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Abstract

Anthropogenic activities highly contributed to increase nitrogen (N) and sulfur (S) atmospheric emissions since 1880. Since the 1980's, within Geneva Convention on Long-Range Transboundary Air Pollution, European countries have joined their efforts to abate atmospheric pollution. In France, atmospheric S emissions decreased by 80% whereas the decrease was less obvious for N. Thus, atmospheric deposition and effects of N on ecosystems remain a major research challenge during last decades.

Atmospheric N deposition is known to severely impacts forest ecosystem functioning by influencing soil biogeochemistry and nutrients balance, and consequently, tree growth and global forest health and biodiversity. To assess the impact of N deposition on ecosystems, the concept of "N critical loads", defined as the maximum N deposition that an ecosystem

can tolerate without any harmful effects and changes, was developed. Moreover, because climate influences greatly soil processes, climate change and atmospheric deposition must be conjointly taken into account to assess the evolution of forest ecosystem status over time.

To test different scenarios and their potential interactions on the long term, dynamic biogeochemical models such as ForSAFE have been developed. Here, we run this model to predict the combined effect of atmospheric deposition and climate change on two temperate French forest ecosystems dominated by oak and spruce, and more precisely on forest soil biogeochemistry, from nowadays to 2100. Two atmospheric N deposition scenarios were tested (CLE – Current Legislation in Europe – and MFR – Maximum Feasible Reduction) combined to three climate SRES scenarios from IPCC (current, A2 – the worst climate scenario – and B1 – the best climate scenario). After a step of calibration and validation, the changes in base saturation and N content in soil were compared between all these scenarios combinations and N critical loads were estimated and discussed. Thus, acidification and eutrophication recovery of the two forest ecosystems could be predicted up to 2100.