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FACILITATING RESPONSIBLE USE OF MODELLING IN IMPLEMENTATION OF EU AIR QUALITY DIRECTIVES - AN EU PERSPECTIVE

Andrej Kobe

DG Environment, European Commission

Abstract: The last few years had seen an expansion of modelling use in support to the implementation of EU air quality implementation. Serious abatement efforts are still needed as the significant proportion of all zones in EU still exceed the PM10 and nitrogen dioxide limit values and the new Directive 2008/50/EC provides for additional time to comply under conditions. Models provide information on assessment and source apportionment, and underpin projections that inform air quality planning and time extension notifications. Exchange on their use is important to steer initiatives such as FAIRMODE, GMES, and development of air quality reporting, to ensure modelling provides best possible implementation support.

Key words: *air quality, modelling, implementing provisions, FAIRMODE, GMES, 2008/50/EC*

INTRODUCTION

The Commission in 2005 adopted the Thematic Strategy on Air Pollution (the Strategy). The Strategy sets interim objectives for improvement of human health and environment through improvement of air quality up to year 2020. It points to fine particles PM2.5 as the most important culprits for health impacts, as they currently contribute to more than 350.000 premature deaths annually in Europe. In the Strategy the most important sources and their abatement potential have been identified and need for specific measures outlined, including EU measures such as energy efficiency action plan, vehicle emission standards EURO 5/6 & EURO VI, the revision of IPPC, NEC directive, and addressing shipping and aviation at the international level.

The Commission has jointly with the Strategy proposed a new Directive 2008/50/EC on ambient air quality and cleaner air for Europe that will in June this year also formally replace the Framework Directive 96/62/EC and the first three daughter directives. It includes new $PM_{2.5}$ environmental standards and introduces requirement for an overhaul of the reporting system.

Concentrations for some of the most important pollutants have levelled off or are even in the increase in the past 10 years. The limit values for particulate matter PM10, to be attained already by 2005, are still exceeded in almost a third of all zones in the EU. The similar exceedance situation is expected for nitrogen dioxide NO_2 with the attainment date this year. Reasons are complex and span across different spatial scales, from the inability to resolve local street-canyon hot spot situations to increasing hemispheric contributions. Some of the underlying reasons are discussed in the chapter on modelling challenges as they importantly influence the ability of models to support AQ planning.

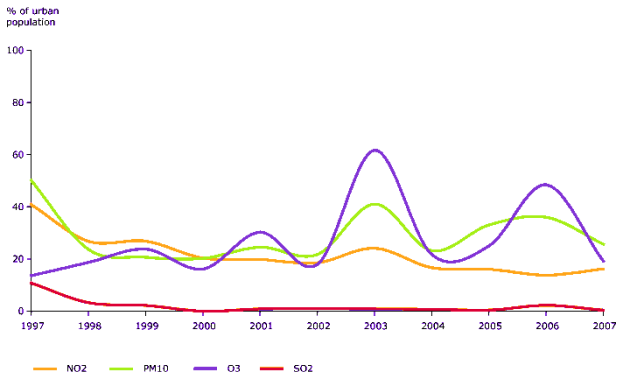

Figure 1. The percentage of urban population exposed to concentrations exceeding EU air quality limit values. Source : EEA.

The new Directive provides for flexibility to address compliance with PM_{10} and NO_2 limit values, based on tight conditions which include introduction of further abatement measures and the assessment of the air quality plan by the Commission. Over 20 Member States had used the possibility and the Commission has until now assessed AQ plans for over 320 zones. Practically all had used modelling in at least one phase of problem definition and resolution.

In parallel, FAIRMODE is by now in full swing, and the FP7 MACC project is developing pre-operational GMES atmosphere core services by the next year; many products are already available. They include AQ modelling and forecasting on the regional scale and support model nesting but also more complex downstream services such as inverse emission modelling. There had been recent calls for supporting 'downstream' services and projects such as PASODOBLE has just been launched.

MODELLING AND ITS CHALLENGES IN AQ IMPLEMENTATION

The ambient air quality assessment and management are becoming increasingly dependent on modelling. In assessment, modelling supports optimization of measurement network, provides more comprehensive spatial information and delivers

additional information in understanding of the contributing sources of pollution. The required assessment regime has not been fundamentally altered by the new Directive, but introduced some new provisions such as one on the modelling uncertainty. As provisions by themselves do not guarantee that modelling is either easily or correctly applied, the Commission (DG Environment and DG JRC) jointly with the European Environment Agency (EEA) launched FAIRMODE, a forum for modellers and model users under EU AQ legislation implementation (http://fairmode.ew.eea.europa.eu/). Within the two years FAIRMODE has managed to develop a number of actions, in particular the development of Guidance on the use of models and initiation of the platform for model benchmarking. It has also established itself as the principal overarching activity promoting innovation and inclusion of research and international cooperation (such as AQMEII) in the model application under EU AQ legislation. More will be presented in the dedicated FAIRMODE session. Guidance is currently in final evaluation by the WG on Implementation of the Directive 2008/50/EC AQ committee and is becoming part of the pack of guidance documents supporting the new Directive. The guidance is expected to mature in the next years through its use and evaluation, so feedback to the authors is strongly encouraged.

It is now commonly accepted that modelling is a very useful tool that can be used on equal terms to support air quality assessment and demonstration of compliance. Validation of models by actual measurement, even by dedicated monitoring sites is thus an important assessment activity. Guidance is providing some recommendations in this respect, but more are expected from the FAIRMODE in due course.

The models are starting to play an important role also as supporting tool in demonstration of contributions from natural sources or winter sanding and salting, as the Directive 2008/50/EC provides for accounting these contributions in the demonstration of compliance and in gauging the ambition level of the AQ plans. Specific guidance documents have been developed and are expected to be published by the Commission after their presentation to the AQ committee in June 2010. Identification of such specific conditions must still be strongly underpinned by measurements (comparison of measured PM levels in times of natural events, PM composition to evidence presence of salt etc.), however the models provide information on spatial distribution and support the necessary source apportionment.

MACC project (http://www.gmes-atmosphere.eu/) as the principal activity delivering GMES Atmosphere core services in a pre-operational manner, is making a number of products already available at its website. Inclusionary approach such as the adoption of ensemble modelling platform, ability to react fast in exceptional situations (example of the Iceland volcanic eruption) and openness to address EU initiatives (such as INSPIRE) and user input in a well defined manner has proven its high potential to develop in the well accepted and useful EU service.

There is strength in the diversity of models as it increases robustness and promotes innovation. FAIRMODE fosters such diversity for the maximum benefit of the users while supporting responsible use by promotion of common benchmarking and recommendations regarding transferability of models between different areas. On the other hand, use of some commonly accepted products at EU level would increase comparability and effectiveness of modelling at all scales. It will be an important role of the modelling community to critically assess GMES Atmosphere products to ensure that they can become such as source. The critical appraisal should not extend only to the quality of the products, but should be able to assess the complete production chain from the inputs such as emission inventories and measurement data (remote and in-situ), through modelling, validation and data assimilation to the product data and metadata.

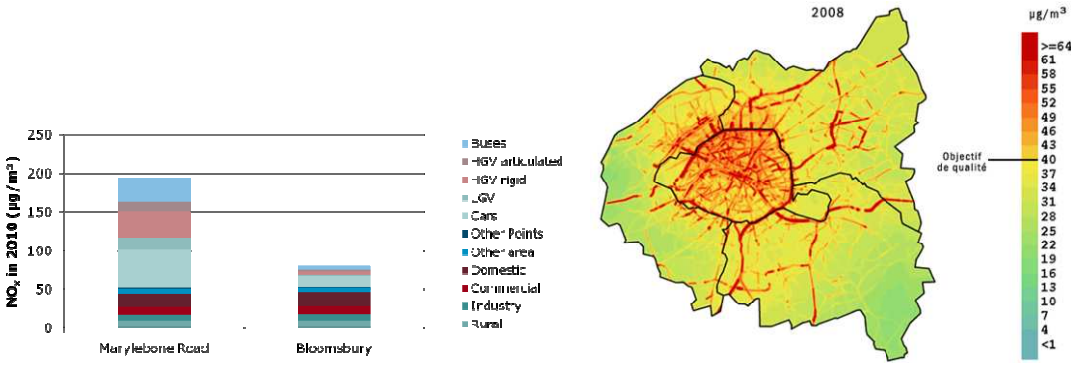

Figure 2. Example of modelling support to the AQ management. Source appotionment in London at two different locations (Source: DEFRA AQEG 2004), and modelling of NO_2 annual average in Paris. Source : airparif.

Perhaps even more than in the AQ concentration levels model results, the strengths and weaknesses of models are exposed in their support to the AQ management as shown in Figure 2. As the low lying fruit in terms of pollution abatement measures have mainly been picked, modelling is becoming the essential air quality management tool to find further cost-efficient abatement solutions. Source apportionment determined through modelling may be critically dependent on input data and assumptions such as fleet composition and emission coefficients. Perhaps the most striking recent example, with very important policy consequences, are the re-evaluated real life emissions from the EURO standard vehicles as seen in Figure 3.

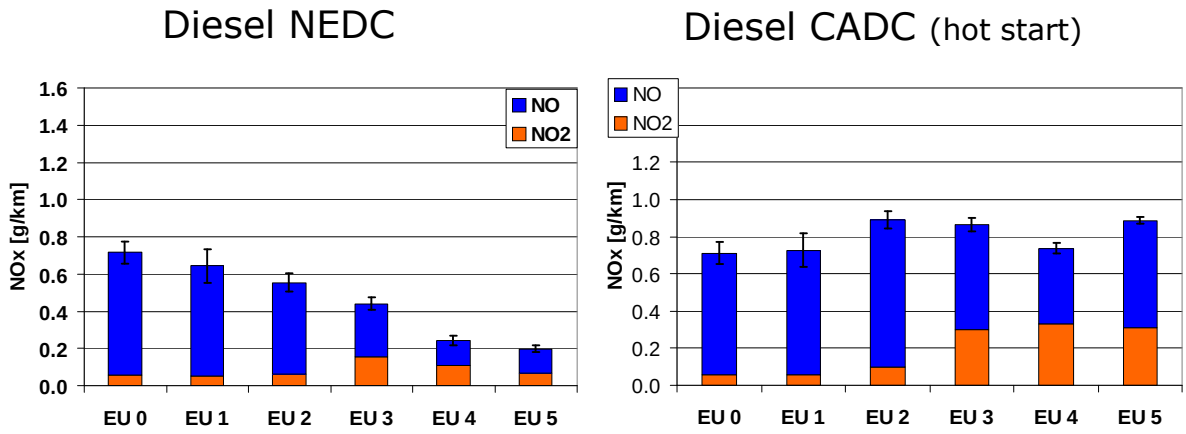

Figure 3. Demonstration of importance of the test cycle on the estimated emissions of the vehicles. NEDC is the official EURO type approval cycle, while the CADC is the test cycle closer to the real-life emissions in urban driving. Note: only very few EURO 5 vehicles have been tested under CADC test cycle. Source: S. Hausberger, TU Graz, presentation at EC NO2 workshop April 2010, Brussels.

When the information provided by NEDC figure (on the left) enters into the AQ projection as assumption for the performance of the changing vehicle fleet, the modelled future may look much brighter than it actually is. This may skew the focus on the actual abatement needed and delay implementation of perhaps more difficult and lenghty, but at least effective structural measures that would address the activity.

The time extension exercise has provided a unique opportunity to collect, in a structured way, information on the AQ plans with all essential information on concentration levels, source apportionment, projections and measures. Comprehensive information on the exercise, the complete notifications and all subsequent Commission decisions (in EN and in the language of the addressed Member state), and in particular the database which includes all information provided by the Member states through the notification Forms, is available at
http://ec.europa.eu/environment/air/quality/legislation/time_extensions.htm.

IMPLEMENTING PROVISIONS ON REPORTING

The Directive 2008/50/EC announced the revision of the reporting provisions to take into account the adoption of the INSPIRE Directive 2007/3/EC and related initiatives such as the Shared Environment Information System (SEIS). The revision is also the opportunity to facilitate exchange of modelling information. Due to various reasons the development has been slow, but in April 2010 a comprehensive proposal has been prepared by the European Commission. It is currently discussed in the Data Exchange Group (DEG) and will be presented in detail in the upcoming June AQ committee under Directive 2008/50/EC. The proposal takes due account of the different roles models play in AQ implementation. Proposal also provides specific reference to near real time exchange and the compilations at the EU level which can be of significant importance to the modellers.

Outline of the new scheme will be presented at the meeting.

CONCLUSIONS

Modelling is an integral part of implementation under EU AQ directives. A number of initiatives are in progress to facilitate its use and to provide EU modelling and model-support products for common use. On the other hand, consistent difficulties to address issues such as PM mass closure, or the challenges to correctly project evolution of concentration levels of 'simpler' pollutants such as NO_2 remind us that the research and development work is far from over. Critical dependencies on the inputs such as emission coefficients and their underlying assumptions (real life emissions, primary emissions) indicate that constant vigilance and validation are required to ensure that the models perform as expected, and also for correct reasons.

In 2013 the revision of AQ Directive is expected to take place. Based on the FAIRMODE input and the availability of the operation services at EU level, the Commission will make a detailed review whether AQ assessment requirements should be modified to reflect better the modelling state-of-the-art. By that time, it is very important that modellers and model users actively contribute within FAIRMODE and provide feedback on the experiences with the implementation using the developed guidance or the pre-operational GMES products.

Information on the AQ Directives, policy documents and initiatives mentioned in the text can be found at http://ec.europa.eu/environment/air/index_en.htm.