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High missing OH reactivity in summertime boreal forest environment

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Forest emissions represent a strong potential sink for the main tropospheric oxidant, the hydroxyl radical (OH). Resulting photochemical products can influence ambient ozone, contribute to particle formation and growth processes, and therefore impact climate and air quality. Direct measurements of total OH reactivity in ambient air can reveal gaps in the general understanding of reactive gaseous emissions from the biosphere to the atmosphere. By comparing the contribution from individually measured compounds to the overall OH sink and the directly measured total OH reactivity, the size of any unaccounted for, or “missing” sink can be deduced.

In July and August 2010 an intensive field measurement campaign (HUMPPA-COPEC 2010) was performed at the Finnish boreal forest station SMEAR II in Hyytiälä (Latitude 61° 51’ N; Longitude 24° 17’ E) to investigate the summertime emissions and photochemistry of volatile organic compounds (VOCs) [1]. Speciated VOCs, the key oxidants OH, O_3 and NO_3, as well as aerosol, ions and other trace gases were quantified. Total OH reactivity was measured directly using the Comparative Reactivity Method (CRM) [2]. This total OH reactivity method is an in-situ determination of the total loss rate of OH radicals caused by all reactive species in ambient air.

During HUMPPA-COPEC 2010, total OH reactivity was monitored both inside and directly above the canopy. The impact of various parameters such as temperature and light dependent biogenic emissions and reaction products in “normal” and “stressed” conditions, the long-range transport of pollution and the boundary layer height development were characterized. For “normal” boreal conditions a missing reactivity of 58% was determined, whereas for “stressed” boreal conditions this increased to 89 %. Possible explanations are proposed to explain the high missing OH reactivity in summertime boreal forest environment.

[1] J. Williams et al, 2011, Atmos. Chem. Phys., 11, 10599-10618
[2] V. Sinha et al, 2008, Atmos. Chem. Phys., 8, 2213–2227