

Upper tropospheric water vapour and its interaction with cirrus clouds as seen from IAGOS long-term routine in-situ observations

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IAGOS (In-service Aircraft for a Global Observing System) performs long-term routine in-situ observations of atmospheric chemical composition (ozone, CO, NO_x, NO_y, CO₂, CH₄), water vapour, aerosols, clouds and temperature on a global scale by operating compact instruments on board of passenger aircraft. The unique characteristics of the IAGOS data set originate 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. Here, we present the analysis of 15 months of simultaneous observations of relative humidity with respect to ice (RH_{ice}) and ice crystal number concentration in cirrus (N_{ice}) from July 2014 to October 2015. The joint data set of 360 hours of RH_{ice} – N_{ice} observations in the global upper troposphere and tropopause region is analysed with respect to the in-cloud distribution of RH_{ice} and related cirrus properties. The majority of the observed cirrus is thin with N_{ice} < 0.1 cm⁻³. The respective fractions of all cloud observations range from 90% over the mid-latitude North Atlantic Ocean and the Eurasian continent to 67% over the subtropical and tropical Pacific Ocean. The in-cloud RH_{ice} distributions do not depend on the geographical region of sampling. Types of cirrus origin (in situ origin, liquid origin) are inferred for different N_{ice} regimes and geographical regions. Most important, we found that in-cloud RH_{ice} shows a strong correlation to N_{ice} with slightly supersaturated dynamic equilibrium RH_{ice} associated to higher N_{ice} values in stronger updrafts.