Atmos. Chem. Phys. Discuss., 8, S447–S451, 2008
www.atmos-chem-phys-discuss.net/8/S447/2008/

Atmospheric Chemistry and Physics Discussions

ACPD

8, S447–S451, 2008

Interactive Comment

Interactive comment on “Probing ETEX-II data set with inverse modelling” *by* M. Krysta et al.

Anonymous Referee #3

Received and published: 29 February 2008

The manuscript presents the application of the Maximum Entropy Method to the analysis of the measurements performed during the ETEX-II experiment. This is certainly an interesting attempt to shed some light on the puzzling issue of poor performance of the tracer models simulating the second ETEX release. The paper is well written and concise. The ideas discussed in the paper will certainly help to understand how complex is the evaluation of atmospheric tracer models using tracer experiments.

The evidence presented in the paper quite clearly points to some problem with data collected from the observing stations. It is, however, worthwhile to mention that the meteorological situation during this experiment was very difficult for both the forecast tracer models and for the models calculating the influence function which is essential for the application of the Maximum Entropy method. According to Gryning et al. (1998), the meteorological conditions during ETEX-II release were very complex contrary to rather simple meteorological situation in the first experiment. Consequently, transport models were not able to capture correctly transport patterns as successfully as during ETEX-I test. The main reasons for the poor performance of all models during the ETEX-II according to Gryning el al. (1998) were: a) passage of the cold front over the

release site leading to a sudden change of local meteorological conditions

b) strong vertical motions along the frontal zone not accounted in transport models

c) fragmentation of the tracer plume in a highly nonstationary flow

d) insufficient temporal resolution of wind data

The careful analysis of the meteorological conditions shows that the kinematics of the tracer cloud during ETEX-II experiment is still poorly understood. The study with high resolution models performed by Bellasio et al. (2000) seems to support this opinion. Furthermore, it has been shown that with the increasing resolution it is possible to reproduce some of features found in the experiment.

It is quite likely that ETEX-II plume had a complicated three–dimensional fractal structure as opposed to a relatively smooth distribution observed during the ETEX-I experiment. It is not surprising that the general performance of models was rather poor. In many ways the disappointing accuracy of the transport models is not unusual but quite

ACPD

8, S447–S451, 2008

Interactive Comment

typical for most of meteorological situations characterized by nonstationary meteorological conditions.

When looking at the particular details of the ETEX-II case, we can certainly suspect the strong layering of the tracer and the subsequent decoupling of the low and high level transport. According to Ryall and Marion (1998), the vertical structure of ETEX-II cloud was characterized by the older part of the cloud above the capping inversion thus effectively decoupled from the surface layer. This indicates clearly a pre-cold-front uplift of tracer. The complex kinematics of the tracer transport following the ETEX-II release was very challenging for all models employed in the study. Quite likely, both temporal and spatial resolutions were not adequate to address the nonstationary and fragmented tracer cloud.

In the case of Eulerian models it was evident that they represent neither the complex spatial patterns nor intermittent character of the time dependence of the tracer concentration. One can anticipate similar difficulties when solving the inverse tracer transport problem in order to calculate the influence function and subsequently the matrix H.

A model executed in the adjoint mode will likely suffer from the same numerical dispersion errors as a forward in time model. How the errors of the advection scheme affect the result of the inversion?

The difficulties with correct calculation of the influence function can be additionally compounded by the inadequate spatial distribution of detectors. We can imagine, for

ACPD

8, S447–S451, 2008

Interactive Comment

example, the situation in which the majority of detectors are placed at the ground level whereas the transport takes place aloft at levels fully decoupled from the surface. In such an extreme case, measuring stations will detect only a small fraction of the tracer cloud very often in a form of erratic measurements very similar to those detected during the ETEX-II.

The influence function obtained in such a case will not lead to a very accurate evaluation of the source term. The entire inversion is also dependent on the vertical distribution of the forcing term in the equations calculating influence function. What was the specific form of this function used in the calculations?

It will be quite helpful to add a few sentences discussing these problems in order to emphasize what are the potential limitations of the method used in the manuscript.

REFERENCES

Bellasio R., Bianconi R., Mosca S., Girardi F., Graziani G., Klug W., 2000: Simulation of the second ETEX release in the proximity of the source. *International Journal of Environment and Pollution*, **14**.

Gryning Sven-Erik, Batchvarova E., Schneiter D., Bessemoulin P. and Berger H., 1998: Meteorological conditions at the release site during the two tracer experiments. *Atmospheric Environment*, **32**, 4123-4137.

Ryall D. B. and Maryon R. H. , 1998: Validation of the UK Met. Office8217;s name model against the ETEX dataset. *Atmospheric Environment*, **32**, 4265-4276.

ACPD

8, S447–S451, 2008

Interactive Comment

Interactive comment on Atmos. Chem. Phys. Discuss., 8, 2795, 2008.

ACPD

8, S447–S451, 2008