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Assurance of MOZAIC/IAGOS relative humidity data quality by evaluating the Capacitive Hygrometer during airborne field studies

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Water vapour is a major parameter in weather prediction and climate research but the interaction between the water vapour in the upper troposphere and lowermost stratosphere (UT/LS) and tropopause dynamics are not well understood. A continuous measurement of upper tropospheric humidity (UTH) is difficult because the abundance of UTH is highly variable on spatial and temporal scales that cannot be resolved, neither by the global radiosondes network nor by satellites.

Since 1994, data with high spatial and temporal resolution for relative humidity are provided by the in-situ measurements aboard civil passenger aircraft from the MOZAIC/IAGOS-programme (www.iagos.org). The data set emerging from this long-term observation effort builds the backbone of the ongoing in-situ UTH climatology and trend analyses.

In order to assess the validity of the long-term water vapour data and its limitations, an analysis of the humidity data sets of two field campaigns is presented. The validation of applied measurement methods, i.e. the MOZAIC/IAGOS Capacitive Hygrometer, is valued on the basis of the aircraft campaigns CIRRUS-III (2006) and AIRTOSS-ICE (2013), where research-grade water vapour instruments were operated simultaneously to the MOZAIC/IAGOS Capacitive Hygrometers.

The performance of the MOZAIC Capacitive Hygrometer (MCH; operated from 1994 to 2014 on MOZAIC aircraft) and the advanced IAGOS Capacitive Hygrometer (ICH; operated since 2011 on IAGOS aircraft) are explored in clear sky, in the vicinity of and inside cirrus clouds as a blind intercomparison to the research-grade water vapour instruments.

From these intercomparisons the qualification of the Capacitive Hygrometer for the use in long-term observation programmes is successfully demonstrated and the continuation of high data quality is confirmed for the transition from MCH to ICH.
In particular the Capacitive Hygrometer response time to changes in relative humidity could be determined for the full range of temperatures in the comparison against the research-grade instruments.