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Observation of 2-methyltetrols and related photo-oxidation products of isoprene in boreal forest aerosols from Hyytiälä, Finland

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Abstract. Oxidation products of isoprene including 2-methyltetrols (2-methylthreitol and 2-methylerythritol), 2-methylglyceric acid and triol derivatives of isoprene (2-methyl-1,3,4-trihydroxy-1-butene (cis and trans) and 3-methyl-2,3,4-trihydroxy-1-butene) have been detected in boreal forest PM₁ aerosols collected at Hyytiälä, southern Finland, during a 2004 summer period, at significant atmospheric concentrations (in total 51 ng m⁻³ in summer versus 0.46 ng m⁻³ in fall). On the basis of these results, it can be concluded that photo-oxidation of isoprene is an important atmospheric chemistry process that contributes to secondary organic aerosol formation during summer in this conifer forest ecosystem. In addition to isoprene oxidation products, malic acid, which can be regarded as an intermediate in the oxidation of unsaturated fatty acids, was also detected at high concentrations during the summer period (46 ng m⁻³ in summer versus 5.2 ng m⁻³ in fall), while levoglucosan, originating from biomass burning, became relatively more important during the fall period (29 ng m⁻³ in fall versus 10 ng m⁻³ in summer). Pinic acid, a major photo-oxidation product of α -pinene in laboratory experiments, could only be detected at trace levels in the summer samples, suggesting that further oxidation of pinic acid occurs and/or that different oxidation pathways are followed. We hypothesize that photo-oxidation of isoprene may participate in the early stages of new particle formation, a phenomenon which has been well documented in the boreal forest environment.

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