Geophysical Research Abstracts
Vol. 13, EGU2011-9929, 2011
EGU General Assembly 2011


# CARIBIC airborne observations in the UTLS interpreted by Lagrangian model diagnostics

Hella Riede (1), Patrick Jöckel (2), Rolf Sander (1), Ralph Lehmann (3), Heini Wernli (4), Carl A. M. Brenninkmeijer (1), and the CARIBIC team (5)

(1) Max Planck Institute for Chemistry, Atmospheric Chemistry, Germany (hella.riede@mpic.de), (2) Deutsches Zentrum für Luft- und Raumfahrt, Institut für Physik der Atmosphäre Oberpfaffenhofen, 82234 Wessling, Germany, (3) Alfred Wegener Institute for Polar and Marine Research, Potsdam, Germany, (4) ETH, Institute for Atmospheric and Climate Science, Zurich, Switzerland, (5) CARIBIC project

The project CARIBIC (Civil Aircraft for the Regular Investigation of the atmosphere Based on an Instrument Container; www.caribic-atmospheric.com) has successfully operated since 1997, and with an extended measurement system since 2005. CARIBIC provides a comprehensive database of atmospheric compounds covering a wide range of lifetimes, from hundreds or thousands of years, such as $SF_6$, to shorter-lived compounds, for example nitrogen oxides or acetone. The broad variety in lifetimes is linked to the different atmospheric processes that chemical compounds undergo; some compounds are mainly transported while for others, chemistry dominates. The CARIBIC dataset consisting of about 15 species measured on-line and more than 50 species measured off-line is especially suitable for extensive observation-model intercomparison in the upper troposphere / lower stratosphere (UTLS) region, where CARIBIC mainly operates.

While in-situ observations offer straightforward information about the composition of the atmosphere at a given point in space and time, their interpretability is limited by their local nature. We use here CARIBIC observations to assess the consistency between EMAC (ECHAM5/MESSy atmospheric-chemistry model; www.messy-interface.org), a 3-D global GCM nudged with ECMWF data, and the actual state of the atmosphere in the UTLS region. We combine back-trajectory calculations with model results from EMAC and from the corresponding trajectory-box model CAABA to study the history of air masses that were encountered by the CARIBIC measurement system. In the model domain, we developed a method to separate and quantify the contributions of chemistry, transport, and mixing processes to the concentration of each species in air masses being transported towards the CARIBIC flight track.

We show results of these new Lagrangian model diagnostics applied to chemical tracers on their way into the Eurasian UTLS for CARIBIC flights between Germany and the Philippines. The important catchment areas of air masses reaching the air corridor as well as hot spots of mixing and chemistry are located. We identify dominant chemical reactions pathways during transport and corresponding chemical lifetimes. Especially the lifetimes – and thus the transport budgets towards the UTLS – feature drastic variations depending on the origin of air masses. In this way, we learn from CARIBIC airborne observations and complement them with a 3-D dynamical and chemical history.