Tender for work requested by ADMLC

Topic for which funding is sought:
Application of dispersion modelling to the design of local monitoring

Name and address of organisation	

ADMLC Technical Annex: Review of application of dispersion modelling to the design of local monitoring

Introduction

Dispersion modelling can be used to inform the design of ambient air-quality monitoring schemes by showing how monitor types, locations and schedules can be optimised to collect efficient and effective data for managing sources. But monitoring is often not planned with modelling. This may be because monitors have been relatively bulky, expensive and inflexible (e.g. needing mains power) so plans have been governed by these factors – with little scope to refine them with modelling. However, recently monitors have been developed that are smaller, cheaper and more flexible, so they can be deployed more widely (e.g. in networks) and by more users (e.g. by public and environment groups as well as by industry and regulators). So there is now more scope to use modelling to develop and refine monitoring plans. The benefits from using modelling to inform monitoring include:

- Savings from getting the same or better information from fewer or cheaper monitors;
- More frequent and better-resolved data on the impacts of specific sources;
- Earlier detection of adverse trends in impacts and/or in the performance of emission control systems;
- Better information for targeting improvements on relevant sources and for evaluating their effectiveness;
- Better ambient data for evaluating individual source emissions with inverse dispersion modelling;
- Better understanding between regulators, industries and public when interpreting monitoring results.

Because monitoring plans are rarely informed by modelling, these benefits are rarely realised, and may only be recognised after issues arise with monitoring that was not informed by modelling. For the same reason, there is limited information and experience on how modelling can be used to support monitoring design. But plans for deploying monitors are better informed if modelling is done beforehand to predict and map the measurable "signals" expected at potential monitor locations. The predictions can cover different: pollutants; averaging times (short/long-term); positions (fore/background, down/upwind); statistics (percentiles, data for angular sectors); and obscuring impacts, i.e. "noise", from other sources that may overlay the "signal" from a particular source of interest.

Objectives, scope and approach

Overall objective is to: *review how dispersion modelling can be applied to inform the design of ambient monitoring schemes, and to recommend next steps for improved applications*. This is a large topic, so the scope focuses on:

- Local impacts due to a "main site" that emits from point (stack) and area (low-level fugitive) sources.
- Dispersion over flat terrain without building effects (rather than over complex/urban topography);
- Static monitors that measure regularly at their locations (rather than mobile or remote-sensing devices).

The review will consider how modelling can be used to predict "signals" and "noise", and how such predictions can be mapped and used to design efficient monitoring schemes for detecting, distinguishing and tracking "main site" impacts. The approach will begin with a literature search to identify "key examples" of using models to design monitoring (Task 1). The "key examples" will then be summarised (Task 2), and used to review and comment on different aspects of "modelling for monitoring design" (Task 3). Conclusions will be drawn on the "state of the art" and recommendations made for "next steps" to make "modelling for monitoring" more recognised, systematic, effective, and accessible (Task 4). The work will be set out in a report, and in a presentation to ADMLC (Task 5).

Task 1 Literature Search

Task 1 is a systematic search for published studies that describe situations where models have been used to guide the type, placement and duration of local monitoring around continuous-emission sources e.g. industrial sites. The focus will be on situations with a "main source" that is well-defined and prominent i.e. with few other local sources whose impacts overlap those of the "main source". The search should identify "key example" studies for summarising in Task 2. "Key examples" should cover a range of situations where models have been used to plan monitoring e.g. for incident response, or where monitoring is being designed for purposes of model validation.

Task 2 Summaries of "key example" studies

Task 2 will summarise the "key examples" from Task 1, and it will identify different aspects of "modelling for monitoring" for consideration in Task 3. Each summary should outline:

- The context, objectives and approaches taken when using modelling to plan local monitoring.
- The pollutants, spatial scales, time scales and receptors of interest, and types of monitors considered.
- How modelling was arranged to predict measurable main-source impacts at different positions, including impact levels and frequencies, and how these impacts were distinguished from other-source impacts.
- How model results were interpreted i.e. used to compare/optimise between monitoring options/schemes.

.**Task 3 Review and commentary on aspects of modelling for monitoring design**

Task 3 will use the "key examples" to collate and comment on different aspects of modelling studies for monitoring design. The aspects follow a sequence, from the initial collection of input data, to the final interpretation of model predictions for optimal design. Task 3 will focus on aspects that are specific to modelling-for-monitoring, and should provide useful advice for future studies. There are 3 sub-tasks in sequence:

3.1 Initial information. Sub-task 3.1 will review and comment on the types of information and data that need to be defined, gathered and prepared in "modelling for monitoring design" studies. This includes:

- Monitoring objectives, including the temporal and spatial scales to be covered.
- Meteorological and dispersion conditions in line with the monitoring objectives.
- Release rates and discharge conditions, from both "main" and "other" sources.
- Sensitive receptor types and locations, and information on relevant ambient air-quality criteria.
- Types of monitors and their applicability e.g. cumulative/passive, continuous/automatic; also cost.

3.2 Model selection, dispersion scenarios, monitoring options and model runs. Sub-task 3.2 will review and comment on how the information from 3.1 is used to formulate dispersion scenarios and model runs for assessing monitoring options. This includes:

- How models are chosen for monitoring design.
- How different scenarios of emissions and dispersion are defined for inputting to model runs.
- How different monitoring options are defined, so that they can be compared on the basis of model runs.

3.3 Processing, presentation and interpretation of model outputs. Sub-task 3.3 will review how model outputs from 3.2 can be presented and interpreted as statistics and maps for comparing monitoring options. This includes:

- Maps of signal strength from the "main source" for different temporal statistics e.g. percentiles.
- Maps of signal-to-noise ratios i.e. of the ratio between "main source" and "other source" impacts.
- Maps of the amounts of time when "main-source" impacts are detectable and/or significant.

Task 4 Conclusions and recommendations

Task 5 will draw conclusions about how models are currently applied to plan monitoring. It will also comment on the potential and constraints for further applications in future, and will make recommendations for future work e.g. for case studies to research the benefits of "modelling for monitoring", and to inform practitioners. It will consider:

- The advantages of using models to plan monitoring, and how they can be demonstrated and validated.
- Factors that constrain the use of models to plan monitoring, and how they might be addressed.
- Gaps in the methods or data required e.g. in procedures for optimising monitored signal-to-noise ratios.
- Whether or not systematic modelling procedures might be developed to optimise monitoring.
- How modelling can be used to predict/compare plans based on different monitors e.g. passive; automatic.
- Methods of optimisation for (a) single monitors, (b) monitoring networks.
- How to define and manage uncertainties in the application of models to the design of monitoring schemes.

Task 5 Report and presentation

A draft report should be prepared on Tasks 1-5. It should include recommendations on the use of modelling for the design of local monitoring schemes at a "main site" using static monitors. Areas of uncertainty should be discussed and recommendations made for additional work to reduce them. Options for further research to extend model-based design to other monitoring schemes should be discussed e.g. to mobile monitoring or short-term sampling campaigns. Task 5 should allow time/expenses for the team to present their work at an ADMLC meeting.

Timescales

	Item or deliverable	**Date**
	Start date	
	Intermediate stages or deliverables	Add rows as needed
	Draft report for ADMLC comment	
	Final report	

Costs

Indicate points at which intermediate payments, if any, are required.

Note that ADMLC will only make intermediate payments on receipt of identified deliverables or the draft report

CVs of Project Staff

Provide CVs of 2 staff involved in the project.

This section should be no more than 1 page in total.