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Seven years of observations from CARIBIC: On the way to an observational climatology of reactive nitrogen in the UTLS

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Nitrogen oxides and total reactive nitrogen have a decisive influence on the chemistry in the upper troposphere and lower stratosphere (UTLS). Nitrogen oxide act as catalyst in several reaction chains influencing the cycling of OH and the production of ozone. The impact of additional emitted nitrogen oxides by aircraft depends on the background composition of the atmosphere. However, there is a high uncertainty of the abundance of nitrogen oxides in the UTLS.

During more than seven years a large set of NO and NO_y data has been obtained in the UTLS. 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. More than 250 flights have been performed since December 2004 covering predominantly northern mid-latitudes. Additionally flights have been performed to destinations in South America and South Africa.

The present data set of reactive nitrogen is suitable to form the base for an observational climatology. 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. Significant regional and seasonal differences in the NO and NO_y abundance have been observed. Signatures of aircraft emissions or biomass burning respectively have been regularly observed. Concurrent measurements of CO, O_3, and aerosol particles are used to study the contribution of different sources on the nitrogen budget.