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SPACCIM model studies of the multiphase aerosol processing in warm tropospheric clouds

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The parcel model SPACCIM (Spectral Aerosol Cloud Chemistry Interaction Model / Wolke et al., 2005) has been applied to investigate the effect of multiphase processing of tropospheric aerosol particles and trace gases resulting from passages through warm tropospheric clouds. The applied model includes a complex microphysical and a detailed multiphase chemistry model. The applied multiphase chemistry model consists of the gas phase mechanism RACM (Stockwell et al., 1997) coupled to the detailed aqueous phase mechanism CAPRAM 3.0 (Herrmann et al., 2005). The chemical mechanism incorporates a detailed description of the multiphase chemistry based on time-dependent size-resolved aerosol/cloud spectra. The model data of the joint research project FEBUKO (Tilgner et al. 2005) provided the basis for the chemical and physical model initialization of the SPACCIM model. Simulations were carried out for a meteorological scenario with two cloud passages and interstitial deliquescent aerosol periods at a 90% relative humidity level by neglecting the effects of non-ideal solutions. Simulation results have been analyzed including size resolved source and sinks studies with special emphasis on multiphase phase radical as well as non-radical oxidants, particulate mass productions, aerosol acidification and multiphase oxidations of organic compounds. The multiphase oxidation studies of organic compounds have been focused on important multiphase oxidations of C_2–C_4 compounds. Moreover, the results have been compared to 0-D box model simulations considering a permanent cloud conditions (Herrmann et al., 2005). This model study shows a cloud condensation nuclei mass processing according to chemical processes for particles with sizes mainly up to about 500 nm and droplet depositions for larger particles. Furthermore, interesting effects of the on the oxidation capacity caused by the in-cloud phase transfer and oxidation processes have been observed such as a reduction of the gas phase

O_3 concentration of about 6 % compared to the simulation without cloud interactions. Moreover, significant organic in-cloud productions of monocarboxylic acids such as acetic acid as well as multiphase formations of substituted dicarboxylic acids such as tartronic acid in cloud droplets and deliquescent particles of about $5{\cdot}10^{-10}$ mol m^{-3} has been modeled in good agreement with the permanent cloud studies of Herrmann et al. (2005).

References:

H. Herrmann et al., Atm. Env. 39 (23-24), 4351-4363. (2005)

W. R. Stockwell, JGR 102 (D22), 25,847-25,879. (1997)

A. Tilgner et al., Atm. Env. 39 (23-24), 4389-4401. (2005)

R. Wolke et al., Atm. Env. 39 (23-24), 4375-4388. (2005)