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3:30 PM, 1315 CHEMISTRY

Special Seminar

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“ Atmospheric Oxidation after Dark: The Unseen Interactions between Humans and the Biosphere “

Emissions of hydrocarbons from vegetation, collectively known as biogenic volatile organic compounds (BVOC), represent a large natural input of chemically reactive species to Earth's atmosphere at both regional and global scales. Chemical degradation of these short-lived compounds through both photochemical and dark reactions influences burden of oxidants and aerosols, affecting both air quality and climate. The presence of air pollution in the form of nitrogen oxides ($\text{NO}_x = \text{NO} + \text{NO}_2$), which arise mainly as a byproduct of combustion, strongly perturbs both the photochemical and nighttime oxidation cycles. The photochemical NO_x perturbation occurs through the well-known reaction of peroxy radical ($\text{ROO}\bullet$) intermediates with NO , a mechanism that leads to catalytic production of ozone. At night, the NO_x perturbation occurs through formation of the nitrate radical, NO_3 , an oxidant that is unstable in sunlight. This radical greatly accelerates the rate of nighttime BVOC oxidation in a series of reactions that serve as a source of organic nitrogen and secondary organic aerosol, SOA.

Understanding the dark side of these oxidation cycles is challenging due to the lack of mixing in the nighttime atmosphere that leads to gradients in chemical composition with height above ground. Nighttime research flights of the NOAA P-3 aircraft over a number of recent field campaigns have provided the only detailed investigation of this nighttime atmospheric oxidation. This presentation will summarize several key findings from this research program. We undertake the first analysis of budgets for isoprene (C_5H_8 , the most prevalent BVOC) consumption in the residual layer, the altitude range that incorporates the previous day's emissions and that is isolated from the surface at night. We further evaluate the the potential for nocturnal SOA formation from nighttime reactions of both isoprene and monoterpenes ($\text{C}_{10}\text{H}_{16}$) and show its variation with altitude. Finally, we assess the transition between NO_x -dominated and NO_x -limited nighttime chemistry as a result of ongoing reductions in U.S. emissions.