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The lifecycle of a mesoscale convective system (MCS) over South America: Airborne chemical measurements and trajectory analyses during TROCCINOX

H. Huntrieser (1), H. Schlager (1), A. Roiger (1), M. Lichtenstern (1), U. Schumann (1), C. Kurz (1), D. Brunner (2,3), C. Schwierz (2), A.Richter (4), and A. Stohl (5)

(1) Institut für Physik der Atmosphäre, Deutsches Zentrum für Luft- und Raumfahrt (DLR), Oberpfaffenhofen, Weßling, Germany, (2) Institute for Atmospheric and Climate Science, ETH Zurich, Switzerland, (3) now at Laboratory for Air Pollution and Environmental Technology, Empa, Swiss Federal Laboratories for Materials Testing and Research, Dübendorf, Switzerland, (4) Institute of Environmental Physics (IUP), University of Bremen, Germany, (5) Norwegian Institute for Air Research (NILU), Dept. Regional and Global Pollution Issues, Kjeller, Norway (Heidi.Huntrieser@dlr.de).

During the TROCCINOX field experiments in February-March 2004 and February 2005, airborne in situ measurements of NO, NO_y, CO, and O_3 mixing ratios and the $J(NO_2)$ photolysis rate were carried out in deep convection over southern Brazil. A number of flights were performed in the anvil outflow of active thunderstorms (diameter $\sim$20-40 km) close to the operation site. Several times during the observation period, large, persistent mesoscale convective systems (MCSs) developed over northern Argentina, Uruguay and Paraguay. The aged anvil outflow from these MCSs was occasionally advected into the TROCCINOX area. For the first time in the wet season, detailed airborne measurements in the outflow of one of these MCS succeeded, which are know to have the highest flash rates globally. On 7 March 2004, distinctly enhanced NO_x, CO and O_3 mixing ratios in the range of 0.6-1.1, 110-140 and 60-70 nmol mol^{-1}, respectively, were observed in the aged outflow from a MCS that developed $\sim$1 day earlier. These NO_x mixing ratios are as high as measured in the vicinity of active Brazilian thunderstorms. The MCS outflow observed by the aircraft covered a large area of about 400 km in the horizontal N-S direction and about 2 km in the vertical. However, LNOx model forecasts and satellite observations of NO_2 indicate that the total extension in the N-S direction was about 800 km and in the E-W di-

rection about 400 km. Analyses from trace gas correlations and a Lagrangian particle dispersion model indicate that polluted air masses, probably from the Buenos Aires urban area and from biomass burning regions, were uplifted by the MCS. Ozone was distinctly enhanced in the aged MCS outflow, due to photochemical production and entrainment of O_3-rich air masses from the upper troposphere - lower stratosphere region. The aged MCS outflow was transported to the north, ascended and circulated, driven by the Bolivian High over the Amazon basin. In the observed case, the O_3-rich MCS outflow remained over the continent and did not contribute to the South Atlantic ozone maximum.