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Reactive nitrogen in the tropopause region: Six years of observations from CARIBIC

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Reactive nitrogen species 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) and therefore have a strong impact on the radiative forcing of the atmosphere. 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, and air traffic emissions.

Since December 2004 a unique set of nitrogen oxides data has been obtained in the upper troposphere and lower stratosphere. These data have been acquired within the CARIBIC project (Civil Aircraft for the Regular Investigation of the Atmosphere Based on an Instrument Container) on a monthly base using a Lufthansa Airbus A340-600.

During more than 200 flights between Frankfurt in Germany and airports in South and North America, Asia, and South Africa the sum of all reactive nitrogen species and nitric oxide have been observed in the tropopause region. Only recently this instrumentation has been extended by a photolytic converter for the measurement of NO2.

The acquired data set is suitable for a reliable base assessing the atmospheric relevance of nitrogen oxides. The large scale seasonal and regional distribution of nitrogen oxides at the UTLS is presented and compared to other measurements and the results of model simulations. The data are analysed along with species as CO, O3, and aerosol particles. Tracer correlations are used to investigate the contribution of different sources on the nitrogen budget. Case studies show the influence of biomass burning events and air traffic emissions.