FAIRMODE CONTRIBUTION TO THE E-REPORTING IMPLEMENTATION

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1. Introduction

On 1st January 2014 entered into force the Commission Implementing Decision 2011/850/EU of 12 December 2011 which introduced a new mechanism for mutual exchange of information and reporting on ambient air quality, so called "e-reporting". The new implementing provisions for reporting (IPR) reorganise the mechanism member states (MS) used to transfer the information collected under the implementation of the air quality directives (2008/50/EC and 2004/107/EC) to the Commission. In addition, it gave the European Environmental Agency (EEA) the task of developing and maintaining the respective data repository.

The annex I of the IPR defines data requirements, environmental objectives and metrics while the annex II contains a detailed list of the information to be reported arranged in flows identified with letters from A to K. An important novelty introduced by the IPR is the specification of mandatory information about source apportionment and air quality plans and programmes (flows H to K).

Even though models can substantially contribute to the assessment of air quality, only few MS report modelled data to the Commission. Modelling could complement monitoring to increase the spatial and temporal resolution and opening the opportunity for a more efficient use of resources and savings. By the end of 2013, the development of the e-reporting system was quite advanced for the measured data while the data flows regarding modelling were still under construction. At that time, one of the main areas to be defined was the description of the meta-data code lists. FAIRMODE, as a European community dealing with harmonisation of air quality modelling, was considered the most suitable partner to provide recommendations on: a) common quality standards to be met by models in order to be used in e-reporting (assessment) and b) discuss which type of common framework would be necessary to adequately describe models and, modelled data (e.g. by means of the model documenting system, MDS). Moreover, FAIRMODE was also in the position to provide advice about the new data flows (H-K) concerning "plans and programmes" on the basis of the knowledge developed under the groups working on source apportionment and planning. In order to promote the communication among the relevant communities, it was decided to invite FAIRMODE representatives to participate in the e-reporting sessions of the Pilot Project meetings. The EEA was in charge for specifying the input they would need from FAIRMODE to support the definition of minimum requirements for modelled data.

The work carried out under FAIRMODE to provide advice to the e-reporting process consisted in three main activities:

a) to carry out a survey among FAIRMODE national contact points (NCPs) to investigate what are the limiting factors for MS to report modelled data,

b) to create an "ad hoc" task force to answer the questions submitted by EEA about model formats and model code lists,

c) to provide advice and support the implementation of data flows (H-K) in collaboration with the JRC (plans and programs reporting tool developer) and report the comments from European experts about source apportionment section of the IPR.

2. Survey on e-reporting

Following preliminary discussions with DG Environment and the EEA, the issue of reporting model data was included in the 2014-2016 FAIRMODE road map:

"A longstanding open issue is the use of model output in formal reporting by Member States. As a matter of fact, many regions and member states are using models in their day -to-day air quality management activities, but apparently only very few of them actually use those results in the formal reporting procedures at the EU-level. FAIRMODE will explore current practices to understand the objections and obstructions in this process. Based on those findings, recommendations can be drafted to stimulate the use of models for air quality management and the formal reporting."

In order to obtain information about the limitations found by MS to report modelled data, FAIRMODE carried out a survey by distributing a questionnaire to the FAIRMODE national contact points (NCPs). To that end, MS currently not including modelled data in their official reporting were asked to indicate their agreement/non-agreement with the following proposed reasons and MS currently including modelled data in their official reporting were asked to indicate which of the following factors was more problematic at that moment:

1 Lack of technical capacity

2 Insufficient reliability of models

3 Too expensive and/or time consuming

4 Brings too little added value

5 Lack of clear and common guidelines

6 Limitations of administrative kind

7 Lack of clarity in legislation

In order to simplify answering the questions and summarising the overall results, multiple choice answers ranging from "strong agreement" to "strong disagreement" were proposed. In addition, facultative comments were possible.

Fifteen MS delivered their answers (PL, NL, PT, CZ, FI, EL, HU, LT, UK, HR, AT, SE, BE, IE, FR)

<u>Summary of the answers</u>

1. Most of the answers expressed the opinion that the little added value of models was not a problem for reporting.

2. There was a general agreement on the lack of clarity in the legislation and the lack of clear guidelines as a limiting factor for reporting.

3. For the other proposed motivations the NCPs expressed different opinions:

a). the majority of the answers did not consider the reliability of models an issue;

b). many answers agreed that common guidelines are missing;

c). a wide range of opinions were expressed about the impact of administrative limitations, the lack of technical capacity and the resources (costs, staff, time) required for modelling.

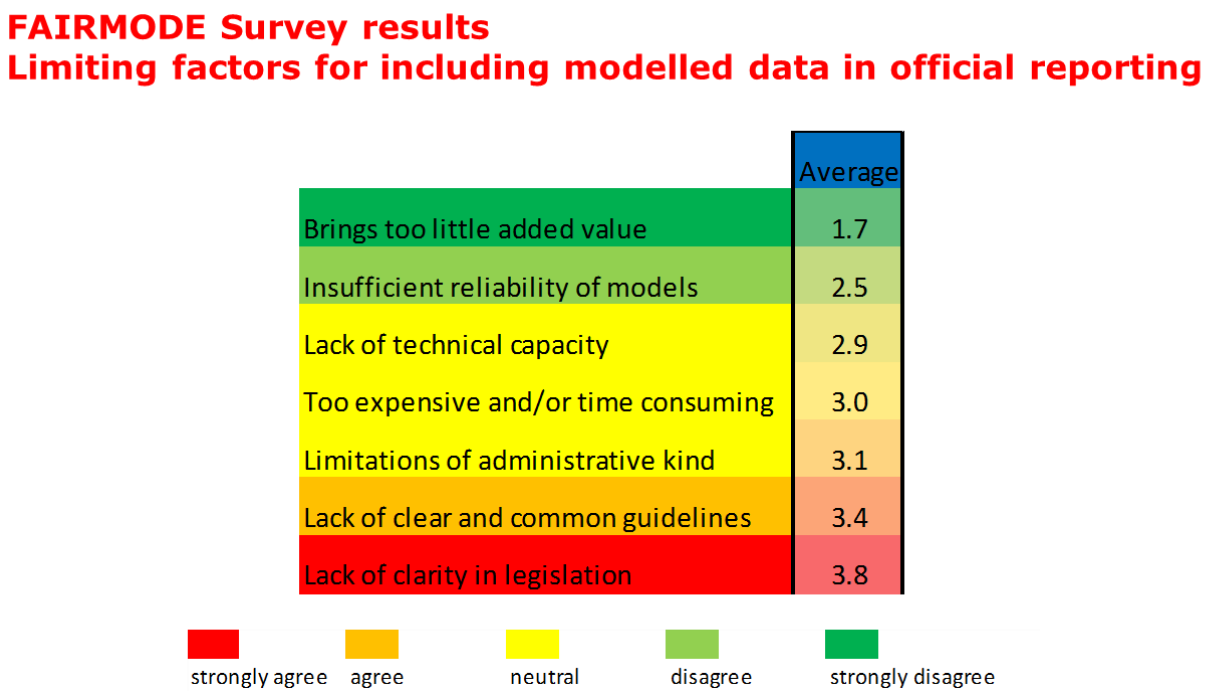


Figure 1. Average of the answers obtained by attributing a value from 1 to 5 to answers ranging from strongly disagree to strongly agree.

In figure 1 are summarised the averages for every option obtained by attributing a value from 1 to 5 to answers ranging from strongly disagree to strongly agree. The statements at the top and the bottom of the list were those with the highest consensus (green or red). The answers in the middle of the list (yellow) were those where opinions most diverged. More details about the answers and comments to each question are reported in Annex 1.

The conclusions of this survey are that there is a general agreement about the added value of models even though more clear rules are needed. FAIRMODE can certainly contribute to the development of technical guidelines and can provide recommendations for the future development of the legislation.

3. FAIRMODE's technical input for e-reporting

The FAIRMODE community has been asked to contribute to the data model of AQ e-Reporting by answering a number of specific questions formulated by EEA in Spring 2014 (update in June 2014). The detailed answers, their context and some background information is added in Annex 2.

A group of FAIRMODE voluntary experts provided input for the response over Summer 2014:

Jenny Stocker (UK), Malgorzata Paciorek (PL), Laure Malherbe (FR), Fernando Martin (ES), Alexandra Monteiro (PT), Hans Backström (SE), Cristina Guerreiro (NO), John Stedman (UK)

A summary of the answers was compiled by the FAIRMODE Steering Group (S. Janssen & C. Belis)

The SG summary was distributed to the National Contact Points to have a final feed-back in October 2014.

The FAIRMODE answers are summarised below:

1) **Feedback on the scope of the model parameterisation code list**

Code list compiled by the EEA (http://dd.eionet.europa.eu/vocabulary/aq/modelparameter) is a good starting point but more aspects should be included and the list could be organised according to specific topics:

- Model type (Eulerian, Lagrangian, Gaussian plume…)
- Model characteristics (advection, convection, turbulence, deposition, chemical schemes…)
- Model input (meteo, emissions, topography, boundary conditions…)
- Model application (assessment of AQ concentrations, assessment of population exposure, source apportionment…)

For the combined use of modelling and monitoring data via Kriging or data assimilation, the methodology used and monitoring data used should be added.

Space for "free-text" descriptions should be allowed.

2) **Feedback on the scope of the modelling meta-data profile**

Model meta data profile as proposed by the EEA is in general OK. However, the requirement for the IPR dataflow E1b (primary modelled results) to report hourly data everywhere is too strict and should be modified (some models only provide annual averages).

Some applications calculate both concentrations on a grid and on many receptor points (typically located along major roads), is it possible to report both types of results simultaneously?

3) **Feedback on 'data quality report' element**

Data quality objectives are a way to ensure that the model is fit for purpose. FAIRMODE's Model Quality Objective and Benchmarking procedure is more and more used as a reference tool to evaluate modelling results in the framework of the AQD.

There is a clear need to further develop the model benchmarking system in FAIRMODE and guidance on how to perform the modelled data quality testing and reporting. There is ongoing work in FAIRMODE about this issue.

It is considered difficult to calculate a value for model uncertainty suitable for inclusion in dataflow E.

4) **Feedback on your preferred file formats**

The output file formats mainly used by the modelling community are ASCII style, netCDF or Shapefile. netCDF seems to be the format which is most widely accepted and preferred.

GML is flexible, open and supports mixed forms of geographic objects. However, it is not considered as an appropriate format for data reporting. GML is not practical for gridded data and the files are large and slow to use and transfer.

Most of the MS do not have modelled data available as a web services.

5) Feedback on common projection and a common projection grid

A common projection for modelling applications is in principle no problem via recalculation of coordinates.

FAIRMODE does not recommend a common projection grid because of the following potential problems/questions:

- choice of the modelling grid depends on many aspects and a common grid cannot be imposed to modellers for their calculations,
- which grid would be suitable for which spatial scale?
- which interpolation method should be selected?
- what is the risk of impairing the quality of the results?
- risk of wrongly comparing modelling data obtained at different scales.

A detailed version of the answers that were submitted to the EEA is available in Annex 2. In January 2015, the EEA (Gsella et al.) presented their comments to the FAIRMODE answers (Annex 3). The need of additional code lists was underlined taking into consideration the FAIRMODE proposals. Flexibility was expressed about the temporal resolution in the E1b values and there was agreement about the use of FAIRMODE's Model Quality Objective and Benchmarking procedure for harmonization of the model evaluation. After an evaluation of the pros and cons of the different model formats, the EEA decided to adopt the GML format for the modelled data and to study the feasibility of conversion from other formats. The discussions about the common projection grid led to the launch of the FAIRMODE *EU Composite Mapping* exercise for the development of a European wide pollution map based on modelled data from different MS and regions (see section 5).

4. Recommendations on the IPR provisions concerning source apportionment

According to the Article 23 of Directive 2008/50/EC, when the concentrations of legislated pollutants exceed a limit or target value in given zones or agglomerations, MS shall establish air quality plans to bring the levels below the threshold. In this case, MS shall report the information indicated in the IPR article 13 concerning: air quality plans, source apportionment, scenarios for attainment and measures.

In the IPR context, source apportionment is of particular relevance because the air quality plans have to target the emission sources that are considered responsible for the exceedances. In addition, the plans shall estimate the time interval required to achieve the expected reduction of concentrations and describe the abatement measures.

Concern was expressed by FAIRMODE about some provisions in the e-reporting mechanism that are not fully consistent with the atmospheric processes associated with air pollution sources and their spatial patterns and the way they are reported in many up-to-date methodologies.

In the IPR the source apportionment is entirely based upon the incremental approach (Figure 2). It assumes that the contributions to one pollutant from all the sources present in a city (urban increment , solid blue arrow) can be estimated as the difference between the concentrations in an urban background site (empty blue arrow) and a rural background site (empty green arrow). In addition, the contribution of traffic (solid red arrow) can be estimated by subtracting the concentrations in the urban background site (empty blue arrow) to those observed in a traffic monitoring site (empty red arrow).

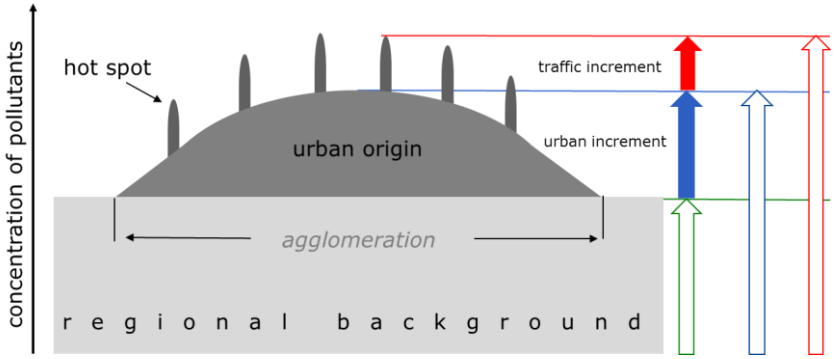
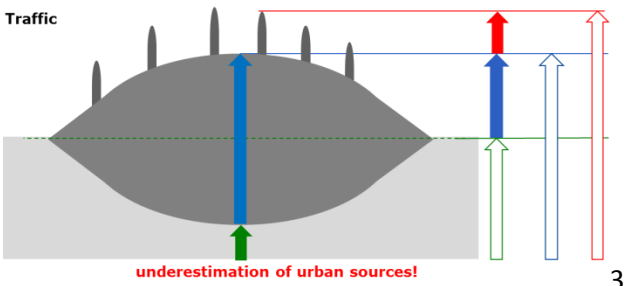


Figure 2. Schematic representation of the incremental approach (modified from Lenschow et al., 2001) The empty arrows represent concentrations and the filled arrows represent increments.

This incremental approach is suitable to describe the total mass of pollutants in flat and ventilated areas with sources mainly located within the cities (e.g. Berlin, Paris). However, this simplified approach assumes that the contribution of regional background is the same outside the city and in the city. If the regional background was lower in the city, this assumption would led to the underestimation of the city contribution (Figure 3a). Moreover, it has been observed the incremental approach is not suitable for areas with air stagnation, strong thermal inversion and/or considerable emissions outside the cities (e.g. The Netherlands, Po Valley, Visegrad area). Indeed, it is not appropriate to estimate the contribution of sources such as agriculture, biogenic, biomass burning that have the highest contributions in the regional background area because this would lead to negative increments (Figure 3b). Last but not least, to estimate the increments are necessary at least three measurements (or estimations) while other methods work with only one site.



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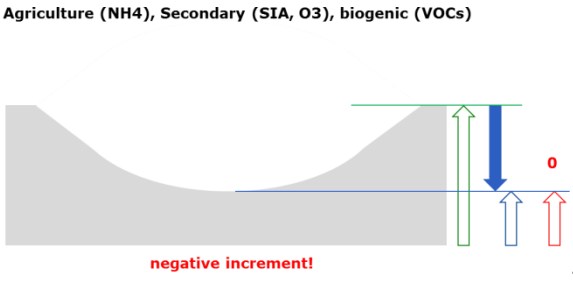

3b

Figure 3. Situations that cannot be properly described with the incremental approach: 3a) when the contribution of specific sources are higher in the background area than in the urban agglomeration; 3b) when the regional background measured in the rural area is not homogeneous.

Another aspect that may lead to inconsistencies, identified by FAIRMODE, is the identification of specific methodologies for the identification of sources for selected pollutants (e.g. NO_2). Selecting a methodology does not allow MS to adopt the one that is most suitable for the kind of sources and the kind of data and skills they have. In addition, in this way it is not possible to take into account the scientific development that took place in this field in the latest years.

Also the list of source categories should be revised. The IPR list a pre-established number of source categories to be reported. Nevertheless, the used nomenclature is not corresponding to any currently internationally accepted system. In the classification of the sources categories there are two mixed criteria: the activity source and the area source (local or transboundary). These two criteria should be kept separate.

In order to overcome the above mentioned critical aspects, FAIRMODE drafted a list recommendations.

FAIRMODE recommendations about source apportionment for e-reporting

FAIRMODE recommends allowing MS to report the "contribution" of every source at a given site with the most suitable approach without imposing "a priori" the incremental approach. MS deciding to use this approach are still allowed to do so.

FAIRMODE recommends to let MS to choose the source apportionment methodology most suitable for their situation, provided their performances and uncertainties have been tested using, for instance, intercomparison exercises or benchmarking tools and are documented in scientific articles and official technical documents drafted by international recognised bodies (e.g. CEN, ISO, FAIRMODE).

FAIRMODE recommends to use a widely recognised classification of emission sources with the minimum required level of disaggregation by activity sector (NFR-UNECE aggregation for gridding). Pollutants formed in the atmosphere should be referred to as "secondary" and when possible attributed to their precursor's sources.

5. FAIRMODE follow-up work on e-reporting during 2015

<u>Informal guidelines about Plans and Programmes</u>

In the first half of 2015, the tool developed by JRC to manage the e-reporting data flows related to "plans and programmes (H-K)" was finalized and its operation was transferred to EEA. When MS started to populate it in preparation for the first mandatory reporting deadline (Sept. 2015), many of them pointed out a number of inconsistencies. In this context, the recommendations from FAIRMODE concerning the reporting of source apportionment were acknowledged. MS requested more comprehensive written guidelines for the air quality aspects of this section (flows H-K) and asked EEA and DG ENV to organize an "ad hoc" meeting to clarify ambiguities and technical issues connected to Plans and Programmes. Before

the meeting, MS submitted almost 90 questions to DG ENV that were discussed and answered with the support of the EEA, the JRC and FAIRMODE. After the meeting, that took place on 29/6, the answers were collated in a document which is used as informal guidelines for reporting data on source apportionment, scenarios, plans and measures. Even though a short term solution for the initial application of the IPR was agreed, a number of technical questions are still open and would require further work.

Composite mapping exercise

In 2015, FAIRMODE launched an activity aiming at creating a bottom-up composition map of air quality over Europe on the basis of regional/national air quality maps provided by national/regional agencies and modelling teams. This mapping exercise is expected to contribute to gain an insight into: border effects, use of data assimilation or data fusion techniques, consistency of underlying emission inventories and spatial resolution for every application.

As first step, the maps will be collected in a platform to allow the comparison between the different used methodologies without linking them to the formal reporting process. Nevertheless, in the longer term, the lessons learned with this exercise are expected to provide valuable information to process the modelled information submitted under the e-reporting mechanism. This will be accomplished by developing harmonized methodologies and guidelines on the approaches used to report modelled data.

Source apportionment intercomparison exercise for receptor and source oriented models

The ongoing intercomparison exercise for the most commonly used kind of source apportionment models is expected to provide new information about the performances and uncertainties of the different methodologies. The intercomparison is also a unique opportunity to analyse in detail the response of the models to critical variables and set up a robust methodology that takes advantage of the synergies between the different methodologies. The lessons learned in the intercomparison will be used to improve the European guide on source apportionment (Belis et al., 2014) and contribute to define the source apportionment approaches that are most suitable for e-reporting.

6. Conclusions and future work

Despite it was not originally planned, FAIRMODE was able to react to the request of support from the DG ENV and the EEA providing timely and authoritative feed-back from the modellers' community. The survey on e-reporting made it possible to learn about the critical aspects that prevent MS from reporting and start taking actions to contribute solving the problem. It came clear that for certain matters there is not a common view among modellers. This is mainly due to the different degree of implementation of the air quality directives, technical capacities and economic resources. Sometimes the views of FAIRMODE were taken on board and sometimes not. The first steps of the collaboration in the field of e-reporting carried out between 2014 and 2015 led to development of new activities (plans and programs informal guidelines, composite mapping exercise, etc.).

The analysis of the FAIRMODE experts about source apportionment anticipated part of the problems that were later on reported by MS. This preparedness give the chance to react readily and provide valuable analysis of the different options.

The continuous FAIRMODE technical work makes it possible the continue development of guidelines based on the most advanced scientific knowledge to deal with specific practical aspects of the implementation of the Air Quality Directives: model quality objectives, source apportionment methods, mapping, etc. The involvement of FAIRMODE in the standardization process is expected to provide normative technical references beneficial for the e-reporting process.

7. References

Belis, C. A; Favez, O.; Harrison, R. M; Larsen, B. R; Amato, F.; El Haddad, I.; Hopke, P. K; Nava, S.; Paatero, P.; Prévôt, A., Quass U., Vecchi R., Viana M., 2014. European Guide on Air Pollution Source Apportionment with Receptor Models. Publications Office of the European Union, Luxemburg.

Commission implementing decision of 12 December 2011 laying down rules for Directives 2004/107/EC and 2008/50/EC of the European Parliament and of the Council as regards the reciprocal exchange of information and reporting on ambient air quality

Directive 2008/50/EC of the European Parliament and of the Council of 21 May 2008 on ambient air quality and cleaner air for Europe.

Directive 2004/107/EC of the European parliament and of the Council of 15 December 2004 relating to arsenic, cadmium, mercury, nickel and polycyclic aromatic hydrocarbons in ambient air.

Lenschow, P., Abraham, H. J., Kutzner, K., Lutz, M., Preuß, J. D., and Reichenbächer, W., 2001. Some ideas about the sources of PM10. Atmospheric Environment 35, S23-S33

Annex 1. Summary of detailed answers to the e-reporting survey

In this annex a detailed the analysis of the answers is reported. Numbers ranging from 1 to 5 were attributed to answers ranging from strongly disagree to strongly agree.

1) Lack of technical capacity (average score: 3)

   The technical capabilities vary among MS and within MS between the national and the subnational level. Some countries have highly skilled personnel in the national bodies but the regional/local authorities do not have specialised staff (e.g. AT, SE). In other cases, the national authorithies do not have modelling skills and have to rely on external services (e.g. PO, PT, GR) or have skills but do not have enough personnel (e.g. HR).

   In one case, the current implementation of the IPR is considered to go further than the INSPIRE directive and would like AQUI to report also modelling information and do be kept as an alternative for e-reporting in the future.

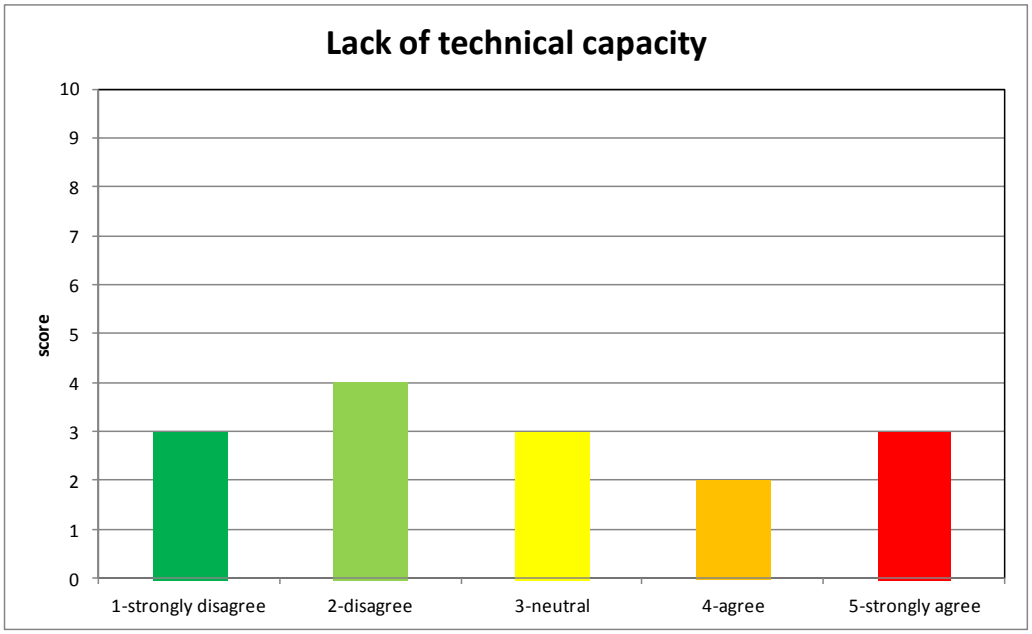

Figure 1. Summary of the answers the question 1.

2) Insufficient reliability of models (average score: 2.5)

The perception about the reliability of models is quite different among the MS. Many NCPs consider this aspect is not preventing their country to report modelled data while others quite agree this is a limiting factor. The main motivations for skepticism about models are: possibility of models to deliver false alerts or false exceedances, models do not cover all regulated pollutants with the same degree of confidence (e.g. big uncertainties for metals and organic compounds), model output influenced by the poor quality of emission inventories, difficulties to model short term windows (e.g. daily averages), QA/QC procedures not yet standardized and therefore difficult judge the reliability of the model output.

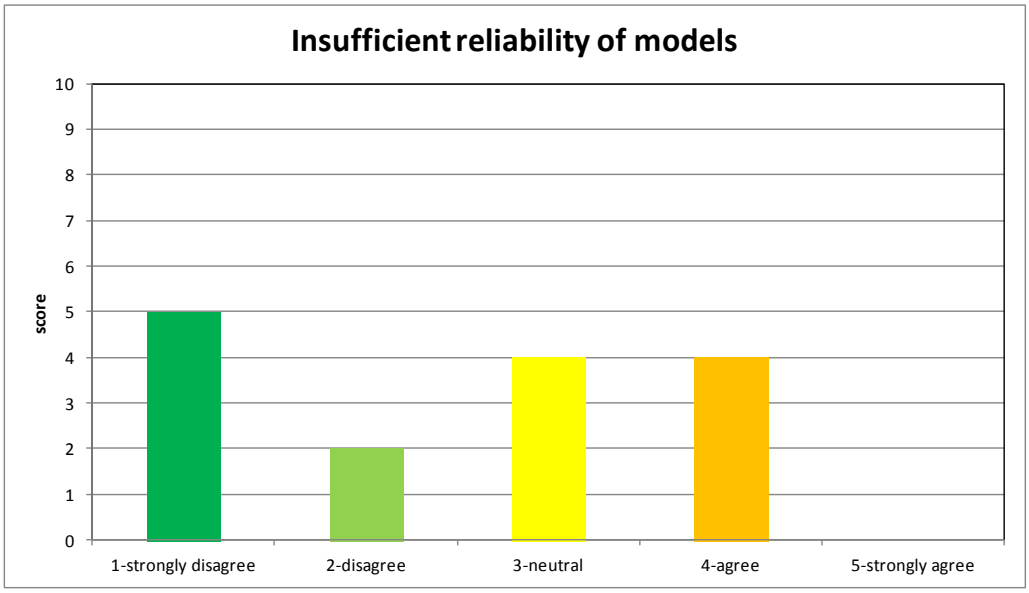

Figure 2. Summary of the answers the question 2.

3) Too expensive and/or time consuming (average score: 3.1)

The views of the NCPs diverge also about this topic. For many countries the need of resources either in terms of staff, time and/or funds is quite stringent. Some countries externalise model services and, therefore, need economic resources to accomplish this task (PO, PT, GR). Others indicate that resources are also needed to coordinate modelling services at the national and regional levels because local authorities responsible for air quality management do not have enough resources to maintain highly specialized modelling teams. Among those who do not consider costs as an issue, there are countries that see in modelling an opportunity for savings by reducing measurements.

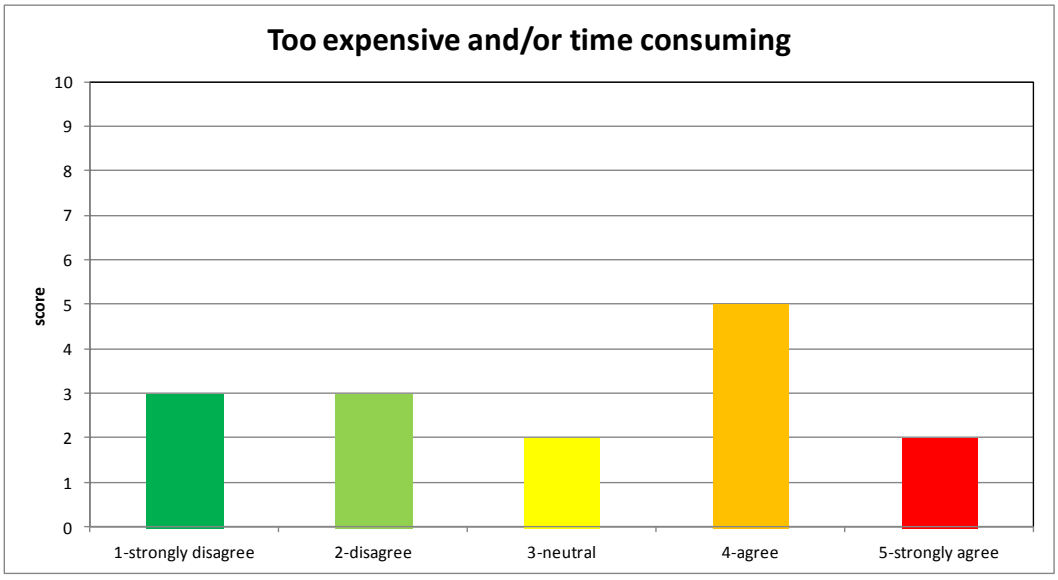

Figure 3. Summary of the answers the question 2.

4) Brings too little added value(average score: 1.7)

There is a general agreement about the added value of modelling for understanding and assessing air pollution. In general, modelling is seen as a complement to measurements. In particular, models are considered useful to improve the spatial coverage, provide forecast capabilities, identification of sources and support governments responsible for air quality management.
The lack of added value is not considered a cause for not submitting modelled data.

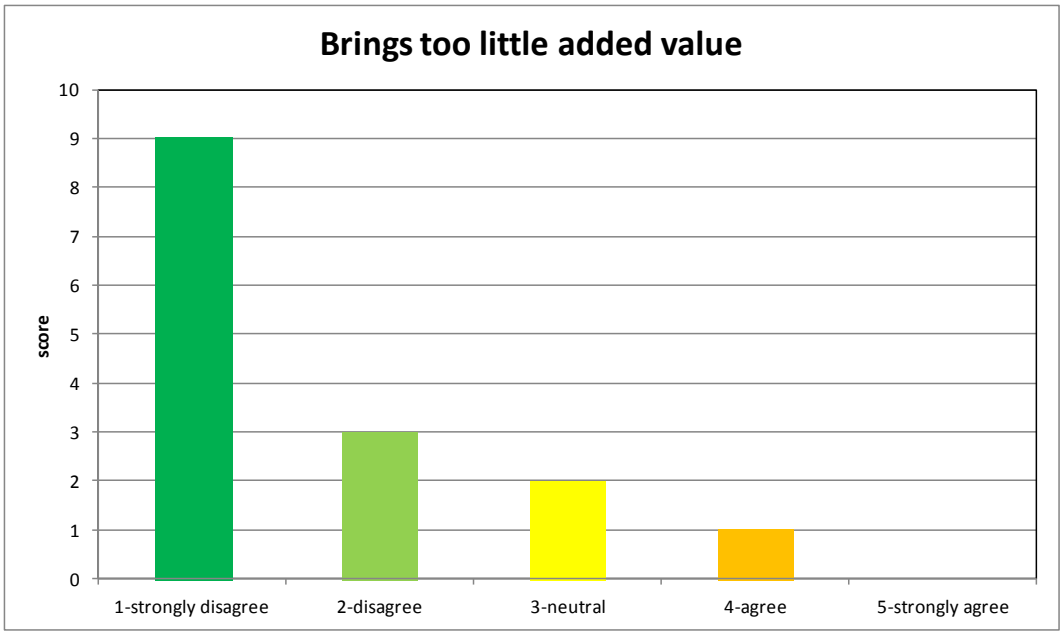

Figure 4. Summary of the answers the question 4.

5) <u>Lack of clear and common guidelines(average score: 3.3)</u>
There is a quite common understanding about the need to improve the technical guidelines for modelling and model output interpretation and implementation. Nevertheless, this is not always considered as a cause for not submitting modelled data. Lack of clarity was mentioned by NCPs about the following aspects: definition of the area of exceedance, coherence among different geographical scales, coherence between emission inventories and application of model performance indicators. Some countries also mention the need of technical guidelines and best practices for model operation. The initiative under the CEN to draft technical standards has been pointed out as possible way out.

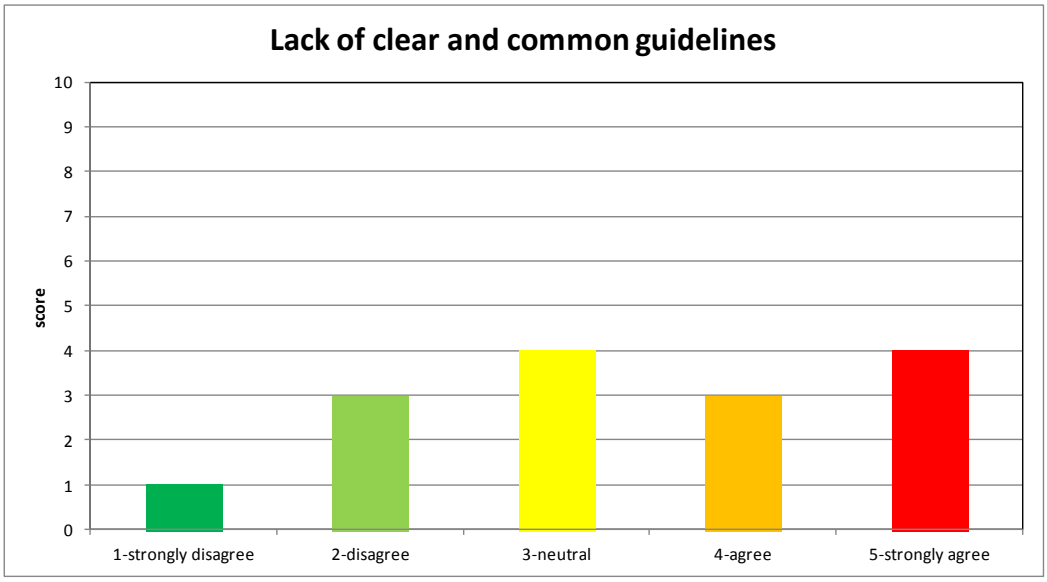

Figure 5. Summary of the answers the question 5.

6) Limitations of administrative kind(average score: 3)

The NCPs expressed different views about administrative restrictions to report modelled data.
In some cases the motivations coincide with those expressed in other questions: lack of staff and funds. A number of NCPs report that coordinating the regional competent authorities poses significant administrative problems while others consider the deadline for data submission too short.

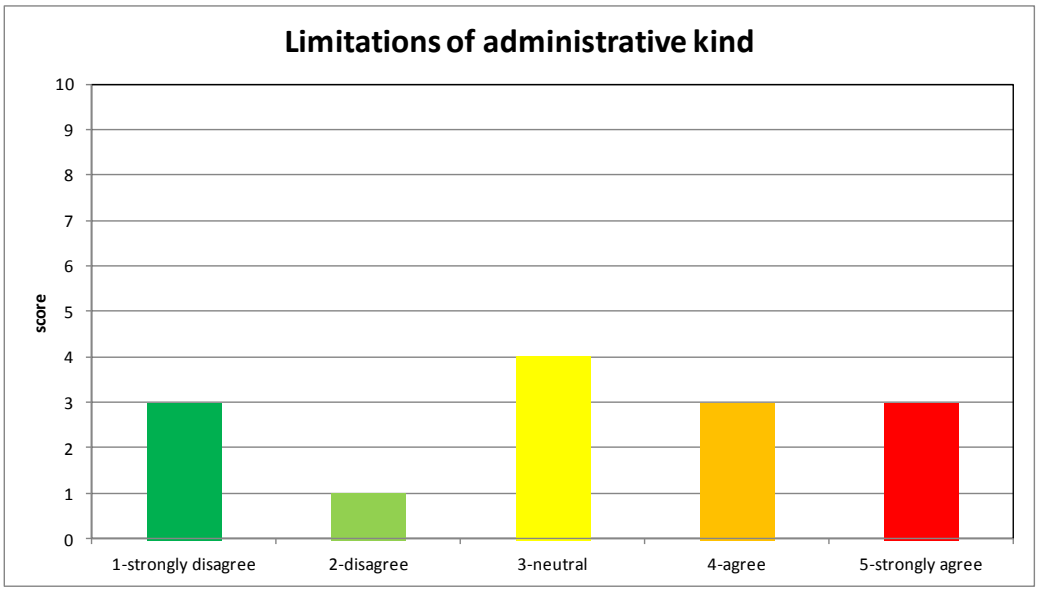

Figure 6. Summary of the answers the question 6

7) Lack of clarity in legislation(average score: 7)

There is a general agreement about the impact of the legislation as a limiting factor for reporting model output to the EU. Some MS do not report modelled data simply because this is not mandatory. Others claim it is not clear when modelling can be considered suitable for assessment with regard to the limit value. Moreover, there is a need to clarify possible conflicts between modelled and measured data. For

example, how to deal with cases where models predict exceedances in areas not (sufficiently) covered by measurements.

Many NCPs consider there is too much space for interpretation in the legislation and the IPR. Some of them believe there is too much flexibility and stress the need to define reference standard methods or reference models like in the US.

A univocal interpretation of the ambiguities it the legislation and official technical documents made by European and national authorities is requested.

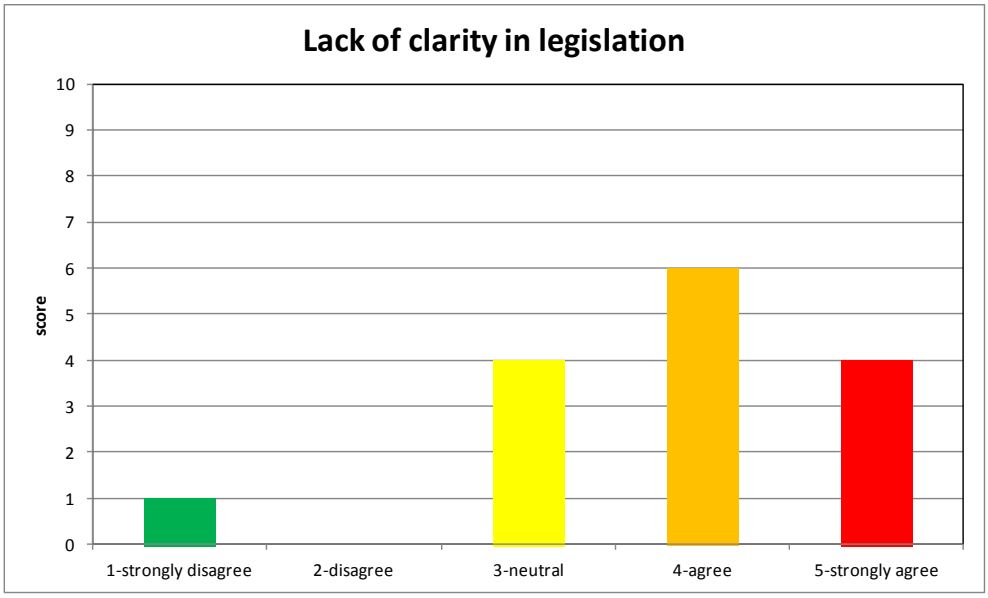

Figure 7. Summary of the answers the question 7.

Annex2. FAIRMODE feedback on e-reporting questions

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Date: 20/10/2014

This document describes the FAIRMODE feedback on three questions which were raised by the E-Reporting team. Background information related to each of the questions can be found in Annex 1.

Question 1. Feedback on the scope of the model parameterisation code list

- *Is the Code list [2] based on the MDS a good starting point?*
- *Is there any other way to progress on this?*
- *What shall be included there which is not available currently within the MDS structure?*
- *Can information of other code lists [4] [5] [6] provide additional information?*
- *Are there more code lists needed for reporting data from AQ models?*
- *If yes – what kind of code lists? Is there anything we can refer to?*

FAIRMODE confirms that the Code list [2] is a good starting point as model parameterisation code list. The code list [8], [9], [10] and [11] might be useful as well to report the modelling process in a referable and quality assured way. We don't think that the code lists [4] [5] [6] are useful in this context. However, they could be useful for applications different than assessment. E.g. although code list 4 may be of little relevance for assessment it is relevant for source apportionment applications. For these applications, however, the code list should be revised.

In addition to the code list [2], FAIRMODE recommends to include additional aspects which are relevant to describe the model properly:

- We recommend to separate the characterisation of the model (e.g. in terms of advection, convection, turbulence, deposition and chemical schemes), from input data used as meteorology, topography, emissions, boundary conditions, etc. The characterisation of the model could just point at the description of model (and version) in the MDS.
- We recommend to include a basic description outlining the basic principles of the model (e.g. Eulerian, Lagrangian, Gaussian plume etc.). This can be done either within the model description or as a separate parameterisation field. This description is important in interpreting the meaning of some of the model parameterisation fields.
- The code list should clearly indicate for what kind of application the model has been used for: e.g. assessment of AQ concentrations, assessment of population exposure, assessment of main sources or source apportionment, etc. Currently what used to be reported as part of the "Questionnaire" is now part of the E1b data flow, as the G data points at the E data flow for the assessment on exceedances. It is therefore necessary to include this characterisation of the model application in the code list.
- The code list should be extended to take into account the boundary conditions being applied to the model
- The methodology used to combine modelling and monitoring data should be reported (either offline, e.g. by kriging, or through data assimilation algorithm). One would need to both provide information under the model characterisation on the methodology for assimilation/kriging used,

and under the description of input data on the assimilated or/and kriging data used. If available information of the evaluation procedure or uncertainty estimate should be also reported.

- Some expert would like more space for "free-text" descriptions (UK, ES) and claim that the the MDS "Long Description Option" is more complete than the proposed code list.

Question 2. Feedback on the scope of the modelling meta-data profile

Questions related to the data model are:

- *The current data model/schema focuses on models to support compliance assessment and the e-Reporting process. Are there any modifications necessary in the current data model/schema to reflect better current practice in the AQ modelling?*
- *Are there other ways of using the 'data quality report' element? What would be the role of Data Quality Objectives in here?*

Your engagement with the data model would be very helpful in order to:

- *generate more example data sets,*
- *consider what guidance the Member States may need.*

The current schema is good according to FAIRMODE. Slide nr 9 in the presentation [1] is relevant as an introduction to the data model. The [7] web link could be better organized in order to facilitate the access to the documentation data, namely for the AQD_Model [8]; AQD_ModelArea[9]; AQD_ModelProcess[10].

Data quality objectives are a way to ensure that the model is fit for purpose. FAIRMODE's DELTA tool is more and more used as a reference tool to evaluate modelling results. There is a clear need to further develop a model benchmarking system in FAIRMODE and guidance on how to do the modelled data quality testing and reporting.

A link to the data quality report is required in dataflow D. Values for the uncertainty of the modelling are required in dataflow E for each model results dataset included. However, we have found it difficult to calculate a value for model uncertainty suitable for inclusion in dataflow E because the guidance provided in the directive is not comprehensive and no definition of 'in the vicinity of the limit value' has been specified.

Most of the models used for policy support are designed to produce results that are comparable with the AQ directive. However, some models are not designed to produce hourly fields. For those models, hourly or daily statistics are based annual values via on correlations functions. In our opinion, the requirement in IPR dataflow E to report hourly data everywhere is too strict and should be modified.

Some applications calculate both concentrations on a grid and on many receptor points typically located along major roads and where people live. It's unclear to us if the xml scheme allows reporting of both receptor points and gridded data simultaneously.

We have detected some confusing terms, for example, "temporal resolution" (in the Model Process scheme) when "time period" seems to be more suitable.

UK and Spain have provided example datasets.

Question 3. Feedback on your preferred file formats and additional needs ('user stories')

- *How and what do you model for compliance assessment?*
  In a few MS, model data is used for compliance assessment. In many countries models are applied to produces supplementary material. In those cases modelled data is made available for the most relevant pollutants and related statistic under the Air Quality Directive or related indicators such as surface exposed to an exceedance.

  FAIRMODE is currently performing a survey via the FAIRMODE National Contact Points to gain more insight in the drivers and obstacles for using modelling results in the official reporting cycle. The results of the survey will be presented during the FAIRMODE plenary in February 2015.

- *What are your output formats? How can we reduce the variety of formats to some base formats for grids, receptors/irregular grids, vector data, polygons…?*
  The output file formats mainly used are ASCII style, netCDF or Shapefile. netCDF seems to be the format which is most widely accepted and preferred within the modelling community. The format is able to handle large data volumes, it is well supported and there has been a lot of work on defining standard formats.

- *From your point of view: is it feasible to get it all encoded in GML?*
  Even though GML is flexible, open and supports mixed forms of geographic objects it is not considered as an appropriate format for data reporting. GML is not practical for gridded data and the files are large and slow to use and transfer. In addition, it is not well supported and unsuitable for non-standard projections.

  Most of the MS do not have modelled data available as a web services.

- *Is it possible to agree a common projection and for the gridded data also a common projection grid for the reporting purposes?*
  It could be possible to convert the coordinates of modelling data into a given projection system if this system is appropriate for the whole of Europe. Recalculation of coordinates is in principle not a problem.

  FAIRMODE does not think it is feasible and appropriate to have a common projection grid. The choice of the modelling grid depends on many aspects: resolution of the input data, model characteristics, computational resources, nature of the modelling zone, etc. A common grid cannot therefore be imposed to modellers for their calculations. Having a common projection grid for the transmission of the modelling results appears also difficult and should be very carefully considered. Modellers would have to interpolate their results on this grid, which means additional burden and raises several questions: which grid for which spatial scale? Which interpolation method? What is the risk of impairing the quality of the results? In addition, the use of interpolation on a common grid increases the risk of wrongly comparing modelling data obtained at different scales. A modelling at 50km resolution can hardly be compared with a modelling at 4km resolution, both results cannot be compared directly on the same grid.

Annex 1: Background information

Dear FAIRMODE colleagues,

During the IPR Pilot meeting on 3-4th of April there was a session dedicated to reporting data from AQ models [1] and some of the issues where we may need support from the FAIRMODE community were presented there.

In this short document, following the 'information on the AQ e-Reporting' email from the 31st of March/1st of April, we would like to give you more details on this matter, asking if you could spend some time discussing it.

1. Feedback on the scope of the model parameterisation code list

Code list [2] has been used in the data model for describing the model parameterisation. The code list has been updated based on the structure of the Model Documentation System [3]. The questions are:

- Is there any other way to progress on this?
- What shall be included there which is not available currently within the MDS structure?

There are also other code lists [4] [5] [6], related with emissions and dispersion situations (used for meta-data of fixed AQ measurements). The questions are:

- Are these code lists sufficient?
- Could they be used within the data model also for the modelling results?

Some more general questions:

- Are there more code lists needed for reporting data from AQ models?
- If yes – what kind of code lists? Is there anything we can refer to?

2. Feedback on the scope of the modelling meta-data profile

The data model and its parts relevant for reporting results from Air Quality modelling was presented both during the FAIRMODE Plenary meeting in February and during the IPR Pilot Meeting in April.

You can look at the documentation available online [7] for such elements as:

- AQD_Model [8],
- AQD_ModelArea [9],
- AQD_ModelProcess [10] or
- OM_Observation (AQD_ModelObservation) [11].

AQD_Model was presented on slide nr 9 in the presentation [1] mentioned above. There have been test data [12] delivered by UK (in the EEA's test repository) where you can look at how the elements from the data model have been/can be implemented (explore both XML file and the HTML factsheet). You will realise that AQD_Model contains also the link to the AQD_ModelProcess – within element called

'procedure'. There is also AQD_ModelArea embedded within the Feature of Interest (with gml id) but not linked.

AQD_ModelArea corresponds to the Feature of interest within Observing Capabilities, it contains geometry of modelling domain and it is shown on slides nr 10 and 11. In the original XML you will find the geometry of the modelling domain within this element.

AQD_ModelProcess corresponds to the Procedure within Observing Capabilities, it is shown in details on slide nr 11. When exploring this element in example data [13] you will see how the 'modelparameter' code lists have been used at present to define the parameterisation of the model producing the outputs. As mentioned above in the 'code list' section the 'process parameter' element needs to be extended and better structured. In the AQD_ModelProcess you will also find the 'data quality report' element which in this example links to a pdf document on the UK DEFRA web site.

OM_Observation (AQD_ModelObservation) is presented on slide nr 13. In the example data file from UK [14] you will find links to the AQD_Model (e.g.: GB_Model_3), the AQD_ModelProcess (e.g.: GB_ModelProcess_3) and AQD_ModelArea (e.g.: GB_Area_3) which has generated the model output. Currently the modelling results can be encoded in GML or linked as an external file. In the example from UK the latter option has been implemented. In this example you can also see that the model geometry is given within the modelling results (apart from the geometry declared in the AQD_ModelArea described above). Work is ongoing to move away from declaring geometry in two places of the data model.

Questions related to the data model are:

- The current data model/schema focuses on models to support compliance assessment and the e-Reporting process. Are there any modifications necessary in the current data model/schema to reflect better current practice in the AQ modelling?
- Are there other ways of using the 'data quality report' element? What would be the role of Data Quality Objectives in here?

Your engagement with the data model would be very helpful in order to:

- generate more example data sets,
- consider what guidance the Member States may need.

3. Feedback on your preferred file formats and additional needs ('user stories')

Agreement on the reporting format of the modelling results is one of the most important issues, determining EEA's ability to process the incoming data. The favourite solution would be to encode the data into a limited number of established GML formats, however discussion during the IPR Pilot meeting showed that there may not be enough experience available in the modelling community to go for this option. Another option could be the netCDF format, however we would need your input on how feasible is to standardise the netCDF files so that we have limited number of alternatives for automatic data processing.

So the conclusion was that we need first to know what the common practices are and what is possible regarding the data formats. The questions we have are:

- How and what do you model for compliance assessment?

- What are your output formats?
- How can we reduce the variety of formats to some base formats for grids, receptors/irregular grids, vector data, polygons…?
- From your point of view: is it feasible to get it all encoded in GML?
- Is it possible to agree a common projection and for the gridded data also a common projection grid for the reporting purposes? The EEA has developed reference grids [15]. They are available for 1, 10 and 100 km resolution, projected in ETRS89 Lambert Azimuthal Equal Area (EPSG: 3035). Perhaps in cases when the resolution of the reference grid is not suitable it could be any sub-grid defined on the reference grid? This would facilitate reporting formats because once the grid is defined it would be only necessary to report values and time steps assigned to the appropriate grid identifiers. Keep in mind that for reporting purposes only one (the lowest) layer of models would be used so we do not need 3D data. In case it is necessary in the future we could add additional field with the altitude information.

In addition to the points above we are also working on procedure for checking evidence on concentrations in AQ zones supplied by models, i.e. how to go from gridded data (or irregular grids, vectors, etc.) to attainment reports, including NS/WSS corrections. As soon as we have more details on the procedure, we will also ask you for feedback regarding its feasibility.

The main place to look for news about the AQ e-Reporting is the Air Quality Portal on EIONET web site: http://www.eionet.europa.eu/aqportal. However if you have any questions, do not hesitate to send us an email.

Looking forward to successful collaboration

Kind regards,

AQ e-Reporting team

[1] IPR Pilot presentation on reporting data from AQ models: http://www.eionet.europa.eu/aqportal/pmeet/AQDpil10/Day2_0900-1030_e-Reporting_Modelling_1.2.pdf

[2] Code list for model parametrisation: http://dd.eionet.europa.eu/vocabulary/aq/modelparameter

[3] Model documentation system: http://acm.eionet.europa.eu/databases/MDS/index_html

[4] Code list for emission sources: http://dd.eionet.europa.eu/vocabulary/aq/emissionsource

[5] Code list for regional dispersion situation: http://dd.eionet.europa.eu/vocabulary/aq/dispersionregional

[6] Code list for local dispersion situation: http://dd.eionet.europa.eu/vocabulary/aq/dispersionlocal

[7] Data model – an HTML documentation: http://www.eionet.europa.eu/aqportal/datamodel

[8] Data model – an HTML documentation, AQD_Model: http://www.eionet.europa.eu/aqportal/datamodel/xsd-1-0/html-documentation-version-1.0.3_AQD_Model.html#Link0000000E

[9] Data model – an HTML documentation, AQD_ModelArea: http://www.eionet.europa.eu/aqportal/datamodel/xsd-1-0/html-documentation-version-1.0.3_AQD_ModelArea.html#Link00000010

[10] Data model – an HTML documentation, AQD_ModelProcess: http://www.eionet.europa.eu/aqportal/datamodel/xsd-1-0/html-documentation-version-1.0.3_AQD_ModelProcess.html#Link00000012

[11] Data model – an HTML documentation, OM_Observation (AQD_ModelObservation):

http://www.eionet.europa.eu/aqportal/datamodel/xsd-0-3-7c/AirQualityReporting_OM_Observation.html#Link0000011D

[12] Example data, AQD_Model and AQD_ModelArea: http://cdrtest.eionet.europa.eu/gb/eu/aqd/d/envuui6ga (see the D_GB_Model.xml)
[13] Example data, AQD_ModelProcess: http://cdrtest.eionet.europa.eu/gb/eu/aqd/d/envuui6ga (see the D_GB_ModelProcess.xml)
[14] Example data, OM_Observation (AQD_ModelObservation): http://cdrtest.eionet.europa.eu/gb/eu/aqd/e1b/envuvdcxw (see the E1b_GB_ModellingObservations.xml)
[15] EEA reference grid: http://www.eea.europa.eu/data-and-maps/data/eea-reference-grids-2

Annex 3. EEA's answer to FAIRMODE recommendations

EEA: Artur Gsella, Valentin Foltescu, Anke Lükewille
Consultation: Tony Bush (Ricardo-AEA, work under contract with ETC/ACM)

AQ e-Reporting from models

This note summarises ideas on meta-data as well as reporting formats for AQ modelling results which are currently under discussion between EEA and FAIRMODE.

1. Feedback from FAIRMODE

The FAIRMODE community has been asked to contribute to the data model of AQ e-Reporting by answering set of questions related to the meta-data, code lists as well as reporting formats (see in [1]). The first document with questions was sent to FAIRMODE in April 2014 and then an updated version with a proposal of a common projection grid was sent in June 2014. The first document with feedback was received in October 2014 from which we conclude that:

- ***regarding the scope of the model parameterisation code lists:*** there will be more code lists necessary to describe the AQ modelling properly within the AQ e-Reporting meta-data, the code lists would be:
    - model characteristics including concepts such as: advection, convection, turbulence, deposition and chemical schemes, etc.
    - model input with concepts such as: meteorology, topography, emissions, boundary conditions, etc.
    - model type including concepts for basic principles of models such as: Eulerian, Lagrangian, Gaussian plume etc.
    - data assimilation specifying methodology used (kriging, regression kriging, kalman filter, 3-4DVAR, etc.)
    - model applications, e.g.: analysis of AQ concentrations, population exposure, main sources or source apportionment, compliance assessment under the IPR etc.

  More space for "free-text" descriptions is required.

- ***regarding the scope of the modelling meta-data profile:*** FAIRMODE community points to a need for relaxing the AQ e-Reporting schema for model uncertainty reported under data flow E1b. They also noticed that a "requirement for the IPR dataflow E1b to report hourly data everywhere is too strict and should be modified".

- ***preferred file formats and additional needs:***
    - FAIRMODE community suggests netCDF as preferred format for AQ e-Reporting, pointing out that "GML is not practical for gridded data and the files are large and slow to use and transfer",
    - It seems that a common projection is not an issue, however FAIRMODE does not recommend a common projection grid because of the following potential problems/questions:

        - choice of the modelling grid depends on many aspects and a common grid cannot be imposed to modellers for their calculations,
        - which grid would be suitable for which spatial scale?
        - which interpolation method should be selected?
        - what is the risk of impairing the quality of the results?
        - risk of wrongly comparing modelling data obtained at different scales.
    - "FAIRMODE is currently performing a survey via the FAIRMODE National Contact Points to gain more insight in the drivers and obstacles for using modelling results in the official reporting cycle. The results of the survey will be presented during the FAIRMODE plenary in February 2015."

2. EEA position and ideas

- ***regarding the scope of the model parameterisation code lists:*** additional code lists are needed indeed. Any kind of information which is difficult to systematise can be included in the free-text description which is already foreseen in the data model (voluntary description elements such as e.g. gml:description, ef:name, ef:additionalDescription).

- ***regarding the scope of the modelling meta-data profile:***
    - In the EEA's point of view there is no requirement for the IPR dataflow E1b to report hourly data and countries may report within E1b values with any temporal resolution which can be considered as a 'primary' output from AQ modelling for regulatory purposes. The code list for primary data, see [2] has been extended with concepts reflecting annual values.
    - DELTA tool should be considered as the way to standardise evaluation of AQ models. However there is a need to better align outputs from DELTA tool with the AQD Directive and the guidance for model uncertainty or to provide guidance how to treat discrepancies between the DELTA tool and DQOs.
    - Feasibility of relaxing the AQD schema for model uncertainty reported under E1b has to be evaluated.
    - Reporting more geometries than one simultaneously is addressed below in section on preferred formats.

- ***preferred file formats and additional needs:***
    - (FAIRMODE plenary in February 2015 should be attended by EEA staff member).

  EEA proposed solution with a common projection grid which would be the EEA reference grid based on the recommendation at the 1st European Workshop on Reference Grids in 2003 and later INSPIRE geographical grid systems. For each country three vector polygon grid shape files, 1, 10 and 100 km, are available at the moment, see [3]. The concept should be probably rephrased as it does not impose a single spatial scale but rather a single geometry framework, i.e. it is about common projection grids not a single grid.

  To answer doubts raised by the FAIRMODE:

    - netCDF would be an option as it "is able to handle large data volumes". We should keep in mind however that there is no need to report 3D fields of hourly data to the EEA, usually

only the first bottom layer of the model is expected and aggregated (annual) values are allowed.

- As countries/modelling teams would use common geometry, there would be no need for reporting it with values and therefore GML format could be used in which data array includes an additional element called e.g. 'GeometryID', see [4]. Additional code list may be necessary to include concept of geometry identifiers.
- The common geometry grids can be adapted to different spatial scales. For the moment there are 3 resolutions available officially (INSPIRE compliant grids: 1, 10 and 100 km) and there is also version with 5 km resolution. Other resolutions can be generated if necessary.
- In case the models do not use (only) regular grid but (also) other geometries such as lines (for road links) or points (irregular grid of receptors) the geometry can be reported within meta-data (AQD_Model pointing to AQD_ModelArea via 'Feature of interest', see [5]), preferably encoded in GML. Values in data array can refer to the corresponding localIDs of the geometries via 'GeometryID'. All geometries should follow the same projection as defined for the common projection grids. The rules and guidance for links to the common grids would need to be specified.
- The common geometry grids would not be imposed to country modeller teams for their calculations but they would re-calculate results from their usual grids into the common one for the purpose of reporting to the EEA.
- Interpolation method used for re-calculating results from one grid to another should be 'the best available'. Modellers should have freedom in selecting the methodology to obtain results (on a common grid) as close to the original as possible.
- Risk of impairing the quality of the results would have to be evaluated by MS (country modeller teams) and output of the evaluation summarised in a short report included e.g. in the data quality report. DELTA tool could be used for this purpose to standardise the evaluation process.
- We should keep in mind that the main purpose of the harmonisation is to facilitate data processing at the EEA with all related benefits (e.g. overlays with fixed measurement data, standardised AQ interpolations – filling the gaps in spatial AQ distribution, improved health impact calculations, etc.). Countries would be asked to deliver AQ modelling results on common geometry but they would have freedom to report also the original data (e.g. for compliance purposes) and refer to it from the GML file as shown in [4]. In such case however processing of data from AQ models can be only performed on a specific demand and will require much more time than processing of the standardised data.
- There is no intention to compare results between the models at the EEA.

3. Reporting data from AQ models as exchange of information

Outcome of the FAIRMODE survey on e-Reporting [6] suggests that obstacles to report data from AQ modelling (for compliance) are related to lack of clarity in legislation and lack of common guidance. As stated during an informal FAIRMODE/DG-ENV/EEA meeting on the 12th of November 2014, some Member States do not report data from AQ modelling simply because it is not mandatory. However, this should be seen in a context of another strongly related factor (obstacle to report data) which is fear that models deliver false alerts or false exceedances. Taking this into account we can turn the problem 'upside-down' and present it as opportunity. Since there is no obligation to declare the AQ modelling data for compliance, countries are free to report the data for AQ exchange of information only (it is already possible with the current schema to clearly flag the purpose of the AQ model). Taking this as a chance, EEA could suggest and

encourage countries to broader participation in reporting of AQ modelling results for exchange of information. The more countries involved, the easier it will be to evaluate feasibility of solutions proposed in this document and/or agreed in further discussion, both for the modelling teams in the countries as well as for the EEA. This would be also a good starting point to tackle the other issues such as lack of clarity in legislation and lack of common guidance, standardising QA/QC procedures, framework to ensure equity and comparability of modelling data, etc. The reporting for exchange of information may be initiated in spring 2015 (with the reporting deadline of 30th/09) after a guiding document on e-Reporting from AQ models is elaborated. As stated during the 12th IPR Pilot meeting [7] the countries will have freedom to report also original data (original formats) for compliance purposes.

[1] http://www.eionet.europa.eu/aqportal/pmeet/AQDpil12/12th_D1_05_FAIRMODE_DataInput.pdf

[2] Code list for primary observations: http://dd.eionet.europa.eu/vocabulary/aq/primaryObservation/view

[3] EEA reference grid(s): http://www.eea.europa.eu/data-and-maps/data/eea-reference-grids-2

[4] Examples of data array:

```
<om:result>
    <swe:DataArray>
        <swe:elementCount>
            <swe:Count>
                <swe:value>2</swe:value>
            </swe:Count>
        </swe:elementCount>
        <swe:elementType name="ModelledObservations">
            <swe:DataRecord>
                <swe:field name="GeometryID">
                    <swe:Category definition="http://dd.eionet.europa.eu/vocabularies/aq/geometryidentifiers/1km" />
                </swe:field>
                <swe:field name="StartTime">
                    <swe:Time definition="http://www.opengis.net/def/property/OGC/0/SamplingTime">
                        <swe:uom xlink:href="http://www.opengis.net/def/uom/ISO-8601/0/Gregorian" />
                    </swe:Time>
                </swe:field>
                <swe:field name="EndTime">
                    <swe:Time definition="http://www.opengis.net/def/property/OGC/0/SamplingTime">
                        <swe:uom xlink:href="http://www.opengis.net/def/uom/ISO-8601/0/Gregorian" />
                    </swe:Time>
                </swe:field>
                <swe:field name="Verification">
                    <swe:Category definition="http://dd.eionet.europa.eu/vocabularies/aq/observationverification" />
                </swe:field>
                <swe:field name="Validity">
                    <swe:Category definition="http://dd.eionet.europa.eu/vocabularies/aq/observationvalidity" />
                </swe:field>
                <swe:field name="Value">
                    <swe:Quantity definition="http://dd.eionet.europa.eu/vocabulary/aq/primaryObservation/day">
                    <swe:uom xlink:href="http://dd.eionet.europa.eu/vocabulary/uom/concentration/ug.m-3" />
                    </swe:Quantity>
                </swe:field>
                <swe:field name="Correction">
                    <swe:Quantity definition="http://dd.eionet.europa.eu/vocabulary/aq/primaryObservation/day">
                    <swe:uom xlink:href="http://dd.eionet.europa.eu/vocabulary/uom/concentration/ug.m-3" />
                    </swe:Quantity>
                </swe:field>
            </swe:DataRecord>
        </swe:elementType>
        <swe:encoding>
            <swe:TextEncoding blockSeparator="@@" decimalSeparator="." tokenSeparator="," />
        </swe:encoding>
        <swe:values>
        "1kmE0N1",2013-10-23T00:00:00+00:00,2013-10-23T23:59:59+00:00,3,1,15,0@@"1kmE0N10",2013-10-24T00:00:00+00:00,2013-10-
24T23:59:59+00:00,3,1,9,0@@
        </swe:values>
    </swe:DataArray>
<gml:File>
    <gml:rangeParameters/>
    <gml:fileReference>
        http://cdr.eionet.europa.eu/gb/eu/aqd/e1b/envu_czcg/so213_9973bk_etrs89.tgz#VALUE
    </gml:fileReference>
    <gml:fileStructure>ascii-grid</gml:fileStructure>
    <gml:compression>LZ77</gml:compression>
</gml:File>
</om:result>
```

Figure 1. Data array following the template of fixed measurements.

```
<om:result>
    <swe:DataArray>
        <swe:elementCount><swe:Count><swe:value>2</swe:value></swe:Count></swe:elementCount>
        <swe:elementType name="ModelledObservations">
            <swe:DataRecord>
                <swe:field name="GeometryID">
                    <swe:Category definition="http://dd.eionet.europa.eu/vocabularies/aq/geometryidentifiers/1km" />
                        <swe:uom xlink:href="http://www.eea.europa.eu/data-and-maps/data/eea-reference-grids-2#tab-gis-data" />
                </swe:field>
                <swe:field name="StartTime">
                    <swe:Time definition="http://www.opengis.net/def/property/OGC/0/SamplingTime">
                        <swe:uom xlink:href="http://www.opengis.net/def/uom/ISO-8601/0/Gregorian" />
                    </swe:Time>
                </swe:field>
                <swe:field name="EndTime">
                    <swe:Time definition="http://www.opengis.net/def/property/OGC/0/SamplingTime">
                        <swe:uom xlink:href="http://www.opengis.net/def/uom/ISO-8601/0/Gregorian" />
                    </swe:Time>
                </swe:field>
                <swe:field name="Verification">
                    <swe:Category definition="http://dd.eionet.europa.eu/vocabularies/aq/observationverification" />
                        <swe:uom xlink:href="http://dd.eionet.europa.eu/vocabulary/aq/observationverification/1" />
                </swe:field>
                <swe:field name="Validity">
                    <swe:Category definition="http://dd.eionet.europa.eu/vocabularies/aq/observationvalidity" />
                        <swe:uom xlink:href="http://dd.eionet.europa.eu/vocabulary/aq/observationvalidity/1" />
                </swe:field>
                <swe:field name="Value">
                    <swe:Quantity definition="http://dd.eionet.europa.eu/vocabulary/aq/primaryObservation/day">
                    <swe:uom xlink:href="http://dd.eionet.europa.eu/vocabulary/uom/concentration/ug.m-3" />
                    </swe:Quantity>
                </swe:field>
                <swe:field name="Correction">
                    <swe:Quantity definition="http://dd.eionet.europa.eu/vocabulary/aq/primaryObservation/day">
                    <swe:uom xlink:href="http://dd.eionet.europa.eu/vocabulary/uom/concentration/ug.m-3" />
                    </swe:Quantity>
                </swe:field>
            </swe:DataRecord>
        </swe:elementType>
        <swe:encoding><swe:TextEncoding blockSeparator="@@" decimalSeparator="." tokenSeparator="," /></swe:encoding>
        <swe:values>"1kmE0N1",15,0@@"1kmE0N10",9,0@@...</swe:values>
    </swe:DataArray>
<gml:TimePeriod gml:id="ReportingPeriod_Timestamp">
    <gml:beginPosition>2013-01-01T00:00:00.000Z</gml:beginPosition>
    <gml:endPosition>2013-12-31T24:00:00.000Z</gml:endPosition>
</gml:TimePeriod>
<gml:File>
    <gml:rangeParameters/>
    <gml:fileReference>http://cdr.eionet.europa.eu/gb/eu/aqd/e1b/envu_czcg/so213_9973bk_etrs89.tgz#VALUE</gml:fileReference>
    <gml:fileStructure>ascii-grid</gml:fileStructure>
    <gml:compression>LZ77</gml:compression>
</gml:File>
</om:result>
```

Figure 2. Data array – more compact version.

(Presented examples consist of: fields definitions (<swe:DataRecord>), data (<swe:values>) and linked original model output (<gml:File>). Fields definition in the examples of data array has been extended also with 'Correction' field which will be described in another note dealing with the issue of NS/WSS corrections reporting)

[5] 10th IPR Pilot presentation on reporting data from AQ models: http://www.eionet.europa.eu/aqportal/pmeet/AQDpil10/Day2_0900-1030_e-Reporting_Modelling_1.2.pdf
[6] http://www.eionet.europa.eu/aqportal/pmeet/AQDpil12/12th_D1_04_FAIRMODE_survey.pdf
[7] http://www.eionet.europa.eu/aqportal/pmeet/AQDpil12/12th_D1_06_DataAQmodels.pdf