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Vertical Mixing and Ascent in the TTL during the SCOUT-O3 and AMMA/SCOUT Aircraft Campaigns

C.D. Homan (1), C.M. Volk (1), J. Baehr (1), A.C. Kuhn (1), A. Werner (1), S. Viciani (2), A. Ulanovski (3), F. Ravegnani (4), P. Konopka (5), D. Brunner (6)

(1) Institut für Atmosphäre und Umwelt, J.W. Goethe Universität Frankfurt, Germany, (2) Instituto Nazionale di Ottica Applicata, Florence, Italy, (3) Central Aerological Observatory, Dolgoprudny, Russia, (4) CNR Institute of Atmospheric Science and Climate, Bologna, Italy, (5) Forschungszentrum Jülich, Germany, (6) Empa, Swiss Federal Laboratories for Materials Testing and Research, Switzerland (c.homan@iau.uni-frankfurt.de)

We present in situ measurements obtained in the tropical tropopause layer (TTL) from the M55 Geophysica aircraft during the SCOUT-O3 Tropical Aircraft Campaign conducted from Darwin, Australia (12˚S, 130˚E) in November/December 2005 and the AMMA/SCOUT-O3 campaign in Ouagadougou, Burkina Faso (12˚N, 1˚W) in August 2006. A suite of long-lived tracers (CO_2, N2O, F12, F11, H-1211, SF_6) was measured by the University of Frankfurt's High Altitude Gas Analyzer (HAGAR), CO was measured by the Cryogenically Operated Laser Diode (COLD) instrument, and O_3 by the Fast Ozone ANalyzer (FOZAN). During the Darwin campaign eight (mostly northbound) local flights were conducted within the TTL and the lower stratosphere (up to 20 km); five local flights were conducted from Ouagadougou. These flights included both survey flights designed to sample the background TTL and flights sampling the plume, turret, and outflow of deep convective cells.

A focus of our study will be the vertical mixing of air in the TTL. Vertical mixing is a key process for the upward transport of convectively detraining boundary layer air to the upper TTL, from where air can finally be lifted to the stratosphere via diabatic ascent. During the Darwin campaign, two flights on November 30 exhibit elevated ozone and CO levels between 360 and 375 K potential temperature. The flights from Ouagadougou show even higher ozone levels in the TTL. As long-lived tracers show

no detectable influence of horizontal mixing from the extra-tropical stratosphere, these observations suggest vertical mixing throughout the depth of the TTL (350-385 K) bringing down O3 from the tropopause level or even the tropical stratosphere while lifting CO from the main convective outflow level at $\sim$355 K. To identify the regions of origin of these signatures and answer the question why these elevated ozone levels are found, backward trajectories and simulations with the Chemical Lagrange Model of the Stratosphere (CLaMS) will be used.

CO2 profiles during AMMA are very coherent above 370 K and exhibit a pronounced maximum at 400 K potential temperature due to the vertical propagation of the tropospheric seasonal cycle. We will use this signature to estimate the residence time and ascent rates for air in the TTL during NH summer.