FAIRMODE: A FORUM FOR AIR QUALITY MODELLING IN EUROPE

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Abstract: FAIRMODE (Forum for AIR quality MODelling in Europe) is an air quality modelling network that was established as a joint initiative of the European Environment Agency (EEA) and European Commission's Joint Research Centre (JRC). In a common effort EEA and JRC aim at responding to the requirements of the new Air Quality Directive, with particular focus on the introduction of modelling as a necessary tool for air quality assessment and air quality management. The main aim of the modelling network is to bring together air quality modellers and model users in order to promote and support harmonised use of modelling for the assessment of air quality by EU and EEA member countries. The network will thus encourage synergy – at a local, national and European level - through the development and implementation of a common infrastructure based on best practices for reporting and storing information relevant to air quality modelling. A major objective of the FAIRMODE initiative is to provide guidance to present and future air quality model users in EEA's EIONET partnership network. FAIRMODE also aims to enhance awareness of model usefulness, reliability and accuracy through model validation and intercomparison exercises at a national or European level. The JRC has taken on a leading role in the co-ordination of the latter activities gaining from its experience in leading the "Eurodelta" and "CityDelta" intercomparison exercises.
A centralised web portal has been created in support of FAIRMODE, which is currently being used for internal communication purposes of the network participants, but will also provide the means for exchange of relevant material and experiences between all interested modellers and model users. The initial activities of the network will be organised by two main Work Groups, focusing on the preparation of a Guidance Document for model use and on model QA/QC procedures (input data, other uncertainties) respectively. The progress of the preparation of these documents as well as of the rest of the regular activities of the network will be reviewed and discussed within the frame of annual Plenary meetings and Steering Committee meetings.

Key Words: New Air Quality Directive, Modelling guidance, Modelling network, FAIRMODE, harmonisation

1. INTRODUCTION

FAIRMODE (Forum for AIR quality MODelling in Europe) has been established as a joint initiative of the European Environment Agency, EEA (URL 1) and the European Commission Joint Research Centre, JRC (URL 2), in a common effort to respond to the requirements of the new Air Quality Directive (AQD) of the 21st of May 2008 on ambient air quality and cleaner air for Europe (URL 3), with particular focus on the introduction of modelling as a necessary tool for Air Quality Assessment (AQA) and Air Quality Management (AQM). The name that was selected for the network, FAIRMODE, reflects its function. As the role of modelling in understanding the influence of physical and chemical processes on the dispersion and transformation of pollutants is increasingly being recognised, the recent European Directives on air quality emphasise the importance of modelling as a tool in the identification of high pollutant concentration areas that are not in compliance with air quality limit or target values. The role of modelling for regulatory purposes is particularly highlighted in the new AQD. Therefore, atmospheric modelling has lately received an increasing attention from local authorities and decision makers (Borrego *et al.,* 2003).

Modelling tools are useful for a wide range of policy needs. For example, photochemical grid models have frequently been used to inform air quality policy decisions because of their ability to integrate meteorology and chemistry, allowing for the calculation of the effects of proposed emissions changes. Typically, air quality policy makers use these models to simulate specific "what if" scenarios that assess the impacts of a given control strategy (Cuvelier e*t al*., 2007). Scenarios are also used in order to assess the effect on air quality of planned or existing major constructions, such as airports (Moussiopoulos *et al*., 1997; Peace *et al*., 2006) or roads. Models are also useful for predicting pollutant distribution following an accidental release, and the production of air pollutant dispersion and concentration maps (de Smet *et al*., 2007). These maps are necessary both for public awareness as well as for indicating areas where more strict policy measures are required to improve air quality and to comply with the legislation standards.

The use of modelling tools in regulatory activity has also been supported by several authorities in the U.S, such as the U.S. Environmental Protection Agency that supervised the development of a Support Center for Regulatory Atmospheric Modelling, SCRAM (URL 4). In Europe, several activities exist in the area of air quality modelling, which are organised by relevant projects or Excellence Networks, such as the "Initiative on Harmonisation" that was launched in 1991 to promote increased cooperation and standardisation of atmospheric dispersion models for regulatory purposes. Other examples are the current COST Actions 728 (URL 5) and 732 (URL 6), which respectively focus on the development and evaluation of modelling tools for air quality assessment. Also, the reports produced under the EU funded "Air quality assessment by monitoring and modelling for regulated pollutants in

Europe" (AIR4EU) project (URL 7) have provided guidelines for authorities to establish best AQA practices, where the use of modelling is particularly encouraged.

2. THE MODELLING NETWORK - FAIRMODE

Scope and objectives

As stated previously, the main aim of FAIRMODE is to bring together air quality modellers and users in order to promote and support the harmonised use of modelling practices for the assessment of air quality by EU member countries. In view of these requirements, the network promotes synergy - at a local, national and European level - through the development and implementation of a common infrastructure based on best practices for reporting and storing information relevant to air quality modelling. In this way, a repository could be created where tools, results and maps will be readily accessible to authorities and scientists of the member states.

Further, FAIRMODE focuses on scientific research that will establish improved and validated modelling tools on which decision making can be based. This is particularly important, as meteorological and air quality models are increasingly recognised as the main conduit for the transfer of scientific understanding of the atmospheric processes that control air quality to the management of air quality. The network also aims to enhance awareness of model usefulness, reliability and accuracy through model validation and intercomparison exercises at national or European level.

Some important objectives of FAIRMODE are to:

- Establish the tools and mechanisms for enhancing communication between modellers and model users and provide a framework for exchange of experience at all levels of application. This will include electronic interfaces, databases and tools as well as workshops, seminars and common activities.
- Provide guidance on best modelling practices for AQA.
- Provide a centralised portal for information concerning the new AQD, submission of compliance data based on modelling, references and experiences of other users through case studies, and will provide QA/QC methods for users and provide information support for these services.

More detailed objectives regarding model use and evaluation include:

- The assessment of air quality in (urban) hot-spot areas, focusing on local/urban vs. regional/global contributions.
- The promotion of model validation and quality assurance of model results to identify limitations and remove error factors. This implies the analysis of existing model validation and intercomparison exercises and, if necessary, the organisation of and participation in additional exercises at national or European level. Such exercises will be complementary to other parallel activities.

Structure

The structure of FAIRMODE is schematically represented in Figure 1.

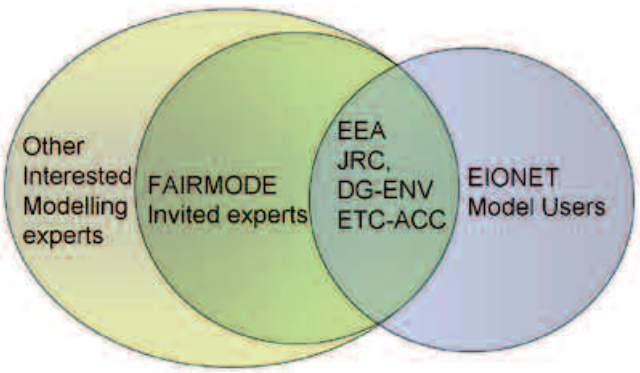

Figure 1. The structure of FAIRMODE.

FAIRMODE is lead by a Steering Committee jointly chaired by the EEA, DG-JRC and DG-ENV. It is expected that a Memorandum of Understanding will govern the operation of the network. The FAIRMODE Steering Committee was officially formed on the 9th of April 2008 after a series of preparatory meetings between the establishing members of the network. The members of the Steering Committee have been selected after taking into consideration the main aims and expected function of the network. Suitable EEA, JRC and EIONET (URL 8) representatives were initially identified. Model users from several European countries were then nominated, as well as several stakeholders from the relevant scientific projects/actions and bodies (URL 9). This synthesis of the Steering Committee will facilitate concerted interactions between modellers and air quality managers from the various member states in order to ensure maximum impact of the planned network.

FAIRMODE is planned to operate in a similar way as the AQUILA network (URL 10), which has been focusing on air pollutant measurement methodologies. Experts from EU Member States and EEA Member Countries are expected to participate in FAIRMODE open activities, especially the network's Plenary meetings. The first Plenary meeting will take place in Cavtat, Croatia on 10 October 2008. On such occasions the support of additional independent experts will also be sought, according to the needs and topics foreseen to be covered. The country experts are expected to participate at their own costs, or otherwise seek funding within their own country for most of the activities.

Work plan

FAIRMODE has set up two Work Groups (WGs), the first of which focuses on the development of a Guidance Document on best modelling practices. This activity is lead by EEA's European Topic Centre on Air and Climate Change (ETC-ACC). A second WG will deal with QA/QC issues. The two groups will evolve simultaneously and through continuous feedback and cooperation, as the modelling exercises that will be carried out in the scope of FAIRMODE will be relevant to both. The main activities of the network examine the role of modelling and its application relative to EU Directives and guidelines. Initially, a detailed review of past examples on the use of modelling in AQA, case studies, model description and validation will be undertaken in order to define current needs. Following this review, in terms of more practical activities and depending on the users' and stakeholders' needs, modelling assessment exercises will be carried out. The JRC has taken on a leading role in the co-ordination of such an action, gaining from its experience in leading the "Eurodelta" and "CityDelta" intercomparison exercises. Needs in terms of AQA and model evaluation criteria will be defined at different scales through relevant exercises (for example through benchmark tests following the relevant European Network of Excellence on Atmospheric Composition Change (ACCENT) activity on model benchmarking (Moussiopoulos and Isaksen, 2007)). Most of these modelling activities directly address actual modelling needs and refer to exchanging scientific knowledge, as well as user experiences through case studies and practical guidance on preparation of input to modelling cases. They will provide valuable information on the usefulness, reliability and accuracy of different models and will reveal potential roles of modelling in air quality assessment, such as in the assessment of future pollutant concentrations if a particular mitigation policy is followed. In these exercises, suitable operational tools – either already existing or especially developed for this purpose within FAIRMODE - will be utilised to ensure the meaningful and accurate review of the modelling results. As an essential part of the network activities, the results and findings from these exercises will be stored and disseminated through suitable interfaces to EU Member States and EEA Member Countries. Existing databases and interfaces such as the EEA's Data Centre will play a crucial role for collecting, storing and making the results readily available.

Model validation will be a crucial outcome of the review analysis and modelling exercises. Several infrastructures will be combined and established to serve the model validation purpose. Existing databases, such as the Model Documentation System (MDS (URL 11)), the COST728/732 Model inventory (URL 12) and EEA's AirBase (URL 13), will contribute towards model validation, by providing information on model performance and observational data based on previous applications. They will facilitate model application through their comprehensive and detailed description of a significant number of models. Information on model features, limitations and best use, as well as model and input data availability, will further encourage model application. The validation meta-database developed within the COST728 framework (URL 14) will provide a flexible system both for submitting as well as for searching information on available validation datasets. The overall activity will be closely connected to JRC actions related to air pollution modelling, as well as to the EEA's Data Centre on Air. The connection to the Data Centre on Air will be established by providing quality assured data for model validation, emissions maps and modelled air quality maps (e.g. ensemble means). The parallel development of the Shared Environmental Information System SEIS (URL 15), a collaborative initiative of the European Commission and the EEA, will also contribute in this data exchange activity. FAIRMODE will contribute to the Data Centre work through improving the dissemination of air quality data held in databases for model use.

A working document is being created setting out aims and methods of FAIRMODE for dissemination purposes. The network will be responsible for the preparation and organisation of other dissemination activities, such as theme specific seminars and information days. Relevant stakeholders will be invited to participate in discussions and workshops focused on the exchange of ideas, problems, information and practical/technical knowledge on air quality modelling. These events will thematically address aspects of modelling that will promote the ideas of good modelling practices. Such themes could include, for example, model assessment, validation and uncertainty, process descriptions in models, data assimilation and the use of monitoring. The overriding principle will be to communicate experience from expert to non-expert users, providing first hand practical experience.

3. DELIVERABLES AND EXPECTED OUTCOMES

The initial activities of FAIRMODE are focusing on the preparation of the Guidance Document for model use and on model QA/QC procedures (uncertainties, input data) by the two relevant Work Groups. The progress of the preparation of these documents will be reviewed and discussed within the frame of the 1st Plenary meeting.

A major aim of the Guidance Document on model use is to build up confidence in air quality modelling and its use within the framework of the EU air quality legislation. The draft document that is currently under preparation

includes an interpretation of respective requirements of the new AQD, followed by the specific topics of model validation, quality assurance and control and the use of models for air quality assessment and the development of mitigation strategies. A chapter of the Guidance Document will be dedicated to best practices of reporting model use and results. Topics of special interest such as air pollutant source apportionment and natural source contribution to limit and target value exceedances will also be covered. An advanced draft of this document will be presented as an ETC-ACC deliverable to the EEA in September 2008. The draft will be introduced to model users and policy makers for their comments during the 1st Plenary meeting of FAIRMODE. The Guidance Document will be further updated with the experience gained from the modelling exercises and case studies within the framework of FAIRMODE activities.

A centralised web portal has been created in support of FAIRMODE (URL 16). A web site is also hosted by EEA (URL 17). The present version of the web portal provides information on the scope and objectives of the network, as well as on its structure and main participants. It includes several links to relevant projects, legislation and actions, as well as a collection of general guidance documents on model use and some guides to specific models. An operational, password-protected "members' area" is an area of the web portal dedicated to internal communication and exchange of data and information, which is restricted only to the network managers and members of the Steering Committee. The web portal will be continuously updated to include announcements of relevant events and meetings, FAIRMODE newsletters and other dissemination material. Finally, as the activities of the network progress, results of the FAIMODE Work Groups will be presented via the web portal using appropriate storage and analysis tools. In its final version, the web portal is expected to function as a common platform for reporting and storing modelling information, results and maps that will facilitate communication and interaction between countries, but also between modellers and policy makers.

FAIRMODE members recognised the need to set up an official system for the accreditation of models for policy support. The development of such a system would necessarily include a series of modelling exercises and tests and it is scheduled for the next stage of the network operation. It is expected that this system will be an important and useful outcome of the work by the Work Group on the quality assurance of models.

4. CONCLUDING REMARKS

FAIRMODE was set off by EEA and JRC, in a common effort to respond to the requirements of the new AQD, in particular regarding the introduction of modelling as a necessary tool for AQA and AQM in the context of the assessments required under the EU Air Quality Directives. The 1st Plenary Meeting of the Modelling Network will be co-chaired by the EEA and JRC and will take place back-to-back with the 12th International Conference on Harmonisation within Atmospheric Dispersion Modelling for Regulatory Purposes (Cavtat, Croatia, October 6th -9th, 2008). The session will include an official presentation of the structure, aim, objectives and work plan of FAIRMODE, and will initiate the function and activities of the network, thus providing an excellent opportunity for network members to meet and organise future steps. Invited experts and local/national model users, as well as other interested parties, will be able to comment on the concept and current plan according to their needs.

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