

CONTRACE - CONVECTIVE TRANSPORT OF TRACE GASES INTO THE MIDDLE AND UPPER TROPOSPHERE OVER EUROPE: BUDGET AND IMPACT ON CHEMISTRY

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The objective of the CONTRACE project is to investigate the impact of convective transported (and/or frontal lifting of) air masses from the boundary layer on the trace gas composition and budget in the middle and upper troposphere over Europe. The first airborne field experiment was carried out from Southern Germany in fall 2001. The DLR research aircraft Falcon was equipped with a complex instrumentation to measure NO, NO_y, CO, CO₂, O₃, J(NO₂), acetone, SO₂, ions, H₂O₂, formaldehyde, NMHC, J(O₁D) and particles. An extensive set of chemical and meteorological forecast products, including trajectory calculations, was developed and used in combination with satellite images (METEOSAT and GOES) to plan the flights. A passive tracer for surface emissions (CO) was included in the forecast models to separate the regional and intercontinental transport of polluted air masses. During all CONTRACE flights in the free troposphere polluted layers with different origin (European/North American) and distinctly enhanced trace gas mixing ratios (especially NO_y and CO) were successfully observed. On November 14th the chemical forecast models indicated lifting of surface emissions in the Mediterranean area ahead of a cold front system that passed over Central and Southern Europe. The airborne measurements showed that these emissions were lifted up to 3 km altitude over Corsica. Further, several pollution layers were found in the middle and upper troposphere (4-7 km) over Corsica. The outflow from nearby thunderstorms to west probably caused these enhancements in the CO (120 ppbv), NO (1.5 ppbv) and NO_y (3 ppbv) signals. For the first time it succeeded to guide the Falcon aircraft very precisely into pollution

plumes transported all the way from North America. Until now these plumes had only been observed by coincidence. The forecast models showed how pollution plumes were lifted over Eastern North America, ahead of approaching cold fronts, in so-called warm conveyor belts (WCB) and then rapidly transported to the east. In about 4 days these pollution plumes reached Europe. Three out of four CONTRACE flights were used to probe the pollution plumes from North America (e.g. case 19th November). Several vertical profiles were flown between Oslo and Stockholm indicating a polluted CO-layer located in the lower and mid troposphere with CO mixing ratios reaching up to 170 ppbv.