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## Influence of in-cloud oxidation of organic compounds on tropospheric ozone

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Large parts of the troposphere are affected by clouds, whose aqueous-phase chemistry differs significantly from gas-phase chemistry. Box-model studies have demonstrated that clouds influence the tropospheric oxidation capacity. However, most global atmospheric models do not represent this chemistry reasonably well and are largely limited to sulfur oxidation. Therefore, we have developed the Jülich Aqueous-phase Mechanism of Organic Chemistry (JAMOC), making a detailed in-cloud oxidation model of oxygenated volatile organic compounds (OVOCs) readily available for box as well as for regional and global simulations that are affordable with modern supercomputers. JAMOC includes the phase transfer of species containing up to ten carbon atoms, and the aqueous-phase reactions of a selection of species containing up to four carbon atoms, e.g., ethanol, acetaldehyde, glyoxal. The impact of in-cloud chemistry on tropospheric composition is assessed on a regional and global scale by performing a combination of box-model studies using the Chemistry As A Boxmodel Application (CAABA) and the global atmospheric model ECHAM/MESSy (EMAC). These models are capable to represent the described processes explicitly and integrate the corresponding ODE system with a Rosenbrock solver.

Overall, the explicit in-cloud oxidation leads to a reduction of predicted OVOCs levels. By comparing EMAC's prediction of methanol abundance to spaceborne retrievals from the Infrared Atmospheric Sounding Interferometer (IASI), a reduction in EMAC's overestimation is observed in the tropics. Further, the in-cloud OVOC oxidation shifts the hydroperoxyl radicals (HO<sub>2</sub>) production from the gas- to the aqueous-phase. As a result, the in-cloud destruction (scavenging) of ozone (O<sub>3</sub>) by the superoxide anion (O<sub>2</sub><sup>-</sup>) is enhanced and accompanied by a reduction in both sources and sinks of tropospheric O<sub>3</sub> in the gas phase. By considering only the in-cloud sulfur oxidation by O<sub>3</sub>, about 13 Tg a<sup>-1</sup> of O<sub>3</sub> are scavenged, which increases to 336 Tg a<sup>-1</sup> when JAMOC is used. With the full oxidation scheme, the highest O<sub>3</sub> reduction of 12 % is predicted in the upper troposphere/lower stratosphere (UTLS). Based on the IASI O<sub>3</sub> retrievals, it is demonstrated that these changes in the free troposphere significantly reduce the modelled tropospheric O<sub>3</sub> columns, which are known to be generally overestimated by global atmospheric models. Finally, the relevance of aqueous-phase oxidation of organics for ozone in hazy polluted regions will be

presented.