Geophysical Research Abstracts,
Vol. 11, EGU2009-6415, 2009
EGU General Assembly 2009

Observations of ultrafine particle nucleation events in the tropical UT/LS over West Africa and Brazil

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New particle formation by gas to particle conversion in the tropical upper troposphere and lower stratosphere (UT/LS) may be a major source of aerosols for origin and maintenance of the global stratospheric Junge aerosol layer. Once created in the tropical upper troposphere these ultrafine particles can be carried aloft towards the tropopause by the -radiatively driven- slowly rising air, and subsequently enter the Brewer-Dobson circulation for global distribution within the stratosphere.

During the TROCCINOX (2005) and AMMA-SCOUT (2006) campaigns in South America (Brazil) and West-Africa (Burkina Faso) the Russian M-55 high altitude research aircraft "Geophysica" performed in-situ measurements of trace gases and aerosols in the tropical UT/LS. By means of the four channel COPAS condensation particle counting system total ultrafine particle number concentrations were measured for ambient aerosol particles with size diameters larger than 6 nm, 10 nm, and 14 nm, respectively. The fourth channel also had a lower "cut-off" diameter of 10 nm, but here the sample air was heated to 250 °C prior to the particle detection. Thus, this channel delivered the number of non volatile particles providing information on the fraction of particles NOT consisting of binary sulfuric acid/water solutions.

During both campaigns cloud free air masses were encountered between 12 and 14 km altitude with ultrafine particle concentrations as high as 8000 to 10000 particles per cm^3. Based on the difference of the count results from the channels with 6 nm and 14 nm cut-off diameters it can be concluded that the particles were freshly formed in-situ during so called nucleation events. Covering flight path lengths of roughly 300 km over West-Africa and 600 km over Brazil these areas with enhanced particle concentrations are of significant scale. For the data observed over Brazil oxidation of ground released SO2 to H2SO4 while being lifted -possibly supported by ion induced nucleation- is a likely explanation. By contrast, for the nucleation event over West-Africa trajectory analyses, as well as correlations with in-situ CO measurements indicate biomass burning as possible source of the gases for the gas-to-particle conversion processes underlying this particular event.

In the presentation the "Geophysica" data sets and their differences are shown, and comparisons with tropical data from the literature are provided. Furthermore, the data from the observed nucleation events are juxtaposed with the measured results of background ultrafine aerosol particle concentrations. Here the differences in non-volatile fractions of the UT/LS aerosol over Brazil and West Africa are highlighted, and compared to corresponding measurements over Darwin, Australia, during SCOUT-O3 in 2005.