Change in Sulphur pools in forest ecosystems following the reduction of atmospheric SO_2

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Keywords: air quality, sulphate, allocation, trend analysis, ICP Forests

Due to the reduction in sulphur emissions from transport and industry, atmospheric sulphur dioxide (SO_2) concentrations and sulphur deposition in Europe decreased significantly in the last decades. Sulphur is an essential plant nutrient needed for the production of certain amino acids. Its compound sulphate is the principal anion in soil solution and a driver of base cation and aluminium leaching from soils. However, few studies have examined changes in sulphur pools in forest ecosystems as a response to reduction of dry and wet S deposition. Within the monitoring framework of ICP Forests (International Co-operative Programme on Assessment and Monitoring of Air Pollution Effects on Forests) sulphur compounds in soil, soil solution, biomass and deposition have been measured many years across Europe, allowing for the evaluation of sulphur pools and dynamics. In this study, we quantified the change in sulphur pools (forest floor, mineral soil, soil solution, tree biomass and litterfall) between 2007 and 2014 across Europe, focusing on ecosystems dominated by European beech, Norway spruce and Scots pine. Results show how the magnitude of decline in S deposition and atmospheric SO_2 concentration as well as climate, species and soil characteristics moderate sulphur cycling in forest ecosystems, while the absolute effect can differ due to site-specific aspects like management or understory vegetation. The results inform our understanding regarding the long-term effects of elevated SO_2 concentrations and deposition and help to evaluate the time scales and magnitude at which the main forest ecosystem compartments react to changes in sulphur exposure. Eventually, consequences for forest ecosystems in countries with ongoing sulphur emissions to the atmosphere may be predicted. On the other hand, the results may be used to improve predictions of forests likely to become deficient in S.