

Nitrous oxide fluxes in the context of ecosystem nitrogen cycles

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Nitrous oxide fluxes from soil to the atmosphere are one of the most challenging biogeochemical fluxes. This gas is produced and consumed by multiple biological processes, with multiple controlling factors, leading to extreme variation in flux in time and space. While there have long been ideas that there should be coherent relationships between nitrous oxide fluxes and overall patterns on nitrogen cycles in ecosystems, these relationships have been hard to establish. Here we present long-term (18 years) data from two U.S. National Science Foundation funded projects; one in northern hardwood forests in New Hampshire and one in temperate forests in Maryland, showing strong relationships between nitrous oxide flux and overall patterns of ecosystem nitrogen cycles. In New Hampshire, decreases in atmospheric nitrogen deposition and increases in atmosphere carbon dioxide levels have led to an apparent nitrogen oligotrophication of the northern hardwood forest ecosystem including a marked decreases in soil to atmosphere fluxes of nitrous oxide. In Maryland, variation in flux between forests exposed to urban and rural atmospheres has shown coherent patterns with ecosystem nitrogen cycling. These results suggest that low-intensity, long-term data collection can help to elucidate fundamental controls on challenging biogeochemical fluxes.