CASE STUDY 6: tree growth vs. Atmospheric nitrogen deposition

**Description:**

Atmospheric deposition of nitrogen (N) influences forest demographics and carbon (C) uptake through multiple mechanisms that vary among tree species. Prior studies have estimated the effects of atmospheric N deposition on temperate forests by leveraging forest inventory measurements across regional gradients in deposition. However, in the United States (U.S.), these previous studies were limited in the number of species and the spatial scale of analysis, and did not include sulfur (S) deposition as a potential covariate. Here, we present a comprehensive analysis of how tree growth and survival for 71 species vary with N and S deposition across the conterminous U.S. Our analysis of 1,423,455 trees from forest plots inventoried between 2000 and 2016 reveals that the growth and/or survival of the vast majority of species in the analysis (n=66, or 93%) were significantly affected by atmospheric deposition. Species co-occurred across the conterminous U.S. that had decreasing and increasing relationships between growth (or survival) and N deposition, with just over half of species responding negatively in either growth or survival to increased N deposition somewhere in their range (42 out of 71). Averaged across species and conterminous U.S., however, we found that an increase in deposition above current rates of N deposition would coincide with a small net increase in tree growth (1.7% per Δ kg N ha-1 yr-1), and a small net decrease in tree survival (-0.22% per Δ kg N ha-1 yr-1), with substantial regional and among-species variation. Adding S as a predictor improved the overall model performance for 70% of the species in the analysis. Our findings have potential to help inform ecosystem management and air pollution policy across the conterminous U.S., and suggest that N and S deposition have likely altered forest demographics in the U.S.

**Primary question(s) of interest:** How does atmospheric nitrogen deposition impact the survival of certain species trees—particularly after accounting for sulfur deposition?

**Data source:** <https://datasetsearch.research.google.com/search?src=0&query=survival%20analysis%20dataset&docid=L2cvMTFuZzYzeHJwbg%3D%3D&filters=WyJbXCJmaWVsZF9vZl9zdHVkeVwiLFtcImFncmljdWx0dXJlXCJdXSJd&property=ZmllbGRfb2Zfc3R1ZHk%3D>

**Dataset:** treeGrowthVSnitrogenDeposit.zip