Knowledge Transfer Proposal from the Lancaster Environment Centre: Response to reviewers comments

DEMONSTRATING TECHNIQUES FOR AIR-POLLUTION-SOURCE PERFORMANCE ASSESSMENT

The proposers are grateful for comments received from 4 reviewers, and would like to respond here with further detail, explanation and illustration of our proposed work. Our response is arranged in 4 parts:

* Section 1 addresses wider questions about our strategy for knowledge development, dissemination and uptake.
* Section 2 provides a worked example to illustrate further how we will apply our strategy in practice.
* Section 3 answers more specific questions raised about particular details of our work plan and activities.
* Section 4 summarises the outcomes that we would aim for in our KT work, and would use to judge its success.

We have adopted a consolidated approach, so that similar questions raised by different reviewers are addressed together.

1. STRATEGIC APPROACH

1.1 Techniques: advertisement or development ?

[**Reviewer 10146***: "Is the main thrust of the KT proposal to advertise the techniques presented so far to interested user groups, or to develop further new analytical techniques and subsequently promote them to the users?"*]

Our approach is to strike a balance between: (a) refining existing research methods so they are more user-friendly, (b) developing new methods that give fresh insights into air-quality performance, and (c) promoting uptake of both existing and new methods by air-quality professionals and wider environmental/industry groups. We think this multi-faceted approach is the best way of connecting successfully with all the audiences for knowledge transfer, who have different motivations and applications for air-quality analyses. We must not only attract users' interest initially by promoting existing methods, but we must also show new methods that expand their interest over the project (3-years) so they incorporate the methods in their regular assessments and reporting of air quality. Our proposal involves a sustained dialogue with users, to show them that better exploitation of air-quality data is not a "one-off" event, but is a process of continuing improvement & innovation that can regularly deliver more informed decisions and more effective interventions, and is adaptable to new issues and priorities.

1.2 Communication: how ?

[**Reviewer 10146***: "How will this communication with the users happen?"*]

Our approach is to work with existing professional bodies, technical groups and knowledge networks so that we (a) present our methods to users, (b) get feedback and suggestions for improvements and new applications, (c) involve key groups in the work e.g. in case studies, and (d) establish the methods as tools for regular use by air-quality practitioners. We can transfer our methods more efficiently and authoritatively by using existing professional and technical networks in this way, rather than by diverting effort into setting up alternative outlets. Moreover, if the methods are to be widely recognised and adopted, it is essential that they are vetted by the various established organisations with an interest in air quality. As evidence of this approach, we have obtained letters of support and involvement from relevant organisations including:

- **Environmental Protection uk***:* "we would be keen to assist with the dissemination of the case studies to our membership, and promoting the general outcomes of the project".
- **Institute for Air Quality Management***:* "as Chairman of IAQM, I am very supportive of the more detailed analysis methods under investigation in this KT proposal. My hope is that the proposal will lead to the development of additional official & technical guidance on advanced monitoring & interpretation methods."
- **Atmospheric Dispersion Modelling Liaison Committee**: "ADMLC considers that the issues listed above are all areas in which further research would be helpful for improving the application of atmospheric dispersion modelling to the authorisation and licensing of discharges…ADMLC would welcome updates on its progress and by this means to become part of the Knowledge Transfer process".

As well as transferring knowledge through these organisations, we will use other outlets such as the **MESO-NET** network (chaired by one of our CIs), technical conferences (e.g**. HARMO** where we have presented), & local authorities (e.g. **Halton Borough Council** who are a project partner). The various outlets give opportunities at different intervals e.g. EPuk has spring & autumn workshops, ADMLC meets 3 times/year. An early task will be to draw up a schedule of dissemination events. We identify 7 practical mechanisms we will use to communicate knowledge: (i) website, (ii) case studies, (iii) user handouts & presentations, (iv) conference posters/papers, (v) peer reviewed publications, (vi) final report, (vii) closing workshop.

2. WORKED EXAMPLE

[**Reviewer 10148:** *"unless there is a clearly defined path showing the benefits... e.g. delivering performance measurements /evidence of the success or otherwise of a traffic management strategy... it is extremely difficult to achieve uptake"].*

The following example shows how we will apply our strategy to attract user interest, participation and uptake.

2.1 Case study selection: Hillingdon NOx

We will choose case studies that target key air-quality problems which are prominent at both a local level and at a strategic/national level. For example here: NOx impacts from M4 traffic in Hillingdon that are contributing to local exceedences of an EU NO_2 limit, and that are also constraining the strategic development of nearby Heathrow Airport - and hence of the UK economy. By choosing such critical case studies, will attract a wide group of stakeholders with substantial environmental, political & economic influence/interests e.g. London local authorities, GLA, Defra, DfT, BAA.

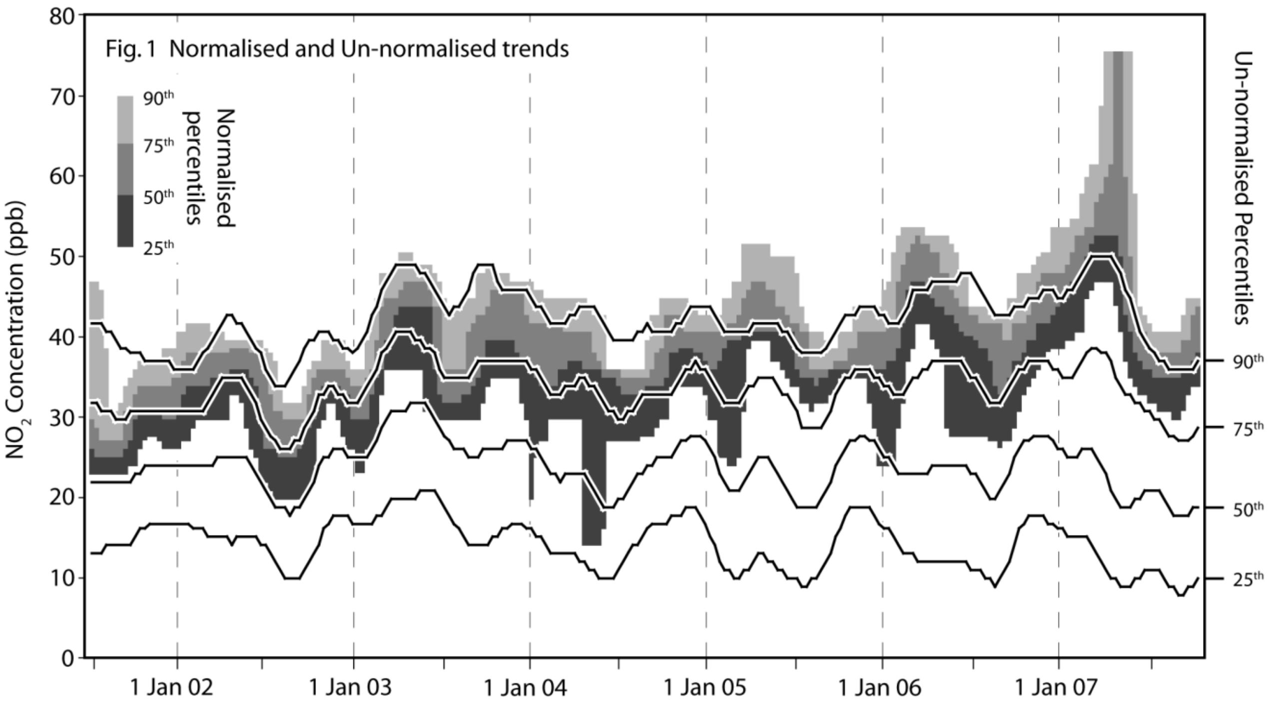


Fig. 1 Normalised and Un-normalised trends

Fig. 2a Nocturnal baseline: NO_x and NO_2 trends

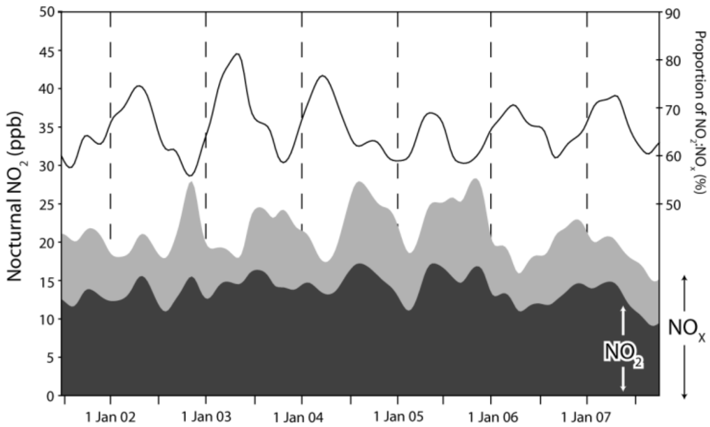


Fig. 3a Nocturnal baseline: monthly variation

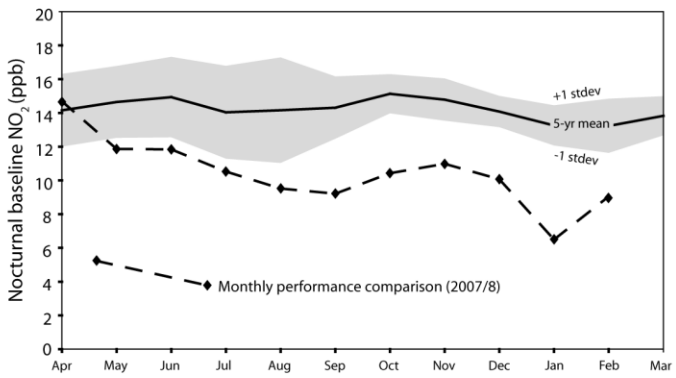


Fig. 2b Rush-hour increment: NO_x and NO_2 trends

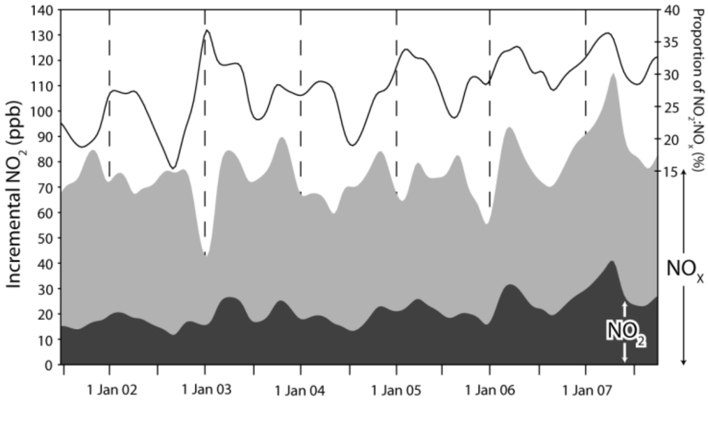
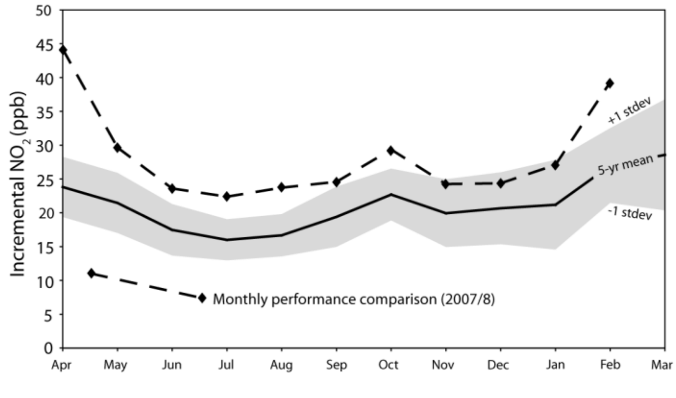


Fig. 3b Rush-hour increment: monthly variation



2.2 Aerometric analysis: tracking rush-hour pollution performance

Fig 1. shows 6 years (2001-7) of NO_2 records from 30m North of the M4 at Hillingdon. The sequence of white-grey histograms shows normalised NO_2 percentiles (25^{th} ,50^{th}, 75^{th}, 90^{th}) during weekday rush-hours (0700-1000) in conditions when winds blow from the M4 (190-230°) at moderate speeds (3-6 m/s). For comparison, the sequence of 4 black lines show corresponding un-normalised percentiles. The normalised sequence reveals the seasonal variations and upward trend of rush-hour NO_2 at all percentiles, which is not apparent in the un-normalised sequence.

Fig 2. shows similar normalised data from the same 6 years at Hillingdon for NOx, NO_2, & the ratio NO_2/NOx. In order to distinguish the impact of the morning rush-hour, a time series for the pre-rush-hour nocturnal period (0200-0500; Fig 2a) was subtracted from a time-series for the rush-hour, to give the incremental contribution of the rush hour (Fig 2b). Pre-rush-hour levels have not increased, but there is clearly a continuing upward trend in the incremental impact of rush-hour traffic affecting all 3 parameters: NOx, NO_2, & their ratio.

2.3 Management implications and practical applications

Plans to comply with the EU limit and to expand Heathrow Airport depend critically on managing down the contributions of road-traffic to NO_2 at places like Hillingdon. Our example shows how the incremental impact of that traffic can be discriminated and tracked, and compared with the wider/baseline air-quality situation as shown by pre-rush hour levels. This information is useful for developing local air-pollution control policies and for relating them appropriately to wider air-quality trends.

The information in Fig. 2 can also be used to track the normalised pollution performance of rush-hour traffic on a c. monthly basis. This is shown in Fig. 3 where measurements made in each of the past 11 months are compared with the mean and standard deviation of equivalent data for the past 5 years. There are separate comparisons for the nocturnal baseline period (Fig 3a) and the rush-hour period (Fig 3b). These show the nocturnal baseline is decreasing/ improving, but that rush-hour increments are continuing to increase/deteriorate. This finding has important implications for compliance with the EU AQ Directive and for the expansion of Heathrow Airport, both of which are likely to require reductions in traffic impacts.

The results for key cases like Hillingdon/Heathrow will be of great interest to air-quality practitioners and policy-makers, both locally and strategically/nationally. The methods that underpin them will therefore be readily transferable to users– not only in London but in other critical urban/trafficked areas. The methods will give users new and accessible ways to dissect, interpret & present their ambient data, so they can track the performance of air-quality policies & of contributing sources.

A key reason why air-quality data have remained under-exploited is that the link between better aerometric analysis and better outcomes for health and the economy has not been made clearly enough. The Hillingdon example illustrates how we would establish that link using selected prominent cases, in order to confirm that the marginal cost of analysis is amply repaid by the benefit of having better evidence to manage strategic issues like AQ Directive compliance and infrastructure planning. Using case studies like these, we will create a situation where practitioners can argue strongly and effectively for the budgets they need to extract appropriate evidence on source-performance from their currently under-exploited air-quality data.

3. SPECIFIC POINTS

3.1 Wider representation & steering group

[**Reviewer 10147**: *"I'd like to see more engagement with a wider range of stakeholders….Maybe workshops at the beginning,..middle..end to drum up interest, support and a steering group"]*

We appreciate these suggestions and will adopt them by: (a) identifying case studies like Hillingdon that will attract wide participation, (b) highlighting the work in a sequence of workshops/presentations for users, (c) setting up a broadly-composed steering group with representatives from academia, government (e.g. EA), environment groups (e.g. EPuk), professional bodies (e.g. IAQM), technical committees (ADMLC), and local authorities (e.g. Halton). The letters of support for our proposal show our supporters' willingness to help on a steering group in this way. Moreover, in preliminary discussions Defra have shown interest in using our KT methods to inform EU Directive negotiations, which again would widen engagement.

3.2 Economic and policy relevance/benefits

[**Reviewer 10148** "*Also, the policy implications should be highlighted and should not be underestimated*"].

Our proposal is based on a premise that there is under-exploited value in the information that is collected by air-quality monitors. We will reveal this value to users by showing that the cost of extra aerometric analysis gives disproportionate benefits in terms of: (a) earlier and so less costly interventions to improve air quality, (b) more accurate targeting of abatement costs onto culpable sources, (c) greater efficiency in air-quality management decisions, and (d) greater confidence in how the air-quality performance of sources and infrastructure developments can be tested/proven in practice.

We aim to show users that they are actually incurring greater costs now by <u>not</u> making full use of their expensively-acquired air-quality records. The greater costs arise from: (a) later/costlier interventions, (b) inaccurate targeting of abatement, (c) less efficient decisions, and (d) uncertainty about source performance and infrastructure developments. We aim to show that better aerometric analysis is not just valuable scientifically, but is also a very cost-effective way of improving environmental protection and of delivering clearer evidence to inform policy decisions. For example, Halton Borough Council don't understand why Deacon Road regularly exceeds NO_2 limits. Using methods like those shown above they could unravel the reasons – which would have environmental, economic & political benefits.

The methods proposed should not only improve exploitation of existing monitoring, but should go on to affect how monitoring networks are designed. In future some sites may be chosen for their ability to discriminate the performances of different sources on a temporal, directional, or meteorologically-normalised basis, using our methods. This could allow savings, so that one new/optimised site may provide as much/better information as 2 or more conventional sites.

3.3 Links to Air quality issues/policies

[**Reviewer 10145**:*"could do with linking objectives of project to addressing particular AQ issues e.g. Strategy Objectives"]*

The techniques described in our proposal provide us with additional power to detect relevant signals in noisy AQ data, including signals that are relevant to particular policies and management interventions. For example the tracking of fuel S at Ferrybridge power station was relevant to policy-based limits on S in oil and on 15-minute ambient SO_2. Similarly the above example for Hillingdon is relevant to compliance with the EU NO_2 Directive, and to UK negotiations with EU for derogations (more time) to achieve compliance. As explained in Section 2.1, we will choose case studies that are particularly relevant to live AQ issues and policy concerns.

4. OUTCOMES & SUCCESS MEASURES

Good Knowledge Transfer should make a positive and lasting difference to the targeted users; here we explain the difference we will make and how our success will become apparent.

4.1 Outcomes

Our overall aim is to change the status of methods for source-performance analysis with ambient air-quality data from being (a) methods only used occasionally in the research base, to (b) methods used routinely by practitioners to track policies, to target controls and to streamline planning. It is important to be realistic about what can be achieved in a 3-year study, and to identify priorities. In our view, the first objective is to establish the advantages of better data exploitation in the minds of users and policymakers – so they are driven to adopt such better analyses because of their practical benefits. Using selected prominent case studies, like Ferrybridge for power stations and Hillingdon for road traffic, we will change awareness and expectations so that ambient source-performance analysis is used commonly in appropriate situations. We will choose case studies that engage major groups within the operator community (e.g. power companies, transport planners, landfill operators, intensive livestock farmers), within environmental/professional bodies (e.g. EPuk, IAQM, ADMLC), and within government (e.g. EA, Defra, LAs).

We believe that once the demand for source-performance analysis has been established in this way, the supply of specialist software/services to meet the demand will develop via the usual commercial routes. We foresee that some users may have facilities/skills to design and implement their own analyses, but more often the work will be shared between specialists and general air-quality practitioners. We will encourage feedback between novel analysis methods and other assessment techniques. In particular, we expect our methods to affect how some monitoring networks are designed (e.g. modified to maximise relevant performance signals) and to give new insights into model performance (e.g. into how well models reproduce normalised ambient source signals). We believe that our methods are not only applicable to UK, but can be disseminated more widely through interactions with European Agencies e.g. European Environment Agency.

4.2 Success measures

In line with above anticipated outcomes, we expect the success of our KT study to be evident from 12 measures:

(a) Practitioners are aware of the source-performance analysis methods and of how they can use/benefit from them.
(b) Compelling examples of effective analyses are available for major sectors e.g. power, traffic, landfills, agriculture.
(c) Examples and underlying methods are consolidated/explained in easy-to-understand/access documentation.
(d) Professional institutions and trade associations endorse/expect source-performance analyses in relevant cases.
(e) Users are aware of key analysis stages e.g. reconnaissance, temporal/spatial mapping, normalisation.
(f) Users take "ownership" of methods/applications by helping to select/manage case studies & by positive feedback.
(g) Software/services for source-performance analysis are being developed through normal commercial channels.
(h) Source-performance analysis methods are routinely included in air-quality management and planning proposals.
(i) New monitors and existing networks are designed/reviewed to maximise source performance signals.
(j) Source-performance analysis methods have been promulgated via workshops, conferences, peer-reviewed papers.
(k) Methods are starting to be embedded in "best practice" guides and formal regulatory procedures.
(l) Uptake of methods is extending into Europe & being applied to new AQ strategies like "Exposure Reduction".