

Sources, Sinks and Lifetime of Reactive Nitrogen Species in A Temperate Forest

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Abstract

Through observations of reactive nitrogen species, volatile organic compounds and O₃ in the Rambouillet forest near Paris, France, (as part of the ACROSS campaign, 2022) we have gained insight into processes controlling NO_x, peroxy nitrates and alkyl nitrates in an anthropogenically impacted forest environment. O₃ mixing ratios displayed a strong diel profile at the site, which was driven by a variable but generally rapid deposition to soil and foliar surfaces. Only when the O₃ mixing ratio was sufficiently low (and thus the NO lifetime sufficiently long), were sustained NO peaks observed above the instrumental detection limit, enabling derivation of average NO emission rates from the soil of ~1.4 ppbv h⁻¹. Observations of the lack of increase in NO₂ at night, despite a significant production rate from the reaction of NO with O₃, enabled an effective lifetime of NO₂ of ~0.5-3 h to be derived. As the loss of NO₂ was not compensated by the formation of gas- or particle-phase reactive nitrogen species it was presumably driven by deposition to soil and foliar surfaces, or any products formed were themselves short-lived with respect to deposition. Box modelling has been used to understand the sources of organic nitrates in this study. The atmospheric effective lifetime of peroxy nitrates and alkyl nitrates in this environment were determined to be of the order of 1-3 hours, which is approximately the same as for NO₂. We conclude that the nighttime deposition of reactive nitrogen plays a major role in limiting the loss of nitrogen from the ecosystem and also in reducing the daytime (photochemical) formation of O₃ at the site.

Early Career Scientist

YES, I am an early career scientist.