



Contents lists available at ScienceDirect

Environmental Science & Policy

journal homepage: www.elsevier.com/locate/envsci



Overview of current regional and local scale air quality modelling practices: Assessment and planning tools in the EU

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ARTICLE INFO

Article history:

Received 13 November 2015

Received in revised form 22 March 2016

Accepted 23 March 2016

Available online xxx

Keywords:

Air quality modeling

Air quality planning

Integrated assessment modeling

Air quality directive

ABSTRACT

The 2008 European Air Quality Directive (AQD) (2008/50/EC) encourages the use of models in combination with monitoring in a range of applications. It also requires Member States to design appropriate air quality plans for zones where the air quality does not comply with the AQD limit values. In order to cope with these various elements, a wide range of different modeling methods have been developed and applied by EU Member States in the last decade to assess the effects of local and regional emission abatement policy options on air quality and human health. However, an overall review of the methodologies that are used in different countries to compile local and regional air quality plans has not been performed so far. Such a review has been the objective of the APPRAISAL EU FP7 project with the main goal to identify methodologies and their limitations and to propose possible key areas to be addressed by research and innovation on the basis of this review. To fulfill these objectives, a structured online database of methodologies has been developed in collaboration with experts involved in the design of air quality plans (AQP). The current work relies on the APPRAISAL database which currently totals 59 contributions from 13 Member States. In this paper we summarize the outcome of the APPRAISAL project with respect to the review of current Integrated Assessment Modeling practices.

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1. Introduction

The 2008 European Air Quality Directive (AQD) (2008/50/EC) encourages the use of models in combination with monitoring in a range of applications. It also requires Member States (MS) to design

appropriate air quality plans (AQP) for zones where the air quality does not comply with the AQD limit values, i.e. to plan possible emission reduction measures to improve air quality. These emissions reductions should be implemented in a cost-effective way through the territory. Obligations resulting from other EU directives (e.g. the National Emission Ceiling Directive) and targeting more specific sectors of activity (e.g. transport, industry, energy, agriculture, etc.) must also be considered when designing

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<http://dx.doi.org/10.1016/j.envsci.2016.03.013>

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and assessing local and regional air quality plans (Syri et al., 2002; Coll et al., 2009). In order to cope with these various elements, a wide range of different modeling methods have been developed and applied by EU Member States in the last decade to assess the effects of local and regional emission abatement policy options on air quality and human health. These modeling methods range from simple scenario approaches, i.e. running the model with/without a specific emission source to quantify its impact on air quality levels (e.g. Cuvelier et al., 2007; Thunis et al., 2007; De Ridder et al., 2008) to more comprehensive ones like full cost-benefit analyses (Carnevale et al., 2012; Mediavilla-Sahagun and ApSimon, 2013), in which abatement measures as well as their benefit are monetarized.

However, an overall review of the methodologies that are used in different countries to compile local and regional air quality plans has not been performed so far. Such a review has been the objective of the APPRAISAL EU FP7 project (<http://www.appraisal-fp7.eu>) with the main goal to identify methodologies and their limitations and to propose possible key areas to be addressed by research and innovation on the basis of this review. To this end, a structured online database has been developed in collaboration with experts involved in the design of AQP. The following topics were considered: (1) synergies among national, regional and local approaches, including emission abatement policies; (2) air quality assessment, including modelling and measurements; (3) health impact assessment approaches; (4) source apportionment; and (5) uncertainty and robustness, including Quality Assurance/Quality Control (QA/QC).

The current work relies on the APPRAISAL database which currently totals 59 contributions from 13 MS. Two groups were distinguished to refine the analysis: the stakeholders involved in the design of “air quality plans” (AQP) and groups involved in “research projects” (RP). While AQP, which represent 60% of the database information coming from 10 MS, is representative of current practices in the decision process, RP (30% of the database contributions, coming from 7 MS) are usually assumed to be based on the most updated methods. Countries represent the study area in 20% of cases, regions in 25% and agglomeration or urban level in 30% of the cases. The remaining percentage refers to other types of focus which could not be classified in these categories. Note that the database (<http://servizi.appraisal-fp7.eu/appraisal/faces/pages/public/query.xhtml>) is still open to contributions. An example of the current status (September 2015) is presented in

Fig. 1 where the contributions are represented per country. Local planning authorities (e.g. municipality) represent 25% of the respondents whereas universities, research institutions, environmental agencies represent each, about 20%.

The final purpose of this review is to contribute to improved knowledge on integrated assessment for air quality plans on the regional and local scales and to improve the use of scientific knowledge by policy makers and regulatory bodies across member states.

In the present paper we focus only on the second topic of the database, i.e. on the air quality assessment. Companion papers (Rasoloharimahefa et al., 2016; Carnevale et al., 2016; Viaene et al., 2016) are devoted to the other aspects of the database. Section 2 details the approach followed to review the methodologies used to assess air quality, along 5 subtopics detailed here per section: Section 3 gives an overview of existing integrated assessment tools; Section 4 focuses on their air quality modelling component; A particular attention is given to resolution and downscaling in Section 5, whereas emissions and other model inputs are discussed in Section 6; finally, we assess in Section 7 the way in which measurements and modelling are associated within these methodologies both in terms of data-assimilation and evaluation of the model performance.

2. Methodology

In order to characterize the usage of AQ assessment and planning tools, the APPRAISAL questionnaire included questions around a topic called “Air quality assessment and planning, including modelling and measurement”.

Questions addressed the following points: purpose of the modelling (air quality assessment, mitigation and planning, source apportionment), the strategy followed (scenario analysis, cost-benefit, cost-effectiveness, multi-objective approach), the type of source-receptors approach used (methodology, spatial and temporal resolutions, indicators), the modelling approaches (models, processes, spatial and temporal resolutions, nesting), the input data including emissions (inventory approach, split into activity sectors, resolution . . .), the meteorological input (models, processes, time and spatial resolution), the initial and boundary conditions and some information on the use (or not) of measurements (measurements method, type and location of the monitoring stations, temporal resolution, transformation of the data if

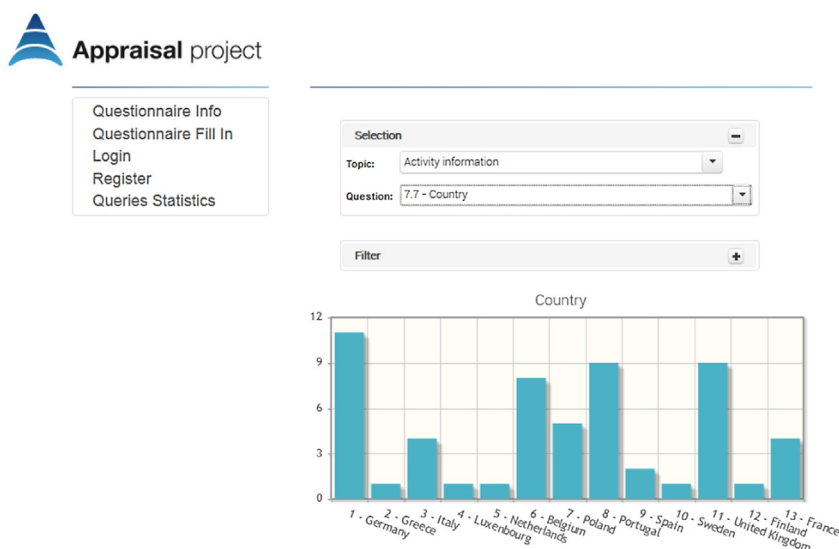


Fig. 1. Screenshot of the Appraisal query selection with a specific application to the current database contributions in terms of countries.

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