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Global lightning nitrogen oxides source estimate from TROCCINOX data

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The EU project TROCCINOX (Tropical Convection, Cirrus, and Nitrogen Oxides Experiment, http://www.pa.op.dlr.de/troccinox/) was performed in cooperation with the Brazilian project TROCCIBRAS and in coordination with the EU-project HIBISCUS, within a large team of scientists, in the period 2002-2005. The project investigated the contributions of tropical continental deep convection to lightning-produced nitrogen oxides (LNO_x) and to other trace gases (including water vapour) and particles (ice crystals and aerosols). The project performed airborne measurements with three research aircraft (Geophysica, Falcon, and Bandeirante) at altitudes up to 20 km over Southern Brazil in February 2005, extending data obtained with the Falcon and Bandeirante in January/February 2004. TROCCINOX provided data suitable for significantly reducing the uncertainty in previous estimates of the LNOx source strength (1 to 10 Tg/a in nitrogen mass units). The LNOx source rate is determined using results from several global chemical transport models for at least two LNOx values and from the TROCCINOX data. A least square fit of the model results along the flight paths of the measurements to the data provides an accurate LNOx estimate together with error bounds due to random or systematic errors. A robust LNOx estimate representative for tropical and subtropical thunderstorms is obtained not only from nitrogen oxides (NO and NO_y) mixing ratio data but also from ozone and carbon monoxide. The latter are sensitive to LNOx sources due to tropospheric photochemistry during their chemical life-time and hence provide an integral measure of LNOx sources for a large part of the tropics. Further analysis is underway to provide a globally representative best estimate.