Introduction

Formaldehyde, the simplest but most abundant of the aldehydes
is harmful to health, environment, ... 
HCHO is an important indicator of hydrocarbon emissions and photochemical activity
HCHO sources
- oxidation of Methane provides constant HCHO source
- tropospheric NMHC emissions
- biomass burning
- fossil fuel combustion
HCHO sinks
- reaction with OH
- photolysis (<400 nm)
→ HCHO is a good test for model oxidation mechanism and emission scenarios
→ it could be used as a proxy for biogenic emissions (isoprene) e.g. Palmer et al., 2003

Data retrieval

- Differential Optical Absorption Spectroscopy (DOAS) yields slant columns – averaged absorption along all contributing light paths
- Conversion to vertical columns using air mass factors (AMF) calculated by radiative transfer model SCIAMACHY (Rigault et al., 2004)
- for satellites: constant background between 200 and 220°E assumed (normalisation) to account for instrumental drifts/inhomogeneities - lookup table for AMF taking into account albedo, orography, aerosol and HCHO profile shape in (total 48,000 scenarios)
- from MAX-DOAS observations profile retrieval possible using Breman Advanced MAX-DOAS Retrieval Algorithm (BREAM, see poster Oetjen et al.)

The Global View

GOME HCHO 1997-2001

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<th>VC (mole cm⁻²)</th>
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LMDz-INCA HCHO 1997-2001

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Fig 2: The upper figure shows average values for HCHO calculated from all GOME instruments between 1997 and 2001. BREDOM stations for latitudes less than 60° and the location of the FORMAT campaigns in 2002 and 2003 (see Figure 4) are marked. The lower figure illustrates the HCHO distribution as modelled by LMDz-INCA. The correlation between both datasets is 0.73. The maximum values of HCHO are well correlated to regions with a high vegetation index (tropical rainforest). The impact of industrial emissions on the total column is small.

Validation

Fig 3: Comparison between GOME and SCIAMACHY. Better spatial resolution for SCIAMACHY, but bias to higher latitudes.

HCHO Time series from GOME and LMDz-INCA

Fig 4: Comparison between GOME/SCIAMACHY and MAX-DOAS data analysed with BREAM above Milan region (Alps).

Conclusions

- continuous GOME nadir measurements of HCHO since July 1995
- SCIAMACHY HCHO available, but poorer quality at high latitudes
- agreement between different instruments quite o.k. at low latitudes
- MAX-DOAS Network is able to validate the satellite measurements and provide a valuable link between in situ observations and satellites
- reasonable agreement between model and observations, but:
  - lower values in model above oceans, not an offset problem! at least in part outflow
  - significantly smaller values from satellite above the tropical rainforest in Brazil
  - in general a better agreement between model and observations is obtained for the run taking into account the annual variation of biomass burning

References


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