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Trends in fluxes and N-isotope ratios in atmospheric nitrogen deposition in Germany

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Due to the worldwide increasing production and using of fertilizer and combustion of fossil and biogenic fuels, more reactive nitrogen (Nr) is released to the atmosphere and consequently deposited on the surface. This additional Nr is held responsible for eutrophication and acidification of ecosystems. Atmospheric N deposition is particularly important through its direct influence on aquatic ecosystems and its high proportion to the nutrient budget of oligotrophic ecosystems.

To evaluate the impact of atmospheric deposition on nitrogen budgets and cycle, both wet and dry only deposition samples have been collected east of the city of Hamburg, Germany. This study site is influenced by intensive agriculture use, traffic and industrial pollution driven by westerly winds from the city of Hamburg, thus representing an ideal study site to investigate high anthropogenic impacts. Both nitrate (NO_3^-) and ammonium (NH_4^+) concentrations and isotope ratios (δ^{15}N-NO_3^- and δ^{15}N-NH_4^+) are investigated. Determination of isotope ratios allows a source attribution of deposited Nr, providing the means to explain seasonal trends and potential historical changes in atmospheric Nr inputs.

First results of a comparison with historical data have shown that NO_3^- inputs in wet and dry deposition have increased, while NH_4^+ concentrations show no significant change, resulting in a decreasing trend of NH_4^+/ NO_3^- in winter and spring compared to a similar study site in Jülich/Germany 30 years ago. The isotopic data of δ^{15}N-NO_3^- show a clear seasonal trend, but also a distinct difference to historical data: In comparison to Jülich in the 1970s, when δ^{15}N-NO_3 values were at0.6 ‰ and -5.0 ‰ in winter and spring, respectively, they have now risen to 4.5 ± 1.8 ‰ and 1.3 ± 2.3 ‰ at our study site. Anthropogenic NO_x sources are known to have positive δ^{15}N values in comparison to natural sources; hence, these isotope data are indicative of a growing proportion of anthropogenic nitrate in atmospheric deposition. As possible source, an increased impact of traffic on land or sea emerges, while this hypothesis yet awaits further investigations.