Geophysical Research Abstracts
Vol. 15, EGU2013-11524, 2013
EGU General Assembly 2013

The impact of acetone photolysis to the production of HO_x around the tropopause

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Since May 2005 the CARIBIC passenger aircraft (Civil Aircraft for the Regular Investigation of the atmosphere Based on an Instrument Container – Lufthansa, Airbus 340-600) measures ∼100 trace gases and aerosol components in the UTLS (9-12 km altitude) on four consecutive long-distance flights per month. Acetone along with other VOCs like acetonitrile and methanol is measured with a PTRMS (proton-transfer-reaction mass spectrometer).

The contribution of acetone photolysis to HO_x formation around the tropopause (TP) is compared to primary HO_x production from ozone photolysis and subsequent reaction with water vapor. The presented data analysis is in large part based on CARIBIC in-situ data of acetone, ozone and water and takes into account newer acetone photolysis rates (recommended by the JPL in Evaluation No. 17, JPL Publication 10-6) that question the former picture of acetone as being an important HO_x precursor in the dryer upper TP region. Modeling parameters not easily accessible via experiment like photolysis rates were taken from the ECHAM/MESSy Atmospheric Chemistry (EMAC) model. It can be shown that acetone photolysis contributes up to ∼40 % to the total (= acetone and ozone photolysis) HO_x production rate at the TP in autumn and around ∼30 % in summer. Circa 2 km above the TP the contribution from acetone photolysis becomes smaller due to the quickly decreasing mixing ratio of acetone at higher altitudes (up to ∼20 % in summer and up to ∼ 30% in autumn). The findings are contrasted to results based on older photolysis rates that are larger by a factor of ∼3.5 in summer at cruising altitudes (∼ 9-12 km). Furthermore, as a sensitivity study acetone, ozone and water data from the EMAC model were used as input parameters in order to assess the reliability of the above data analysis.