Simulating transport and chemistry of Air pollution in Asia using the MATCH model.

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Introduction

MATCH, Multiscale Atmospheric Transport and Chemistry model is a three-dimensional Eulerian model developed at SMHI, Swedish Meteorological and Hydrological Institute. It has previously been used for urban and national simulations in Sweden but also for continental investigations over Europe (Solberg et al., 2005) and Asia (Engardt, 2001). In Mics Asia phase one it was used to simulate sulphur transport and deposition (Carmichael et al., 2002).

The MATCH model – current setup

The MATCH model can be used with several different chemistry, deposition and advection schemes. In this survey thermal and photochemical gas-phase chemistry based on Simpson et al. (1993) was used with 70 species considered.
Antropogenic emissions of SOx, NOx, NHx, CH4, NMVOC, and CO from Streets et al. were used with monthly variations. The NMVOCs were split into 11 component classes without consideration of different types of sources. The gases were emitted in the three lowest vertical layers of the model. 50 % in layer 1 reaching from surface to 20 meter, 30% in layer 2 from 20 to 50 meter, and 20% in layer 3 from 50 to 100 meter. Emissions from volcanoes and LPS were emitted at 1500 and 300 meter altitude respectively. There were also natural emissions of isoprene according to GEIA (Guenther et al., 1995).
The driving meteorological data were taken from ECMWF. It was updated every 6 hours and then interpolated to one-hour resolution. The resolution was 0.5 * 0.5 in the horizontal with 25 vertical layers reaching the top boundary at approximately eight km. The domain was based on the emission inventory and the reference domain for Mics Asia phase two, and reaches from 13 S to 54 N and 75 E to 158 E.
Boundary values from the global model MOZART were applied and an initial field based on these values was used. The simulation started February 2001 and finished April 2002 to get good initial concentrations for the four months of interest for the model inter comparison study.
The dry deposition velocities were derived as a function of stability and species and were given a diurnal variation. There was also a land/sea dependency but as the model had only one type of land-use there were no difference between, for example, step and mountainous areas.

Results

A few examples of results are presented in the following pictures.
Near surface O_3 concentrations, shown in figure 1, were lower than most of the other models. Comparisons with measurement data at remote stations do show a quite good agreement (figure 2). For some stations MATCH is underestimating the ozone and for others overestimating. Time series with one example of under- , Tappi and one of overestimating, Ogasawara, are presented in figure 3.

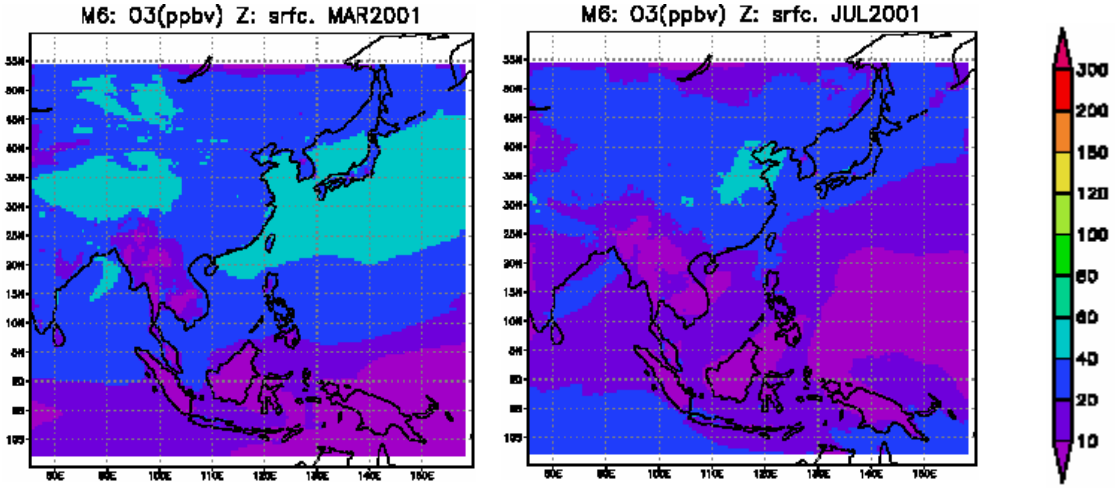

Figure 1. Monthly mean of ozone.

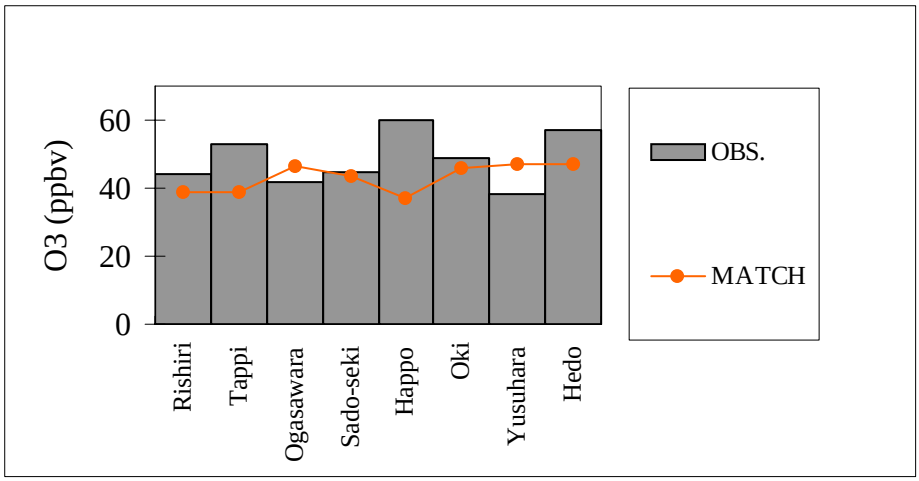

Figure 2. Comparison between MATCH and observed ozone levels at remote stations, March 2001.

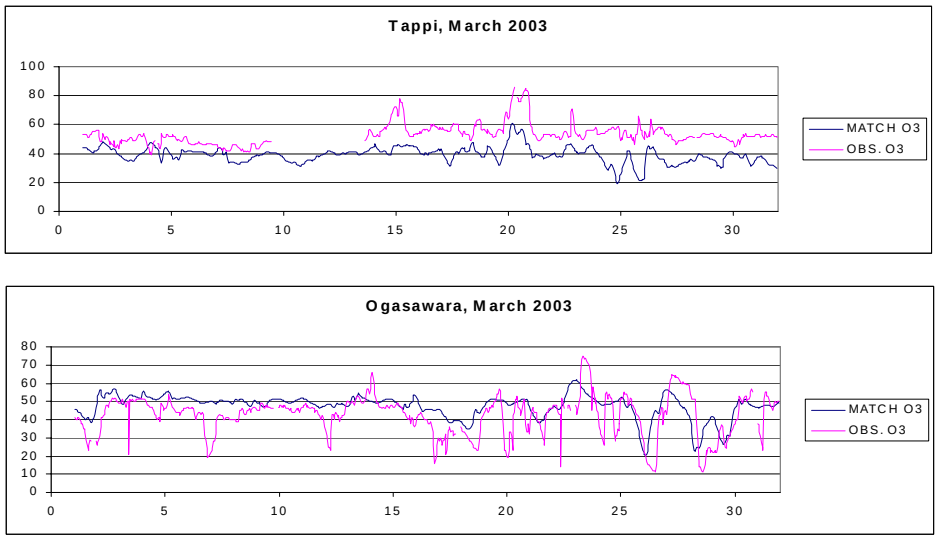

Figure 3. Tappi and Ogasawara time series, hourly values

The agreement of modelled and observed sulphate on aerosol particles at 13 stations is presented in figure 4. A study of sulphate in Southeast Asia using MATCH with a linear sulphur scheme (Siniarovina and Engardt 2004) reports observations and model results from the remote station Tanah-Rata in Malaysia for year 2000. A comparison between results from the different sulphur chemistry schemes is seen in table 1. Unfortunately both measurements and modelled results have increased at least 20 % (table 1) from year 2000 to 2001.

g/m^3	MATCH 2001	OBSERVATION 2001	MATCH 2000	OBSERVATION 2000
MARCH	0.9	0.8	0.3	0.5
JULY	0.9	1.1	0.6	0.8
DECEMBER	1.2	0.5	0.3	0.3

Table 1. Modelled and observed sulphate concentrations in Tanah-Rata, Malaysia.

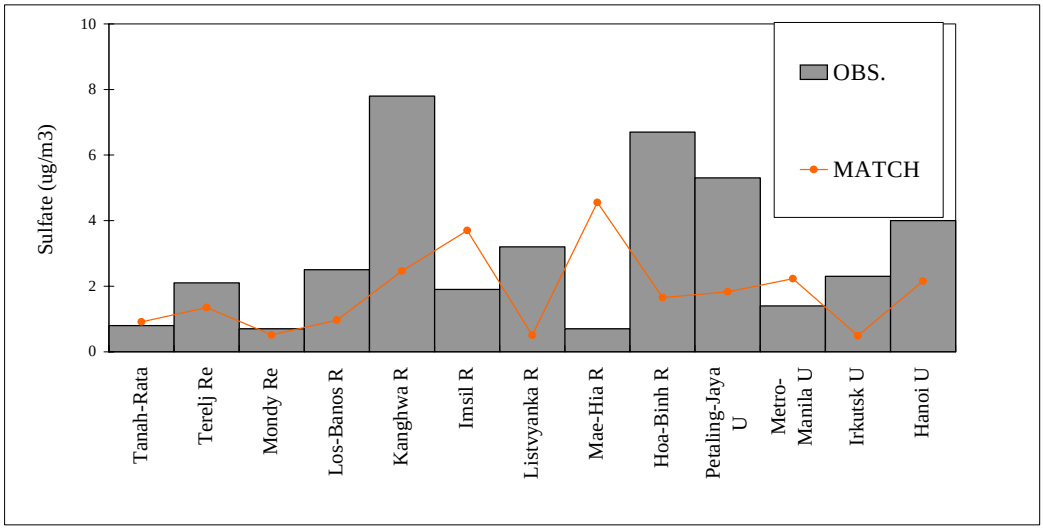

Figure 4. Monthly mean of sulphate concentration for March 2001.

Conclusion

This first attempt to run our photochemistry model in Asia has given reasonable results. We are looking forward to the analysis and results from the comparison study.

In the future we will look more into the possibility to apply several different land-use types with corresponding dry deposition velocities in the MATCH model for Asia. We will more carefully investigate our results and try to focus on Southeast Asia where our results seems to deviate most from the other models in the study.

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