4.242 Upper tropospheric water vapour and its interaction with cirrus clouds – Insights from two decades of IAGOS in-situ observations.

Presenting Author:
Andreas Petzold, Forschungszentrum Jülich, IEK-8 Troposphere, Jülich, Germany, a.petzold@fz-juelich.de

Co-Authors:
Patrick Neis, Forschungszentrum Jülich, IEK-8 Troposphere, Jülich, Germany
Susanne Rohs, Forschungszentrum Jülich, IEK-8 Troposphere, Jülich, Germany
Herman G.J. Smit, Forschungszentrum Jülich, IEK-8 Troposphere, Jülich, Germany
Martina Krämer, Forschungszentrum Jülich, IEK-7 Stratosphere, Jülich, Germany
Martin Gallagher, University of Manchester, Manchester, UK
Gary Lloyd, University of Manchester, Manchester, UK
Peter Spichtinger, Institute for Atmospheric Physics, Johannes Gutenberg University, Mainz, Germany
Andreas Wahner, Forschungszentrum Jülich, IEK-8 Troposphere, Jülich, Germany

Abstract:

IAGOS (In-service Aircraft for a Global Observing System; www.iagos.org) and its predecessor programme MOZAIC perform long-term routine in-situ observations of atmospheric chemical composition, water vapour, aerosols, clouds and temperature on a global scale by operating compact instruments on board of passenger aircraft. The unique character of the IAGOS data set originates from the global-scale sampling on air traffic routes with similar instrumentation such that the observations are truly comparable and well suited for atmospheric research on a statistical basis. The programme started in 1994 and emerging data records cover more than 20 years for ozone and water vapour, whereas ice cloud particle data are available since 2011.
Two decades of data on water vapour mixing ratio and relative humidity over ice have been re-analysed with an advanced in-flight calibration technique to improve data precision, particularly for regions in the atmosphere where ice supersaturation occurs. The high-resolution vertical distribution of ice-supersaturation across the tropopause layer at mid-latitudes indicates a distinct layer of supersaturated air masses right below the thermal tropopause which favours formation of ice clouds (cirrus) and persistent contrails from aviation. The record of ice-supersaturation probability distribution for the highest upper tropospheric layer demonstrates a strong inter-annual variability of occurrence probability; e.g., over the North Atlantic region, this value varies between 20 and 40%.
The shorter record of collocated observations of water vapour and ice crystals is used for further analyses of properties of natural and anthropogenic ice clouds forming in the uppermost troposphere, and their link to relative humidity over ice. Of particular interest is the fraction of ice-supersaturated regions which exist outside of cirrus clouds.

Combining both data sets will allow conclusions on the long-term evolution of cirrus cloud coverage over the regions sampled by IAGOS aircraft and can be linked to satellite observations of cirrus coverage.