Recovery from N saturation in Flemish forests under high N deposition

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The objective of this study was to evaluate the recovery from nitrogen (N) saturation in forests under high N deposition in Flanders, northern Belgium. Deposition and soil solution concentrations of inorganic nitrogen (DIN) and total N were measured at five ICP Forests intensive monitoring plots (1 Pinus sylvestris, 1 P. nigra subsp. laricio, 2 Fagus sylvatica and 1 mixed F. sylvatica – Quercus robur) from 1996 till 2013 (DIN) and from 2005 till 2013 (total N). Deposition and soil solution concentrations of organic nitrogen (DON) were calculated as total N - DIN. The sodium mass balance approach was used to calculate N fluxes through the soil. In 1996 all forests were strongly N saturated, indicated by year-round elevated nitrate (NO$_3^-$) leaching. Despite an overall decrease of DIN depositions, DIN + DON depositions still amounted to 22-32 kg N ha$^{-1}$ y$^{-1}$ in 2013. This coincided with a decline of NO$_3^-$-leaching, and an increase of the DON/DIN ratio in deposition and soil solution. Though, the recovery rates varied among the plots. In the two beech plots NO$_3^-$-leaching decreased rapidly around 2004. Coniferous plots showed a more gradual recovery, with actual NO$_3^-$-concentrations below 2 mg N l$^{-1}$ in the deeper mineral soil during most part of the year. Only the mixed oak-beech plot remained highly N saturated, probably due to elevated humus desintegration in the mineral topsoil. This study points out that chemical recovery of forest soil solution could also be expected under high N deposition, and that NO$_3^-$-leaching may cease rapidly when the retention capacity of the forest ecosystem is no longer exceeded.