Comparing methane data from Ny-Ålesund with results from a regional transport model (MATCH) and a trajectory model

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Background

Methane (CH_4) is an important greenhouse gas and a key molecule in tropospheric photochemistry. The global burden of atmospheric CH_4 has risen dramatically since the preindustrial era. The rate of increase has slowed over the past decade. In situ methane measurements from the Zeppelin station in Ny-Ålesund, Svalbard (figure 1) are studied by comparing continuous gas chromatograph data and flask data to simulated methane concentrations from an atmospheric transport model. The model is used to investigate the distribution and transport of methane in and out of the Arctic region. In addition a trajectory model is used to investigate how the flow patterns influence the observed methane (Eneroth et al, 2003).

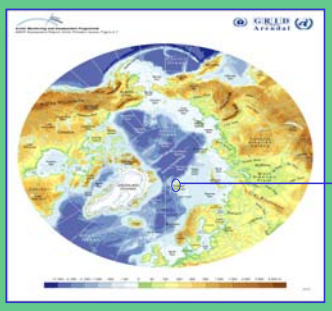

Figure 1: Zeppelin Mountain research station located at 475 m.a.s.l. near Ny-Ålesund, 79° N 12° E.

Trajectory Model

- A 3-dimensional model of MCGrath (1989) is used to calculate 5-day back-trajectories for the 3-year period 2000-2003. The model uses wind fields from ECMWF.
- The trajectories are classified into transport patterns through the use of cluster analysis.

Transport Model

- A 3-dimensional regional transport model MATCH (Multiple-scale Atmospheric Transport and Chemistry modelling system),1°x1° horizontal resolution (Robertson et al., 1999).
- Meteorological fields (eg. wind, temperature and pressure) from the European Centre for Medium range Weather Forecasts, ECMWF, every 6 hours.
- Emission and boundary conditions from a global tracer transport model developed at "Centre for Atmospheric Science" in Cambridge, U.K, on 5° x 5° horizontal resolution (Warwick et al, 2002).

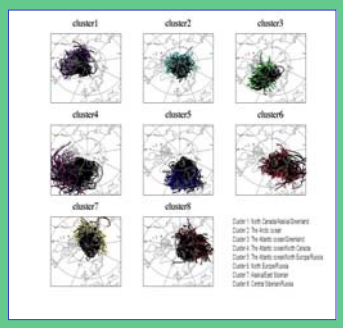

Figure 2: Transport patterns from 2000-2003 divided into 8 clusters with the use of cluster analysis. Arriving height at Zeppelin station is 850 hPa.

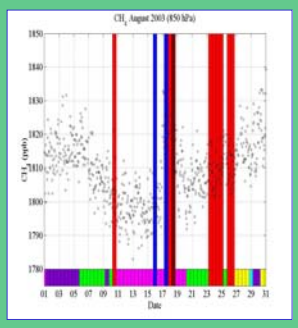

Figure 3: Concentration of methane at Zeppelin station (black circles) compared with cluster patterns (colours from figure 2).

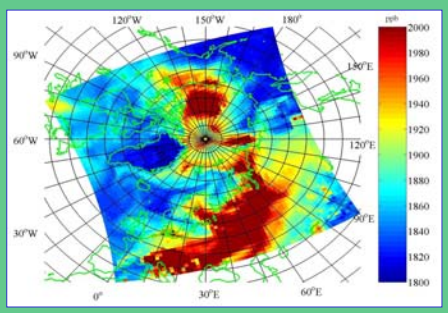

Figure 4: Modelled methane concentration in ppb on 28/12 1998 3 UTC in level 1 (nearest ground). Blue is low concentration and red is high.

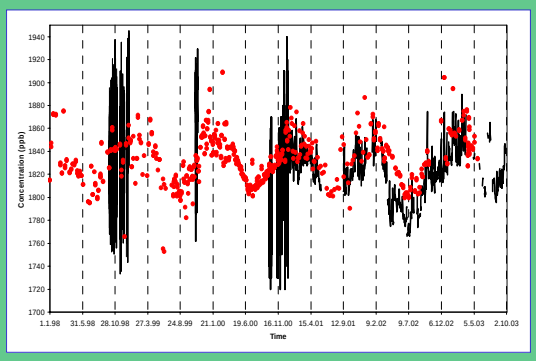

Figure 5: Continuous methane measurements (black lines) and weekly flasks samples (red circles) at Zeppelin station for 1998-2003.

Data

- Continuous methane measurements with a gas chromatograph (GC) with flame ionisation detection (FID) and a 1 ml sample loop giving 96 chromatograms per day (Zellweger et al., 2001).
- Flask samples approximately every week from May 1994, analysed at NOAA CMDL in Boulder, Colorado by a GC/FID (http://www.cmdl.noaa.gov/).

Result and discussion

- Cluster analysis for Ny-Ålesund is shown in figure 2 with 8 clusters representing different transport patterns. In figure 3 methane data from Zeppelin are compared with the different clusters during August 2003. Around the 18th, there is a peak in methane and the clusters dominating in this period are 5, 6 and 8 which indicate a source in this area that is shown in the measurements.
- In figure 4 the MATCH model gives a picture of a typical situation of methane during winter. The concentration is large over Europe and North Russia, and also over the Pole. This indicates transport of methane from Europe over Russia and to the Arctic basin and Svalbard.
- Figure 5 shows the methane measurements from Zeppelin station from 1998-2003. The seasona variation can easily be seen with a maximum in winter and a minimum in summer. The trend is weakly positive.

References

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