

Tropical Convection, Cirrus, and Nitrogen Oxides Experiment

TROCCINOX

A project under the Research and Technological Development (RTD) Programme of the European Commission, DG RTD-I.2, "Energy, environment, and sustainable development", Key Action: 2 (Global Change, Climate and Biodiversity)

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The project TROCCINOX (Tropical Convection, Cirrus, and Nitrogen Oxides Experiment) investigates the impact of **tropical deep convection** on the distribution and the sources of **trace gases, cloud and aerosol particles** focusing on processes in the upper troposphere and lower stratosphere.

General objectives of TROCCINOX are:

1. to improve the knowledge about lightning-produced nitrogen oxides (NO_x) in tropical thunderstorms by quantifying the produced amounts, by comparing it to other major sources of NO_x and by assessing its global impact, and
2. to improve the current knowledge on the occurrence of other trace gases (including water vapour) and particles (ice crystal and aerosols) in the upper troposphere and lower stratosphere in connection with tropical deep convection as well as large scale upwelling motions.

These problems on different spatial scales are addressed by field observations and model simulations. **Two aircraft** (Geophysica and Falcon) probe the atmosphere during transfer flights (large scale) from Europe to the tropical destination. At the tropical site the local aircraft operations are coordinated with further aircraft, detailed ground-based observations of thunderstorms like radar, lightning and other relevant observation systems. Satellite data are used to establish the link between local and global-scale parameters.

A **first field experiment** has been performed in South America during February/March 2004 based in **Gavião Peixoto** and **Bauru** in the State of São Paulo, Brazil, see Figure 1. In addition to transit flights from and to Europe, a total of 14 local flights were performed with the **Falcon** instrumented with a Differential Absorption H₂O/aerosol Lidar (DIAL) and in situ chemical/aerosol probes. Falcon missions included measurements in fresh and aged outflow from deep convective events and large-scale survey flights across the Intertropical Convergence Zone (ITCZ). See <http://www.pa.op.dlr.de/troccinox/Publications/publications.html> for some first publications. The field experiment was performed along with the Brazilian partner project **TroCCiBras**, coordinated by **IPMET** (Instituto de Pesquisas Meteorológicas). TroCCiBras provided chemical and aerosol measurements from a low-flying **Bandeirante** aircraft, **weather radar** and ground-based **lightning data**, as well as **regional weather forecasts**. The IPMET is part of the UNESP (University of the State of São Paulo). TROCCINOX and TroCCiBras were also coordinated with the EU-project **HIBISCUS** with similar objectives performing balloon-borne meteorological and chemical measurements in the upper troposphere and lower stratosphere.

A **second field experiment** in Brazil is planned likewise for about six weeks during the period mid January 2005 to about end of February 2005 using both TROCCINOX aircraft, the Geophysica and the Falcon. The **Geophysica** is a high-altitude aircraft with a maximum cruise level of 21 km. The Geophysica was not available for the first campaign. Thus, measurements will be possible this time over the full altitude range of outflow from intense tropical thunderstorms. The second TROCCINOX campaign will be extended by additional

Geophysica and Falcon flights for validation of the European **ENVISAT satellite** in the tropics. Some Falcon flights will be dedicated to investigate particle and cirrus interaction according to the project PAZI of DLR (<http://www.pa.op.dlr.de/pazi/>). The Brazilian partners intend to deploy at least one Bandeirante aircraft during the campaign. The measurements will take place in the domain shown in Figure 2. At present, we plan to perform the experiments locally from the airport of Araçatuba (21°08'29" S/ 050°25'29" W) in the State of São Paulo.

Within Brazil, the legal basis for this experiment are

- 1) the official permission, No. 625, by the President of Brazil and the Minister of Defence, as given on Dec. 22, 2003 and as published in the Official Newsletter (Diário Oficial da União República Federativa do Brasil, No. 253, 30 Dec. 2003).
- 2) the PORTARIA Nº 419, de 25 de Agosto de 2004, in the 'Diário Oficial da União' Nº 171, of 3 Sept. 2004 of the 'Ministério da Ciência e Tecnologia' in Brasilia, Brazil. The list of team members is presently being updated. Copies of the Portaria are available from the internal TROCCINOX homepage: <http://www.pa.op.dlr.de/troccinox/Internal/internal.html>

The large range of scales addressed in the field studies requires the use of a variety of **models**, each applied for a special aspect of the project. Modelling covers the growth of ice crystals and aerosol particles, the effects of clouds on the radiative transfer, chemistry and transport of trace gases, precipitation formation, lightning and the related NO_x-production, and the global scale climatic impacts of deep tropical convection. Weather prediction and model based computational predictions of the chemical composition of the atmosphere are used for local flight planning and analysis. The models are discussed in the joint HIBISCUS / TroCCiBras / TROCCINOX Workshop in Bauru, 16-19 Nov 2004.

First publications on TROCCINOX are available from
<http://www.pa.op.dlr.de/troccinox/Publications/publications.html>

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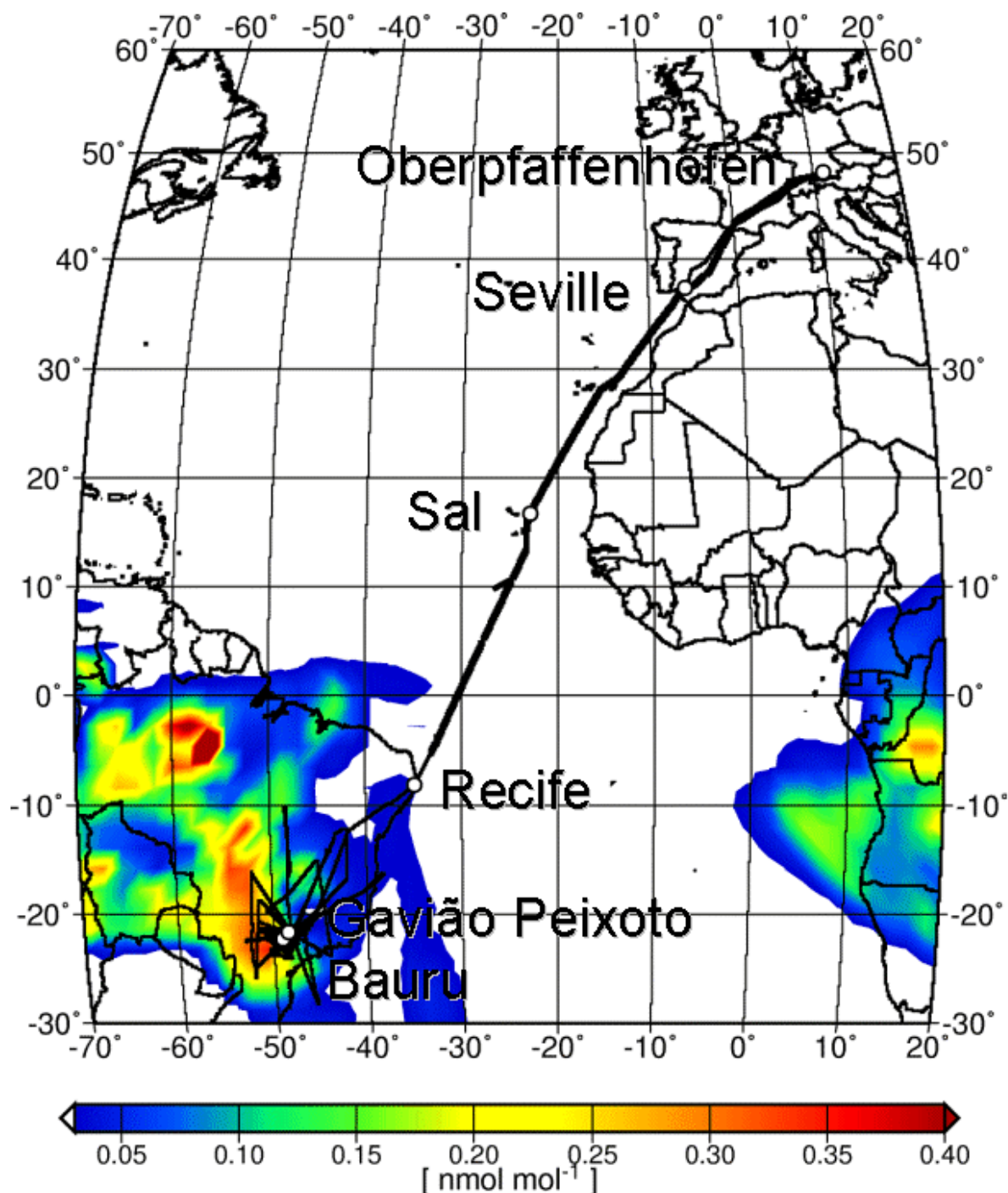


Figure 1: Map of locations and flight routes of the first TROCCINOX field campaign. The Falcon was instrumented at its DLR home base in Oberpfaffenhöfen (Germany). Transfer flights to and from Recife via Seville (Spain) and Sal (Cape Verde Islands) provided meridional cross-sections. Gavião Peixoto, about 300 km north-west of São Paulo (Brazil) was selected as base for the Falcon and Bandeirante aircraft. At Bauru, in the centre of the State of São Paulo, the IPMET (Instituto de Pesquisas Meteorológicas) of the UNESP (University of the State of São Paulo) provided Radar and other observations and hosted the HIBISCUS balloon operations. A variety of models were run in real time for supporting the flight planning during the campaign. The NO_x field at 200 hPa analysed by the ECHAM model for 14 February 2004, 00:00 UTC is shown color-coded.



Figure 2: Map with a polygon enclosing the measurement domain with flight operations of the Falcon and the Geophysica during TROCCINOX/TroCCiBras within Brazil. The letter "A" symbolises the approximate position of the airport of Araçatuba in the state of São Paulo, Brazil.