Comparison of Formaldehyde Measurements by HANTZSCH, CRDS and DOAS instruments in the SAPHIR Chamber

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Three instruments using different measurement techniques were used to measure formaldehyde (HCHO) concentrations during experiments in the atmosphere simulation chamber SAPHIR at the Forschungszentrum Jülich. An AL4021 instrument by Aero Laser GmbH uses the wet-chemical Hantzsch reaction for efficient gas stripping, chemical conversion and fluorescence measurement. An internal permeation gas source provides daily calibrations characterized by sulfuric acid titration. A G2307 analyzer by PICARRO INC. uses Cavity Ring-Down Spectroscopy (CRDS) technique to determine concentrations of HCHO, water and methane. A high-resolution laser differential optical absorption spectroscopy (DOAS) instrument provided HCHO measurements along the central chamber axis using an optical multiple reflection cell. The measurements were conducted from June to December 2019 in experiments when ambient air was flowed through the chamber and also in photochemical experiments in synthetic air with mixtures of different reactants, water vapour, nitrogen oxides, and ozone concentrations. Results demonstrate the importance for a linear base line interpolation between zero measurements for the Hantzsch instrument. In addition, a strong water dependence of the baseline of CRDS measurements was found. After correction for the baselines, the correlation analysis of measurements demonstrate good agreement (R > 0.98) between the instruments.