FAIRMODE Technical meeting
Zagreb (Croatia) 27-29/06/2016

The meeting was attended by 78 participants from 24 EU Member States and was held in parallel working group sessions (see Agenda). The summary below is structured according to these WG sessions. A series of sessions shared between WGs has been organized as well. A summary of their outcome is provided in the second part of these minutes.

• WG1: Assessment

WG1 was attended in average by 30-35 participants.

○ Guidance on Model Quality Objectives (MQO) & Benchmarking

The guidance document on MQO and benchmarking updated (V2.0) as a follow-up of the CEN WG TC264/43 is available on the Fairmode web site. It includes a revised formulation of the MQO as well as updated interpretations. It also includes the revised MQO parameters for long-term PM and O3 concentration averages. All updates were summarized by P. Thunis during the meeting. This guidance is intended as a living document, with the expectation that remaining issues will progressively be solved during technical meetings and be promoted to the "mature" part of the guidance document, while new issues will emerge with time. Presentations focused on the comparison of the "old" and revised formulations and associated parameters as well as on the remaining open issues. Presentations in this session included feedback from J. Horalek for the ETC, P. Durka for Poland, Cristina Guerreiro and G. Sousa Santos from Norway, A. Monteiro for Portugal and J. Wesseling for the Netherlands. A proposal by A. Monteiro for a joint peer-reviewed publication on the MQO formulation and best practice has been discussed and agreed upon.

○ Composite mapping exercise

A presentation related to the update of the composite mapping platform has been presented by S. Janssen. The platform has now been improved by (a) adding monitoring Airbase data on top of the air quality modeled maps, (b) extending it to emission data and (c) accounting for all new (since Baveno) participants upload. The two first features have been made available as prototype to stimulate the discussion. Small working groups have been organized in terms of EU regions (north, west…) to study the map with the aim of identifying possible causes for the inconsistencies. Among others, emissions and data-assimilation techniques were pointed out as points requiring more attention. Although meant as a longer-term objective, the links with e-reporting have been stressed as these maps can be a useful support to the drafting of guidance document to support e-reporting. This map is intended to be regularly updated to provide a view of the state of the art in terms of air quality assessment.

Spatial representativeness

With a view of harmonization in this field, an inter-comparison (IE) exercise of different spatial representativeness methods of Air Quality Monitoring Stations (AQMS) has been launched as a joined effort within FAIRMODE and AQUILA. After a presentation of the common dataset (based on the city of Antwerp) which has been distributed to all participants in June, the discussion focused on the methodology to compare the results. During the meeting, the objectives of the IE have been slightly amended, in particular:

- Determination of the area of representativeness for additional stations (Borgerhout-Straatkant, Antwerpen-Linkeroever, Schoten as well as 8 additional virtual stations.
- As participants showed their interest for the methodology used to classify stations, the comparison of the classification for the 8 virtual stations will also be performed as part of the IE.

It has been agreed that all participants shall report their estimated area of spatial representativeness with quantitative values (area in km2) and that the areas shall be identified with shape files or raster files. The population density and standard deviations of pollutant values within the area of representativeness shall be computed and reported as well. Even for qualitative methods, quantitative values shall be provided for comparison purposes. A template to report the results will be circulated.

The deadline to submit results has been set to end October 2016 with possibilities to postpone to end of November on request.

Interest for the conclusions of the IE goes beyond the IE participants. The attendance proposed in particular the development of guidelines to (1) highlight the improvements to be expected when increasing the input data supplied to the methods of determination of SR, but also to (2) stress the associated additional costs.

Forecasting

This activity aims at providing a specific assessment of air quality forecasts. Indicators have been developed to provide additional information about the capability of the forecasting system to detect/anticipate regulatory threshold exceedances and to check its ability to provide more accurate forecasts than a persistence model. Following up the Aveiro technical meeting a concrete proposal has been made and a series of presentations focused on the evaluation of this approach. Among the many indicators proposed for testing, only a few will be kept for further evaluation and the guidance document will be simplified accordingly.

Calculation of exceedance indicators

A number of exceedance indicators have to be officially reported by member states. However, a clear need for a more harmonized approach was illustrated by S. Nordmann based on a few German cases. In order to better understand the problem, a few WG1 participants (J. Stocker, A. Piersanti and H. Olesen, J. Horalek) presented how the indicators are currently estimated in the UK, Italy, Denmark and Czech

Republic. The discussion made clear that the topic is very relevant for FAIRMODE and very much links to the ongoing discussion about the appropriate spatial scale of the assessment method.

Work-plan 2017-2019

WG1 will further support the ongoing CEN work to elaborate a standard for the Modelling Quality Objective. The major "open issues" which are currently described in the Guidance Document will be further discussed to find consensus within the community.

WG1 will support the e-Reporting process for all aspects related to assessment methodologies. Ongoing discussions such as estimation of exceedances or model's fitness-for-purpose will be key topics for discussion.

The three Cross Cutting Activities *Spatial Representativeness*, *Forecasting* and *Monitoring & Modelling* have mainly focused on assessment aspects so far. It should be discussed whether the activities remain cross cutting to all working groups or become part of the WG1 activities.

The Composite Mapping exercise has demonstrated to trigger interesting discussions that touch the core of the WG1 activities. The exercise will be continued and elaborated to serve as a catalyst for WG1 work.

WG2: Emissions

WG2 was attended in average by 10-15 participants

During this technical meeting, the topics to focus on were (1) the guidance on best practices to compile traffic emissions and (2) benchmarking. The latter included discussions related to (a) training, with a separate training session organized to support the use of the emission benchmarking tool (b) conclusions on the use of the tool and the comparison of bottom up versus top-down inventories and (c) to the opportunity of extending the current air quality composite mapping exercise to emissions. The latter topic is not reported here but in cooperation with WG1, as part of the common sessions.

Guidance on best practices in urban traffic emission compilation

This part of the work in WG2 focuses on the compilation of good practices for urban emission compilation. The current work focuses on mobile exhaust sources and includes the identification of best available data sources and methods, identification of methodologies to understand emission processes and the comparison of emission factors. An on-line questionnaire was sent to WG2 participants prior to the FAIRMODE technical meeting with the objective of gathering their experiences on the methodologies that they currently use for determining urban traffic exhaust emissions. Answers from a total of 16 participants, representing more than 30 cities from 13 different EU countries, were presented and discussed by M. Guevara during this first session. The combination of traffic models with automatic traffic recorders, manual counting and use of instrumented vehicles was identified as the main current approach used in European cities to collect traffic volume and speed data. Concerning vehicle fleet composition, official registration data is the most common source of information, although the use of Automatic Number Plate Recognition Systems is gaining ground. Regarding the Emission Factor models, the results obtained confirm that COPERT and HBEFA are currently the leading EU models. Nevertheless, a significant amount of participants indicated that measurement based corrections (PEMS, RSD) are applied to these models to reduce their associated uncertainty. The use of Floating Car Data (FCD) technology is still limited and challenging due to several reasons, including: (i) need for infrastructure to process the data and (ii) privacy concerns (access to information is restricted and involves multiple sources including private companies). Presentations in this session included also the discussion of best practices applied to other emission sectors such as residential biomass burning (S. López-Aparicio) and shipping (A. Karppinen). In both presentations, further attention was given to the use of crowdsourcing methods and GPS data to determine atmospheric emissions.

Training

A training session was organized to support the interpretation of the bar and diamond diagram plots (A. Clappier, M. Guevara). Each participant had to answer a set of multiple choice questions based on the results obtained from a case study. The session was organised as part of the WG2 agenda and competed with other group sessions. The attendance to this session was disappointingly low, despite the fact that in the discussions the next day when sharing experiences with the benchmarking emission tool, it was recognized that most participants in the group need guidance to understand the results of the diamond diagrams. This triggered a discussion about the organization of parallel sessions and the need for a revision of the channels used for training FAIRMODE participants.

Urban Emission Benchmarking

One of the main objectives of WG2 for the current period 2014-2016 is to develop, test and document a benchmarking tool for emission data. During this technical meeting, participant experiences were presented and discussed for the following cities: Oslo, Stavanger and Bergen (S. López-Aparicio), Stockholm (K. Eneroth), Athens (V. Assimakopoulos), Madrid and London (M. Vedrenne). The experiences focused on the learning from the emission benchmarking comparison of urban scale inventories versus regional scale inventories. Based on the analysis of these cities a series of key issues

have been identified providing feedback from local urban knowledge to regional scale inventories. It was discussed that generally current regional top down inventories (used for regulatory purposes) need to pay special attention to

- re-suspension processes that are generally not included in top-down inventories,
- residential combustion emissions where practices and proxies cannot be extrapolated from one country/region to another the way current regional inventories usually do
- Mobile sources where a finer spatial and sectoral disaggregation is needed in particular with respect to fuel use and vehicle fleet classification.

Also the bottom-up urban scale inventories profited from the comparison with regional top-down inventories: in many cases identifying inconsistencies or missing sources. For the sector "other mobile sources" the comparison showed that many urban scale inventories need to add finer sectoral disaggregation to the sources in this sector.

The discussion included also a presentation of benchmarking results comparing the different existing regional scale inventories in Europe (M. Trombetti). The comparison highlighted recurrent problems in the industry and residential sectors. In particular, for industrial emissions there are identified problems with the inventories of diffuse emissions from small combustion plants. These sectors were identified as priority areas for future work in WG2.

Work-plan 2017-2019

WG2 will further provide local emission knowledge to the compilation of urban, regional, national and European emission inventories to support air quality assessments and the elaboration of national plans and program under EU legislation. Recommendations for work plan priorities are:

- Promotion of best practices, in particular for re-suspension processes and with further focus on the following sectors: Residential combustion and Wood burning; Small combustion and industry; Agriculture
- Enhanced use of benchmarking for the evaluation of local inventories and the comparison of these versus regional and/or European wide inventories, documenting how increased understanding of the results from these comparisons using the Δ-emission benchmarking tool allows relevant feedback to improve both urban, regional and European emission inventories
- Initialization of a composite emission mapping exercise, with the inclusion of diamond diagrams as quality control and emission information to help interpreting Chemical-transport models results and differences between countries, also providing feedback to national EU wide inventories.
- Extended dissemination and communication of results, to involve more groups in the work of WG2. For training, it was recommended to consider bilateral group communication (through Skype meetings), to consider a YouTube video for training on how to use the tool, to upload training presentations on how to interpret the results from the tool and to introduce Training sessions with presentations in the FAIRMODE Technical meetings : In addition to publication of main methods and results, it is further recommended to promote participation at relevant

meetings from EEA, GEIA, EMEP (TFEIP and TFIAM) and CAMS to show the capabilities of the FAIRMODE emission evaluation approach.

The main goals of these activities is that WG2 local knowledge on emission information will (in time) add to a complete Europe wide composite map and provide relevant feedback to improve TD inventories from EMEP (regulatory), TFIAM (EC4MACS) and CAMS (TNO-MACC).

• WG3: Source apportionment

WG3 was attended by an average of 25-30 participants

○ Inter-comparison exercise (IE)

The preliminary results of the first inter-comparison exercise (IE) for receptor models (RM) and chemical transport models (CTM) were presented by C. Belis. The inter-comparison was launched in July 2015 and involved 40 teams (33 RMs and 7 CTMs).

The main objective of the IE was to assess the performance and the uncertainty of the source apportionment (SA) methodologies and to compare different approaches. In addition, the IE was an opportunity to gain an indirect measure of the overall output uncertainty and to obtain more robust SA results (ensemble) of the studied areas.

The SA results were evaluated using the methodology developed in the framework of WG3, comparing the results among RMs, among CTMs and across the two types of models. In order to have a common definition of the sources, the source categories of the database SPECIEUROPE were used as a reference.

D. Mooibroeck, D. Salameh and I. El Haddad presented sensitivity tests and enhanced constrained RM approaches used for this IE and in other projects. G. Pirovano, J. Ferreira and G. Calori illustrated the CTM runs and sensitivity tests carried out for the current IE.

Both RMs and CTMs presented good performances when evaluated using their respective reference values. Both types of models demonstrated quite satisfactory capabilities to estimate the yearly source contributions while the estimation of the source contributions at the daily level was more critical. CTMs showed a tendency to yield lower contribution for some specific sources, such as soil and exhaust, when compared to RMs. Additional sensitivity tests made it possible to identify the influence of different vertical mixing and spatial resolution approaches on the SA performance of CTM.

The results of this study are relevant for CEN WG 44 because they demonstrate that the source apportionment assessment methodology developed by the JRC is applicable to any kind of SA model application.

The unprecedented database created with the inter-comparison requires further analysis to extract more detailed information about the factors that affect the SA models' performance. Further technical work is needed, including:

- data pre-treatment, uncertainty estimation and use of constraints for RMs;

- multi-receptor analysis, tagged species vs. brute force method comparison, space and time resolution, vertical dispersion, processes for the formation of secondary organics, more detailed chemical source profiles, preliminary evaluation of source regions contributions for CTM.

Guidelines and DELTASA tool

The IE is also an essential building block for the development of new SA guidance. As decided in the previous meeting (Aveiro), next step will be to develop a new section of the SA guidance focusing on the CTM SA applications. In addition, the existing version of the guidance dedicated to RM will be updated to account for the most recent developments in this field. A drafting group was proposed for the development the new version of the SA guidelines: M. Mircea (ENEA), O. Favez (INERIS), G. Calori (ARIANET), I. El Haddad (PSI).

The JRC presented the recently developed "Delta Source Apportionment tool". It is an on-line interface that enables users to autonomously test the performance of SA model applications using the same testing methodologies and the reference datasets used in the inter-comparisons. DeltaSA opens the door for a continuous benchmarking service for new methods or approaches and for training of users with limited experience. A group of experts volunteered to test the tool: D. Salameh (LGGE/INERIS), Z. Kertész (INR-HAS) and E. Venturini (Univ. Bologna).

A. Pietrodangelo presented the progress in the activity of the CEN WG44 group on SA.

Work-plan 2017-2019

The following topics were given priority for the future activity of the WG:

- Development of the new release of the SA guidelines
- Further technical work on the factors that influence SA models' performance (see section 3)
- Training activities on the SA guidelines and the use of DeltaSA
- Development of a tool and guidelines to support MS for a better and harmonized reporting of SA data
- Collaboration with CEN TC264 WG44 on the development of model performance technical specification/standard for source apportionment.
- Evaluate the feasibility of a SA modelling exercise focusing on the geographical origin of pollutants to better quantify local and regional contributions as well as long range transport and transnational contributions.

WG4: Planning

During this technical meeting, the WG4 sessions were mostly organized in plenary or in parallel with WG3.

SHERPA

SHERPA is a screening tool developed by the JRC aiming at supporting the design and assessment of air quality plans. It can also be a useful tool to support the harmonization of modelling approaches, especially with respect to scenario analysis (WG4), source apportionment (WG3) or emission inventories (WG2). This is why a plenary session was organized to provide an introduction to this approach to all participants. A specific practice session dedicated more specifically to the WG4 participants followed this overall introduction to the tool. Small working groups were created and each produced a scale-dependent source apportionment report over their own region to get acquainted with the SHERPA tool.

Work-plan 2017-2019

Within WG4 but also during the WG3-WG4 common sessions, SHERPA has been identified as a valuable tool to help in the design of air quality plans but also to support the comparison of CTM models in scenario mode. On the other hand, validating the SHERPA approach is also essential to strengthen our confidence in the tool. Consequently, the following points have been prioritized for the future activities in WG4:

- Provide guidance for source apportionment and planning applications based on SHERPA current and future versions.
- Include an additional module in SHERPA to provide automatic e-Report facilities for any European regions.
- Use SHERPA to compare models in scenario mode, with a particular focus on the comparison of bottom-up approaches (provided for different European regions) with top- down approaches (provided for all Europe by INERIS and/or EMEP).
- Validate the SHERPA approach with detailed source apportionment measurements.
- Contribute to the JRC abatement measures database in terms of (1) quantification of the impacts of measures on air quality levels and (2) harmonization in the way measures are reported, ideally with the support of pilot cities.

Common sessions

E-reporting, source apportionment and SHERPA (WG3 & WG4)

The aim of this session was to assess how SHERPA might be useful for e-reporting, especially with respect to planning and source apportionment as requested by the current e-reporting scheme. After a brief overview regarding the e-reporting requirements in terms of source apportionment and planning, the discussion focused on the possible SHERPA developments needed to support e-reporting. Several points were addressed among which the need to report for all locations where exceedances are reported, the time averages to be considered (yearly vs. seasonal vs. episodes). It was stressed that SHERPA was not able yet to work at the local scale (street), a development planned for the coming years. In general, there was a great interest in building an “automatic” reporting facility in SHERPA to support Member States with the e-reporting process. The issue of validating the SHERPA results with source apportionment measurements has been addressed in the “Source apportionment and planning” session (see below).

Composite mapping: towards emission mapping (WG1 & WG2)

A joint session between WG1 and WG2 on the composite mapping exercise has been organized to investigate the added value of extending it to emissions to complement the ongoing one on air quality. Despite the fact that this emission exercise would not allow identifying the main causes of divergence between inventories (because the underlying spatial proxies would not be available), this extension has been seen as a positive step as it will help understanding the differences seen in terms of concentrations and also provide an overview of the state of the art regarding local vs. EU wide inventories in Europe. Similarly to the air quality exercise where the longer term intention is to associate a "quality stamp" (target diagram) to each air quality map, the addition of a similar stamp (diamond diagram) to the emission map has been discussed. Several gridded emission inventories are already available and will be uploaded in the coming months.

Source apportionment and planning (WG3 & WG4)

The session was opened with two presentations to summarize the most relevant recent activities of the two groups: the results of the SA inter-comparison (WG3) and the connections between the methodologies used for planning and for source apportionment. The discussion that followed clarified that the two approaches are similar but put the accent on different aspects of the interactions between emission sources and air concentrations, particularly:

- WG3 outcomes can support SHERPA in providing more robust SA and scenario evaluation; for example:
    - Evaluating the role and behavior of main sources over regions as well as at specific receptors
    - Evaluating mean contribution as well as the temporal evolution of the different SA estimates
    - Cross-comparing different species, sources and receptors along time
    - Investigating the influence of model performance on SA
    - Linking dispersion and chemical transformation processes to SA
- Source apportionment provides a snapshot of the actual situation and can support SHERPA users in designing the most effective air quality scenarios;
- Air quality scenarios need then to be evaluated and ranked by SHERPA; finally the best ones should be thoroughly evaluated by a full CTM.

In order to test the allocation of sources produced with SHERPA, validation with independent SA output is needed (mainly RM and also different CTM approaches). However, collection of new large datasets of measures would be too expensive and time consuming. For that reason, taking advantage of existing databases like the one of the SA inter-comparison and the one used for the Paris Megapolis study are most feasible alternatives. For the latest study the database and publications are available (O. Favez). In addition, joint work with the TFMM planned activities including collection of data in urban and background areas was also proposed.

The list of abatement measures to be considered for air quality plans was also discussed in this common session. A shortened database including the more effective measures with their corresponding efficiency as well as information gathered by Member States that have applied such measures would be of interest**.** It was agreed that FAIRMODE would contribute to this database and further develop the current air quality measures JRC database based on https://luft.umweltbundesamt.at/measures.