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Secondary Organic Aerosol Formation from the Photooxidation of Naphthalene

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Polycyclic aromatic hydrocarbons (PAHs) are ubiquitous air pollutants that are released into the atmosphere as a by-product of combustion processes. The gas-phase PAHs can be chemically transformed via reaction with the hydroxyl radical to produce a range of oxidised organic compounds and other pollutants such as ozone and secondary organic aerosol (SOA). Epidemiological studies have established that exposure to this type of air pollution is associated with damaging effects on the respiratory and cardiovascular systems, and can lead to asthma, oxidative stress, health deterioration and even death.

The major anthropogenic source of SOA in urban areas is believed to be aromatic hydrocarbons, which are present in automobile fuels and are used as solvents. As a result, research is currently being performed on the characterisation of SOA produced from aromatic hydrocarbons such as toluene, the xylenes and trimethylbenzenes. However, significant amounts of PAHs are also released into urban areas from automobile emissions and the combustion of fossil fuels for home heating. Naphthalene is regularly cited as the most abundant PAH in polluted urban air, with typical ambient air concentrations of 0.05 - 0.20 parts per billion (ppbV) in European cities, comparable to the xylenes. Since naphthalene reacts in an analogous manner to monocyclic aromatic compounds then it is also expected to make a significant contribution to ambient SOA. However, the yield and chemical composition of SOA produced from the atmospheric degradation of naphthalene is not well known.

In this presentation, the effects of NO_x level and relative humidity on the SOA formation from the phootooixdation of naphthalene will be presented. A series of experiments has been performed in a large atmospheric simulation chamber equipped with a gas chromatograph and analyzers for monitoring nitrogen oxides (NO_x) and ozone. SOA formation from the photooxidation of naphthalene was measured using a scanning mobility particle sizer. The effect of NO_x concentration on SOA formation was evaluated by varying the initial naphthalene and NO_x concentrations. The results clearly show that a higher hydrocarbon to NO_x ratio produces a higher yield of SOA. The SOA mass yields were also found to increase as the relative humidity was raised from 0 to 50%. A recently developed denuder-filter sampling technique was used to investigate the gas/particle partitioning behavior of the photooxidation products. This work is the first study of the formation of SOA from naphthalene and the results will be compared to those obtained from other aromatic compounds.