Global patterns of foliar nitrogen isotopes and their relationships with climate, mycorrhizal fungi, foliar nutrient concentrations, and nitrogen availability

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Ratios of nitrogen (N) isotopes in leaves could elucidate underlying patterns of N cycling across ecological gradients. To better understand global-scale patterns of N cycling, we compiled data on foliar N isotope ratios (delta(15)N), foliar N concentrations, mycorrhizal type and climate for over 11,000 plants worldwide. Arbuscular mycorrhizal, ectomycorrhizal, and ericoid mycorrhizal plants were depleted in foliar delta(15)N by 2 per thousand, 3.2 per thousand, 5.9 per thousand, respectively, relative to nonmycorrhizal plants. Foliar delta(15)N increased with decreasing mean annual precipitation and with increasing mean annual temperature (MAT) across sites with MAT = -0.5 degrees C, but was invariant with MAT across sites with MAT <-0.5 degrees C. In independent landscape-level to regional-level studies, foliar delta(15)N increased with increasing N availability; at the global scale, foliar delta(15)N increased with increasing foliar N concentrations and decreasing foliar phosphorus (P) concentrations. Together, these results suggest that warm, dry ecosystems have the highest N availability, while plants with high N concentrations, on average, occupy sites with higher N availability than plants with low N concentrations. Global-scale comparisons of other components of the N cycle are still required for better mechanistic understanding of the determinants of variation in foliar delta(15)N and ultimately global patterns in N cycling.
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