Important aspects of the NO_x dependence of SOA formation: Organic nitrates and oxidation via NO_3

The relationship between NOx and the formation and processing of organic aerosols (OA) is poorly understood. Evidence suggests that NO_x enhances aerosol formation in some systems, while suppressing it in others[1, 2]. Few existing methods are capable of observing molecules with carbon – oxygen – nitrogen linkages making it difficult to learn about the chemistry of nitrogen containing SOA. Because NO_x sources are primarily anthropogenic, this relationship between NO_x and OA is an important one to understand from a policy making perspective, and for an understanding of pre-industrial SOA. Organic nitrates in aerosol may also have important consequences for transport of NO_x and these OA components may have different hygroscopicities and light scattering properties than other organics.

My research studies the relationship between NO_x chemistry and SOA by: 1) Observing and modeling the SOA yield of NO_3 initiated VOC oxidation, and 2) Measuring the uptake coefficients of synthesized organic nitrates onto atmospheric aerosol surfaces. Our modeling of chamber experiments performed at Forschungszentrum Jülich of SOA formation from NO_3 oxidation of isoprene, limonene and β-pinene at near ambient concentrations of VOC and NO_x has demonstrated significant SOA yields, with the formation of gas phase organic nitrates correlated to aerosol mass spec measured nitrates. In our laboratory I am using a new organic nitrate aerosol detection technique to measure the dependence of the uptake of organic nitrates onto aerosol surfaces in a flow tube, and plan to also examine the aging of organic aerosols in the presence of NO_3 in a small chamber. This combination of uptake and chamber experiments will provide mechanistic details necessary to build a more fundamental understanding of the role of NO_x in aerosol formation, growth and aging.

[1] Ng et al., Atmos. Chem. Phys., 7, 5159-5174, 2007.

[2] Kroll and Seinfeld, Atmos. Environ., 42, 3593-3624, 2008.