INTERCONTINENTAL TRANSPORT OF POLLUTION FROM NORTH AMERICA TO EUROPE: AIRBORNE TRACE GAS MEASUREMENTS OVER CENTRAL AND NORTHERN EUROPE DURING CONTRACE

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The CONTRACE project investigates the uplift of pollution in frontal systems (warm conveyor belts) over North America and the transport of these air masses to 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, NOy, 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 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. For the first time it succeeded to guide the Falcon aircraft into pollution plumes transported all the way from North America (NA). On 22nd November a complex chemical weather situation was predicted for Central Europe with lifting of European emissions into the lower troposphere ahead of an approaching cold front and simultaneously, the advection of a pollution plume from Eastern NA in mid tropospheric layers. Similar CO mixing ratios were observed in both plumes making it difficult to distinguish the two plumes without additional trace gas information. The European pollution plume was characterized by large enhancements in the CO (150 ppbv) and NOy (6 ppbv) mixing ratios. The NOy/CO ratio was

0.135 (typical value for fresh emissions). In comparison the estimated NOy/CO ratio for the NA pollution plume was 0.010 which indicate a tracer age of 4 days. The observed CO and NOy mixing ratios in this plume were 160 ppbv and 1 ppbv. The two plumes were also characterized by very different O3/CO relationships. In the plume from NA a positive O3/CO slope was observed indicating photochemical ozone production (O3 mixing ratios up to 50 ppbv were observed). Most likely O3 was produced photochemically in the polluted boundary layer over Southeastern North America and not in transit over the North Atlantic. The European plume showed a strong negative O3/CO relationship with O3 mixing ratios dropping down to 20 ppbv (due to titration by NO emissions in winter in northern latitudes).