

# Project VALIUM

## Development and Validation of Tools for the Implementation of European Air Quality Policy in Germany

Contribution to subproject SATURN

Frauke Pascheke, Michael Schatzmann

*Meteorological Institute, Centre for Marine and Atmospheric Research, University of Hamburg, Germany*  
*e-mail: [pascheke@dkrz.de](mailto:pascheke@dkrz.de)*

### Summary

The European Union released the guideline 96/62/EU 'Assessment and Control of Air Quality in Europe' which is presently supplemented by so-called 'daughter directives'. This set of regulations requires from the EU-member-states to provide maps that show the spatial distribution of several key air pollutants in their territory. These maps should illustrate the situation

- for the member state in total,
- with higher resolution for conurbations with more than 250 000 inhabitants and
- with very high resolution for typical micro-environments as, e.g., residential areas in the neighbourhood of industry or streets with heavy traffic loads.

The values presented in the air quality maps should be based on representative measurements. Since measurements are generally taken at specific points only, the data need to be generalized by numerical modelling in order to achieve a spatial picture. It is the first time that a European guideline requires explicitly the use of dispersion models as tools for the execution of air quality policy. A program package is needed which covers the demands outlined before and which is able to deliver results in conformity with European and German law.

It is the objective of the project to develop and validate a hierarchy of numerical models that can be applied as tools for the execution of European air quality policy. Scientists from several German research institutions, consultancy firms and environmental agencies will work together to prepare the software package M-SYS that provides the input for local and regional air quality maps. The group works out guidance for the preparation of emission data, as they are needed for the application of the modelling system. A method for the statistical analysis of time series will be developed which allows classifying the dispersion situations into representative clusters. In addition, a high quality data set for the validation of the modelling system will be developed. This data set will be based on a combination of field and corresponding wind tunnel experiments.

### Introduction

The council of the European Union released on Sept. 27, 1996 the guideline 96/62/EU on the 'Assessment and Control of Air Quality in Europe'. This guideline is presently supplemented by so-called 'daughter directives' which determine details of the intended policy.

Initiated by the coordinator of project VALIUM, the German 'VDI-Commission on Clean Air' together with experts from the Federal Government and the German states organized an

internal workshop on the subject, which was held Oct. 8/9, 1998 in Hamburg. It was discussed how the new European legislation should be transferred into national law and which new tools would be required for the implementation of the European air quality policy in Germany.

With respect to the development and adjustment of modelling tools, the discussion resulted in the following (somewhat simplified) picture:

- Of concern are the pollutants SO<sub>2</sub>, NO<sub>2</sub>, particulates PM<sub>10</sub>, Ozone, Benzene, CO, PAH and several heavy metals.
- For the pollutants of interest here, limit values and guidance values have been or will be defined to protect human health and the environment. After certain deadlines these values should not be exceeded anymore.
- The limit values are defined in terms of annual mean and percentile values, different for the individual pollutants.
- In order to assess the air quality in the European member states, maps that show the spatial distribution of individual air pollutants have to be generated. These maps have to show the situation
  - a) for the member state in total,
  - b) with higher resolution for conurbations with more than 250 000 inhabitants, and
  - c) with very high resolution for typical micro-environments as, e.g., residential areas in the neighbourhood of industry or streets with heavy traffic loads.
- The values presented in the air quality maps should be based on representative measurements. Since measurements are generally taken only at specific points, the data need to be generalized by numerical modelling in order to achieve an areal picture. If the pollutant level is below certain threshold values, the maps can be based on model simulations alone.
- If the maps indicate that thresholds are exceeded, the reason for this has to be investigated and actions to improve the situation have to be worked out. The effect of these actions must be predicted which also requires the utilization of models.

## **Objectives**

The demand for scientific research work resulting from the implementation of the Air Quality Guideline is significant. Following the path of the pollutants from emission over transmission to immission, the following tasks can be identified:

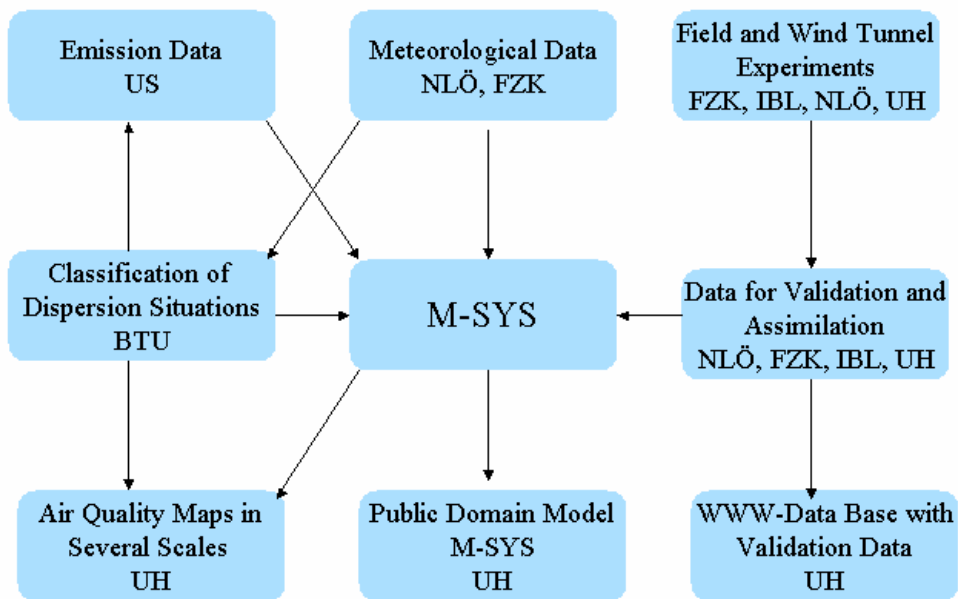
- Delivery of emission databases for the different scales that are of interest here. Such databases have partly been developed for meso-scale Chemistry Transport and Flow Models (CTFMs). They need to be extended to cover also the demands of micro-scale models, the emission situation of present years and of pollutants which were previously not considered (e.g., particulates).
- High-resolution meso-scale and micro-scale models are already available. The models are of non-hydrostatic character, they use non-uniform grid spacing, utilize terrain-following coordinates, account for chemical transformations and have the potential to cope with the problem here under consideration. Not yet solved, however, is the direct coupling of

meso-scale and micro-scale CTFMs. An algorithm is needed which combines the two models in an intelligent, user-friendly way, controls the proper interaction of the models and delivers an output which allows the subsequent statistical treatment of results. Further development work is needed with respect to the optimisation of the two codes for applications in a PC environment, with respect to the assimilation of measured data into the model runs, with respect to the extension of the chemistry modules to additional pollutants (mainly particulates), and finally with respect to further quality assurance work, especially for model applications under urban conditions.

- Whereas in the past numerous field experiments have been carried out to generate data for the validation of meso-scale models (TRACT, FluMOB, BERLIOZ, Augsburg,...), comparable field data for micro-scale models do not yet exist. It is urgently necessary to close this gap. Within the frame of this project, it is intended to carry out field experiments in a city quarter with heavy traffic load. Since field experiments are (1) expensive, (2) may lack representativeness in areas with strong local variations of the measured properties, (3) do generally not cover the whole spectrum of weather situations of interest and (4) provide data only at a very limited number of positions, it is intended to enhance the scope of these data by complementary measurements in a boundary layer wind tunnel.
- The models discussed here are episode models. It is theoretically possible to permanently re-initialise them and to run them also over periods of several weeks or even months, but there is not yet much experience available on how successful that would be with respect to stability of the model runs and the quality of the results. Moreover, the required computer capacity would exceed what is presently available. In order to produce nevertheless the annual mean and percentile values required by the European guideline, it is more sensible to cluster the weather into a limited number of dispersion categories, to do the calculations for them and to generalize the model outputs statistically. This task has not yet sufficiently been tackled. It contains several open questions, which also need to be answered within this project.

## **Activities**

A consortium was formed which combines the experience of teams from the Universities of Cottbus (BTU), Hamburg (UH) and Stuttgart (US), from the Research Centre Karlsruhe (FZK), from the Lower Saxony State Agency for Ecology (NLÖ, Hanover) and from a private consultancy (Ingenieurbüro Lohmeyer, Karlsruhe, IBL). The consortium develops, validates and applies the public domain model M-SYS. The major responsibilities of the six teams are briefly indicated in Fig. 1. A more detailed report on the activities is given in the contributions submitted by the individual teams.



**Figure 1:** Structure of the project

## Results

Funding of the project started only a year ago. The results presently available are presented in the posters prepared by the VALIUM research teams.

## Acknowledgements

The authors gratefully acknowledge financial support from the German Federal Ministry of Education and Research under grant No. 07ATF12.

## References

- Leitl, B. (2000): Validation Data for Microscale Dispersion Modelling. EUROTRAC Newsletter, 22, pp. 28-32.
- Schatzmann, M., and Leitl, B. (2002): Validation and Application of obstacle resolving urban dispersion models. *Atmospheric Environment* (submitted).

## Aims of next year

Continuation of the project program, publication of validation data sets and of first model results.