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Title:	Observation and modelling of HOx radicals in a boreal forest
Authors:	Sinha, V. (/jspui/browse?type=author&value=Sinha%2C+V.)
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Abstract:	<p>Measurements of OH and HO₂ radicals were conducted in a pine-dominated forest in southern Finland during the HUMPPA-COPEC-2010 (Hyytiälä United Measurements of Photochemistry and Particles in Air - Comprehensive Organic Precursor Emission and Concentration study) field campaign in summer 2010. Simultaneous side-by-side measurements of hydroxyl radicals were conducted with two instruments using chemical ionization mass spectrometry (CIMS) and laser-induced fluorescence (LIF), indicating small systematic disagreement, OHLIF / OHCIMS Combining double low line 1.31 ± 0.14). Subsequently, the LIF instrument was moved to the top of a 20 m tower, just above the canopy, to investigate the radical chemistry at the ecosystem-atmosphere interface. Comprehensive measurements including observations of many volatile organic compounds (VOCs) and the total OH reactivity were conducted and analysed using steady-state calculations as well as an observationally constrained box model.


 Production rates of OH calculated from measured OH precursors are consistent with those derived from the steady-state assumption and measured total OH loss under conditions of moderate OH reactivity. The primary photolytic sources of OH contribute up to one-third to the total OH production. OH recycling, which occurs mainly by HO₂ reacting with NO and O₃, dominates the total hydroxyl radical production in this boreal forest. Box model simulations agree with measurements for hydroxyl radicals (OH_{mod.} / OH_{obs.} Combining double low line 1.00 ± 0.16), while HO₂ mixing ratios are significantly under-predicted (HO_{2mod.} / HO_{2obs.} Combining double low line 0.3 ± 0.2), and simulated OH reactivity does not match the observed OH reactivity. The simultaneous under-prediction of HO₂ and OH reactivity in periods in which OH concentrations were simulated realistically suggests that the missing OH reactivity is an unaccounted-for source of HO₂.

 Detailed analysis of the HO_x production, loss, and recycling pathways suggests that in periods of high total OH reactivity there are additional recycling processes forming OH directly, not via reaction of HO₂ with NO or O₃, or unaccounted-for primary HO_x sources. Under conditions of moderate observed OH reactivity and high actinic flux, an additional RO₂ source of approximately $1 \times 10^6 \text{ molec cm}^{-3} \text{ s}^{-1}$ would be required to close the radical budget. Nevertheless, a major fraction of the OH recycling occurs via the reaction of HO₂ with NO and O₃ in this terpene-dominated environment.</p>
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