MIPAS ozone
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Assimilation is like
Not straightforward
Previously: assimilation of NRT MIPAS
Re-assimilation of reprocessed MIPAS
Ozone

- ECMWF: GCM (our Ground Segment failed, summary here)
- DARC: GCM (UM Met. Office) reprocessed
- GMAO: GCM reprocessed
- BASCOE: 4D - VAR around 3D - CTM (57 species), NRT
Ozone, summary

- Assimilation of reprocessed MIPAS: Sept. 12 - 28, 2002 in addition to SBUV data for ozone

- Key findings:
  - Ozone profiles: better agreement with ozone sondes
  - Total column ozone: better agreement with TOMS
  - Better agreement with similar experiment (GOME RAL ozone profiles)
  - Better quality than NRT
  - Fewer signs of cloud contamination
O-B statistics for MIPAS L2 ozone - DARC analyses, 12-17th September 2002

- MIPAS ozone typically well within +/-2 ppmm of the background forecast
- Obvious features in upper stratosphere between 15°S and 15°N are explainable by UM problems (too fast vertical transport of ozone)
- Further work needed to interpret other features
Cloud clearing improvement near tropopause (corresponding approximately to 15km MIPAS retrieval level)

Original NRT data

Rejected by quality control

Accepted

Reprocessed Cal/Val data

...but note that extended retrievals at levels 12km and below do show some signs of possible cloud contamination.
Assimilation:

• On-line ozone transport within GEOS-4 GCM.

• Tropospheric chemistry: production and loss rates from GEOS-CHEM

• “Cold tracer” scheme

• SBUV/2 total & partial columns assimilated

Impact of inserting MIPAS stratospheric profiles (13 levels from 100 – 0.1 hPa) into assimilation:

Zonal-mean ozone, Nov 2002
SBUV assimilation (contours), MIPAS&SBUV minus SBUV assimilation (shaded)

Coverage of MIPAS data
144 profiles from the Polar Ozone and Aerosol Measurement (POAM III) instrument, 65N – 69N. Large improvement in O₃ around 70 hPa. Note: MIPAS has better coverage in high latitudes.

69 profiles from the HALogen Occultation Experiment instrument, 30S – 30N. MIPAS data yield a small increase of O₃ in the lower stratosphere.
- observed species: $O_3$, $H_2O$, $CH_4$, NO and $NO_2$
Ozone: (HALOE – ANALYSIS)/ANALYSIS
HALOE sunrise & sunset comparison consistency
Ozone: (POAM - ANALYSIS)/ANALYSIS
POAM Northern Hemisphere same structure as HALOE
Ozone: \((\text{OFFLINE}_\text{MIPAS} - \text{ANALYSIS})/\text{ANALYSIS}\)

HALOE comparison:
- Similar structure of difference for sunrise & sunset events.
- HALOE > ANALYSIS: $0.1 < \text{pressure} < 10$ hPa
- HALOE < ANALYSIS: $10 < \text{pressure} < 100$ hPa

OFFLINE comparison:
- OFFLINE > ANALYSIS: $0.1 < \text{pressure} < 10$ hPa
- OFFLINE \(\approx\) ANALYSIS: $10 < \text{pressure} < 100$ hPa

Qualitative conclusion
Ozone: (OFFLINE_MIPAS - NRT)/NRT
Conclusions

- Added value of reprocessed or offline MIPAS ozone
  - ECMWF
  - GMAO
- Reprocessed data set better quality than NRT data set
- “BIASES” OZONE OFFLINE MIPAS w.r.t HALOE:
  - Lower stratosphere: pressure > 10 hPa MIPAS: 5 - 10 % higher than HALOE
  - Middle and upper stratosphere: pressure < 10 hPa MIPAS: better agreement with HALOE/POAM
- Precision of INSTRUMENT species, work in progress
- Accuracy of INSTRUMENT species, work in progress