What are the effects of sulphur deposition on species abundance and species richness?
Applying a meta-analysis to uncover effects of sulphur deposition on biodiversity

Level: Master
Start: Any time
Project form: Meta-analysis
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Background

Pollution is one of the main threats to biodiversity, particularly driven by sulphur and nitrogen emissions (IPBES, 2019). Whereas global average impacts of nitrogen addition on local species abundance and richness have been quantified via meta-analyses (Gallego-Zamorano et al., 2022; Midolo et al., 2019) (Fig. 1), global average impacts of sulphur deposition on local species abundance and richness are largely unknown. This may result in an underestimation of global biodiversity impacts.

Aim and approach

In this internship, you will perform a meta-analysis to quantify impacts of sulphur deposition on species abundance and richness. Meta-analyses comprise collection of primary data from various studies and regression analyses on these data to quantify overarching patterns. You will apply a systematic literature search to select articles with field measurement data of species abundance and richness in sites affected by sulphur deposition (treatment sites) compared to sites unaffected by sulphur deposition (reference sites) and compile these in a new database (see Fig. 1A for nitrogen analogy). You will then apply meta-regression analyses (in R) to this data to quantify the global average effects of sulphur edition on species abundance and species richness (see Fig. 1B for nitrogen analogy). You may also assess whether context variables (e.g., climate or soil characteristics) affect the biodiversity responses to sulphur exposure by adding these variables as moderators to the meta-regression models (see Fig. 1C for nitrogen analogy). The results of this analysis can be used to quantify global impacts of sulphur emissions.

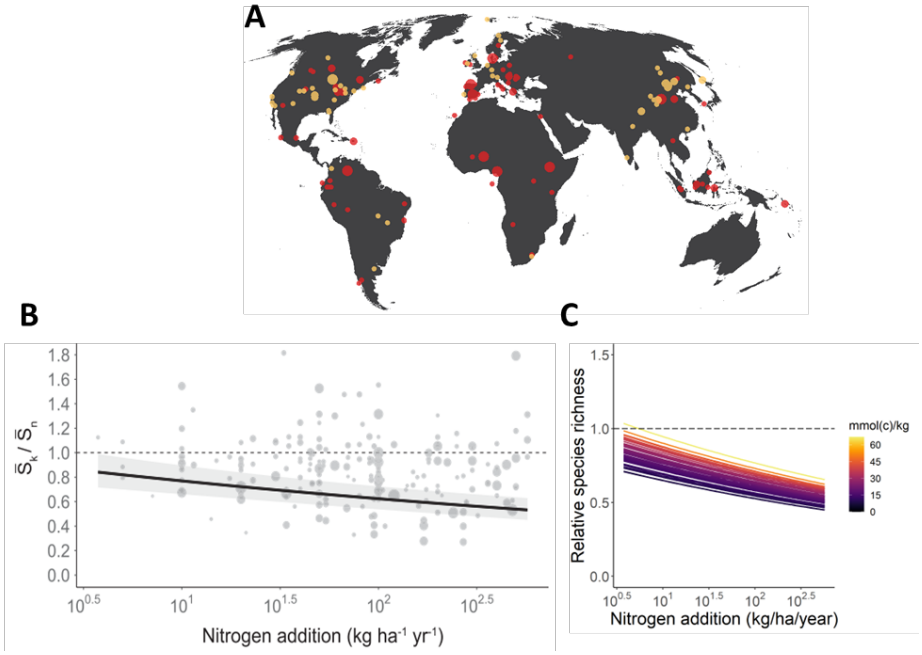

Figure 1. Results of a meta-analysis on nitrogen addition impacts on plant species richness (Gallego-Zamorano et al., 2022). A) the geographic distribution of field measurements used for the data compilation. B) Species richness in a treatment site exposed to a certain level of nitrogen addition (S_k) relative to the species richness in a natural reference site (S_n). C) Effects of the soil cation exchange capacity (an indicator for nutrient retention) on impacts of nitrogen addition on species richness, showing that nitrogen addition impacts are high when the soil nutrient retention is low.

Literature

Gallego-Zamorano, J., Huijbregts, M. A. J., & Schipper, A. M. (2022). Changes in plant species richness due to land use and nitrogen deposition across the globe. *Diversity and Distributions*, *June 2021*, 1–11. https://doi.org/10.1111/ddi.13476

IPBES. (2019). Global assessment report of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services. In E. S. Brondízio, J. Settele, S. Díaz, & H. T. Ngo (Eds.), *Global assessment report of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services*. IPBES secretariat. https://ipbes.net/document-library-catalogue/global-assessment-report

Midolo, G., Alkemade, R., Schipper, A. M., Benítez-López, A., Perring, M. P., & De Vries, W. (2019). Impacts of nitrogen addition on plant species richness and abundance: A global meta-analysis. *Global Ecology and Biogeography*, *28*(3), 398–413. https://doi.org/10.1111/geb.12856