POLMIP
POLARCAT Model Intercomparison

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POLARCAT
Polar Study using Aircraft, Remote Sensing, Surface Measurements and Models, of Climate, Chemistry, Aerosols, and Transport

Many aircraft campaigns in Arctic in Spring and Summer 2008

- NASA ARCTAS (Alaska – April; Canada – June, July)
- NOAA ARCPAC (Alaska – April)
- DOE ISDAC (Alaska – April)
- CNRS (Kiruna – April, Greenland – July)
- DLR-GRACE (Kiruna – April, Greenland – July)
- YAK (Siberia – July)

Satellite and surface measurements also

Mission Goals:

Spring: Arctic haze, long-range transport of pollution to Arctic, stratospheric influence
Summer: Biomass burning
Models

- MOZART-4/GFS & GEOS5 (NCAR, L. Emmons)
- CAM-chem/GEOS5 (NCAR, S. Tilmes)
- TOMCAT/ECMWF (Leeds, S. Arnold)
- CAM-chem/ECMWF (Leeds, S. Arnold)
- LMDZ-INCA (LATMOS-IPSL, S. Turquety & K. Law)
- GEOS-chem (Harvard-Princeton, J. Mao)
- GMI (NASA Goddard, B. Duncan)
- STEM (U. Iowa, G. Carmichael)
- WRF-chem (PNNL, J. Fast)
- MACC (ECMWF, J. Flemming)
- TM5 (KNMI, V. Huijnen)

Same emissions used by all models for this activity
HTAP model simulations show poor agreement to Arctic surface measurements

The numerous aircraft measurements of POLARCAT hopefully will help identify model limitations and how to improve them

Focus on ozone chemistry and precursors, transport pathways, biomass burning

Meeting in 2 weeks

**Fig. 7.** Observed and modeled seasonal cycles of trace species surface concentrations at the indicated Arctic sites. Model results in all panels are in grey. Plots for CO (top row) and ozone (second row) show observations from the NOAA Global Monitoring Division, with 1992-2006 means and standard deviations in red (except for Summit O₃, which is 2000–2006) and 2001 in blue. Sulfate plots (third row) show observations from Alert during 1980-1995 (left) and from the EMEP site in Spitsbergen during 1999-2005 in red, with 2001 Spitsbergen data in blue. BC data (bottom row) are from the IMPROVE site at Barrow during 1996-1998 (red), and from Sharma et al. (2006) for both Barrow and Alert using equivalent BC over 1989-2003 (purple). Models are listed by RMS error scores to the right of each row using the groupings discussed in the text. Models that are separated from others are labeled with the numbers as in the text at right (or Table 1).
Fig. 14. Zonally averaged vertical distribution of the relative CO anthropogenic and fire contributions for different source regions (see Fig. 3) for the Northern Hemisphere in April and July 2008 calculated by MOZART-4.
Comparison of
MOZART-4/GFS/FTUV (2.8°x2.8°) and
CAM-chem (trop_mozart) / GEOS5 / LUT (1.9°x2.5°)
to ARCTAS NASA DC-8 observations
Fig. 1. Spacial coverage of the aircraft observations included in this study between April and July 2008. Aircraft data grouped with regard to mission, location and timing (as described in Table 1) are shown in different colors.
DC-8 Flights between Alaska and Greenland

ARCTAS-A Apr 4, 5, 8, 9

Ozone (ppbv) vs. Altitude (km)

Carbon Monoxide mixing ratio (ppbv) vs. Altitude (km)

OH (pptv) vs. Altitude (km)

SO2 (pptv) vs. Altitude (km)

GT_PAN (pptv) vs. Altitude (km)

HNO3 (pptv) vs. Altitude (km)

Ethane (pptv) vs. Altitude (km)

Propane (pptv) vs. Altitude (km)

Ethylene (pptv) vs. Altitude (km)

CH2O (pptv) vs. Altitude (km)

Acetaldehyde (pptv) vs. Altitude (km)

Acetone (pptv) vs. Altitude (km)
DC-8 Flights over Canada and Greenland

ARCTAS-B-high-lat Jul 1-9

- O3, ppbv
- Carbon_Monoxide_mixing_ratio, ppbv
- OH, pptv
- SO2_CIT, pptv
- GT_PAN, pptv
- HNO3_CIT, pptv
- Ethane, pptv
- Propane, pptv
- Ethyne, pptv
- CH2O_NCAR, pptv
- Acetaldehyde_TOGA, pptv
- Acetone_TOGA, pptv
Model photolysis rates compared to TUV calculations from actinic flux measurements
MOPITT – 800 hPa

MOZART-4/GFS April 2008

MOZART4gfs800 hPa 200804  MOPITT-V4/L3 800 hPa 200804

MOZART4gfs*Kernel minus MOPITT 800 hPa - 200804

MOZART-4/GEOS5 April 2008

MOZART4geosFTUV800 hPa 200804 MOPITT-V4/L3 800 hPa 200804

MOZART4geosFTUV*Kernel minus MOPITT 800 hPa - 200804
MOPITT – 800 hPa

MOZART-4/GFS July 2008

MOZARTgfs800 hPa 200807
MOPITT-V4/L3 800 hPa 200807

MOZART4geosFTUV800 hPa 200807
MOPITT-V4/L3 800 hPa 200807

MOZART4geosFTUV*Kernel minus MOPITT 800 hPa - 200807

MOZART4gfs*Kernel minus MOPITT 800 hPa - 200807
DC-8 Flights over Alaska and northward

ARCTAS-A Apr 12, 16, 17
DC-8 Flights over California

ARCTAS-CARB Jun 18-24

Graphs showing data on various pollutants over different altitudes and concentrations.

- O$_3$, ppbv
- Carbon Monoxide mixing ratio, ppbv
- OH, pptv
- SO$_2$ GIT, pptv
- GT_PAN, pptv
- HNO$_3$ GIT, pptv
- Ethane, pptv
- Propane, pptv
- Ethyne, pptv
- CH$_2$O_NCAR, pptv
- Acetaldehyde_TOGA, pptv
- Acetone_TOGA, pptv
DC-8 Flights over Canada, near fires