Secondary aerosol formation from the oxidation of biogenic hydrocarbons by chlorine atoms

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The chlorine atom (Cl) is a potential oxidant of volatile organic compounds (VOCs) in the atmosphere and is hypothesized to lead to secondary organic aerosol (SOA) formation in coastal and industrialized areas. The purpose of this paper is to test this hypothesis and to quantify the SOA formation potentials of the common monoterpenes a-pinene, b-pinene, and d-limonene when oxidized by Cl in laboratory chamber experiments. Results indicate that the oxidation of these monoterpenes generates significant amounts of aerosol. The SOA yields of a-pinene, b-pinene, and d-limonene in this study are comparable to those when they are oxidized by ozone, by nitrate radical, and in photooxidation scenarios. For aerosol mass up to 30.0 mg m_3, their yields reach approximately 0.20, 0.20, and 0.30, respectively. For d-limonene, data indicate two yield curves that depend on the initial concentration ratio of Cl precursor to d-limonene. It is argued theoretically that multiple SOA yield curves may be common for VOCs, depending on the initial concentration ratio of oxidant to VOC. SOA formation from the three typical monoterpenes when oxidized by Cl in the marine boundary layer, coastal areas, and inland industrialized areas could be a source of organic aerosol in the early morning.

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