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Lower stratospheric aerosol formation following SO2 injection by deep convection: aircraft measurements and model simulations

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We report on aircraft-based simultaneous measurements in the lower stratosphere above Central Europe of elevated abundances of sulphur dioxide, water vapour, and small freshly formed aerosol particles. The elevated SO2 originated from ground-level combustion sources of the Eastern USA. After convective injection into the lower stratosphere the SO2 experienced within 9 days lower stratospheric transport to Central Europe. During that transport OH-induced SO2-conversion to gaseous sulfuric acid (GSA) took place. Using model simulations we have investigated the possibility that the observed fresh aerosol particles were formed by binary GSA nucleation followed by particle growth via binary GSA condensation and particle coagulation. The model results indicate that the observed SO2 is sufficient to explain the observed fresh aerosol particles. This contrasts the situation in the lower troposphere where often, additional trace gases other than GSA control aerosol growth.