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Determination of isoprene aerosol yields in an organic seed by carbon isotope analysis

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At present, the amount of global formation of secondary organic aerosols (SOA) is poorly constrained. A roughly tenfold higher SOA production was inferred from global VOC mass budgets than is estimated from modeling studies. From observations of methyltetrols with the same carbon backbone as isoprene in ambient aerosol it was concluded that isoprene might be an important SOA precursor. Chamber studies with isoprene showed large discrepancies in aerosol yields which seem to be influenced by chamber operating conditions like NOx-level, addition of seed aerosol and reaction speed. We investigated the isoprene induced aerosol yield at low isoprene concentrations and low NOx levels, at a high reaction speed and with an organic seed. To distinguish between the isoprene-derived aerosol components and the seed matrix the stable isotope technique was used. Highly carbon-13 enriched isoprene was generated from plant emissions (Mucuna pruriens, Velvet bean) in a separate plant chamber and then flushed into the smog chamber. Alpha-pinene was added which produces aerosol much faster and in higher yields than isoprene. SOA formed from the photooxidation of this mixture was sampled by three different methods, combusted to CO2 and analysed with isotope ratio mass spectrometry. The isoprene induced mass yields determined by this procedure are presented and compared to other laboratory studies. Implications for regional and global modeling studies with regard to SOA mass are discussed.