EC4MACS workshop – 8-9 March 2012, Paris

Modelling the contribution of local/national/regional sources to the exceedances of air quality limit values

Minutes of the meeting

Introduction

The wide-spread exceedances of the air quality limit values for PM10 and NO2 in many Member States are a critical issue in the forthcoming revision of the Thematic Strategy on Air Pollution. It will be important to identify the major reasons that led to non-attainment and to assess to what extent further measures – at different scales – could contribute to compliance with the limit values. It is clear that not only near-by sources contribute to observed concentrations of air pollutants at a specific location, but that significant shares originate also from more distant sources outside of cities, in other countries and for some pollutants even from other continents. Moreover complex chemical mechanisms and the intrinsic physic-chemical properties of the precursors can make source allocation even more complex.

Within the EC4MACs project (www.ec4macs.eu) funded by the EU-LIFE program, an approach to simulate European air pollutant concentration fields with improved accuracy over the urban areas has been developed to support Integrated assessment modeling tools, and especially the GAINS model. To present and discuss furthermore this methodology and to review other approaches developed in Europe, INERIS, IIASA and JRC organized the 8th and 9th March 2012, a workshop, hosted by INERIS in Paris.

The aims of this workshop were:
1. To present the new EC4MACS methodology to calculate urban increments and decrement regional model results correction.
2. To get the opportunity to discuss the current abilities of models to quantify the linkages between urban air quality and long-range transboundary pollution, and review the state of the art in Europe
3. To agree on a working plan to improve and disseminate the methodology and other national approaches relevant for a better qualification of factors influencing situations where limits values are exceeded.

About 50 experts and national representatives of the Member States attended the workshop. Experts from the European Commission participated to this workshop as well. The first day was dedicated to the presentation of the EC4MACS new methodology developed by INERIS, IIASA and the JRC. This approach is proposed as an improved alternative to the former "City-Delta" approach (2007). Focus is accorded to situations where the regulatory limit values for PM10 and NO_2 are exceeded. Results and models issued from current research EU and national projects were also presented by national experts. The second day was mainly dedicated to discussions related to the implementation of the new methodology in the GAINS model, its evaluation in various European cities, and on the possible options to improve the approach thanks to national experience, models and data.

Frederik Neuwhal, from the European Commission, introduced the main issues that need to be covered with respect with the Air quality Directives. There are still too many non compliance areas in Europe for PM10 and NO2 limit values (annual averages and daily and hourly averages respectively). National and local action plans should be elaborated in order to limit geographical areas and population exposed to such exceedances. The integrated modeling approach should accounts for those strategies that apply at various geographical scales.

Presentation of the EC4MACS results

a. Bertrand Bessagnet (INERIS), Philippe Thunis (JRC) and Gregor Kiesewetter (IIASA) presented the new methodology developed within EC4MACS to compute urban increments for PM10 and NO2.

b. At the city level, urban increments for PM10 concentrations can be derived from high resolution runs (7km) realized for the whole of Europe with the CHIMERE model. INERIS improved significantly CHIMERE, a chemistry-transport model fitted to simulate air pollutant concentration fields at the regional scale: refinement of the vertical resolution, correction of meteorological parameters (Kz, wind speed) over city areas, adjustment of emission heights and SNAP2 emission time profiles. Meteorological fields chosen by INERIS to process the runs were issued from the ECMWF/IFS system. The emission inventory resulted from the TNO high resolution inventory developed for the MACC project, mixed with EMEP totals and some sources being spatially reallocated.

c. Running the year 2009, reasonably good results were obtained for PM10, PM2.5, and inorganic compounds. Significant improvement of the high resolution model results over city areas compared to the coarse resolution results was demonstrated as well. The JRC processed the results to evaluate them in a rigorous way (following the FAIRMODE methodology). The results were commented in the presentation. Some questions remained for NO2 simulations and some inconsistencies, potentially due to the emission inventory were highlighted (Poland, Portugal…). Therefore the 7km resolutions simulations can be used to calculate over the city areas urban increments proportional to low-level traffic and residential emissions, to correct 50km resolution runs.

d. The approach is definitively not appropriate to catch traffic sites situations where NO2 limit values are exceeded.

e. To deal with high NO2 concentrations at traffic sites that hold all over Europe, a hybrid approach, based on observations from the AirBase data base and a box model that simply solves the NOx/ozone chemistry equations, is proposed. A relationship between NO2 concentrations at traffic sites and NOx concentrations depending on emissions, site parameters and background air pollutant concentrations was established. Such a simple model could explain more than 80% of the non background stations with recurrent exceedances.

f. Markus Amann (IIASA) finally synthesized the obtained results and the EC4MACS methodology to address urban and local scales for PM10 and NO2 respectively.

National approaches and other initiatives

Experts from several countries presented their work to simulate regional to local air pollution with the objective of assessing air pollution action plans for compliance checking with the AQD.

a. Stjin Janssen (Belgium) presented a regional to street level coupling approach to simulate NO2 and PM concentrations in various Belgium cities;

b. Martin Williams (UK) presented the nested approach based on a chain of models implemented over London to simulate street level NO2 concentrations;

c. Katarzyna Juda-Rezler (Poland) presented current projects related to source-apportionnement studies;

d. Ari Karppinen (Finland) presented Finnish tools developed to assess exposure to air quality. They rely on a chain of regional to local models. Specific work on sea salts, forest fire emissions, road resuspension and ship emissions modeling was presented as well;

e. Rafael Borge (Spain) presented the nested system that run over the Madrid area to assess the efficiency of various emission control strategies;

f. Ana Isabel Miranda (Portugal) presented a specific model study over Porto to assess the impact of a large number of emission control measures to reduce PM10 concentrations;

g. Gabriele Zannini (Italy) presented the MINNI nested modeling system linked to GAINS Italy;

h. Myrto Valari (France) presented a new approach to correct regional scale simulations with local contribution from road and heating sectors;

i. Martjin Schaap (Netherlands) presented results from source apportionment studies realized for the Netherlands to assess the relative responsibilities of national and foreign activity sectors to air pollution.

Experts involved in several EU projects reported on some initiatives that can be relevant and with possible links with the EC4MACS project:

a. John Douros (Greece) reported on some results of the FP7 MEGAPOLI project related to the development of a simple model to calculate urban increments

b. Guido Pirovano (Italy) presented the PSAT module developed in the CAMx system for source apportionment studies

c. Bruce Denby (Norway) reported some results on exposure assessment issued from the FP7 TRANSPHORM project related to the impact of transports on air pollution and health

d. Sarah Honour and Martin Williams (UK) presented the DEFRA model intercomparison exercise focused on regional to local air quality modeling tools likely to be used in the UK for compliance checking;

e. Bruce Denby the FAIRMODE joint EC/EEA/JRC initiative to frame the use of air pollution models for reporting according to the AQD

f. Julio Lumbreras (Spain) reported on the FAIRMODE activity dedicated to local emission inventory issues.

Question and lessons learnt from the presentations

a. Various approaches are developed in the Member States to model the contributions of regional, national and local sources to air quality and especially to catch situations where limit values are exceeded. **Only some cities are investigated by national systems, but an overall approach consistent for all cities in Europe does not exist**. Note that this analysis can be hampered by various frameworks in the member states: the modeling teams can be mandated by national or local authorities or do some studies by their own within research projects. In that sense the EC4MACS project can bring interesting insights with a European-wide approach.

b. The key issue whatever the approach is **emission inventory**. Dealing with local scale models makes sense only if reliable emission inventories can be used. Several EU countries have developed their own high resolution emission inventory (in several cases with a 1km*1km resolution), but it is not clear whether consistency with official emissions reported to the UNECE is ensured in all cases. This point relates to the well-known debate between top/down versus bottom/up approaches which is not closed. **However, for studies focused on compliance checking with the AQD, it is essential to use the best available spatialised emission data**. At this stage those have not been compiled throughout the Europe in a unique dataset and it is difficult to get an overview of the available data.

c. **Road resuspension is a key issue without any clear answer so far**. However, its role in the occurrence of PM10 exceedances is certainly very significant and more work is needed to better account for that phenomenon.

d. Source apportionment studies are conducted in several member states to assess the most efficient emission control strategies, and if possible, to quantify their impact. They can be based on "zero-out" sectors modeling, or on more sophisticated mathematical approaches. They should develop in the coming years to support policy compliance.

e. Several questions relied on the generalization of the EC4MACS methods to various city typologies, and on how to integrate them in the GAINS model. In particular **consistency with the EMEP source/receptor matrices** implemented in GAINS

should be carefully considered. Finally **how the methods behave to simulate the impact of emission reduction strategy** still needs to be investigated. Those points are main objectives of current developments in the EC4MACS projects.

Follow-up and next steps

a. **The workshop gave the opportunity to review data and tools available to go a step forward in the development and the evaluation of an appropriate approach for accounting for AQD compliance issues in integrated assessment modeling**. The EC4MACS project gives the opportunity to establish in a rather simple way and homogeneously across Europe, local scale contributions in GAINS.

b. **Next step needs to focus on a limited number of cities and scenarios for assessing the EC4MACS and national models responses to emission reduction strategies**. This should help in the validation and the improvement of the methodology, building up a community of national experts ready to provide feedback and recommendations for its implementation in GAINS. Nevertheless, constraints are high: no funding is available and results are expected by the end of the year 2012.

c. **A "tour de table" allowed the review of material in terms of emission data and city air quality assessments**, available to elaborate on this objective. However if most of the participants expressed their interest for the exercise, they mentioned their concerns to re-run modeling systems for new scenario analyses. This is perfectly understandable considering funding and time constraints. In-depth review of available information was recommended:

- UK: extensive studies available for London. High resolution emission inventories over the UK and the city available.
- Czech Republic: Prague already involved in several project. High resolution emission inventories over the Czech Republic and the city available.
- Italy: huge amount of data especially for Milan and the Pô valley for which a high resolution emission inventory is available. Scenario analyses will be conducted in the OPENAIR Interreg project.
- Germany: several projects in the country and Berlin is very active and did a lot for the evaluation of air quality action plans.
- Netherlands: national high resolution emission and concentration maps are produced with zooms over several cities. Rotterdam is particularly active. Source apportionment results can be provided.
- Sweden: cities develop their own emission inventories and several model studies exist, in particular with Stockholm. Contact can be established to gather information.
- Finland: cities 'authorities are responsible for action plans and get some relevant information. Contact with them should be established.
- Spain: available studies on Madrid can be used and available emission data throughout the country as well.
- Romania: a national emission inventory is available for in-depth analyses.

- Poland: existing emission data can be interested for the study but their availability should be checked.
- France: high resolution emission and concentration maps are produced at the national and city scales. National data are available and city scale information can be gathered.
- Croatia: High resolution national emission inventory is available
- Several EU initiatives like the TRANSPHORM, PASODOBLE or the EEA "Pilot cities study" must be carefully considered because they are likely to bring some interesting material for quantitative air quality for policy answers.

d. **Short term work plan** :
- Literature review of what has been done so far in EU countries and cities to assess air quality and the impact of action plans. Analysis of results in terms of exceedances of the limit values gaps, heterogeneities and strategies is expected. This task will be addressed by the JRC (Contact point: Kees Cuvelier kees.cuvelier@jrc.it).
- Collection of emission data. Participants are invited to facilitate access to national and local emission inventory data. Obviously high heterogeneity of data sources and methodologies to elaborate spatialized inventories will limit the integration work. However opportunities to derive a better European-wide emission inventory with national data should be investigated. This is a huge amount of work and feedback from the national expert is quickly expected to frame the work and set the priorities. This task will be addressed by INERIS (contact point: Bertrand Bessagnet: Bertrand.bessagnet@ineris.fr).
- Scenario study: based on the literature review a limited number of scenarios can be defined to conceive a probabilistic approach. The expected answer is the likelihood that a given geographical area complies with the AQ objective under some emission assumptions. The EC4MACS methodologies will be run for a selected set of cities and scenarios already studied by national experts. How these modeled results need to be combined for this probabilistic approach will be investigated by the EC4MACS partners and proposed to national experts in a next step.