheric CO_2 and the high atmospheric nitrogen (N) deposition have increased forest productivity during the last decades. Since N deposition is still high in many European regions and atmospheric CO_2 is still rising, forest productivity in Europe could continue to increase. However, if nutrient availability becomes a limiting factor, forest productivity will not continue its increase, which will inevitably decrease the carbon sequestering capacity of European forests.

The objectives of this study were to describe the nutritional status of the main European tree species, to identify growth limiting nutrients and to assess changes in tree nutrition during the past two decades. We analysed the foliar nutrition data collected during 1992-2009 on the intensive forest monitoring plots of the ICP Forests programme. This dataset is unique in its scope and size, and has the further advantage of being harmonized among all participating countries. Of the 22 significant temporal trends that were observed in foliar nutrient concentrations, 20 were decreasing and 2 were increasing. Altogether our results show a clear deterioration in P nutrition during the past two decades in some of the main tree species. Our study also highlights some downward trends that should be monitored closely in the future since they could become alarming: e.g. decrease in foliar S concentration in P. abies and P. sylvestris, in foliar Mg concentration in F. sylvatica, in foliar K concentration in Q. petraea and P. abies and in foliar Ca concentration in F. sylvatica and Q. petraea. Increased tree productivity, possibly resulting from high N deposition and from the global increase in atmospheric CO_2, has led to higher nutrient demand by trees. Soil nutrient supply was however not always sufficient to meet the demand of faster growing trees. As tree nutrient status exerts a tight control on net ecosystem productivity, this deterioration in tree nutrition could have a strong impact on the response of forest ecosystems to climate change. Nutrient availability and tree nutrition should therefore be accounted for in global carbon cycle to allow climate models to better predict C sequestration capacity of forests and avoid overestimations. Our findings are totally in line with several recent global studies showing that the unbalanced inputs of C and N relative to P induced significant changes in organism stoichiometry resulting in profound and uncertain consequences on the structure, functioning and diversity of terrestrial and aquatic ecosystems.

Key Words (up to five)

forest monitoring, trend analysis, foliar chemistry, mineral nutrition, forest ecosystem

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