FAIRMODE Technical meeting
Athens (Greece) 19-22/06/2017

The meeting, attended by 70 participants, was organised around parallel (WG) and common sessions (see Agenda at the end of these minutes). This document summarizes first the outcome of the common sessions before detailing the outcome of the parallel sessions. All presentations are available on the FAIRMODE web pages.

Common sessions

Composite mapping (WG1 and WG2)

S. Janssen presented an update of the composite mapping platform. From now on, the composite mapping exercise contains a concentration as well as an emission part. The new release, opened a couple of weeks before the technical meeting, includes (1) monitoring Airbase data on top of the air quality modeled maps; (2) top-down (EMEP, JRC…) and bottom-up emission inventory data for a few cities/regions and (3) a quality control tool both for emission and concentrations, to be used prior to the uploading process.

New assessment maps have been uploaded by several groups for the new target year 2015 or have been updated for the original year 2012. These maps are updated regularly to provide a view of the state of the art in terms of air quality assessment. Although the preferred years are 2012 and 2015, other years can be accommodated by the system as well. All pilot regions/cities/countries (see below for details) have been asked to upload their emission and assessment maps in the platform as a first step of the exercise.

Regarding the new emission platform, WG2 hold a specific hands-on session dedicated to the quality control tool and to the uploading process of the gridded emission maps. A first analysis and comparison between bottom-up emissions and the new EMEP0.1x0.1 gridded emissions was performed, with several inconsistencies being spotted. More detailed information on how the spatial mapping of the EMEP0.1x0.1 gridded emissions is performed (which is not currently included in the Informative Inventory Reports, IIR) is needed in order to better assess the differences between results. The pros and cons of changing the current SNAP nomenclature used in all the FAIRMODE Emission tools to the GNFR14 reporting system used by EMEP0.1x0.1 were discussed. The initial conclusion was to focus the analysis on the sectors for which the comparison between SNAP and GNFR14 is straightforward (on-road transport and residential combustion), proposing no changes in reporting of emission in FAIRMODE (for now). Potential functionalities to facilitate the comparison between gridded inventories (e.g. cross section line, curtain effect, visualization of absolute emissions for a selected polygon) were discussed and planned to be included in future versions of the platform.

SHERPA validation and user's feedback (WG2, WG3 and WG4)

SHERPA is a screening tool developed by the JRC with the aim of supporting the design and assessment of air quality plans. It is also used to harmonize modelling approaches within FAIRMODE, especially with respect to scenario analysis (WG4), source apportionment (WG3) and/or emission inventories (WG2).

The aim of the SHERPA session was to discuss SHERPA applications on the basis of user's feedbacks. Thee SHERPA applications were presented: E. Pisoni showed an application in the frame of the Urban Partnership on Air quality; Fernando Martin presented the experience of applying SHERPA for Spain and Madrid region and, finally, Alexandra Monteiro showed how SHERPA is useful to support the Portuguese air quality plan. A discussion about how SHERPA could be promoted and ideas to proceed with a mailing list and users group were shared. The paradox situation of having a large number of registered SHERPA users but few feedbacks was also discussed.

Given its increased use for policy support, the validation of SHERPA is crucial. For instance, a functionality of SHERPA to support e-reporting was developed. P. Thunis reminded the need to separate the evaluation of SHERPA on one side from the validation of the underlying CTM (CHIMERE in this case), itself depending on different input datasets (meteorology, emissions…). Several options to achieve these tasks were discussed. The robustness of the SHERPA simplified approach can be increased by extending the evaluation process to other CTMs while the robustness of the CTM models in planning mode can be assessed by comparing available air quality plan scenarios with SHERPA results. Both options will be followed in WG4. The possibility of testing SHERPA in the source apportionment inter-comparison exercise (SA_IE) has been discussed as well. Although the input data of the SA_IE differ from the SHERPA setting, it remains an interesting exercise to test the overall behavior of SHERPA/CHIMERE. WG3 will take care of this evaluation.

Source apportionment and planning (All WGs)

A. Clappier introduced the connections between air quality planning and source apportionment. Source apportionment techniques (receptor models, CTMs with tagged species approach) are often used with the purpose of supporting air quality planning while methodologies used for planning (e.g. sensitivity studies, also known as brute-force approach) are sometimes used for source apportionment purpose. A. Clappier highlighted the issues that can potentially limit the use of one methodology for a different purpose than initially designed for (e.g. receptor models or tagged species approach in CTMs for planning purpose or sensitivity studies for source apportionment purposes). These issues are related to possible non-linearities that may occur for secondary pollutants, especially during episodic events. WG3 and WG4 will work on better delineating the range of conditions under which source apportionment can be used for planning purpose and vice-versa. An approach combining source apportionment and planning sensitivity tests will probably be required under specific conditions.

Towards methodologies for spatial source apportionment (WG3 & WG4)

This session aimed at exploring possible options to provide information on the geographical origin of pollution. P. Thunis presented a study comparing different approaches to estimate the contribution of urban sources to the pollution in the same cities. The study concludes that the contribution of the rural background in cities cannot be properly estimated from measurements (so called Lenshow approach). In

addition, the influence of the portion of the city and the distance of the selected receptor on the estimation of the contribution from urban sources was discussed. G. Pirovano presented an example of estimation of the contributions from geographic areas and activity sectors in the city of Milan using a tagged species approach (CAMx/PSAT). On the other hand, S. Vratolis illustrated an example of combined use of receptor models and analysis of trajectories with FLEXPART to estimate the probability of geographic areas to contribute to specific sources at a given receptor site. E. Diapouli explained how PMF can be used to assess the variability of emission source profiles within and between cities. The preliminary conclusion of the session was that an inter-comparison of different methods to estimate the geographical origin of pollution would be beneficial for a better understanding and cross check of these methods with a view to support e-reporting and more in general air quality planning. In the next months WG3 will discuss the feasibility of such inter-comparison that could be designed either as a follow up of the previous CTMs – RMs exercise or a as new case study.

Towards a practical implementation of the pilot exercise (WG5 +All WGs)

The new WG on air quality management practices at the local and regional scales (WG5) started its activities during this technical meeting. The main objective of this activity is to ensure that the FAIRMODE methodologies and guidance are applied in practice at all levels, from national to regional and urban. Nine regions/cities/countries (Zagreb/Croatia; Dublin/Ireland; Milan; Emilia-Romagna; Malopolska; Stockholm; Athens, Helsinki, Slovenia, Germany (TBC)) joined the pilot so far. These Pilots presented shortly their experience in terms of air quality modelling (including with the FAIRMODE tools and methodologies) but also their expectations regarding the Pilot exercise.

Given the large number of Pilots and their diversity in terms of experience with the FAIRMODE tools, it was decided that all pilot groups will proceed through the different WGs in a synchronized way, with the benefit of fostering exchanges among pilots. Because emissions are the first key input in the modelling chain, all pilots will start with the WG2 benchmarking activities.

Regarding the time-frame, the cycle through the four WGs will be performed within a period of 2 years, with the third year being devoted to synthesis.

Towards FAIRMODE recommendations

As in the roadmap, the FAIRMODE strategy follows a chronological three steps process: benchmarking, guidance and training. To strengthen the FAIRMODE support to policy, a proposal was discussed to structure the guidance step around the following questions: (1) what is the purpose of my modelling application? (2) is my modelling approach fit for this purpose? (3) Do I apply my modelling approach in the proper way (e.g. resolution) and (4) are my results of sufficient quality for policy support? During this session, the WG chairs presented possible topics that FAIRMODE could do regarding these specific questions.

In WG1, the Air Quality Directive (AQD) requires Member States (MS) to provide information on the length of the road or on the population exposed to concentrations above the limit values. The discussion focused on the possible recommendations FAIRMODE could propose regarding the adequate methodology to retrieve this information (some MS currently use modelling at 2m resolution!), but also

on the purpose (exposure or compliance checking), which has direct implications in terms of modelling cost and in view of a possible application of the approach to all MS.

In WG2, the development and spatial mapping of emission inventories are classified in terms of their complexity, expressed as a tier hierarchy (from simple Tier 1 to complex tier 3 approaches). Recommendations regarding the use of the adequate tier approach for specific modelling applications (e.g. urban scale) was discussed.

In WG3 were reminded the recommendations for e-reporting published in 2016 which are of general application for all source apportionment studies (http://fairmode.jrc.ec.europa.eu/document/fairmode/Fairmode%20recommendations%20e_reporting_final.pdf). Moreover, a number of recommendations derived from the lessons learned in the inter-comparison exercise (see the WG 3 section at the end of the document).

In WG4, the discussion followed the outcome of the common session on "source apportionment and planning" and focused on possible recommendations regarding the use of source apportionment methodologies for planning purpose.

WG1: Assessment

Guidance on Model Quality Objectives (MQO) & links to CEN TC264/WG43

This guidance document 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 formulation of model quality indicators for high percentiles and exceedances (J. Stocker and J. Horalek) and on the use of model quality indicators in the case of limited availability of measurement (G. Santos and J. Kushta). A. Karppinen provided a status of the CEN WG43 activities.

Spatial representativeness

The assessment of the spatial representativeness of air quality monitoring stations is an important subject that is linked to several highly topical areas, including risk assessment and population exposure, the design of monitoring networks, model development, model evaluation and data assimilation. With a view of harmonization in this field, the recently concluded inter-comparison exercise (IE_SR) on the spatial representativeness (SR) of air quality monitoring sites provided an excellent opportunity for the exchange of knowledge on this subject, which was organized in the form of a 1.5 day workshop.

O. Kracht (JRC) presented an evaluation of the outcomes of the IE_SR, which included a detailed quantitative assessment from the results point of view, and a first assessment from the methodological point of view. As a consequence of the absence of a 'true value' for the reference of the SR results, the intercomparison needed to measure 'consistency' rather than 'correctness'. This was demonstrated by using quantitative indicators for mutual similarities that had been summarized in different map views & cross tabulations.

The results of the IE revealed a large variation of the SR estimates – not only in terms of the extent and position of the SR areas, but also in the technical procedures and the extent of input data used. The revelation of these discrepancies triggered of lot of interest from the participants and opened a very insightful and constructive discussion. On the basis of the IE_SR, participants were able to efficiently exchange background information in a detailed way. This was supported by individual presentations of 11 participating teams. In the course of the workshop the major factors triggering and controlling the observed spread of the results have then been identified (basic principles of the methods, effective use of different types of input data, parameterization of the similarity criteria and thresholds, underlying conceptualizations and definitions of SR).

The participants agreed that the discrepancies observed in this exercise require further efforts towards the quantitative definition of the concept of "the area of representativeness" and in eliminating unnecessary differences in the methodologies. Discussion then focused on the need for a paradigm shift in the SR definition. It crystalized that even if different purposes of estimating SR might cause some conflict of goals, there is a substantial need for a higher transparency and a better comparability of SR estimates. It was agreed that for its next (mid-term) objectives the group should be working towards creating a set of guidelines and guidance for determining of the area of representativeness. O. Kracht pointed out that this objective requires first establishing a common framework for SR definitions and SR similarity criteria, and for harmonizing the related terminologies. In terms of immediate actions, the JRC will finalize overview statistics about sundry parameters not yet evaluated (population, mean concentration, concentration standard deviation within the SR areas) and perform a final consolidation of the reported shape-files. From the methodological point of view, matrix tables for summarizing data & methods will be updated by JRC and then amended and counterchecked by all participating teams. The list of the files that have been used from the dataset by each individual team will be compiled. JRC will prepare an Excel template to be completed by all IE participants. Participants will update and harmonize the methodological description files. During the workshop a set of obligatory slides has been used to summarize different key characteristics of the individual methods. These obligatory slides shall be updated and harmonized to then be included in the final reporting.

All IE_SR participants have been asked to prepare a short statement with their conclusions drawn from the exercise results and workshop discussions, including comments and suggestions. O. Kracht will provide a first draft summary in order to streamline this process.

Forecasting

This activity aims at providing a specific assessment of modelled air quality forecasts. Performance 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. Minor improvements have been suggested (J. Stocker, P. Durka) to the current model quality indicators and their treatment in the Delta tool. The proposal of B. Maiheu to use a probabilistic approach to smooth the transition between exceedance and non-exceedance received consensus and will be implemented in the next version of DELTA (foreseen by September 2017). The guidance document sections regarding the forecast QA/QC will be updated to reflect the outcome of the discussions.

Exceedance and fit for purpose modelling

A number of exceedance indicators have to be officially reported by member states (e.g. length of street exposed to concentrations above limit values). The discussion made clear that the topic is very relevant for FAIRMODE and very much linked to the ongoing discussion about the appropriate spatial scale of the assessment method. To gain more insight, spatial variation in a number of monitoring data sets was examined. Especially for NO_2 in an urban environment spatial variations take place at the order of a few meters up to tens of meter. However, (static or home address) exposure of an urban population seems to be less sensitive to these high spatial variabilities since they disappear in the averaging process. Spatial scales in the order of 100m up to a few hundred meter seem to be relevant. Based on these findings, the purpose of the exceedance modelling was questioned: compliance checking vs health impact assessment. At present, an AQD indicator like "length of street exposed to concentrations above limit values" seems not very relevant from an health perspective. However FAIRMODE recognizes that more discussion is needed with the health community to better understand their approach to exposure modelling (static versus dynamic exposure) and their requirements for concentration assessment.

Sensors

L. Malherbe, J. Stocker and A. Karppinen presented case studies where synergy was created between sensors and model applications. Sensors can be used to provide additional information in the assessment process but model applications can also be used as benchmark for (lower quality) sensor data. It was agreed that FAIRMODE has a role to play in this new emerging field of sensors.

• WG2: Emissions

Benchmarking

Three regions/cities/countries (Slovenia; Malopolska; Stockholm) that joined the pilot exercise gave a presentation addressing the following questions: (i) What is in their view the most important emission topic in their city? (ii) What are the main constraints of information? and (iii) How can WG2 FAIRMODE support them? In all three cases, one of the main issues was the significant contribution of residential combustion emissions on PM air quality levels and the high level of uncertainty linked with the estimation of these emissions. The use of the WG2 benchmarking tools (Delta-Emission tool and the new composite mapping platform) was suggested as a first step in order to perform a screening of the current emission inventories and detection of anomalies. The methods presented in the Guidance session may as well be used as a source of inspiration and guide for possible improvements of the current methods used.

Guidance on emission compilation methods

Several WG2 participants shared their knowledge, methods and experience related to the development and benchmarking of urban and regional emission inventories. The presentations showed the importance of choosing process related emission compilation indicators when compiling emissions in fine scale. Residential combustion was identified again as a sector with high uncertainties, that deserves further attention from FAIRMODE.

S. López-Aparicio presented an alternative approach to estimate and distribute national traffic emissions at high spatial resolution using already calculated CO2 emissions as ancillary data. The results obtained are consistent with other traffic inventories developed using bottom-up approaches and subsequently the methodology proposed appears to be a promising method as it represents better the emission processes than other widely used physical ancillary data (e.g. digitalised road traffic maps).

A. Monteiro summarised several works that are currently being performed to improve the emission inventory over Portugal. Wood combustion at the district level disaggregated by wood specie and type of equipment are combined with specific PM emission factors measured in laboratories for the estimation of residential combustion emissions, the new approach allocates less emissions in urban core areas when compared to the traditional method of using population density as a spatial proxy. For the disaggregation of those industrial emissions that cannot be linked to a specific large point source, the industrial land use category reported by CORINE Land Cover was replaced by a National land cover, increasing the surface related to this type of land use.

F. Kyriaki-Maria presented the results of the development of a high resolution anthropogenic and biogenic emission inventory for Greece and the Greater Athens Area for the period 2006-2012. The results of the inter-annual variation of emissions clearly reflected that for some sectors such as residential combustion strong variations may occur from one year to the next due to meteorological (e.g. temperatures) and economical (e.g. European recession) factors.

P. Thunis showed the results of a spatial inter-comparison of several European top-down emission inventories. The regional and sectoral allocation of each inventory for 11 different cities and 3 pollutant sectors (i.e. residential combustion, industry and on-road transport) were compared and the levels of uncertainty for each case were estimated. The largest inconsistencies arise in the industry and residential sectors, especially for Eastern cities/regions, with an uncertainty up to 100%. The large differences observed are city specific and can therefore not be treated systematically but rather through the calibration of country-specific patterns of emissions.

P. Durka presented the main conclusions from on-going work carried out in Krakow, Poland comparing bottom-up and top-down emission inventories. The Top-Down emission inventory is a downscaling of the EMEP emission gridded data in 0.5x0.5 derived for Krakow from the JRC Krakow integrated project 2005. The Bottom-Up inventory for the same city is the one derived from the LIFE IP project and is still under validation. The initial comparison of the two inventories shows significant inconsistencies, specially concerning residential heating emissions where an unknown fraction of the emission flux seems to be due to waste burning in domestic furnaces in winter. The discussion after the presentation recommended to proceed with the study of the differences between these two inventories with the help of the FAIRMODE WG2 emission benchmarking tool and FAIRMODE inter-comparison procedures.

L. Tarrasón presented a new methodology for estimating residential combustion emissions in Oslo using dwelling density and their heating source as a spatial proxy, combined with updated wood combustion statistics obtained from local surveys. Despite using a very detailed methodology, when applying the resulting emissions for air quality modelling, simulated PM concentrations were highly overestimated

compared to observed values. A general scaling factor of 1/3 had to be applied to the emissions in order to reduce the gap between observations and model. This result highlights that improvements, or the use of apparently more detailed data, on the emission data cannot automatically be translated in less uncertainty on air quality results, especially when dealing with complex pollutant sectors such as residential combustion.

Finally, M. Guevara showed the importance of using appropriate and validated traffic emission factors when developing and applying air quality tools for air quality planning. The replacement of the MOBILE6.2-Mexico traffic emission model by MOVES-Mexico (calibrated using remote sensing devices) in Mexico City implied a significant reduction of NOx and VOC traffic emissions, but also an increase of O3 peak concentrations in the urban core region. Characterisation of real-world vehicle emission rates using on road measurements is needed in order to improve the estimation of traffic emissions in urban areas.

• WG3: Source apportionment

Inter-comparison exercise (IE)

The final results of the inter-comparison exercise (IE) for receptor models (RM) and chemical transport models (CTM) that involved 40 teams (33 RMs and 7 CTMs) were presented by C. Belis and G.Pirovano.

All models showed better performances in estimating the average source contribution for longer time windows (representing warm and cold seasons) than the contributions for single time steps (time series) suggesting higher uncertainties in the attribution of sources for short term periods (days to weeks). This is likely due to the influence of non-linear processes. RMs presented comparable results among participants which are also coherent with the measured PM. In this type of models a better definition of certain source categories such as Industry is needed. The inter-comparison showed the importance of capacity building, as more experienced practitioners tend to have better performance. In CTM no geographic pattern was observed in terms of performance. When using the tagged species approach as reference, differences in performance were observed with the brute force approach, especially in sources which emissions undergo secondary processes, likely due to the influence of non-linear relationships on the brute-force contribution estimates (as discussed in the joint session source apportionment-planning, see above). The comparison with RMs showed that CTMs tend to provide lower contributions likely due to the underestimation of the PM mass. The estimated contributions of soil and road dust provided by CTMs are underestimated when compared with RMs while those of traffic and industry were rather comparable.

Guidelines, CEN, local scale models and SPECIEUROPE

G. Pirovano presented on behalf of M. Mircea the progress made in the development of the new source apportionment Guidelines. Many teams contributed to the survey on the source apportionment studies carried out since 2014. More than one hundred studies with RMs, ten with source oriented models and two studies combining both approaches were reported. The structure of the guidelines and the general

lines for the preparation of the chapters were agreed. The next step is to complete the distribution of the chapters among experts with a view to receive the drafts by September / October 2017.

C. Belis presented the progress made in CEN WG44 on source apportionment. The technical specification was revised thoroughly and work needed to validate it was drafted. A discussion about the practical implementation of the TS methodology and the need to extend the range of tested methodologies is in progress.

S. Nordmann and B. Mahieu presented examples of application of different types of local scale models for the quantification of pollution sources with particular reference to hot spot areas. Such models are common practice in Germany to calculate the “local increment” in order to report the contribution of sources to the Commission/EEA. During the session were presented examples from Germany and Belgium. Considering that local scale models (e.g. Gaussian, box, street canyon) are commonly used for air quality management purposes, the WG3 concluded that it would be important to carry out technical work to harmonise their application.

C. Belis announced the release of a new version of SPECIEUROPE with ca. 80 new chemical profiles available at: http://source-apportionment.jrc.ec.europa.eu/