AFO 2000

KODYACS

Institut für Physik der Atmosphäre

DLR

(Kopplung von Dynamik und Atmosphärischer Chemie in der Stratosphäre)

Project Manager: Priv.-Doz. Dr. Martin Dameris, DLR

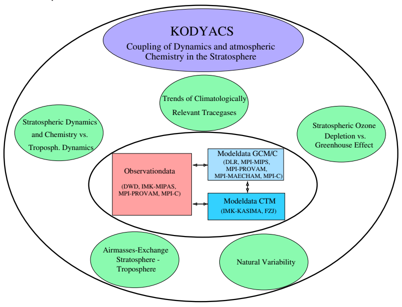
Project Partners: DLR, DWD Hohenpeißenberg, FZ Jülich, Universität Karlsruhe (TH), MPI Mainz, MPI Hamburg

Project Description

The main objectives of KODYACS are the identification and the quantitative determination of the interaction of dynamical, chemical and (micro-) physical processes in the upper troposphere / lower stratosphere (UT/LS) and in the middle atmosphere to improve our understanding of atmospheric changes (trends) observed during recent years. Investigations focus on:

- transport processes near the tropopause,
- the coupling of dynamical and chemical processes in the UT/LS,
- the coupling of the UT/LS and the middle atmosphere,
- the quantitative importance of anthropogenic processes compared to natural variability.

Based on a hierarchy of atmospheric models, which consider dynamical, chemical, and (micro-) physical processes, and of multi-year observations, the mutual effects of dynamics and chemistry will be investigated in the upper troposphere, in the stratosphere, and in the lower mesosphere.



Central Questions

- How do dynamical and chemical processes or changes of the chemical composition in the stratosphere affect tropospheric dynamics?
- How do tropospheric dynamics affect stratospheric chemistry?
- What's the origin of changes of climatologically relevant trace gases (e.g. H_2O, O_3, aerosol) in the upper troposphere / lower stratosphere?
- What kind of interaction exists between stratospheric ozone depletion and the greenhouse effect?
- How does the cross tropopause airmass transport work?
- Which part do individual components of natural variability (e.g. solar activity cycles, QBO, volcanic aerosol) contribute to observed changes of trace gases and meteorological variables?

Partners and Project Titles

- DLR: Investigation of mutual influences of greenhouse effect and changes of dynamic and chemical processes in the UT/LS employing model simulations and observations
- DWD: Mechanisms coupling stratosphere and troposphere in observations and modelling results
- FZJ: Lagrangian modelling of vertical transport and chemical ozone destruction (LAVERO)
- IMK: Troposphere-stratosphere exchange, influence of solar variability and denitrification processes as examples to coupling of chemistry and dynamics in the middle atmosphere
- MPI-C: Dynamical-chemical interactions in the stratosphere - chemistry and external forcings
- MPI-MAECHAM: Dynamical-chemical interactions in the stratosphere - dynamics and transport
- MPI-MIPS: Microphysical processes in the stratosphere and their non-linear interactions with a chemical-microphysical climate model
- MPI-PROVAM: Process oriented validation of atmospheric circulation models

Relations to and Cooperation with National and International Projects

- CRISCA (AFO2000, TG-2)
  Analysis of stratosphere dynamics on small and mean skales using data from CRISTA
- SPURT (AFO2000, TG-2)
  Tracegas transports in the tropopause region
- POSTA (AFO2000, TG-3)
  Multiphase processes in the polar stratosphere: in-situ observations and simulations
- COBI (DEKLIM)
  Cold bias in atmosphere general circulation models
- KLIMESTO (DEKLIM)
  Diagnosis of climate variability employing mechanistic and stochastic models
- PARTS (5.FP EU)
  Particles in the upper troposphere and lower stratosphere and their role in the climate system
- TOPOZ III (5.FP EU)
  Towards the prediction of stratospheric ozone: The partitioning of the NO_y components
- TROPOSAT (EUROTRAC-2)
  The use and usbility of satellite data for tropospheric research
- HGF-ENVISAT (HGF-Network-Fund)
  Generation and validation of data products from ENVISAT-observations and their use for investigation of the upper troposphere and stratosphere

Results of Cooperation - Highlights

- Intercomparison of 8 chemistry-climate models (CCMs) of the stratosphere including E39/C and MAECHAM/CHEM within the framework of the WMO ozone assessment 2002 *(Austin et al., Atmos.Chem.Phys.Disscuss., 2, 1035-1096, 2002)* (DLR, MPI-C, MPI-MAECHAM)
- Definition and determination of boundary and initial conditions for the transient model simulations (1960-2000), start of the simulation (July 2002). Consideration of individual requests for special model results, also from "external" partners. The results/progress of the experiment is published in the internet (DLR, MPI-C, MPI-MAECHAM)
- The first GCM simulations of Mt. Pinatubo aerosol including both interactive and prognostic volcanic aerosol have been performed with promising results. This has not been done by any other group so far. (MPI-MIPS, MPI-C)
- A revised version of the microphysical model SAM has been coupled with the MAECHAM4/CHEM and is currently being tested. This new model approach will give us more insights of the highly nonlinear interactions bewtween chemistry, microphysics radiation and dynamics in the stratosphere. (MPI-MIPS, MPI-C)
- Comparisons between ECHAM timeslice experiment data and observations from about 10 northern midlatitude stations, as well as SLIMCAT chemical transport model data driven by ECMWF transports. (DLR, DWD)
- Intercomparison of results of the CCM E39/C and of the CTM CLaMS which employs E39/C windfields for the transport of atmospheric tracers (FZJ, DLR)
- Parametrisation of the actinic flux of the solar Hydrogen Lyman-alpha radiation for studies of solar variability within GCMs (IMK)
- On-line simulation of the QBO in MA-ECHAM with high vertical resolution (L90); realistic reproduction of the atmospheric tape recorder in specific humidity. Derivation of a parametrisation for tropical winds ("QBO-nudging") in GCMs/CCMs (MPI-MAECHAM, MPI-C, DLR)

Institut für Physik der Atmosphäre, DLR Oberpfaffenhofen   Telefon: 08153/28-1558   Fax: 08153/28-1841   E-Mail: martin.dameris@dlr.de