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The influence of deep convection on HCHO, H2O2 and organic peroxides in the upper troposphere over Europe

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Deep convection is a highly efficient mechanism of vertical transport from the Earth's surface to the upper troposphere (UT). In convective clouds the rapid uplift of different trace gases with surface sources results in a C-shaped vertical profile and generally longer chemical lifetimes in the UT region affecting photochemical processes, e.g. ozone production. Formaldehyde (HCHO), hydrogen peroxide (H_2O_2) and organic peroxides, which are all important HO_x precursors, are highly soluble trace gases. They can be efficiently scavenged and subsequently removed by precipitation in deep convective clouds.

The analysis of a case study of deep convection over Germany in summer 2007 within the framework of the HOOVER II project is presented. Airborne in situ measurements in the outflow and near the assumed inflow region of an isolated convective cell provide an excellent data set to study the influence of deep convection on the mixing ratios of many different species in the UT region. A comparison of outflow and boundary layer mixing ratios indicate an almost undiluted transport of the longer lived species (CO, CH_4) to the UT with [Outflow]/[BL] ratios of 0.94 ± 0.04 (CO) and 0.99 ± 0.01 (CH_4). For the highly soluble species HCHO and H_2O_2 the ratio still amounts to 0.55 ± 0.09 and 0.61 ± 0.08. Thus these species are not completely washed out in the convective updraft. Degassing during cloud drop freezing, i.e. a retention coefficient of less than unity, is one possible mechanism to contribute to the observed outflow value of these soluble species. For the organic peroxides the ratio is 1.47 ± 0.20 suggesting secondary production in the updraft or anvil region of the cloud. Box model calculations constrained by the measurement data of this case study are performed in order to better understand the effects of convection on the HO_x budget in the tropopause region.