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Ozone tendencies in the free troposphere: A comparison of net ozone production for background conditions and convectively processed air in the tropics and extratropics

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Ozone is an important oxidant and a greenhouse gas. While the highest mixing ratios are found in the stratosphere, significant changes of ozone at tropopause levels can have significant climate effects. Furthermore ozone is the main precursor of the hydroxyl radical OH, thus strongly affecting the oxidation power of the atmosphere. Convective transport of ozone and its precursors between low altitudes near the surface and the middle and upper troposphere influences ozone in the tropopause region.

Data from the airborne measurement campaigns, GABRIEL 2005 (Suriname, South America) and HOOVER 2006 and 2007 (Europe) are presented. We investigate the ozone budget in the free troposphere in cases of deep convection and in background conditions. Steady state model calculations, based on in-situ measurements of O_3, NO, OH, HO_2 and actinic radiation are used to calculate the net O_3 tendency for background and convectively processed air. In the extratropics the net ozone production rate (OPR) in convective outflow amounts to 1.85 ppb_v/h (Range: 0.26 to 8.21 ppb_v/h, depending on the mixing ratio of NO and HO_2), while the background atmosphere shows no clear tendency. In the tropics an OPR of 0.23 ppb_v/h (0.01 to 1.13 ppb_v/h) in the outflow and 0.08 ppb_v/h (-0.01 to 0.47 ppb_v/h) for the background atmosphere was calculated. Convective outflow in both regimes is able to produce ozone in high amounts. For background conditions no clear tendency for the extratropics compared to the tropics is found.