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Halocarbon measurements in the UTLS: results from the CARIBIC aircraft project

David Oram (1), Johannes Laube (1), Adam Wisher (1), Debbie O'Sullivan (1,2), Tanja Schuck (3), and Carl Brenninkmeijer (3)

(1) University of East Anglia, School of Environmental Sciences, Norwich NR4 7TJ, United Kingdom (d.e.oram@uea.ac.uk), (2) UK Meteorological Office, Exeter, United Kingdom, (3) Max Planck Institute for Chemistry, Mainz, Germany

The CARIBIC project aims to investigate the spatial and temporal distribution of a wide-range of compounds in the UTLS region by making regular measurements from a commercial airliner. Between 1998 and 2002 an instrumented freight container was flown on a Boeing 767-ER aircraft operated by LTU International Airlines flying regularly between Germany and destinations including the Maldives, southern Africa and the Caribbean. Around 40 successful return flights were completed during this initial 4-year period. The altitude range (up to 12 km) and flight routes allow for sampling of mid-upper tropospheric air in tropical regions and lower stratospheric air in mid-latitudes. The original instrument package included in-situ ozone, H_2O, aerosol and CO measurements, as well as a large volume whole air sampler (WAS), collecting 12 samples during the return flight. Compounds measured in WAS include hydrocarbons, halocarbons and SF6, as well as the concentration and isotope ratios of CO, CO_2, CH_4 and N_2O. In December 2004, the flying programme recommenced with an improved instrument package and a new aircraft/operator (Airbus 340/Lufthansa). New instruments/measurements include NO/NO_y, in situ CO_2, PTRMS (oVOCs, CH_3CN), elemental mercury and DOAS (BrO, HCHO, etc). In addition, the WAS system was upgraded to allow for the collection of 28 samples per flight. Recent flight destinations include India, the Philippines, central America and southern Africa. The WAS samples are analysed at UEA by GC-MS for approximately 40 halocarbons and carbonyl sulphide (OCS). These measurements account for virtually 100% of organic chlorine, bromine and iodine in the UTLS region. Since halocarbons are excellent tracers of air mass origin (industrial pollution, biomass burning, stratospheric air, oceanic air, etc), the data can be used to investigate the age and origin of air in the tropopause region. Here we will give an overview of the CARIBIC halocarbon measurements to date (geographical distributions, long-term trends, identification of source regions, etc). Particular focus will be given to the measurements of very short lived species (VSLS), such as $CHBr_3$, CH_2Br_2 and CH_3I, which are believed to play an important, hitherto underestimated, role in stratospheric ozone chemistry.