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Relative humidities in mid-latitude contrails

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Aircraft contrails frequently occur in the upper troposphere. They consist of ice particles having the potential to directly affect the Earth's climate. The frequency, life time, ice crystal size spectra and thus radiative properties of contrails depend strongly on the ambient distribution of the relative humidity with respect to ice (RHi). In air with RHi below 100% contrails are believed to be short-lived, while persistent contrails require an ambient RHi of at least 100% (Gao et al., 2006, Atmospheric Environment).

During the mid-latitude aircraft experiments CONCERT 2008 (CONtrail and Cirrus ExpeRimenT, 6 flights), CIRRUS 2006 (1 flight) and PAZI 2003 ('PArtikel und ZIrren', 2 flights), RHi inside of contrails were measured using the high precision Fast In-situ Stratospheric lyman-alpha Hygrometer FISH. We present results from about 1 hour of observation time in 52 contrails during the 9 flights. The peak of the RHi frequency distribution is around 90%, i.e. most of the contrails are observed in subsaturated air. There is indication that the age of the contrails is much larger than expected, implying that, to date, the lifetime of contrails below 100% RHi is underestimated. Further analysis of the observations is needed to confirm/explain these results.