Abstract

Forest ecosystems are facing changing environmental conditions induced by anthropogenic pressures, including atmospheric deposition. Elevated sulfur (S) and nitrogen (N) depositions have led to changes in forest soil conditions, inducing acidification and N eutrophication. However, the consequences of atmospheric deposition for the functioning of forest ecosystems may be tree species specific. To assess the effects of S and N inputs on soil functioning of two forest stands, a soil chemistry manipulation experiment took place in two adjacent forest stands – Norway spruce (*Picea abies*) and European beech (*Fagus sylvatica*) – in the Ore Mts. Over six years, separated and combined additions of S and N compounds (50 kg $\cdot ha^{-1} \cdot year^{-1}$) were added to experimental plots in both stands to mimic enhanced atmospheric deposition. The aim of this research was to compare and investigate the soil C and N stocks and fluxes, and their responses in relation to acid and N treatments. We found that under ambient conditions, the beech stand contained more C and N in both the forest floor and the mineral soil compared to the spruce stand. Nitrogen cycling in the beech stand was less tight, with periodical soil N leaching. The manipulated increase of soil acidity (decrease of soil solution pH) reduced the availability of dissolved organic C (DOC) and changed the microbial community structure, resulting in suppressed litter decomposition and C fluxes in both stands, with stronger impacts in the spruce stand. Surprisingly, experimental N addition showed no consistent responses in the microbial community composition or soil nutrient cycling, likely because of forest stand adaptation to ambient long-term enhanced N deposition. Our results have implications for the understanding of controls on both N saturation and C sequestration in forests subject to current and/or historic acid deposition. Considering that many European forests have experienced acid deposition, it is possible that recent measurements of C fluxes from these ecosystems might not be representative of systems in long-term balance with climatic conditions, but of systems subject to additional anthropogenic pressures, and in many cases undergoing transient changes as deposition levels decline.

Key words: tree species, sulfur, nitrogen, soil, carbon cycling, nitrogen cycling, C sequestration