

Dispersion Modelling And Regulatory Requirements

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Dispersion models are used for a variety of purposes, but the most important is probably in support of air pollution regulatory requirements. Since most atmospheric pollution problems are inherently complex, there remains a strong research element and a degree of uncertainty in air pollution estimates. The demands of the regulatory process are not entirely the same as the use of models in scientific activities, but this is not a good argument for failing to consider these uncertainties in regulatory applications.

Different regulatory activities require different models and model uses. The UK Environment Agency is a major user and instigator of the use of air dispersion models, to assess the impacts of airborne pollutants released from prescribed processes, in accordance with the Environmental Protection Act 1990. This assessment is a central feature of IPC (Integrated Pollution Control) and the BATNEEC (Best Available Techniques Not Entailing Excessive Cost) process and will continue to be so under IPPC (Integrated Pollution Prevention and Control) and BAT (Best Available Techniques).

Such calculations are formally required by the Agency for all permissions to operate. In the UK, there is no proscription (that is, the use of specific models) for regulatory studies and differences between dispersion calculations from different models and versions of models are then as important as their absolute veracity. The differences that exist in calculations between models and different versions of the same model are normally large enough to have a significant effect on regulatory decisions, which often involve substantial expenditure on commercial plant.

This problem has recently become more acute in the UK since the appearance of the USEPA's second generation AERMOD model, which is now used alongside the UKADMS model, which had previously become a de-facto standard for regulatory work.

The most widely used of a new generation of models in the UK, ADMS, is installed and in use in some 30 regional/area Agency centres. ADMS has been the principal model used by the Agency for IPC assessment since about 1995. In the last year or so a new model, AERMOD, has become available in the UK. This has been developed by the United States Environmental Protection Agency (USEPA) and is the successor to the widely used ISC (Industrial Source Complex)

model which was the main model used in the UK before the development of ADMS. AERMOD is the USEPA's new generation equivalent to ADMS and AERMOD is used increasingly in the UK for IPC applications. It is also now installed in the Agency centres and is used in parallel with ADMS.

As a result of this the UK Environment Agency has funded a study of the relationships between these model's dispersion characteristics, alongside those of the older USEPA ISC model. A part of this study has been the production of a simple test protocol that will reveal differences between models quickly and easily and which can be used in the long term as a standard procedure for determining the differences between models and versions of models.

The study compared the new generation dispersion models: the USEPA AERMOD and the UK ADMS. The main concern has been with the relative performance of AERMOD and ADMS with each other and with the USEPA ISC and the UK R91 models. These have been in common use for regulatory purposes in the UK for many years, but which are now being replaced by the new generation models.

The project was commissioned to provide an assessment of AERMOD for regulatory purposes in the UK. It had two main objectives:

- a to develop a protocol for model assessment which could be used in this assessment and which will provide a consistent framework for future assessment of models for regulatory purposes;
- b to compare the performance of AERMOD with ADMS and other models and assess its performance for use in regulation.

A suitable protocol has been developed which tests all the main features of models used in regulatory practice with a minimum number of calculations. It comprises a total of about 75 test conditions designed to reveal differences between the most important features of dispersion modelling for regulatory work. The features include calculations in single weather conditions to examine the response of the models to specific meteorological circumstances and annual calculations using sequential hourly weather data.

There have been relatively few model inter-comparison studies of this sort since the introduction of ADMS around 1991/2. Most studies have been concerned with the comparison of single models with field data. Such validation studies are an important feature of model development but are not a good guide to the differences between models. Field data is invariably highly variable and it is only possible to compare models on the basis of bulk statistical parameters, which do not readily reveal the detailed reasons for differences between model dispersion calculations. The latter information can only be readily obtained from systematic parametric studies aimed at revealing differences between the different facets of model calculations such as basic rates of dispersion, plume rise, interaction with the top of the boundary layer, building entrainment and topography.

Only ten studies were found directly comparing either ADMS and AERMOD with each other or with the older models, only four of which were of the systematic parametric variety. They are all reviewed here. Some critical differences between the models are apparent in the studies but they are generally of limited range and leave many matters uninvestigated. The effects of building entrainment and topography in particular have been little studied. The literature is also constrained in that little of it is peer reviewed and a significant part of it is not readily available. Little attention has been given to variant versions of models issued over time and any differences between them. It appears that the choice of meteorological input to different models in inter-comparisons is a critical matter.

The main conclusion is that there are significant differences between the outputs of the models but that these do not follow any consistent pattern. It is not practicable to provide overall recommendations on the use of one or the other model and each specific application must be considered on its own merits.

Nevertheless, the advanced models represented by ADMS and AERMOD provide significant advantages over older models particularly in their treatment of the boundary layer and of complex terrain. However, the results demonstrate that the new generation models are still in a state of development. In particular the study has shown their sensitivity to the methods used to process meteorological data to provide the boundary layer parameters required for dispersion calculations. This and other aspects of the performance of the models require further development and the study provides guidelines and recommendations for good practice in such development and the use of models in regulation.

The full reports of the intercomparison can be found in: :

R&D Technical Report P353: A review of dispersion model intercomparison studies using ISC, R91, AERMOD and ADMS. ISBN 1 85705 276 5.

R&D Technical Report P362: An intercomparison of the AERMOD, ADMS and ISC dispersion models for regulatory applications. ISBN 1 85705 340 0.

Other related papers of interest are:

D.J.Hall, A.M.Spanton, F. Dunkerley, M. Bennett, R.F. Griffiths.

An Intercomparison of AERMOD, ADMS and ISC Dispersion Models for Regulatory Applications.

Paper Presented at the Seventh International Conference on Harmonisation Within Atmospheric Dispersion Modelling for Regulatory Purposes. Belgirate, Italy, 28-31 may 2001.

F. Dunkerley, A.M.Spanton, D.J.Hall, M. Bennett, R.F. Griffiths.

An Intercomparison of AERMOD, ADMS and ISC Dispersion Models for Regulatory Applications: Dispersion Over Terrain.

Paper Presented at the Seventh International Conference on Harmonisation Within Atmospheric Dispersion Modelling for Regulatory Purposes. Belgirate, Italy, 28-31 may 2001.

D.J. Hall, A.M. Spanton.

Meteorological Data and Dispersion Modelling.

Clean Air Vol 29, September/October 1999. Pp130- 137.

D.J. Hall, A.M. Spanton, M. Bennett, F. Dunkerley, R.F.Griffiths, B.E.A. Fisher, R.J. Timmis.

Evaluation of New Generation Atmospheric Dispersion Models.

Presented at Sixth International Conference on Harmonisation within Atmospheric Dispersion Modelling for Regulatory Purposes. Rouen, 11-14th October 1999.