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Atmospheric acidity and its impacts on macronutrient deposition and plant growth

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Biological diversity and competition among species in ecosystems are sensitive to changes in macronutrient supply and nutrient availability. Human activity is intensively and extensively altering macronutrient cycles from a regional to a global scale with rates that can far exceed natural ones. Moreover, anthropogenic pollution exposes ecosystems to additional nutrients and stressors. These processes, although not well studied, can have a strong impact on ecosystem composition and productivity. In this study, we characterize the atmospheric deposition of bioavailable macronutrients from air pollution and study their impact on plant (oat) productivity and soil quality at a site in the Bois-Chamblard forest outside of Lausanne, Switzerland by Lake Geneva.

To evaluate the importance of atmospheric deposition as a nutrient path for soil and plants, we set up a mesocosm experiment where plants and bare soil were exposed to atmospheric deposition for four months (during Spring and Summer, 2021) and compared against replicates not exposed to atmospheric deposition. Carbon (C), N, P in plant and soil, as well as soil enzymatic activity, fungi and bacterial communities are quantified for each member of the mesocosm experiment. Quantification of the total nitrogen (N) and phosphorous (P), gas- and aerosol-species (inorganic/organic species and metals) in rain water, dry deposition and airborne particles and soil is carried out.

We find that plants exposed to atmospheric deposition display higher photosynthetic activity, larger N content and higher capacity to compete for nutrients in the soil. The soil community in the atmospheric deposition treatment shown higher nitrification rate and enzymatic activity towards lignin decomposition compared to the control. These results indicates that atmospheric pollutants act as plant fertilizers fostering their control on soil microbial community and accelerating soil nutrient stocks consumption.