Dynamic modelling of target loads for forest ecosystems in Flanders (Belgium)

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Target loads for acifidication were determined for 83 stands of the Flemish forest condition (Level I) and intensive monitoring (Level II) networks. The chemical composition of soil and soil solution was simulated throughout time based on soil, deposition and growth measurements using the Very Simple Dynamic (VSD) model. The model was validated with time series data of five intensive monitoring plots, and model sensitivity was assessed for all plots by varying input data and parameters within a reasonable range. These analyses showed that the target loads were mostly affected by the base cation (Bc) fluxes, the cation exchange model and the relationship between the soil solution concentrations of protons and aluminium (Al). Target loads were calculated that resulted in a maximum Al:Bc = 1 concentration ratio in the soil solution from three target years on. For target year 2050, e.g., stronger reductions in nitrogen (N) and sulphur (S) deposition than in the Götheborg agreements were needed in 84% of the plots, while in 4% of the plots the Al:Bc criterion could not be reached. The median target loads of S for 2030, 2050, and 2100 amounted to 58, 65, and 86% of the median critical load of S (being 1829 eq ha^{-1} yr^{-1}), respectively. Target loads of N differed less from the critical load than for S due to the time-dependent soil N immobilisation. Target loads were lower for deciduous than for coniferous stands because of higher base cation uptake by deciduous trees. The acceptable acidifying deposition was lowest for forests on sandy soils because of lower mineral weathering rates compared to loamy or clayey soils. Despite the inherent uncertainty in modelling soil acidification at a regional level, this study shows that important N and S deposition reductions are needed to allow recovery of Flemish forest soils.