EXTENDED ABSTRACT

MODEL VALIDATION KIT - RECENT DEVELOPMENTS

H.R. Olesen
National Environmental Research Institute (NERI)
P.O. Box 358, DK-4000 Roskilde, Denmark. E-mail: hro@dmu.dk

ABSTRACT
Over the past few years, the so-called Model Validation Kit has been the basis for much work on model evaluation. The ground is presently being prepared for further development of the kit. Based on data from the Kincaid experiment, investigations have been carried out in order to illuminate features and problems with a methodology for model evaluation proposed in the context of the ASTM. This methodology may eventually become incorporated in the Model Validation Kit. As a by-product, the studies have revealed data problems with a certain version of the Kincaid data set.

KEYWORDS
Model Validation Kit, Kincaid, atmospheric dispersion models, mode evaluation, near-centreline concentrations, ASTM.

NOTE
The full text of the present paper is not on the conference CD-ROM, but is available through the Internet at http://www.dmu.dk/AtmosphericEnvironment/harmoni/Rouen99.htm

The text below is an extended abstract only.

INTRODUCTION
One of the key elements of the work of the initiative on Harmonisation within Atmospheric Dispersion Modelling for Regulatory Purposes is model evaluation.

The so-called Model Validation Kit was created for the second "Harmonisation..." workshop in 1993, and since then it has undergone gradual improvements. The Model Validation Kit has formed the basis for much work on model evaluation, and it has been requested by 160 modelling groups over the past few years.

The Model Validation Kit provides a simple way of evaluating model results against experimental data, where model results are compared directly against observations; various statistical and graphical analyses are easy to undertake with the tools of the kit.

The kit (with its supplement) comprises data sets where a single source emits a tracer gas while arcs of monitors are positioned downwind of the source. The data to be compared are arcwise maximum concentrations and (for some of the data sets) crosswind integrated concentrations along arcs.

There is a basic conceptual problem with the procedure of directly comparing arcwise maxima to modelled maxima, and as a consequence the results should be interpreted with care. The problem is that even a "perfect" model cannot be expected to give the same frequency distribution of arcwise maxima as the one observed. If the monitoring network is sufficiently dense, it must be expected that a "perfect model" will underpredict the highest observed concentrations. This is because atmospheric dispersion is a stochastic process, and models can be expected only to predict ensemble averages – not the results of specific realisations. The Model Validation Kit in its present form does not explicitly address this issue. However, it has the advantage of being straightforward and practically oriented.
Work is in progress, which addresses this challenge, so *ensembles* of observed values are considered rather than individual values. This work may eventually result in tools which can be widely used by the modelling community and which can be incorporated in a future version of the Model Validation Kit.

However, we are not yet at a stage where a well-established set of tools accompanied by "authoritative" data sets can be distributed.

The focus of the ongoing work is a draft for an ASTM standard guide on statistical evaluation of atmospheric dispersion models (ASTM Designation Z6849Z. Draft, April 1999). The contents of this procedure has been described at earlier Harmonisation conferences (e.g. Irwin, 1998; Olesen, 1998). A set of relevant material (explanations, software, data sets etc.) is available through the Internet (see below).

**KINCAID: DATA PROBLEMS IDENTIFIED**

The present paper reports some results of detailed studies of cross-wind concentration profiles from the Kincaid experiment. These investigations were carried out in order to illuminate features and problems with the proposed methodology. Also, it was the original intention with the study to provide quality-controlled values of crosswind integrated concentration for the Kincaid data set. Such values are not present in the current version of the Model Validation Kit. The study, however, revealed inconsistencies between various versions of the Kincaid data set, and pointed to a problem with the version of the data set that is being distributed as part of the ASTM-related package. The implication is that exercises with the ASTM package on its accompanying Kincaid data set should be regarded merely as *exercises* and their results not considered trustworthy. Due to the data problems there is not yet an available data set for Kincaid with quality-controlled crosswind integrated concentrations. The data problems do not affect the Kincaid data in the current Model Validation Kit.

**ISSUES WITH THE ASTM METHODOLOGY**

The full length version of the present paper discusses some major questions related to the proposed ASTM methodology, as well as a number of minor points of concern. Major issues are:

- One can suspect that model evaluation results are strongly dependent on the way ensembles are defined. Ideally, ensembles are groups of observations collected under identical external conditions, so that any variations are due to stochastic fluctuations. But in practice when the ASTM methodology is used, ensembles are composed of all observations in a "regime", which represents a *range of* external conditions, not just one set of conditions.
- One can suspect that the proposed methodology is very sensitive to the treatment of small (zero and near-zero) concentration values.
- Given a set of real scenarios, it is not obvious what we should expect from a "perfect model". Which features of the concentration patterns do we wish our model to reproduce? There are experiments with well-behaved Gaussian concentration patterns where there are some fairly obvious features, which can be compared to model results. But there are other cases - exemplified by many experimental runs at Kincaid - with patchy concentration distributions containing irregular features. When regimewise averages over many such patterns are formed, noteworthy features may be concealed which we would like our models to somehow account for.

Anybody interested can join this work of exploring the set of issues related to the ASTM methodology. The relevant software and data sets can be found through the Internet (http://www.dmu.dk/atmosphericenvironment/Harmoni/ASTM_key.htm). Note, however, that this material is provided "as is", and is not a nice coherent entity.

**REFERENCES**


Olesen, H.R., 1998, 'Model Validation Kit - Status and Outlook.' Presented at the 5th International Conference on Harmonisation within Atmospheric Dispersion Modelling for Regulatory Purpose in Rhodes, May 1998. To be published in the IJEP.