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# Aircraft contrails: do they live longer?

M. Krämer[1], M. Kübbeler[1], J. Meyer[1], M. Hildebrandt[1], C. Schiller[1], M. Fiebig[2], A. Minikin[3], A.Petzold[3], H.Schlager[3], Ch. Voigt[3], J.-F. Gayet[4]

[1]ICG1, Forschungszentrum Jülich, 52425, Jülich, Germany
[2]Norwegian Institute for Air Research (NILU), Dept. Atmospheric and Climate Research, Kjeller , Norway
[3]DLR Oberpfaffenhofen, Institute for Physics of the Atmosphere, Weßling, Germany
[4]LaMP, UMR/CNRS, Universite Blaise Pascal, Clermont-Fd, France
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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´ 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).

During the mid-latitude aircraft experiments CONCERT (*CON*trail and *C*irrus *E*xpe*R*imen*T*, 6 flights, Oct./Nov. 2008), CIRRUS (1 flight, Nov. 2006) and PAZI (`*PA*rtikel und *ZI*rren´, 2 flights, May 2003), RHi inside of contrails were measured using the high precision *F*ast *I*n-situ *S*tratospheric Lyman-alpha *H*ygrometer FISH. Ice crystals were detected using an FSSP300, a Polar Nephelometer and a Cloud Particle Imager. Enhanced signals of gas phase NOy or nonvolatile particle concentration are used to distiguish contrails from natural cirrus.

Contrails were probed in most cases above cirrus appearing together with warm fronts of low pressure systems. Figure 1 (bottom) shows RHi frequencies of occurrence from about 1 hour of observation time in 52 contrails during the 9 flights. The peak of the RHi frequency distribution is at 90%, i.e. most of the contrails were embedded in subsaturated air. For comparison, the most frequent RHi of natural cirrus is 100% in cold as well as in warmer cirrus (Figure 1, top: blue and red curves; Krämer et al., 2008).

The age of the observed contrails was between 3 and 20 minutes. First, observation based model simulations with the detailed kinetical ice cloud model MAID (Bunz et al., 2008) show that contrails, consisting of many small ice crystals, should disappear in between 1-2 minutes and that the longer lifetimes might be caused by very few larger ice crystals evaporting only slowly under subsaturated conditions.

Our results imply that, to date, the lifetime of contrails below 100% RHi may be underestimated. Further analysis of the observations will be performed to confirm and explain these results.

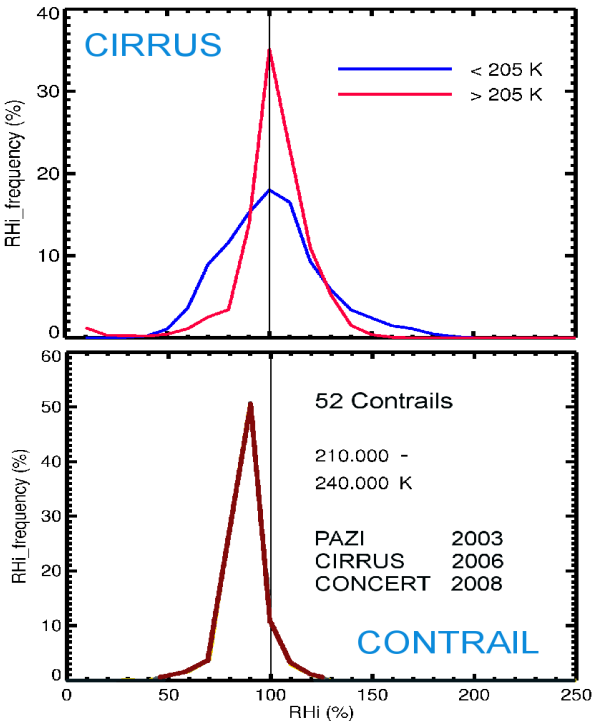


Figure 1. RHi frequency of occurrence in cirrus clouds (from Krämer et al., 2008) and in contrails.

Bunz et al. (2008). MAID: a model to simulate UT/LS aerosols and ice clouds. *Envir. Res. Lett.,* 3, 10.1088/1748-9326/3/3/035001.

Gao et al. (2006). Measurements of relative humidity in a persistent contrail. *Atmos. Env.,* 40, 1590 - 1600.

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