Nitrogen Oxides in the UTLS: Observations from CARIBIC

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1. NO and NOy Measurements on CARIBIC

A unique set of airborne in situ observations of nitrogen oxide (NO) and the sum of all reactive nitrogen species (NOy) has been performed in the tropopause region. These data have been acquired within the CARIBIC project (Civil Aircraft for the Regular Investigation of the Atmosphere Based on an Instrument Container, www.caribic-atmospheric.com). Since December 2004 NO and NOy data have been obtained on a monthly base during more than 170 flights using a Lufthansa Airbus A340-600 (Fig.1). More than 2 250 000 NOy data points were measured during the CARIBIC program to date.

Nitrogen oxides play a key role in atmospheric photochemistry, particularly in controlling the cycling of OH and the production of ozone in the upper troposphere and lower stratosphere (UTLS). The budget of nitrogen oxides in the UTLS is controlled by a variety of different sources and processes, chiefly: long-range transport, lofting from the boundary layer, lightning, anthropogenic pollution from industry and air traffic emissions. In this study the nitrogen oxide data are analyzed along regional and seasonal differences, along with species oxides in the UTLS is controlled by a variety of different sources and processes, chiefly: long-range transport, variations in tropospheric and stratospheric influenced samples of nitrogen oxides. Attempts have been made to assess variations in tropospheric and stratospheric influenced samples of nitrogen oxides.

Between May 2004 and July 2009 187 missions were performed at northern midlatitudes. Nearly 58% of all CARIBIC NOy data were obtained in this area. Fig. 3.1 and 3.2 contain about 1 300 000 NOy data samples. These missions included flight routes to Asia (Guangzhou, Chennai, Osaka and Manila), North America (Denver, Houston, Vancouver, Toronto, Orlando) and South America (Caracas, Buenos Aires, Sao Paulo and Santiago de Chile). NOy is averaged over longitude bins of 1°. The standard deviation is shown in light grey.

3. Longitudinal NOy Distribution at midlatitudes (30°-60°N) - Seasonal Variaton

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5. NOy-CO Correlations - Regional and Seasonal Variation

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6. Outlook

- Detailed investigation of the large scale NOy distribution at the UTLS
- Investigation of sources contribute to the NOy ratio at the UTLS
- Study of the background NOy enhancement caused by air traffic
- Comparison with model simulations and other measurements, e.g. MOZAIC
- Installation of a NOy Converter additional to the NO and NOy Converters