Geophysical Research Abstracts
Vol. 13, EGU2011-1344, 2011
EGU General Assembly 2011

First Observations of Ozone and Carbon Monoxide in the Western Pacific using Fourier Transform Infrared Spectrometry

Theo Ridder (1), Justus Notholt (1), Markus Rex (2), Otto Schrems (3), Thorsten Warneke (1), and Lin Zhang (4)

(1) Institute of Environmental Physics, University of Bremen, Bremen, Germany (tridder@iup.physik.uni-bremen.de), (2) Alfred Wegener Institute Potsdam, Potsdam, Germany, (3) Alfred Wegener Institute Bremerhaven, Bremerhaven, Germany, (4) School of Engineering and Applied Sciences, Harvard University, Cambridge, USA

Observations of tropospheric ozone (O3) and carbon monoxide (CO) in the Western Pacific are presented. The measurements were performed during a ship campaign with research vessel Sonne, starting in Tomakomai, Japan on Oct 09th, 2009 and ending in Auckland, New Zealand on Dec 04th, 2009.
Aboard Research Vessel Sonne, a combination of solar absorption and in situ Fourier Transform infrared (FTIR) spectrometry was applied. Solar absorption FTIR spectrometry measures the absorption spectrum of the sun. The total column concentrations of about 20 different trace gases and the profile information of about 10 trace gases can be derived from the spectrum. CO is mainly sensitive in the troposphere with three to four separable layers; O3 is sensitive in the troposphere and stratosphere with four to five separable layers. The FTIR in situ device samples air into a white cell and also measures the absorption spectrum with a FTIR spectrometer. The ground-level concentrations of about six trace gases with a high temporal resolution of a few minutes can be derived.
During the cruise, four pollution events could be identified; 1) CO/O3 pollution close to Japan 2) CO/O3 pollution close to Townsville, Australia at ground level and in 4-8km height 3) enhanced ground level CO at 10°S and 4) enhanced CO in the upper troposphere in the Woodlark Basin, Papua New Guinea. Pollution events 1) and 2) could be verified with balloon sounding measurements of O3.
The observations are compared with the 3-D chemistry transport model GEOS-Chem. The model is driven by GEOS-5 assimilated meteorological observations from the NASA Global Modeling and Assimilation Office (GMAO) on a horizontal resolution of 2 x 2.5° and 47 layers in the vertical. In general, a good agreement between the observations and the model is found. The model reproduces all pollution events, but underestimates the background CO concentration.
To identify the source regions of CO and O3 with the GEOS-Chem model, CO is decomposed into tagged tracers, indicating different source regions. The CO/O3 pollution around Japan (1) is identified as transport of Asian emission to the Western Pacific. The CO/O3 pollution around Australia (2) is identified as local sources for the ground-level enhancement, plus a long-range transport of biomass burning emissions from Africa and South America for the high altitude enhancement. The ground level CO pollution at 10°S (3) and the enhanced CO in the upper troposphere in the Woodlark Basin (4) mainly origin from Oceanian biomass burning.
The enhanced CO in the upper troposphere in the Woodlark Basin is an indicator for transport of tropospheric pollutants into the stratosphere. The CO enhancement is found between 14km to16km, within the tropical tropopause layer (TTL), where it is transported by radiative heating into the stratosphere.
Finally, CO-O3 correlations are calculated and compared to the GEOS-Chem model. CO-O3 correlations provide information to test our understanding of global anthropogenic influence on O3 and to analyze continental outflow and intercontinental transport of O3 pollution.