A European compilation of national air quality maps based on modelling

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Front-page picture:
Puzzle rugs to jazz up your living space (©eu.fab.com); does the European compilation of national modelled air quality the same?

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Executive summary

Air quality models are increasingly used by European countries in their air quality assessments but there is limited interaction or harmonisation of modelling results between countries. As part of the spatial air quality mapping activities of the ETC/ACM a request for national air quality mapping results, submitted by countries in their official reporting to the European Commission, was made. The national mapping results would be combined into a "composite" map which could be compared with the more traditional European maps annually prepared by the ETC/ACM using the combined information from AirBase monitoring station data, European-wide air quality models and other supplementary data sources.

In the first phase of this activity, Part 1 of this paper, the Air Quality Questionnaire (EC 2004b) has been used to identify the Member States and EFTA countries which have used model calculations to assess the air quality in one or more zones in their country, under the Air Quality Directives (EC 2004a, EC 2004b, EC 2008). Depending on the pollutant, five (PM_{10}) to twelve countries (benzene) reported that air quality assessments are supported with the results of air quality models. In a further e-mail request, sent to all contact persons listed in the Air Quality Questionnaire, all countries have been asked for more information on their models and on their willingness to co-operate in preparing European-wide composite maps. Eleven countries replied positively to this request. As a result of this first phase it became clear that it would not be possible to prepare a pan-European composite map of any of the legislative pollutants. The best coverage, in terms of the number of countries (7 to 8), was found for NO_2 and PM_{10}.

As a result of this first phase activity it was recognised that a more extensive request for mapping data was required. In the second phase of this activity, Part 2 of this paper, a systematic internet search for national and sub-national modelling activities and public information was executed. To collect as much information as possible, the search was extended from the EU 27 Member States to both EEA's 32 Member Countries and its seven Collaborating Countries. To help focus the results the search looked at models or mapping that provided annual averages of PM_{10}, NO_2 and SO_2. To obtain comparable results the year 2010 was identified as the year of interest. Having identified countries that may have the appropriate mapping results available it was decided to approach each country individually with a dedicated request that focussed on just these few pollutant indicators.

This dedicated and personalised approach resulted in many enthusiastic responses to the ETC/ACM request. Out of the contacted 32 countries, 31 countries responded and by mid-November 2012 the requested data had been submitted by 19 countries. Of those 19 countries, 15 provided data for the whole territory and four for one or more region. Twelve countries responded that they currently do not, or did not yet, utilise modelling approaches for regular annual air quality assessments. Several of these countries expected to have modelling instrumentation for annual national air quality assessment and evaluation in place within a timeframe of a few months or up to two years. From these submitted data European composite maps have been produced.

The European composite maps demonstrate that the national maps differ both in grid resolution and in grid orientation. The original spatial resolution and orientation of the national contributions are retained in the European composite maps in order to represent the national modelling results in their original form. The variation in resolution is one source of potential differences in modelling results between countries or at country borders. As part of an assessment of the composite maps we discuss visual consistencies and possible discrepancies in modelling, without any value judgement on model performance. This is intended to indicate where potential model harmonisation and spatial refinement efforts may be needed if a more consistent and homogeneous distribution of modelling results is to be obtained over Europe, independent of territorial borders. Together with the modelling results additional information on the model characteristics and its application criteria have been provided, including a reference to the Model Documentation System (MDS) of EEA, if applicable.

An important conclusion from the model-based mapping inventory is the positive momentum that exists currently in the countries to contribute with and to exchange modelling and mapping information, in relation to their national air quality modelling and mapping activities under the Air Quality Directives. From the country responses one could conclude that there is a clear need for a forum where difficulties and complexities in the air quality modelling and mapping activities for national assessments and evaluations can be expressed and discussed. Furthermore, there seems to be a need for a common platform that has a focus on generating an overview of all national activities and that pro-actively coordinates, facilitates and supports exchange and sharing of modelling experiences and model harmonisation efforts on air quality modelling between the (groups of) countries in Europe.

The Forum for Air Quality Modelling (FAIRMODE) initiative could provide such a platform. Recommended in this paper is that FAIRMODE should then support, next to air quality modelling, mapping techniques in general. As such, similar to the inventory in this paper, FAIRMODE could organise inventories for a series of legislated air pollutant indicators, including additional workshops that discuss the compiled results and the consistencies or mismatches of the modelling and mapping results between countries. This would stimulate model harmonisation activities and streamline model results between bordering countries and between groups of countries, resulting in a more consistent European representation of modelled legislative pollutant indicators.

Contents

Executive summary 3

Contents 5

Introduction 7

Part 1. Initial inventory of models used in national air quality assessments reported to the European Union 7

1. The use of models for regulatory purposes 7

2. Next steps 10

Part 2. Systematic inventory of national model based assessments and its European composite maps 11

3. Systematic internet search for national modelling activities 11

4. Request for national air quality modelling data 11

5. Responses on the data request and its observations 12

6. Data treatment and map production 15

6.1. Characteristics of the data contributions 15

6.2. Characteristics of the european composite maps 15

6.3. Merging criteria applied for the european map composition 16

6.4. Background information on modelling in the countries 19

7. Brief visual interpretation of the European composite maps 19

7.1. Annual average PM_{10} 19

7.2. Annual average NO_2 23

7.3. Annual Average SO_2 26

8. Wrap-up, conclusions and summarised recommendations 29

References 31

Annex 1. Results of a systematic internet search for national modelling activities (internet status: April/May 2012) 33

Annex 2. Example of dedicated email to national contacts with request for modelling data 40

Annex 3. List of national persons contacted by email with modelling data request 41

Annex 4. List of national contact persons responding to the request for modelling data 44

Annex 5. National modelling information as provided by the national representatives or modeller that provided data 49

Introduction

Air quality models are increasingly used by European countries in their air quality assessments. In its Implementation Plan of 2011 the ETC/ACM proposed to collect the national air quality mapping results based mostly on (dispersion) models as used by the countries in their official reporting (e.g. in the Air Quality Questionnaire (EC 2004)). The national mapping results would be combined into a "composite" map which could be compared with the more traditional maps annually prepared by the ETC/ACM using the combined information from AirBase measurement, European-wide models and further supplementary data (see de Smet et al, 2010 and references cited therein). Part 1 of this paper summarises the work done in 2011 and Part 2 reflects the follow-up activities of 2012 and its mapping results.

Part 1.
Initial inventory of models used in national air quality assessments reported to the European Union

1. The use of models for regulatory purposes

Annually the Member States (MS)[1] report to the European Commission under Air Quality Directives (EC 2004a, EC 2004b, EC 2008) on the air quality in their territory in relation to the limit and target values as set in the Directive. These reports are provided in the form of a predefined questionnaire (EC 2004). Member States have to divide their territory into a number of air quality management zones. In each zone, an assessment of the air quality has to be made using measurements, modelling or other empirical techniques. In one of the forms of the Air Quality Questionnaire, the MS provide information whether the levels in their zones exceed or do not exceed the limit or target values. Different markers are used here to indicate whether the assessment is based on measurements (or a combination of measurements and other techniques) or on model calculations solely.

The Questionnaire (EC 2004b) has been used to identify the MS, which have used model calculation to assess the air quality in one or more zones. The results, based on 2010 data, are given in Table 1. A similar exercise has been done for the 2009 data, giving equivalent results. Depending on the pollutant, 5 (PM_{10}) to 12 countries (benzene) reported that the air quality assessments in relation to the limit and target values is supported with the results of air quality models. These numbers might be an underestimation as the combined use of models and measurements is in the reporting indicated in a similar way as an assessment based on measurements only. The largest numbers of countries using modelling can be found for the heavy metals (arsenic, nickel, cadmium and lead) and benzo(a)pyrene (B(a)P). The concentrations of these pollutants are frequently below the lower assessment threshold (LAT; for details see EC 2008). Below this level, modelling or objective-estimation techniques alone may be used to assess ambient air quality. It might be that in these cases simple tools rather than atmospheric dispersion models have been used.

[1] In addition to the 27 Member States (MS), information over 2010 has been received from the EFTA countries Norway and Switzerland. In part 1 of this paper we refer to the EU 27 plus Norway and Switzerland, also by using the abbreviation *MS.*

Table 1. Overview of Member States which have used models in the reporting under the Air Quality Directive to assess air quality in at least one air quality management zone (indicated with "". The situation for 2010 is shown. Note that reports under the Air Quality Directive have not been received from Finland and Malta. Member States, which have confirmed by e-mail the availability of concentrations maps, are indicated with "M" (national maps available) or "m" (maps regional or urban maps not covering the total country).*

country	SO_2	NO_2	PM_{10}	$PM_{2.5}$	O_3	Pb	benzene	CO	As	Ni	Cd	B(a)P
AT	-	-	-	-	-	-	-	-	-	-	-	-
BE	-/M -	-/M	-/M		-/M -	-/m	-	-	-/m	-/m	-/m	-
BG	-	-	-	-	-	-	-	-	-	-	-	-
CH	-	-	-	-	-	-	-	-	-	-	-	-
CY	-	-	-	-	-	-	-	-	-	-	-	-
CZ	*/M	*/M	-/M	*	-/M	-	-/M	-	-	-	-	*/M
DE	*	-/M	-/M	*/M	*/M	*	*	*	*	*	*	*
DK	-	-	-	-	-	-	*	-	-	-	-	*
EE	-	-	-	-	-	-	-	-	-	-	-	-
ES	*/M	*/M	*/M	*/M	*/M	*/M	*/M	*	*/M	*/M	*/M	*
FR	*	*	*	-	-	-	*	*	-	-	-	-
GB	*/M	*/M	*/M	*/M	*/M	*/M	*/M	*/M	*/M	*/M	*/M	*/M
GR	-	-	-	-	-	*	*	-	*	*	*	*
HU	-	-	-	-	-	*	*	-	*	*	*	-
IE	-	-	-	-	-	-	-	-	-	-	-	-
IT	*	*	*	*	*	*	*	*	*	*	*	*
LT	-/m	-/m	-/m	-	-	-	-	-/m	-	-	-	-
LU	-	-	-	-	-	-	-	-	-	-	-	-
LV	-	-	-	-	-	-	-	-	-	-	-	-
NL	-/M	-/M	-/M	-/M	*	*	*/M	-/M	*	*	*	*
NO	*	*	*	*	*	-	*	*	*	*	*	*
PL	-	-	-	-	-	*	*	-	*	*	*	*
PT	-	-	-	-	-	-	-	-	-	-	-	-
RO	-	-	-	-	-	-	-	-	-	-	-	-
SE	-/M	-/M	-	-	-	-	-	-	-	-	-	-
SI	*	*	-	*	*	*	*	*	*	*	*	*
SK	*/M	*/M	-/M	-/M	-/M	-	-/M	*/M	-/M	-/M	-/M	-

In an e-mail request, sent to all contact persons listed in the Air Quality Questionnaire, all MS have been asked for more information on their models and on their willingness to co-operate in preparing European-wide composite maps. A reply to this request has been given by eleven countries. The responses can be summarized as:

Austria: no models are used for national and/or international reporting. In reporting under the Air Quality Directive, indicative methods are used for the assessment of heavy metal levels. These methods are not based on models but on measurements data from stations in neighbouring zones;

Belgium: the RIO-Corine interpolation technique (Janssen et al, 2008) is used to prepare maps of NO_2, PM_{10}, O_3 and SO_2 for each of the three Belgian regions (Flanders, Walloon Region, Brussels Capital Regions). The RIO model is used to publish near real time air quality maps on the website of the Belgian Interregional Environment Agency. (www.ircel.be). The model is also used for assessment and reporting of air quality in Belgium. The RIO-Corine maps for NO_2 and PM_{10} will be spatially refined in the near future by combining RIO interpolation results with the IFDM-model (Immission Frequency Distribution Model, see http://pandora.meng.auth.gr/mds/showlong.php?id=50). The IFDM model is also used to map concentration fields of lead, arsenic, cadmium and nickel;

Czech Republic: Interpolated maps are regularly prepared for PM_{10}, SO_2, NO_2, NO_x, ozone, benzene, and benzo(a)pyrene; maps for cadmium and arsenic are produced on a non-regular basis. The maps, with a resolution of 1 km x 1 km, are prepared with a methodology similar to the routine mapping procedures applied by the ETC/ACM (see de Smet et al (2010) and references cited therein). Measurement and model results (and altitude in some cases) are combined using linear regression, followed by the interpolation of its residuals. For the majority of pollutants, rural and urban background maps are created separately and merged together using population density. In some cases, the traffic layer (created based on the traffic stations) is added (using traffic intensity grid);

Germany: Air quality models are used for official reporting. Maps for NO_2, PM_{10}, $PM_{2.5}$ and ozone have been submitted via the Air Quality Questionnaire (2010 data); these maps are based on an optimum interpolation technique (Flemming and Stern 2004) using monitoring and modelling data (REM-CALGRID model). The spatial resolution is 8 km x 8 km;

Spain: Air quality maps are prepared by combining the results of a dispersion model (CHIMERE, see http://www.lmd.polytechnique.fr/chimere/) and measurement data. For the Iberian Peninsula, the resolution is $0.1x0.1^{o}$. In combining the model and measurement data, a methodology similar to the one used by the ETC/ACM (de Smet et al 2010) is used. Maps are available for PM_{10}, $PM_{2.5}$, SO_2, NO_2, NO_x, ozone, benzene and heavy metals;

Greece: Currently no air quality modelling is applied to assess and report on the air quality. In the past, modelling has been used for the preliminary assessment reports;

Lithuania: For the largest cities (Vilnius, Kaunas, Šiauliai, Alytuje, Klaipėda, Panevėžys, see http://oras.gamta.lt/cms/index?rubricId=f29af7ab-601c-4478-8e88-eadae31e4403) air quality maps are available for CO, PM_{10}, SO_2, NO_2. Calculations are based on the ADMS-urban model (http://www.cerc.co.uk/environmental-software/ADMS-Urban-model.html). The spatial resolution varies from 50 m x 50 m to 200 m x 200 m;

Latvia: Air quality modelling is based on the EnviMan system (developed by OPSIS AB, Sweden, http://opsis.se/Applications/DataHandling/AirQualityModelling/tabid/329/Default.aspx);

Netherlands: The GCN modelling system (http://www.rivm.nl/nl/themasites/gcn/index.html) is used to prepare national maps for NO_2, PM_{10}, $PM_{2.5}$, SO_2, CO, and benzene with a resolution of 1 km x 1 km. The GCN method applies a long-term Gaussian model (OPS, van Jaarsveld 2004) which is calibrated using measurements;

United Kingdom: Maps are produced for the pollutants NOx, NO_2, SO_2, PM_{10}, $PM_{2.5}$, benzene, CO, O_3, BaP, As, Cd, Ni, and Pb. In the majority of cases, these are at 1 km x 1 km resolution for background models and are on a road link basis for the roadside models. The outputs are generally annual means but there are some alternative metrics for CO, SO_2 and ozone. A description of the methodology is given at:

- The first and second Daughter Directive (EC 1999, EC 2000) pollutants (SO_2, NO_2, NO_x, PM_{10}, (excluding Pb), and benzene and CO) modelling methodology http://uk-air.defra.gov.uk/reports/cat09/1101250943_dd122008mapsrep_v4.pdf
- The fourth Daughter Directive (EC 2004a) pollutants (As, Cd, Ni and B(a)P) modelling methodology http://uk-air.defra.gov.uk/reports/cat09/1101250945_dd42008mapsrepv6.pdf
- Ozone modelling methodology http://uk-air.defra.gov.uk/reports/cat09/1101250944_DD3_mapsrep2008_v4.pdf;

Slovakia: The CEMOD model (Szabo, 2003) is used for assessment of SO_2, NO_x, NO_2, CO, and benzene at the national level with a resolution of 1 km x 1 km. CEMOD is a Gaussian dispersion model based on the ISCST3 and CALINE models developed by the US EPA. National maps of PM_{10}, $PM_{2.5}$, heavy metals and ozone are based on the IDWA model (3D anisotropic inverse distance interpolation including empirical altitude dependence

function of concentrations based on background measurements; (see URL)). For source apportionment purposes, high resolution maps (100 m x 100 m to 500 m x 500 m) for PM_{10} are based on the US EPA CALPUFF model. National Maps for 2009 and 2010 provided in http://www.shmu.sk/File/oko/hodnotenie/2010_Hodnotenie_KO_v_SR.pdf;

Sweden: Sweden does not currently report air quality modelling data to international bodies. A number of local authorities and the national transport authorities do however use models for assessing air quality at the local level. Sweden has developed a national air quality modelling tool, called SIMAIR: (http://www.smhi.se/en/services/professional-services/Environment/air-quality-at-and-around-roads-1.7647). This tool is the most commonly used model. For the major cities (Stockholm, Gothenburg, Malmö, Norrköping) local air quality maps are available. The Swedish Meteorological and Hydrological Institute (SMHI) provides maps of background concentrations of NO_2, SO_2 and NH_3 with a resolution of 20 km^2 using the MATCH-Sweden model. (http://www.smhi.se/sgn0102/miljoovervakning/kartvisare.php?lager =09CAIR_NO2__M).

The results of the e-mail request have been included in Table 1. There is some inconsistency between this information and the information extracted from the Air Quality Questionnaire. Two reasons will mainly explain this: (i) in the Air Quality Questionnaire it is indicated when the assessment is based on modelling only; when modelling is used in support to monitoring the same marker is used as for the case that the assessment is based on monitoring only; (ii) when concentrations are below the lower assessment threshold, objective estimation techniques might be used; to indicate this situation, several MS use the marker for model application here. The applied models use a variety of methodologies; interpolation techniques (inverse distance, optimal interpolation, kriging using supplementary data) are frequently used. Lagrangian and Gaussian type models are applied next to the more complex Eulerian models where physical and chemical processes (transport dispersion, deposition, and photochemistry) are calculated in a 3-dimensional grid. Calibration of the modelled concentration fields based on monitoring data is not uncommon.

2. Next steps

From reviewing the Table 1, it becomes clear that for none of the pollutants it will be possible to prepare a pan-European composite map. The best coverage, in terms of the number of countries (7 to 8), is found for NO_2 and PM_{10}.

To improve the coverage, an option is to include in the analysis not only models applied in "official" reporting but also models used at the national level for information of the (general) public. For example, The Department of Labour Inspection (DLI), the authority responsible for the assessment, monitoring and reporting of air quality in Cyprus, provides on its web site maps of NO_2, SO_2, benzene and ozone (see: http://www.airquality.dli.mlsi.gov.cy/Default.aspx?pageid=225&menuitem=67).

Other examples can be found for Denmark: in the annual reports on the Danish air quality monitoring programme the national environmental research institute (NERI) provides next to the review of monitoring data, modelled concentration maps for NO_2, SO_2 and ozone. A suite of models is applied: model calculations of air quality on national scale are carried out using the Eulerian DEHM (version 5.0)-model with a resolution of 6 km x 6 km. The Urban Background Model, UBM, calculates the urban background levels based on input data from DEHM concerning the regional background. The street canyon model OSPM is used to calculate the air pollution at 2 m height at the side walks of selected streets (see, http://www.dmu.dk/en/Air/Monitoring/Reports/)

A third example can be found for France: The Ministry on Environment provides information (including maps) on http://www.developpement-durable.gouv.fr/Bilan-de-la-qualite-de-l-air-en,17701.html. The annual maps show, among others, maps of NO_2, PM_{10} and ozone.

For the activities of the ETC/ACM in 2012, it was recommended to do a more systematic search on the availability of these modelling results used to inform the public. After having analysed the results of this search, a decision on the continuation of the work was taken. Main criteria for this decision was the coverage in terms of Member States (maps should be available for at least some 15 MS) and the area (the total area covered by the contributing countries should be at least some 2/3 of the EU27 and EFTA4 territory). The preliminary results (Table 1) suggest that the best coverage will be obtained for NO_2 and PM_{10}. In view of its health impacts, the preparation of a composite PM_{10} map should be given the highest priority.

Part 2.
Systematic inventory of national model based assessments and its European composite maps

3. Systematic internet search for national modelling activities

As recommendation from the initial inventory in 2011, a systematic internet search for national and regional modelling activities and public information was executed in 2012. To collect as much as possible information the internet search was extended from the EU 27 Member States to both EEA's 32 Member Countries and its seven Collaborating Countries. This resulted per country in a variety of information. Most countries appear to operate or are in a stage of implementing modelling instrumentation for regular (i.e., mostly annual) national and/or regional mapping and assessments; some have not such activities in place. Some countries publish well up-to-date and extended information and documentation about their national air quality modelling efforts and results. Others provide less extended or more scattered information, or the information is more or less lagging behind the actual status and does not reflect the actual activities within the country. For a few countries, hardly any or no information could be found. Details on the internet search strategy and its results are reflected per country in Annex 1.

All together, the available internet information gave the impression that in the early years of current millennium intensive development and implementation efforts took place on air quality modelling and mapping, with a decreasing tendency in several countries to further develop modelling instrumentation and implementation of modelling activities on a more systematic annual basis. This raised the question on how to proceed in the attempt to collect spatial modelling results from the countries with the aim to construct a European composite map that would indicate coincidences and differences between modelling approaches and results between countries (and their regions).

4. Request for national air quality modelling data

Despite limited expectations and due to lack of alternatives, it was decided to approach each country individually with a request for results of spatial modelling data as product of their air quality assessments and evaluation. Driven by poor expectations and the results of the initial

inventory in 2011, the request was focussed on a few pollutants and their indicators. One could expect that, if countries undertook air quality assessments based on spatial modelling, they would at least produce on these major pollutants. To be on the safe side a year was selected for which the countries should have rather recent results readily available, including proper documentation of the modelling approach. The request addressed therefore annual averages for PM_{10}, NO_2, and SO_2 for the year 2010.

As strategy aiming at getting the largest possible response and commitment to deliver data and information on modelling was envisaged. Thus, a dedicated email to individual contacts as found on national web pages was sent out, referring to their modelling project and assessment activities in the single countries, regardless the topicality status of the information available on the respective web pages. Furthermore, the formal contact person of the air quality Questionnaire was included. In many countries, the two contact persons were actually the same, or they appeared to be direct colleagues. To increase the impact of the email, in many cases also the data suppliers under the Exchange of Information Decision (EC, 1997) were approached, especially when there was some doubt about the actuality of the internet information or Air Quality Questionnaire contact details. In the first half of September 2012, this dedicated email was sent to 32 countries (Table 2). Annex 2 provides an example of such a dedicated email: the data request sent to the Spanish internet contacts. Annex 3 lists all contact persons approached, including some relevant details.

5. Responses on the data request and its observations

Originally, we had our concerns that countries would be hesitant to respond and cooperate, and would experience such a data and information request as a potential risk, because the results might be subject to some kind of unintentional judgement mechanism or benchmarking (from the policy or political point of view), i.e. addressing the performance of their national air quality abatement measures and the air quality itself, both based on these modelling results.

Nevertheless, the more dedicated and personalised approach resulted in surprisingly many enthusiastic responses to the ETC/ACM request. Out of the contacted 32 countries, 31 countries responded and by mid-November 2012 the requested data had been submitted by 19 countries. Of those 19 countries, 15 provided data for the whole territory and four for one or more regions, the latter were Austria, Italy, Lithuania, and Poland. Twelve countries responded they currently do not, or not yet, utilise modelling approaches for regular annual air quality assessments. Several of these countries indicated that such activity is under development. They expect to have modelling instrumentation for national (and/or regional) air quality assessment and evaluation on an annual basis in place within a timeframe of few months up to 2 years. Annex 4 lists the experts in the countries who responded in one way or another to our request for national modelling data. Currently, only Hungary did not respond in any form to our request. No data is expected from this country as no modelling information has been found on the internet.

Table 2 summarises the responses and spatial modelling data contributions from the countries. Some countries in the table have not been contacted yet because it is not clear who the proper contact person(s) is. This concerns mostly the EEA Cooperating Countries on the Balkan and Turkey. Considering the current cooperation of these countries with (and support by) the EEA, we expect that within a few years these countries may have implemented some level of air quality modelling and mapping for their national air pollution assessment and evaluation.

Table 2. Overview of the responses and spatial modelling data submissions of the countries.

Country (#)			1 = yes / blank = no									Remark
#	Alpha-2	Short name	Country contacted by ETC/ACM	Country responded	No AQ modelling or no 2010 data	AQ mod. data, but no submission	AQ mod. data submission	Data year	Annual average data submitted PM_{10}	NO_2	SO_2	
1	AL	Albania ***										Not contacted; lacking yet clear contact person
2	AT	Austria *	1	1			1	2006		1		Federal State of Styria (2006, also valid for 2010)
3	BA	Bosnia-Herzegovina ***										Not contacted; lacking yet clear contact person
4	BE	Belgium *	1	1			1	2010	1	1	1	
5	BG	Bulgaria *	1	1	1							
6	CH	Switzerland **	1	1			1	2010	1	1		Eastern CH kantons are in cooperation with LI
7	CY	Cyprus *	1	1	1							Data for 2013 do exist
8	CZ	Czech Republic *	1	1			1	2010	1	1	1	
9	DE	Germany *	1	1			1	2010	1	1	1	
10	DK	Denmark *	1	1			1	2010	1	1	1	
11	EE	Estonia *	1	1			1	2010	1	1	1	
12	ES	Spain *	1	1			1	2010	1	1	1	
13	FI	Finland *	1	1			1	2010	1	1	1	
14	FR	France *	1	1		1		2010				
15	GB	United Kingdom *	1	1			1	2010	1	1	1	
16	GR	Greece *	1	1			1	2010?	1	1	1	Point data; seems not to be 2010, rather 2004
17	HR	Croatia ***	1	1		1		2006				Too outdated; modelling revives now in HR
18	HU	Hungary *	1									No response received
19	IE	Ireland *	1	1	1							
20	IS	Iceland **	1	1	1							Some modelling at capital
21	IT	Italy *	1	1			1	2010	1	1	1	NO2, PM10: Lombardia & Piedmont; SO2: P. only
22	LI	Liechtenstein **	1	1			1	2010	1	1		In co-operation with the eastern kantons of CH
23	LT	Lithuania *	1	1			1	2010	1	1	1	Agglomeration of Vilnius
24	LU	Luxembourg *	1	1		1						Under implementation, with Wallonian ISSeP
25	LV	Latvia *	1	1	1							
26	ME	Montenegro ***										Not contacted; just started monitoring
27	MK	FYR of Macedonia ***										Not contacted; lacking yet clear contact person
28	MT	Malta *	1	1	1							
29	NL	Netherlands *	1	1			1	2010	1	1	1	
30	NO	Norway **	1	1	1							Some local urban AQ modelling
31	PL	Poland *	1	1			1	2010	1	1	1	3 vovoidships: Lódzkie,Mazowieckie, Zach.-pom.
32	PT	Portugal *	1	1			1	2010	1	1	1	
33	RO	Romania *	1	1	1							
34	RS	Serbia ***										Not contacted; lacking yet clear contact person
35	SE	Sweden *	1	1			1	2010	1	1	1	
36	SI	Slovenia *	1	1	1							Implementation and test now; applied in 2013
37	SK	Slovak Republic *	1	1			1	2010	1	1	1	
38	TR	Turkey **										Not contacted; lacking yet clear contact person
39	XS	Kosovo (under UN SCR 1244/99) ***										Not contacted; lacking yet clear contact person
39		**Totals**	**32**	**31**	**9**	**3**	**19**		**18**	**19**	**16**	

* *EU-27 Member States*
** *Non EU-27 Member State, EEA Member Country*
*** *Non EU-27 Member State, EEA Cooperating Country*
(#) *ISO3166-1 country codes: Alpha-2 element and Short Name*

Important and remarkable observations concerning this data request process are:

- The impressive and high degree, well beyond the original expectations of the ETC/ACM, of willingness and/or eagerness to cooperate and submit their data, without signs of policy or political reserve or restraint, as somehow anticipated by the ETC/ACM.
- The enthusiasm with which the national contacts were willing to cooperate concerning the requested contributions, including also the often spontaneous offer for any other indicator and year of data if requested, and/or including the most recent and at times just freshly produced or forthcoming data. In case the requested data were not available some of the modelling teams were even willing to run their models to be able to provide us with the specifically requested, and some actually did.
- The persons contacted by the ETC/ACM appeared in most cases to be the main responsible person on air quality modelling assessments in the country, as well as being regularly the formal national air quality representative in the EU context. In other cases where several contacts exist, it appeared that sending the email with the data request to both the national contact person and the modelling expert stimulated internal communication on whether and which data was available and could be provided to the ETC. This actually speeded up the data delivery considerably. One important conclusion is that screening the internet and using the Air Quality Questionnaire contacts demonstrated to lead to a well-targeted contact list with speedy communication and delivery. Further, through this approach, we reached most of the persons and networks nationally (or regionally) involved in modelling activities per se, as well as in the use of modelling results in the national and regional policy oriented context.
- In case persons contacted were not in charge of modelling activities themselves or not authorised for approval of the requested cooperation and data delivery, they promptly forwarded the request to a more or most appropriate persons within the country or regions. This resulted in the fact that within a 2 - 3 weeks period the ETC had already a rather complete overview of what data for which countries or regions could be expected. The delivery of actual data involved some more handling efforts and time both at the submitters as well as on the ETC/ACM side.
- Most contributors spontaneously gave useful background information about the modelling efforts and approaches applied for national assessment purposes. This includes in several cases indications on the limitations and shortcomings in modelling efforts with which the countries are confronted.
- Several countries asked what kind of data the ETC/ACM intended to request for the next year or the next inventory and whether this would become a regular data reporting flow from now on.
- Some countries explicitly expressed their appreciation about the initiative of this kind of modelling results inventory. They are very eager to learn about the outcomes, in expectation of learning about the extend to which their modelling instrumentation provides results that match up with those of neighbouring countries.
- Almost all countries that currently do not utilise a modelling instrumentation for regular annual air quality assessment indicated that such an activity is under development. They expect to have such modelling instrumentation in place within a timeframe of a few months up to about 2 years. Some promised spontaneously to be able to deliver at a ‘next year's request’.
- The ETC/ACM’s impression is that the contacted persons – both modellers and national representatives – appreciated referring in the email with the data request to the specific information found on the internet, – as a recognition of their activities . It stimulated the spontaneous character of the responses.

Conclusively, a positive momentum exists in the countries to contribute with and to exchange information and results on their air quality modelling activities. The responses gave the impression that our request addressed a certain need from those countries and regions for a

forum where difficulties and complexities concerning their modelling activities in relation to air quality in general and in relation to the Air Quality Directives should be discussed. The Forum for Air Quality Modelling in Europe (FAIRMODE; http://fairmode.ew.eea.europa.eu/) provides in principal for such platform, i.e. a board of national and regional authorities and their modelling communities. FAIRMODE can also play a similar role at the urban scale and/or city authority level. Therefore, the ETC/ACM recommends that EEA and FAIRMODE use the momentum experienced within this study.

6. Data treatment and map production

6.1. Characteristics of the data contributions

Data format: The spatial modelling datasets provided by the countries consisted of various geographical oriented data types. The data formats consisted of Shapefiles, ArcInfo, ArcInfo Export (E00), ASCII, NetCDF, MS Excel or DBF.

Geographic features: The spatial feature types were rasters, grids, isolines or grid-point coordinates. (Spatial information originally submitted as isolines has been resubmitted on our request as gridded or point oriented data, as it facilitated simpler processing into composite maps).

Spatial resolution: The raster or grid resolutions range from 10 m x 10 m (Styria, Austria to 0.1x0.1 degrees (Spain: 0.1 degree ≈ 11 km; also Sweden reports a spatial resolution of 11 km, which most likely refers to 0.1 degree model resolution).

Geographical or Projection system: The spatial data has been provided in various (often the national) projected coordinate systems, or as geographical coordinates (longitude/latitude). In case projection information has been provided, it is included in Annex 5.

Modelling information: All countries that submitted data referred to the models applied. Annex 5 contains that information, with partly reference to the online air quality Modelling Documentation System (MDS) of the EEA (http://acm.eionet.europa.eu/databases/MDS/index_html)[2] (See section 6.4).

6.2. Characteristics of the European composite maps

Data format: ArcGIS Shapefile sets

Geographic features: Original features are kept in the map

Spatial resolution: Original resolutions are kept in the map

Geographic and Projection coordinate system: (as defined by ArcGIS)

Projected Coordinate System:	ETRS_1989_LAEA
Projection:	Lambert_Azimuthal_Equal_Area
False_Easting:	4321000.00000000
False_Northing:	3210000.00000000
Central_Meridian:	10.00000000
Latitude_Of_Origin:	52.00000000
Linear Unit:	Meter
Geographic Coordinate System:	GCS_ETRS_1989
Datum:	D_ETRS_1989
Prime Meridian:	Greenwich
Angular Unit:	Degree

[2] A new version of the MDS, hosted by EEA, is under preparation.

6.3. Merging criteria applied for the European map composition

All file types have been imported into ArcGIS and converted into one geographical coordinate system, the GCS_ETRS_1984. Then they were merged into one component map which is presented in the EEA standard projection ETRS_1989_LAEA_52N_10E as given in section 6.3 (i.e. Lambert Azimuthal Equal Area, with the central meridian of 10° East and a latitude of origin of 52° North).
A few national or regional contributions covered modelling results for areas extending outside their national territorial boundaries. These were clipped (cut) out of the map, meaning the data contribution is presented in the maps only for the national or regional territory itself. As such, no overlapping modelling data will be represented in the maps.
In the composition map the EEA standard template layer "countryborder.<xxx>" (shape file; see http://www.eea.europa.eu/data-and-maps/data/eea-mapdata-and-templates-gis-4, Eionet user account login required) has been used as default border line between countries. This border line version differs from the border lines of the Euroboundary shape files, which has been used by many countries for their national mapping activities. Some countries provided mapped data strictly for their national territory. This resulted in the compilation process at several locations in small "blank areas" between countries where the border lines of Euroboundary and the EEA template do not match fully. To eliminate these tiny blank border areas, existing data from the neighbouring country has been used to fill them as is illustrated in Figure 1 for two cases.

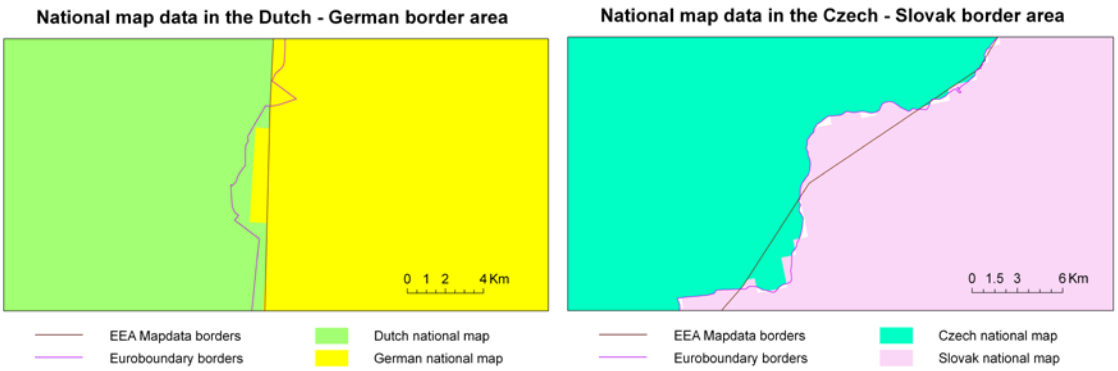


Figure 1. The compilation result of national map data in the Dutch - German (left) and Czech - Slovak (right) border areas. Based on the applied EEA standard border lines, national mapping data is inserted for the involved national territory. In case this results in small blank border areas due to "no data", national map data of the neighbouring country have been used if existing.

The national maps differ both in grid resolution and in grid orientation from each other, due to the application of specific national projection coordinate systems within the countries. These differences can be observed clearly in border areas as is illustrated by Figure 2.

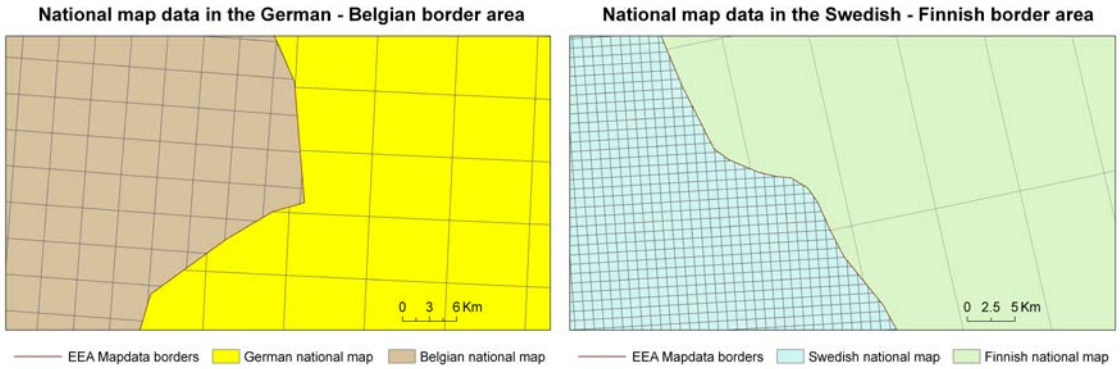


Figure 2. National map data at the German - Belgian (left) and Swedish - Finnish (right) borders illustrate the difference in grid resolution and orientation in the national maps.

The original spatial resolution and orientation of the national contributions are represented in the European composite map with the intention to reflect the national modelling results as original as possible. As such it reflects the different resolutions used in the different countries, which may emphasize potential differences in modelling results between countries or at country borders, primarily related to the chosen modelling resolution itself. Table 3 provides the overview of the original national projection and resolution for each contribution that is included in the composite maps. It indicates also the obvious change in resolution as a result of the data-format and GIS processing of the original data.

Table 3. The projected coordinate system and resolution of each national contribution and its resulting resolution in the composite maps. A change in resolution had its cause in either the original resolution being too high for consequent compilation into the composite map, or a change of the resolution being forced unintentionally during the data-format processing. In case of a change, the original resolution is included in the last column.

Country (Region)	Projection, Coordinate system (ArcGIS Title)	Resolution in the Composite Map [km]	Original Resolution [km]
AT Styria	WGS_1984_UTM_Zone_33N	0.1	0.01
BE	Belge_Lambert_1972	4	
CH	GCS_Bessel_1841	0.2	0.1
CZ	ETRS_1989_LAEA	1	
DE	WGS_1984_Lambert_Conformal_Conic	7x8	
DK	Lon/Lat Coordinates	8	5
EE	Estonia_1997_Estonia_National_Grid	5	
ES	Lon/Lat Coordinates	8x10	
FI	GCS_WGS_1984	10x20	0.2 dec. degrees
GB	British_National_Grid	NO_2 & PM_{10}: 1km; SO_2: 30km	
IT Lombardia	WGS_1984_UTM_Zone_32N	4	
Piedmont	WGS_1984_UTM_Zone_33N	4	
LI	GCS_Bessel_1841	0.1	
LT	GRS_1980_Transverse_Mercator	0.1	
NL	GCS_Amersfoort	1	
PL Lodz	PUWG_92 Gauss_Kruger	variable	variable
Masovia	Lambert_Conformal_Conic	variable	0.5-1.0
West Pomerania	PUWG_92 Gauss_Kruger	variable	0.25-0.5-1.0
PT	Datum_73_Hayford_Gauss_IGeoE	5	
SE	NO_2 & PM_{10}: SWEREF99 TM; SO_2: RT90 2.5 gon V	NO_2 & PM_{10}: 1km; SO_2: 20km	
SK	S-JTSK_Krovak_East_North Coordinates	1	

The European composite maps are based on contributions containing 2010 data, which the we merged into a single European-wide map. We compiled three 2010 maps: annual averages for PM_{10}, SO_2 and NO_2. Some countries provided data for other years, but it was decided to keep the maps for now purely restricted to the year 2010 to avoid inconsistency between the title of this paper and actual map contents. In an attempt to visualise as clearly as possible both the consistencies and the discrepancies of modelling results between countries, especially at bordering countries, the ultimate European composite maps are presented with a rather wide range of legend classes optimized for its class intervals and colour scheme.
The close-to-final versions of composite maps have been communicated to all contact persons that responded to our call for data. We asked the country experts for a brief visual 'review' of the maps, or to provide any other relevant feedback. Several requests for corrections were provided, e.g., the insertion of 2006 modelling data being still representative for the 2010 situation. Meanwhile also some corrections or data updates had been delivered. The review feedback and updates from the countries have been incorporated in the maps. Annex 5 of this paper includes the feedback received.

The final European composition maps, based on the composition of the national air quality spatial modelling data contributions for the year 2010, are presented in Chapter 7 in Map 1 with the annual average PM_{10}, Map 2 with the annual average SO_2, and Map 3 with annual average NO_2.

A few country experts suggested to include in the paper next to the composite maps also the maps with point data representing the annual averages of the 2010 measurements at the stations as reported under the Exchange of Information (EoI, EC (1997)) and stored in Airbase version 6 (AirBase v6 2012). The modelling results are mostly of such spatial resolution that they do not represent hotspots, such as urban traffic areas and industrial locations. Assuming the annual averages at *rural* stations are the best corresponding with the modelled (grid) values at the location of the stations, it has been suggested to prepare annual average PM_{10}, SO_2 and NO_2 concentration maps for the rural stations. This could help identifying areas where countries feel there is a need for more work on model application. For example, it may help identifying those areas where regional and/or national models underestimate the rural PM10 concentrations actually measured at air quality stations in these areas. These underestimates may have their cause in the limited spatial resolution of the models applied. Applying models with a higher spatial resolution instead may result in a better match with the PM10 concentrations actually measured at the rural stations in these areas. Maps 1a, 2a and 3a represent these 2010 annual averages at the rural stations with at least 75 % annual data coverage (extracted from AirBase v6 (2012)).

6.4. Background information on modelling in the countries

In case of a contribution the contact persons were requested to accompany their data with a brief description on the main characteristics of the applied model(s) , including specific criteria of application, e.g. information on which pollutants were modelled, time and spatial resolutions, methodological aspects, etc. In case the model is described in the Model Documentation System (MDS, http://acm.eionet.europa.eu/databases/MDS/index_html) one could simply refer to it, saving time and efforts. Several countries did refer to models in MDS and often included details about the deviations from MDS pertaining to their specific model applications to meet with national or regional conditions. Annex 5 reflects all additional background information as provided with the data submission or through the review cycle of the draft maps.
In a few cases, countries that did not submitted data provided nevertheless information on current ongoing modelling developments. This concerns mostly countries that aim to implement a modelling instrumentation for their national (and/or regional) air quality assessments and evaluation on an annual basis.
After finalisation of the European composite maps and drafting of this paper it appeared that for Italy also air quality modelling on a national scale takes place for the Italian Ministry of Environment. As no results for 2010 were readily available at finalisation of this paper drafting, it was decided to include 2007 maps and a brief model description as demonstration case in the Annex 5 in addition to the Italian regional contributions.

7. Brief visual interpretation of the European composite maps

In this chapter, we briefly describe or indicate where we see consistencies and possible discrepancies in modelling results as presented in the maps, without any value judgement on which model provides the best results. Furthermore, no model benchmarking or deeper analysis has been done and will not be done based on the maps and the provided information. Such exercise was beyond the scope of this inventory and should be based on a more profound collection of information from each modelling nation and/or region.

As explained in the section 6.3, the maps with the 2010 annual averages at the rural stations of AirBase accompany the model composite (gridded) maps. ETC/ACM assumed that the rural stations' annual average is the parameter best corresponding with the modelled annual value (grid cell) at the location of the stations. Thus, if discrepancies were observed between the annual averages measured at the stations and the modelled annual average grid value, this could indicate that modelling results would not reflect accurately enough the actual concentrations in rural (background) areas and that additional effort should be made to improve the modelling approaches.

7.1. Annual average PM_{10}

Map 1 represents the European composite map of the annual average PM_{10} for 2010 based on national modelling contributions from countries and regions. The most striking differences in the annual average PM_{10} values one can observe at national borders between northern Portugal and Spain, at the whole border between Germany and The Netherlands and Belgium, at the majority of borders between Germany and Czech Republic, at the Slovak – Czech border and at the Danish – German border. Furthermore, there is a distinct difference between Denmark and southern Sweden. Denmark has PM_{10} values below 10 $\mu g/m^3$ for almost its complete territory, whereas, the bordering area of southern Sweden has values above 10

µg/m^3. Additionally, the spatial interpolation map of annual average PM_{10} for 2010 (de Smet et al, 2012) shows for both Denmark and southern Sweden values above 10 µg/m^3. In Figure 3 several of these observed differences are presented in enlarged map views. It might be worth to look into the modelling approaches applied by Sweden, Germany and Denmark to find an explanation for the clear difference observed between these countries.

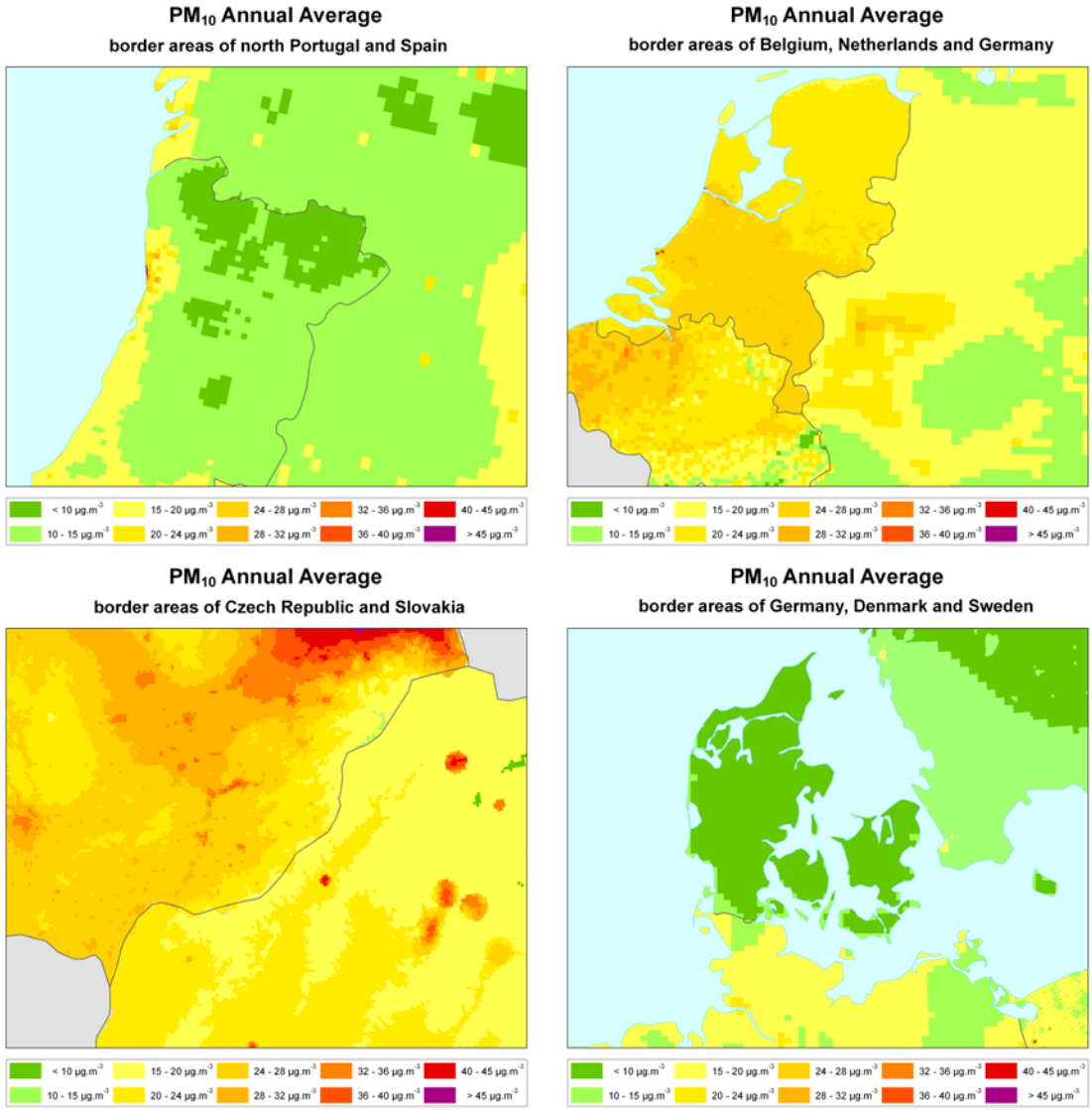
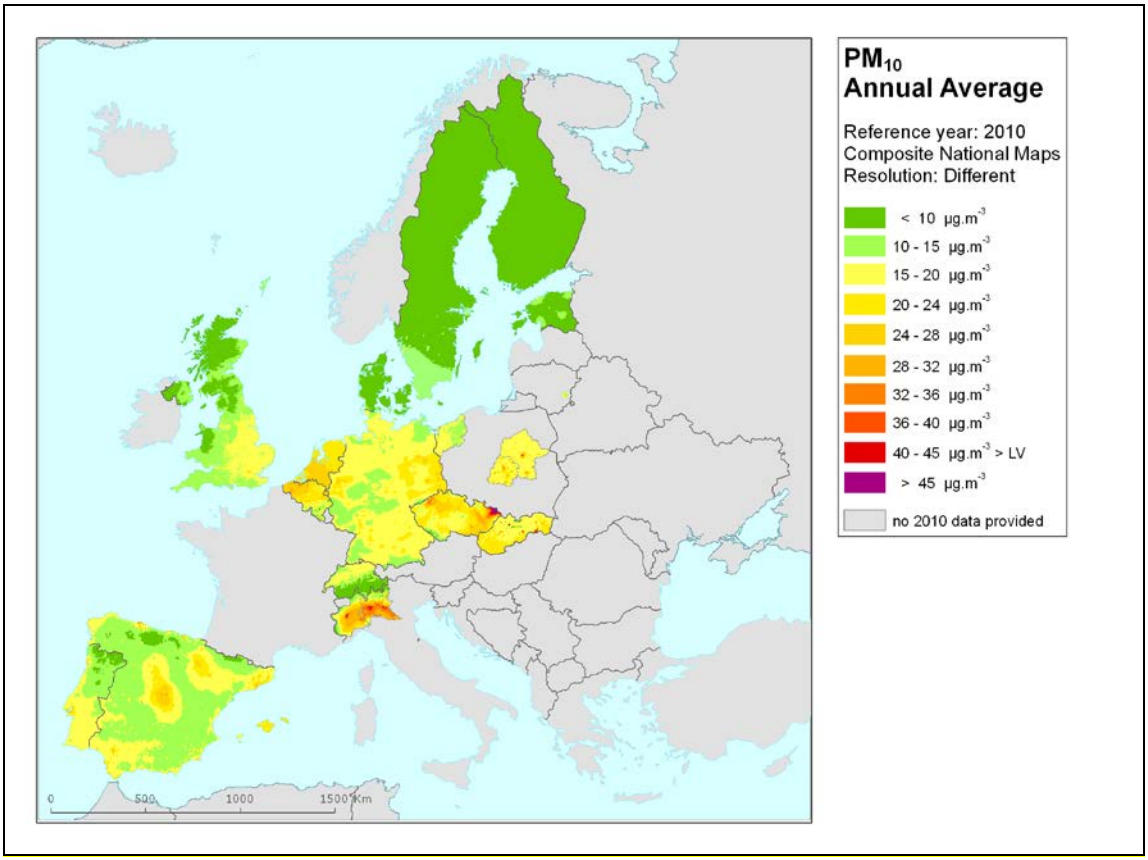


Figure 3. Enlarged map views of the PM_{10} annual average map (Map 1) showing the observed differences between countries at bordering areas.

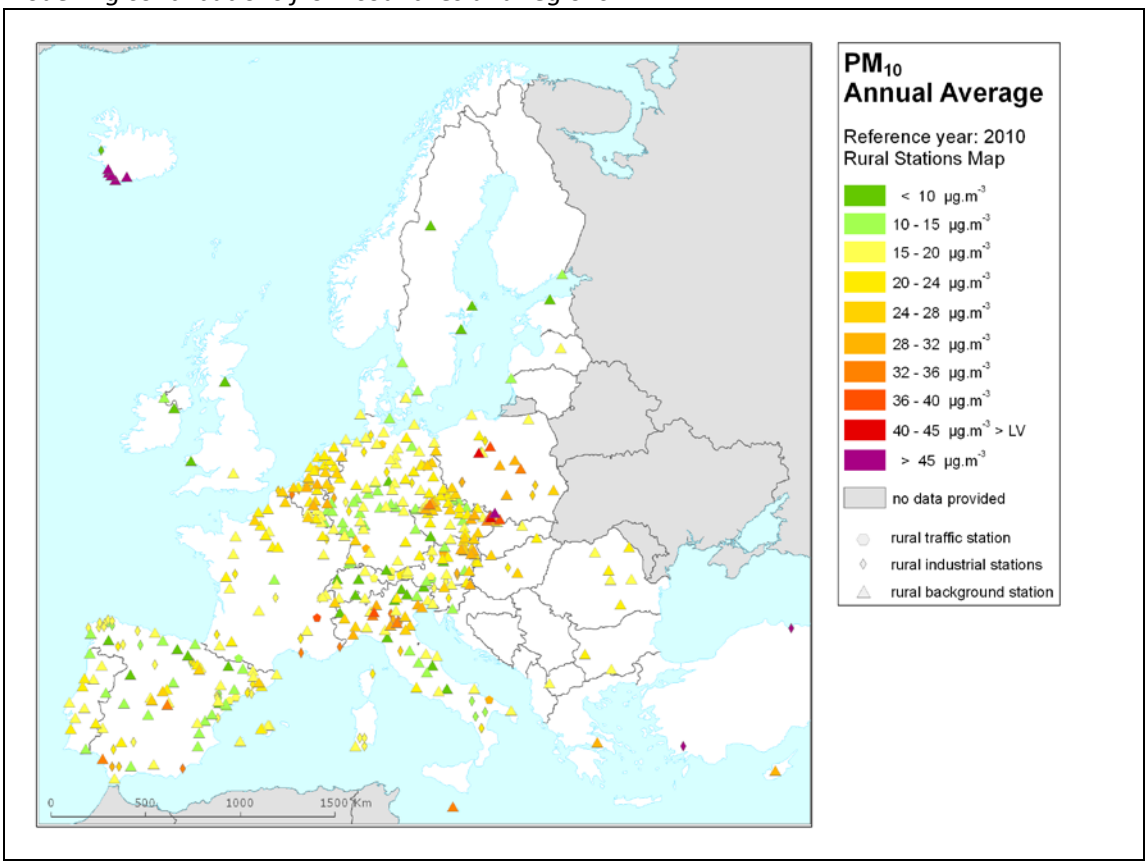
Less prominent differences one encounters where north-eastern Germany borders the Polish West Pomeranian voivodeship, at the border between The Netherland and Belgium and where the Portuguese districts Portalegre, Évora and Beja borders the Spanish region Estremadura. Interesting is the cross-border continuity of class colours at the Swiss – Italian border at the two Italian regions Lombardy and Piedmont. It would be worth to investigate if the Swiss and Italian model results match with each other more or less coincidentally or if they reflect well the actual situation.

The map with the annual average PM_{10} for 2010 at rural stations (Map 1a) can be of help to indicate areas where the modelling results do not adequately match actual measurement results. The map consists of a combination of three map layers: the layer with rural background

stations presented on top of the industrial and traffic station layers. This order of layer presentation has been chosen as the background stations represent a larger rural area than the rural traffic (mainly hotspots) and rural industrial stations. As such, it provides the most balanced visual impression of the annual averages occurring in the rural areas. Putting the higher traffic station values in these European-wide maps on top would provide a distorted visual representation of the actual pollution levels in that rural area. Moreover, some countries do not have rural industrial nor rural traffic stations. Comparing the station values of Map 1a with the modelling results of Map 1, indicates where modelling results are different from the measured levels, which can help improving the modelling approaches.
As it is beyond the goal of this inventory, this paper does not go into the interpretation of the comparison between maps 1 and 1a. The station map 1a is included on specific request of some of the contact persons from the countries.



Map 1. European composite map of the annual average PM_{10} for 2010 based on national modelling contributions from countries and regions.



Map 1a. European map with the annual average PM_{10} values for 2010 at the rural stations as reported by the countries under EU legislation (EC (1997). AirBase v6 (2012).

7.2. Annual average NO_2

Map 2 represents the European composite map of the annual average NO_2 for 2010 based on national modelling contributions from countries and regions. The clearest differences (Figure 4) in the annual average NO_2 values can be found at the Czech – Slovak border with quite a cross-border jump in levels. This seems to be directly linked to the modelling approach used in each country as one can also clearly distinguish different spatial patterns between the countries. Furthermore, the border of the Polish West Pomeranian voivodeship represents throughout its area a lower class value than the German areas in the neighbourghood. In addition, the other two mapped Polish voivodeships, Masovia and Łódź, show values in the lowest range comparable to the levels in West Pomerania. These differences from Germany may actually concern just a minor absolute difference in modelling results closely around the 5 µg/m^3 and disappear in case model approaches would be slightly tuned or harmonised, or different legend class intervals would be chosen. Obvious cross-border jumps exist also at the Swiss – Italian region Piedmont.

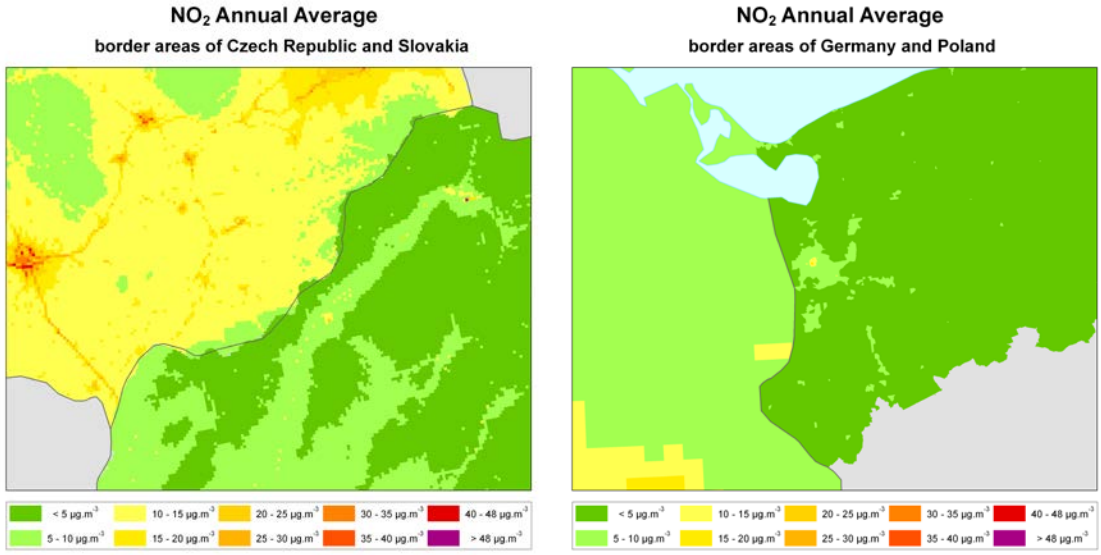


Figure 4. Enlarged map views of the NO_2 annual average map (Map2) showing the observed differences between countries at bordering areas.

Relative little cross-border jumps can be found at the southern Portuguese – Spanish border and at the eastern part of the northern Portuguese – Spanish border. Those findings are most probably due to similar reasons as those discussed above for the Polish West Pomerania – Germany border. The Czech Republic seems to model slightly lower values than Germany at the bordering areas.

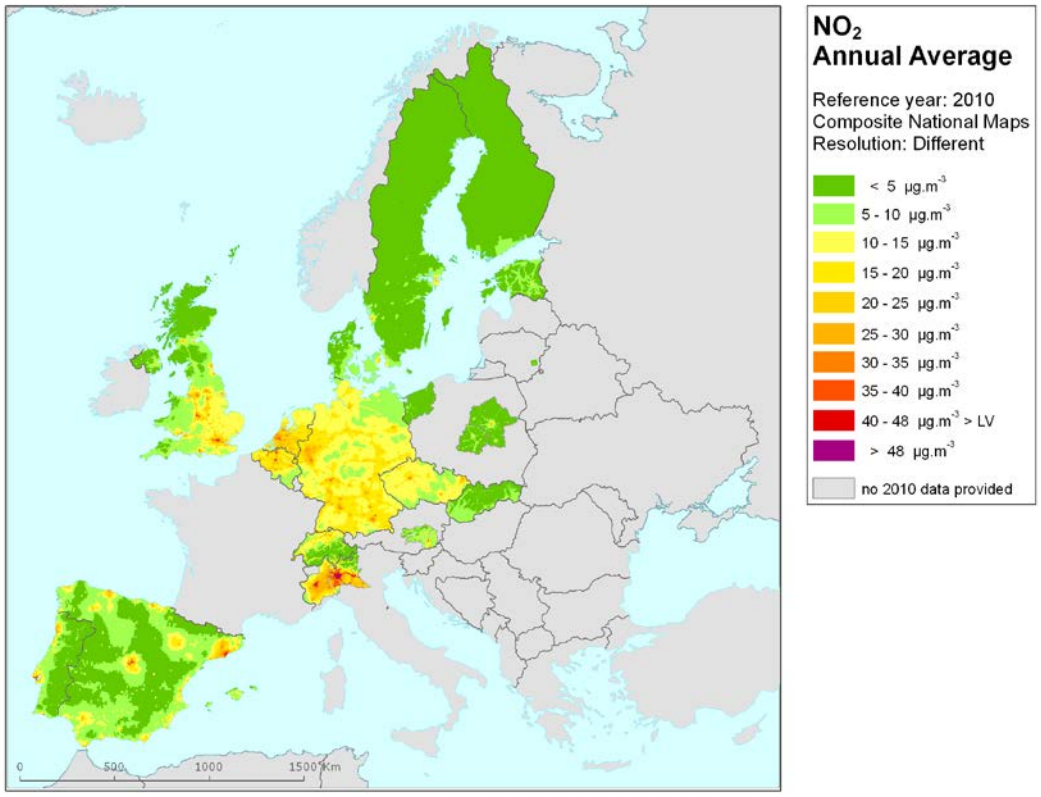
Rather well 'matching' results can be found at for Belgium, The Netherlands and Germany since colour patterns continue quite smoothly across national borders. In addition, the majority of the Portuguese – Spanish border areas show rather well harmonised modelling results.

Well distinguished are the line shaped patterns in several countries. These are the countries that include road networks and traffic intensities in their modelling, such as Estonia, Poland, Czech Republic, Germany, The Netherlands, Belgium, both Italian regions Piedmont and Lombardy, the Austrian region Styria and the UK. The higher the grid resolution the higher the contrast in the line patterns is. The modelling results for Estonia are not completely satisfactory

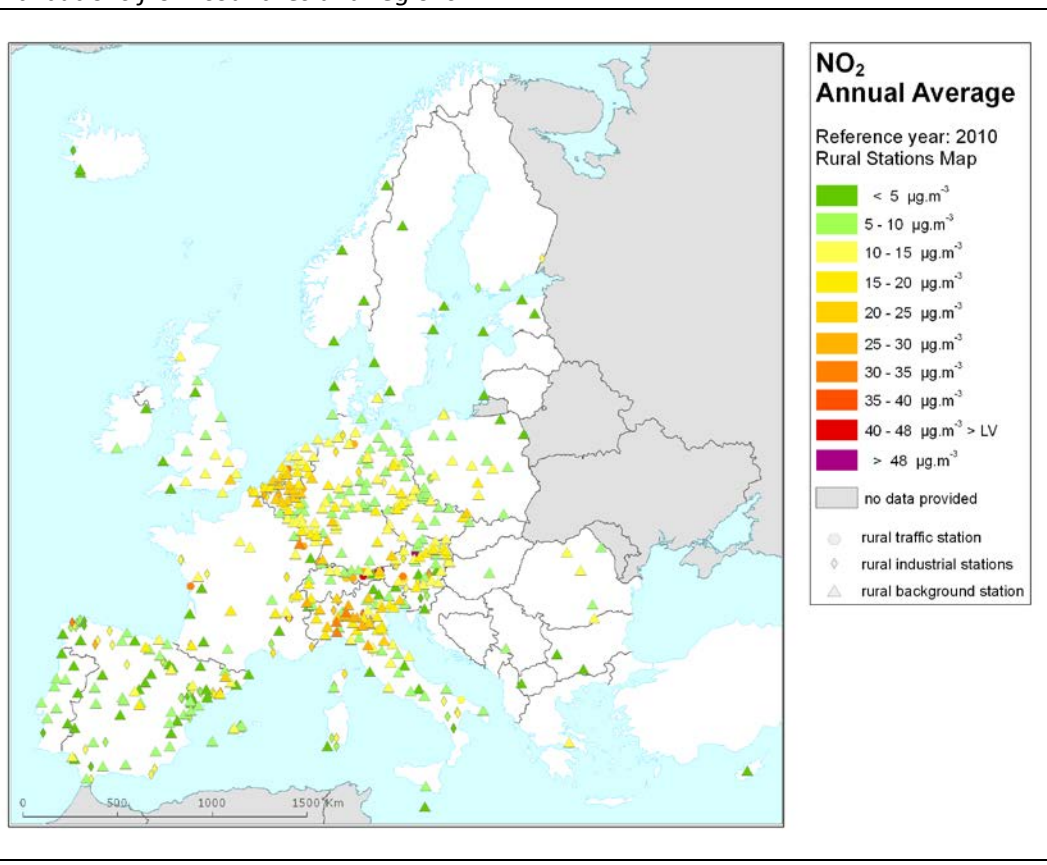
according the contributing modeller; some areas do contain some inconsistencies in the resulting modelling values and are subject of closer examination by Estonian modellers.

No map with European spatial interpolated annual average NO_2 based on Airbase station measurement data has been produced for 2010 by the ETC/ACM, therefore a comparison with such results is not possible.

The map with the annual average NO_2 at rural stations (Map 2a) is shown below to be of help in indicating areas where the modelling results might not match actual measurement results. As the rural background stations represent in principle a considerably larger rural area than rural traffic and rural industrial stations do, the rural background station layer has been presented on top. This provides in these European-wide maps a more balanced visual impression of pollution levels in the area represented. Detailed comparison between rural traffic station values of Map 2a with grid values of Map 2 that may include modelled road traffic contributions might be feasible for those countries where rural traffic stations exist and where road patterns in the modelled maps are visible because of the higher grid resolutions was applied in the modelling exercise.
As it is beyond the goal of this inventory, this paper does not go into the interpretation of the comparison between maps 2 and 2a. The station map 2a is included on specific request of some of the contact persons from the countries.



Map 2. European composite map for annual average NO_2, 2010, based on national modelling contributions from countries and regions.



Map 2a. European map with the annual average NO_2 values for 2010 at the rural stations as reported by the countries under EU legislation (EC (1997). AirBase v6 (2012).

7.3. Annual Average SO_2

Map 3 shows the European composite map of the annual average SO_2 concentration for 2010 based on national modelling contributions from countries and regions. For Switzerland, the Italian region Lombardy and the Austrian federal states of Styria SO_2 modelling results have not been submitted. This maybe because most countries and regions meet the European legally binding thresholds of this indicator already since several years. Thus, their modelling effort is not focussed on this indicator any longer. The UK models SO_2 indicators for ecosystem areas only, as may become clear from the colour pattern in the Map 3.

Most obvious cross-border jumps (Figure 5) can be observed at the German – Danish border with again systematic lower values on the Danish territory. Similar observation can be made along the Dutch – German border and partly for the Dutch – Belgium border. However, one should be aware that the class intervals for the annual average SO_2 cover quite small concentration ranges. On the other hand, the mapped Polish – German and Czech – German bordering areas do show well matching classes along quite extended border lengths.

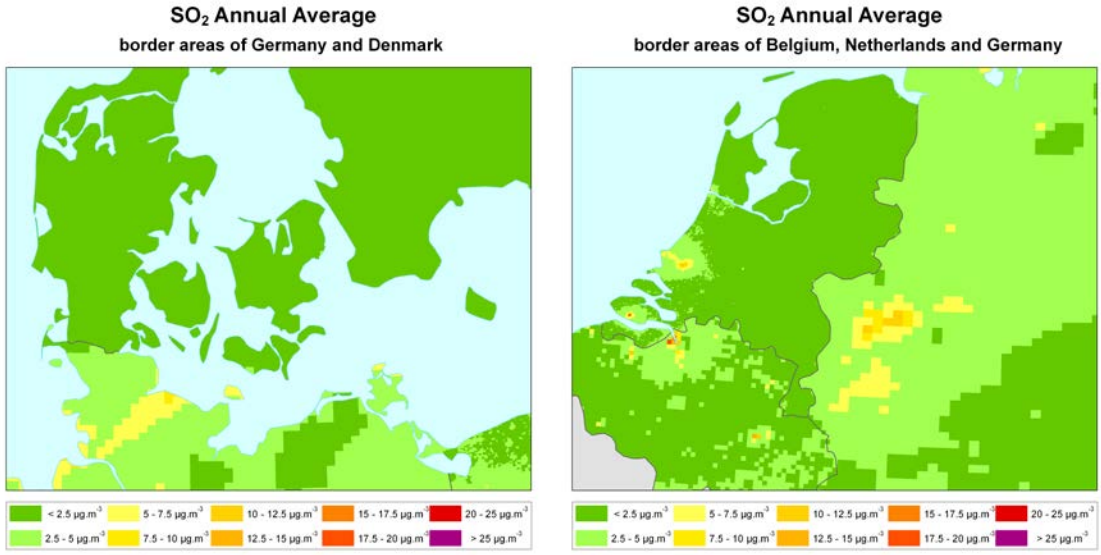
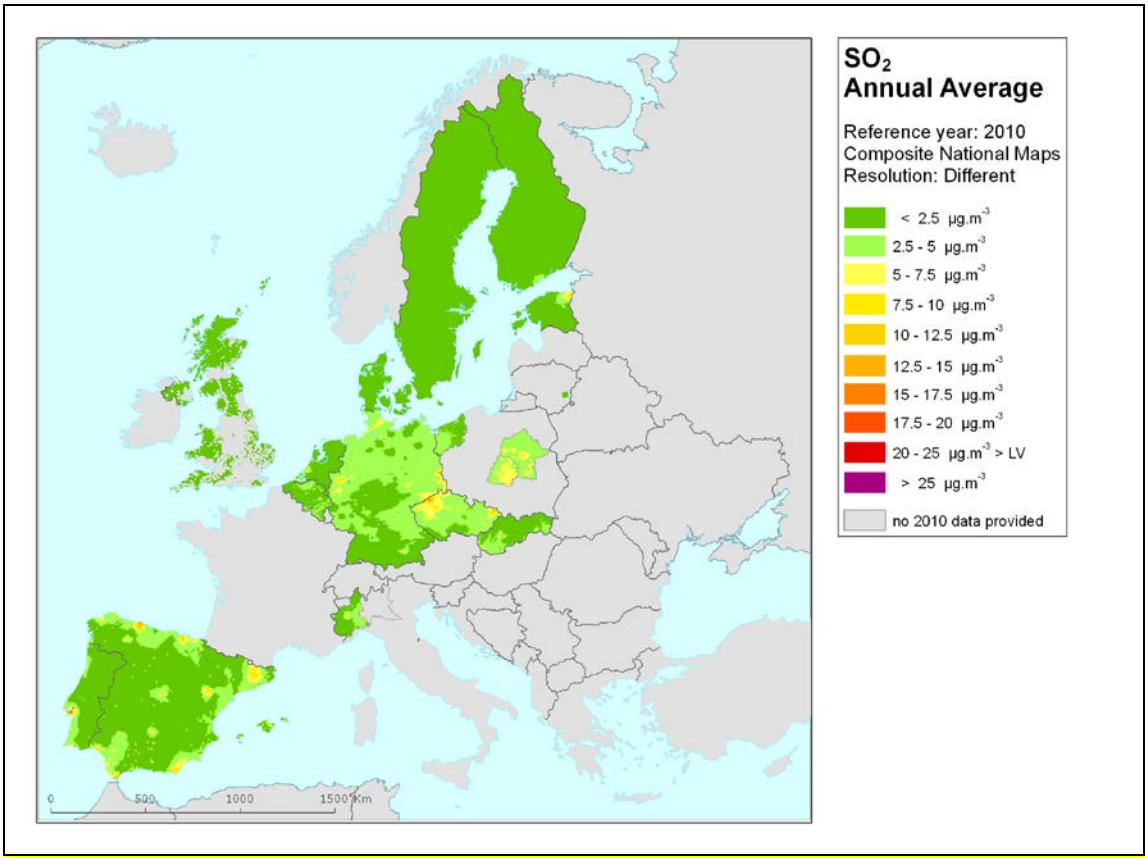


Figure 5. Enlarged map views of the SO_2 annual average map (Map2) showing the observed differences between countries at bordering areas.

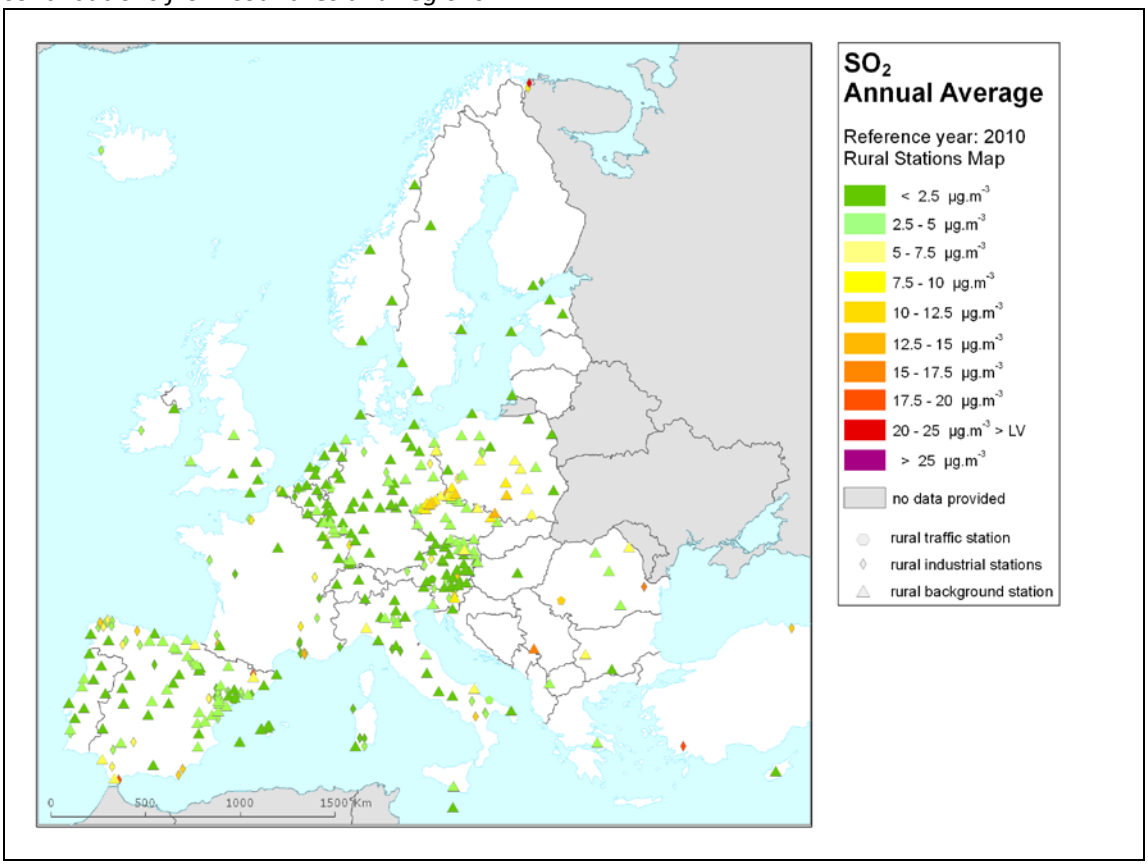
In addition, Portugal and Spain show matching concentration classes along the full length of their borders. Relatively high concentrations can be found on the Iberian Peninsula for the large agglomerations (e.g. Lisbon, Madrid) and in heavily industrialised areas (e.g. Gijón, Bilbao). On first sight, this seems not to be the case to for the north-eastern part of the Estonian territory. However, the Estonian modelling contact person reports that for SO_2 the model results give an unrealistic overestimation in the north-eastern corner of the country not representing the actual situation. In northern Germany annual average SO_2 values are elevated due to the sulphur emissions from intensive shipping transit through the Kiel Canal (or Nord-Ostsee-Kanal). The Polish voivodeships Masovia and specifically Łódź show relatively elevated levels over large areas. This mainly concerns the larger agglomerations in this area such as Warsaw and industrial activities.

No map with European spatial interpolated annual average SO_2 based on Airbase station measurement data has been produced for 2010 by the ETC/ACM, therefore a comparison with such results is not possible.

The map with the annual average SO_2 at rural stations (Map 3a) might help indicating areas where the modelling results do not match well the situation described by station measurement results. As the rural background stations represent in principle a considerably larger rural area than rural traffic and rural industrial stations do, the rural background station layer has been presented on top. This provides in these European-wide maps a more balanced visual impression of pollution levels in the area represented. This might help in identifying modelling shortcomings or limitations.
As it is beyond the goal of this inventory, this paper does not go into the interpretation of the comparison between maps 3 and 3a. The station map 3a is included on specific request of some of the contact persons from the countries.



Map 3. European composite map for annual average SO_2, 2010, based on national modelling contributions from countries and regions.



Map 3a. European map with the annual average SO_2 values for 2010 at the rural stations as reported by the countries under EU legislation (EC (1997). AirBase v6 (2012).

8. Wrap-up, conclusions and summarised recommendations

Important conclusion of this explorative inventory on national air quality modelling and mapping results is that there has been high motivation shown both by modellers and national air quality contact persons in the countries to share and exchanging more modelling and mapping experiences and results, aiming to better match and harmonise national results with neighbouring countries.

In summary of Chapter 5, the following observations have been identified as important:

- Both the modellers as well as the national air quality contact persons showed a high degree of willingness and/or eagerness to cooperate.
- No sign of policy or political reserve or restraint was experienced by the ETC/ACM in their contacts with modellers and national air quality contact persons.
- Contacted persons were in most cases responsible for both air quality modelling assessments and they were the formal national representative in the EU context. If not, then they appeared to be persons in close contact and cooperating with each other.
- Concerning air quality modelling in most countries a good network structure exists.
- The internet proves to be a good (initial) source to get into contact with the appropriate community. Based on the communication within in the framework of this inventory this will improve in coming years because air quality modelling and mapping efforts will gain in importance in the countries.
- A dedicated approach of each country appeared to be very effective considering the amount of speedy and constructive responses ETC/ACM received, however quite labour intensive.
- We have identified with this inventory the majority of the national air quality modelling communities in the European countries, and concerning the EU Member States especially those dealing with reporting under the Air Quality Directives.
- There was quite some enthusiasm to cooperate, which became apparent by the offer to deliver any other data in case the requested ones were not at hand. Examples are data for other years, other indicators, other pollutants, data or versions yet to be delivered or the offer to provide extra model runs and which a few actually did.
- Several countries asked about data we intend to request for the next year or next inventory and whether this will be(come) a regular data reporting flow from now onwards.
- Many contact persons gave the impression that such an inventory supports the wish to establish a practical platform for sharing and exchanging experiences and information on national and regional modelling and mapping efforts and results at a European level.
- Some countries explicitly expressed their appreciation about the initiative of this model results inventory in the hope that it may give indications to what extend their modelling instrumentation provides results that match with those of neighbouring countries, i.e. they expressed a clear need for model harmonisation efforts and some platform that coordinates and facilitates this process.
- Useful background information was provided on model application, approaches, purposes, difficulties and limitations they are confronted with.
- Almost all countries that currently do not utilise a modelling instrumentation for regular annual air quality assessments indicated that such activity is under development. Most of them expected to have such modelling instrumentation in place within a few months to up to 2 years from now. Some promised spontaneously to be able to deliver at “next year's request”.

A main conclusion from these observations is that a certain positive momentum exists currently in the countries to contribute with and to exchange modelling and mapping information and results in relation to their national air quality modelling and mapping activities, and here in particular in relation to reporting under the Air Quality Directives. Based on the country responses, the impression arises that there is a clear need for a sounding board where difficulties and complexities in the air quality modelling and mapping activities for national assessments and evaluations can be expressed and discussed. There seems to be a need for a common platform that coordinates, facilitates and supports exchange and sharing of modelling experiences and model harmonisation efforts. The Forum for Air Quality Modelling (FAIRMODE) initiative could provide such a platform. Based on the inventory provided in this report, a major focus should be put on generating an overview of all national activities and to pro-actively coordinate and facilitate the exchange of information and harmonisation efforts on air quality modelling between the (groups of) countries in Europe.

As stated above, FAIRMODE could well play an important role in this, or even become the platform itself. In the latter case, the forum should support - as a recommendation from the inventory presented in this report - next to air quality modelling approaches also address mapping techniques in general. As such, similar to the inventory dealt with in this paper, FAIRMODE could organise inventories for a series of legislative binding air pollutant indicators, including additional workshops that discuss the compiled results and its consistencies and mismatches of the modelling and mapping results between countries. This would stimulate model harmonisation activities and streamline model results between bordering countries and between groups of countries, resulting in a more consistent European representation of modelled legislative pollutant indicators. The current inventory has clearly documented that most countries already produce model results for such indicators more or less on a routine basis (annually), or that respective modelling mechanisms are under development.

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Air Quality Modelling Documentation System (MDS): The European Environment Agency's air quality documentation system holding a series of air quality models used throughout Europe on different scales and resolutions. http://acm.eionet.europa.eu/databases/MDS/index_html

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Annex 1. Results of a systematic internet search for national modelling activities (internet status: April/May 2012)

In April and May 2012 the ETC/ACM performed a systematic internet search for potential information on air quality modelling activities and products used in national air pollution assessments and evaluations of the EU 27 and EFTA 4 countries. For several countries where no information on national scale was found the focus was on information existing on the regions scale.

As starting point we made use of the listing of URLs from the web site AIRNow – International Air Quality http://www.airnow.gov/index.cfm?action=topics.world. This web site provides for Europe many references to the main national web sites providing all kinds of air quality related information. Despite the at times somewhat outdated references, this site proved to be useful as a very first access point to information potentially available in a country.

Furthermore, the Google search engine has been used with search terms *'air' [<country name>], 'air quality' [<country name>]* and *'air quality model' [<country name>]*. Within the national (and some regional) web sites the main terms used in the search tool were *'model', 'air quality'* and *'maps'*. Within web pages, map viewers, data viewers and web documents again the same terms were used to find relevant information.

These searches have been executed with the focus to obtain information and data for the annual averages for preferably the year 2010 and of NO_2 and PM_{10} as first priority pollutants. Expected was that for this relative recent year 2010 such information and data would be most available and well documented at the countries. Especially for annual averages of NO_2 and PM_{10}, since for these pollutants many countries have to invest most effort meeting legal obligations, resulting in extended assessment analysis leading to prominent availability of such information and data. Secondary priority was put to the other Air Quality Directory pollutants, such as SO_2, $PM_{2.5}$, Ozone, CO, the Heavy Metals, Benzene and B(a)P.

Search results per country

Per country only those search results are included in this annex, which formed the basis for seeking contact with the modellers and national representatives within the country. These results were used as a basis for requesting background information and spatial modelling results as used in the countries' national air quality assessments and evaluations.

In this annex, the countries' internet information is sorted according to the respective alpha 2-character country code. The non-EU 27 countries' specific status is indicated additionally.

The following paragraphs summarise the findings per country:

Albania (AL; EEA cooperative country; no EU MS)
No relevant and up to date information on national or regional air quality modelling found on the internet.

Austria (AT)
Annual report "Jahresbericht der Luftgütemessungen in Österreich 2010" http://www.umweltbundesamt.at/aktuell/publikationen/publikationssuche/publikationsdetail/?pub_id=1930 with brief reference saying "Immissionen werden an Luftgütestationen gemessen oder durch Modellierung – meistens unterstützt durch Messungen – ermittelt."

(Section 1.1, p.16, Bestimming von Immissionen) and "ÖNORM M 9445: Immissionen von Luftschadstoffen – Ermittlung der Gesamtbelastung aus der Vorbelastung und der mittels Ausbreitungsmodellen ermittelten Zusatzbelastung." (Chapter 4 Literaturverzeichnis, Rechtsnormen und Leitlinien, p. 119) (ordering ÖNORM M 9445: http://www.bdb.at/Service/NormenDetail?id=152876)

Bosnia-Herzegovina (BA; EEA cooperative country; no EU MS)
No relevant and up to date information on national or regional air quality modelling found on the internet.

Belgium (BE)
The national portal for air quality in Belgium is: (Dutch web version) http://www.belgium.be/nl/leefmilieu/vervuiling/luchtvervuiling/kwaliteit_en_metingen. The overall national coordination and reporting happens through the Intergewestelijke cel voor Leefmilieu – Cellule interrégionale pour l'Environnement (IRCEL-CELINE) http://www.irceline.be/~celinair/dutch/homenrl_java.html (Dutch web version).

For Flanders the **Vlaamse** Milieumaatschappij (VMM) published a report "Luchtkwaliteit in het Vlaamse Gewest, Jaarverslag Immissiemeetnetten 2010" http://www.vmm.be/pub/jaarverslag-luchtkwaliteit-in-het-vlaamse-gewest-2010/jaarverslag-luchtkwaliteit-in-het-vlaamse-gewest-2010.pdf

For Brussels the Leefmilieu Brussel did not have modelling data or respective references on its site.

For Wallonia the Institut Scientifique de Service Public (ISSeP) and Agence Wallonne de l'Air et du Climat (AWAC) published a report on 2009 modelling assessments on the AWAC web site under Qualité de l'air ambiant de l'AWAC: "Réseaux de surveillance de la qualité de l'air, Rapport 2009" http://193.190.182.213/WebAirQuality/RapportAnnuel.aspx

Bulgaria (BG)
The paper "Status report of Bulgaria" http://cost.fmi.fi/statusreportofbulgaria.pdf by E Georgieva (GFI) and E Batchvarova (NIMH) of several (circa 10?) years ago contains some hyperlinks to air pollution modelling activities and web pages with forecasts. However, not to the type of modelling information and data we are actually looking for.

Switzerland (CH; EEA member country; EFTA 4 country)
Your report "NO2 ambient concentrations in Switzerland, Modelling results for 2005, 2010, 2015" (2011; http://www.bafu.admin.ch/publikationen/publikation/01634/index.html?lang=en)

The mapviewer that opens by default at http://stratus.meteotest.ch/lugis/map/presentation/lugis_style/map.asp?Cmd=INIT&lang=d&Schadstoff=N120_9802&idx=34&Zoomfaktor=1 and contains, *among others*, maps on Immissionen PM_{10} 2010 Szenario M and Immissionen Stickstoffdioxid 2010.

The report "Data Report 2001-2010 EUROAIRNET, Switzerland" (Aug 2011), http://www.bafu.admin.ch/luft/11640/index.html?lang=de&download=NHzLpZeg7t,lnp6I0NTU042l2Z6ln1acy4Zn4Z2qZpnO2Yuq2Z6gpJCFfYR9hGym162epYbg2c_JjKbNoKSn6A--
Prepared by METEOTEST Commissioned by the Federal Office for the Environment (FOEN)

The report "Modelling of NO2 and benzene ambient concentrations in Switzerland 2000 to 2020, (2004; CH_no2_benzene_concentrations_2000-2020_e_PART1.pdf; http://www.bafu.admin.ch/publikationen/publikation/00288/index.html?lang=en (UM-188-E) (Perhaps somewhat outdated)

The report "Modelling of PM_{10} and PM2.5 ambient concentrations in Switzerland 2000 and 2010, 2004; CH_pm10_pm2-5_concentrations_2000-2020_e_PART2.pdf; http://www.bafu.admin.ch/publikationen/publikation/00258/index.html?lang=en (UM-169-E) (Perhaps somewhat outdated)

Cyprus (CY)
Somewhat outdated report: "Preliminary Evaluation of Air quality in Cyprus. Final report 2004", (Chapter 7 Modelling of Pollutants Distribution)
http://www.airquality.dli.mlsi.gov.cy/Files/UploadedFiles/7%20Modelling%20of%20pollutants%20distribution.pdf

Czech Republic (CZ)
The Czech Hydrometerological Institute (CHMI; http://portal.chmi.cz/portal/dt?portal_lang=en&menu=JSPTabContainer/P1_0_Home) should have national maps with modelled air quality, but these were not found on their web site. CHMI happens to be a partner institute of the ETC/ACM Consortium with close contacts between the author and air quality experts at CHMI. Through this channel, direct contact was made with CHMI, without putting further effort in web searches.

Germany (DE)
A web site of the German Umwelt Bundesamt http://www.umweltbundesamt.de/luft-e/immissionssituation/idaten.htm and its interactive map viewer at http://gis.uba.de/Website/luft/index.htm. Germany reports also relevant modeling activities through the air quality questionnaire.

Denmark (DK)

"The Danish Air Quality Monitoring Programme. Annual Summary for 2010", (2011), NERI Technical Report No. 836. By Ellermann, T., Nordstrøm, C., Brandt, J., Christensen, J., Ketzel, M. & Jensen. National Environmental Research Institute, Aarhus University. 55 pp. http://www2.dmu.dk/Pub/FR836.pdf. Furthermore, beginning of July 2012 the formal Danish national representative to the EU on air quality, Rune Keller, requested ETC/ACM whether it is possible to report model data to AirBase through the EoI reporting obligation. And finally, for 2010 at least one air quality management zone on benzene and B(a)P is reported under the air quality questionnaire for which model data has been used somehow.

Estonia (EE)
Some near real time city modelling can be found at:
http://mail.klab.ee/seire/airviro/modelleerimine.html (in Estonian only), on actually NO_2, PM_{10}, SO_2 concentrations. Furthermore, a recent ambient air quality report for the year 2010 can be found: http://mail.klab.ee/seire/airviro/infomaterjalid/ohk2010.pdf (in Estonian and therefore not clear whether any modelling is actually discussed; The report does not contain maps that may indicate some modeling activity).
Nevertheless the Air Quality Management Department (head Erik Teinemaa) of the Estonian Environmental Research Institute, being part of the Estonian Environmental Research Centre (EKUK; "Kesklabor") seem to be the best contacts for air quality modeling activities in Estonia.

Spain (ES)
Air quality modelling based activities: http://www.magrama.gob.es/es/calidad-y-evaluacion-ambiental/temas/atmosfera-y-calidad-del-aire/calidad-del-aire/modelizacion/default.aspx

"Evaluacion de la calidad del aire en España utilizado modelización. Preevaluacion año 2009. (15 May 2010). Marta G. Vivanco, Inmaculada Palomino, Fernando Martín, Juan Luis Garrido y Mª Ángeles González. Unidad de Contaminación Atmosférica. CIEMAT. http://www.magrama.gob.es/es/calidad-y-evaluacion-ambiental/temas/atmosfera-y-calidad-del-aire/preevaluacion_2009-ciemat_tcm7-151374.pdf

A poster by CIEMAT was presented at a HARMO Conference[i] with the same authors as the report mentioned above: "Combination of measured and modelling data in air quality assessment in Spain" by
Fernando Martín, Inmaculada Palomino, Marta G. Vivanco. Atmospheric Pollution Division, Department of Environment, CIEMAT, Madrid, Spain. (fernando.martin@ciemat.es) http://www.harmo.org/Conferences/Proceedings/_Paris/publishedSections/PPT/H13-086-poster.pdf with maps based on 2007 data.

Finland (FI)
Little to no relevant information was found on the internet. On basis of personal information from RIVM colleague M. Posch, we were hinted to contact Niko Karvosenoja and from the air quality questionnaire we had as contact person Tarja Lahtinen, both at the Finnish environmental administration (www.ymparisto.fi). Our request was forwarded to the FMI, the Meteorological Institute, Air Quality Research department (FMI), which presented some PM modeling efforts on their website.

France (FR)
A relevant document "Bilan De La Qualité De L'air En France En 2010 - Et Des Principales Tendances Observées Au Cours De La Période 2000 – 2010", http://www.developpement-durable.gouv.fr/IMG/pdf/bilan_air_2010.pdf, containing national interpolated maps with a series of pollutants calculated using Prev'air (2006 – 2010).

United Kingdom (GB)
"UK modelling under the Air Quality Directive (2008/50/EC) for 2010 covering the following air quality pollutants: SO2, NOX, NO2, PM_{10}, PM2.5, lead, benzene, CO, and ozone" (AEAT/ENV/R/3215 Issue 1, ED46644, Date 29/11/2011), http://uk-air.defra.gov.uk/library/reports?report_id=697, which was included with the delivery of the air quality questionnaire for 2010.

Greece (GR)
No specific information on the internet was found for Greece. As basis the zone(s) as reported under the air quality questionnaire for 2010 were used.

Croatia (HR; EEA cooperative country; no EU MS)
An international project with Met.no (proj./leader), the Meteorological and Hydrological service of Croatia (DHMZ), the Dep. of Geophysics Faculty of Science and Energy and Environmental Protection Institute (EKONERG): "High Resolution Environmental Modelling and Evaluation Programme for Croatia (EMEP4HR)"(2006-2009) with Sonja Vidič as contact person. http://klima.hr/razno_e.php?id=projects&param=emep4hr_en

Hungary (HU)
For several pollutants for 2010, at least one air quality management zone is reported under the air quality questionnaire for which model data has been used somehow. No information about air quality modeling has been found on the internet.

Ireland (IE)
"Review of Ambient Air Quality Monitoring in Ireland ", Barbara O'Leary. Dec 2010. (Prepared in response to the commitment in the Programme for the Government to "Expand the network of air quality monitoring stations to improve national coverage".)
http://www.epa.ie/downloads/pubs/air/quality/ReviewOfAirQualityMonitoring2010NoFinancialInfo.pdf

Iceland (IS; EEA member country; EFTA 4 country)
For Iceland, we did not find any recent spatial air quality modelling activity. Some urban Reykjavik air quality modelling seems to exist.

Italy (IT)
No recent spatial air quality modelling activity was found on web sites on the internet. For Italy, it is indicated that for most pollutants for 2010 at least one air quality management zone is reported under the air quality questionnaire for which model data has been used somehow. The central (ministerial) contact point for Italy that is mentioned in most of the regional the air quality questionnaires as reported by most Italian regional representatives. As relevant contact, we considered Anna Dileo and Nadia Bardizza from ARPA Lombardia as they are mentioned in the questionnaire contribution for Lombardy, and we know they are involved in EEA's Air Implementation Pilot project with the city/region of Milano as a case study.

Lichtenstein (LI; EEA member country; EFTA 4 country)
Neither relevant information on air quality modelling in the air quality questionnaire reports, nor on the internet.

Lithuania (LT)
"Lithuanian Air Monitoring System Modernization Using Diffusive Samplers", Final Report, Contract No 4F10-101, 2010 September 28
http://oras.gamta.lt/files/Final%20Report_LAQMO_En.pdf with spatial air quality model results for urban areas as well nation wide (based on EMEP 50km grid points, zone points and sampling points based air quality modelling interpolations) for the period 3.11.2010 – 4.7.2011.

Some air quality modelling results for 2010 for Vilnius:
http://gamta.lt/files/EK%20oro%20apzvalga%202010_09-19_4doc.pdf

Luxembourg (LU)
Neither relevant information on air quality modelling in the air quality questionnaire reports, nor on the internet.

Latvia (LV)
Some powerpoint presentation providing an overview of model-based air quality assessment and reporting (from circa 2005), including the responsible Latvian institutions at
http://www.environment.ee/uploads/media/AQ_assessment_Latvia_Lithuania_Valts_Vilnitis_03.pdf

Some dated and basic powerpoint information on the use of the model ADMS in a combined effort by Estonia, Lithuania and Latvia for mainly regional and urban spatial air quality modeling at http://gamta.lt/files/seminaras_T_Pallo_ADMS_in_Estonia_2010-01-19.pdf

Montenegro (ME; EEA cooperative country; no EU MS)
No relevant and up to date information on national or regional air quality modelling found on the internet.

FYR of Macedonia (MK; EEA cooperative country; no EU MS)
No specific information found on the internet. Monitoring infrastructural efforts are in implementation phase, not yet ready to execute air quality modeling on a common basis for reporting. Not further contacted due to lack of information and not being an EU Member State (however an EEA cooperative country). FYR of Macedonia should be contacted at future activities.

Malta (MT)
Neither relevant information on air quality modelling in the air quality questionnaire reports, nor on the internet.

The Netherlands (NL)
The Grootschalige Concentraties Nederland (GCN) maps contain the air quality modelling results used in the evaluation and assessment of national and regional air quality policies and measures. http://www.rivm.nl/gcn

Norway (NO; EEA member country; EFTA 4 country)
For several pollutants for 2010 at least one air quality management zone is reported under the air quality questionnaire for which model data has been used somehow. Furthermore, on the internet we found some information on local air quality modeling taking place in Norway, e.g., http://www.environment.no/Topics/Air-pollution/Local-air-pollution

Poland (PL)
For several pollutants for 2010 at least one air quality management zone is reported under the air quality questionnaire for which model data has been used somehow. Furthermore, on the internet the web site of the Chief Inspectorate of Environmental Protection, http://www.gios.gov.pl/artykuly/418/Lista-Wojewodzkich-Inspektoratow-Ochrony-Srodowiska, provides quite a series of references to regional and local web sites providing information (often in polish only) on their specific local air quality modelling activities.

Portugal (PT)
IDAD: Instituto do Ambiente e Desenvolvimento, http://www.idad.ua.pt/PageText.aspx?id=15536 but it was not clear whether it also contained spatial air quality modelling for regional or national policy evaluation and assessment purposes.

The web site of the Agéncia Portuguesa do Ambiente, section Qualidade do Ar Ambiente http://www.apambiente.pt/index.php?ref=16&subref=82&sub2ref=316 provides information with station-wise interpretations, but not specifically more spatially extended modeling results, i.e. as maps.

Romania (RO)
Neither relevant information on air quality modelling in the air quality questionnaire reports, nor on the internet.

Serbia (RS; EEA cooperative country; no EU MS)
No relevant and up to date information on national or regional air quality modelling found on the internet.

Sweden (SE)
"Luftkvaliteten i Sverige 2010 och vintern 2010/11, Resultat från mätningar inom Urbanmätnätet", IVL Report number: B1996, Year: 2011, Type: Rapport (in Swedish).
http://www.ivl.se/download/18.50a499dd132037d524e80006081/B1996+.pdf

Some local and regional air quality modeling by SMHI:
http://www.smhi.se/en/Research/Research-departments/Air-quality/simair-model-tool-for-air-quality-1.6830 on station/street level and http://www.smhi.se/en/Research/Research-departments/Air-quality/air-quality-on-local-and-urban-scale-1.5393 urban / on local and urban level.

Slovenia (SI)
For several pollutants for 2010 at least one air quality management zone is reported under the air quality questionnaire for which model data has been used somehow. No information about air quality modeling has been found on the internet.

Slovakia (SK)
"Hodnotenie Kvality Ovzdušia V Slovenskej Republike 2009", SHMU (in Slovak)
http://www.shmu.sk/File/oko/hodnotenie/2009_Hodnotenie_KO_v_SR.pdf, with some air quality modelling for 2009.

Some information by Hana Pavlendova on the National Forest Centre web site
http://www.nlcsk.sk/nlc_en.aspx, about Slovakian air quality modelling activities.

Turkey (TR; EEA member country; no EU MS)
Not explored.

Kosovo under the UN SCR 1244/09 (XS; EEA cooperative country; no EU MS)
No relevant and up to date information on national or regional air quality modelling found on the internet.

Annex 2. Example of dedicated email to national contacts with request for modelling data

As example the email to the Spanish contact persons (ms. M-B. Larka as formal Air Quality Questionnaire contact person; F. Martin (CIEMAT) found on web pages and report references as most prominent person in relation to the national Spanish modelling activities):

To: *Mblarka@mma.es, fernando.martin@ciemat.es (LARKA ABELLAN Maj-Britt (Min. de Agricultura, Alimentación y Medio Ambiente), Fernando Martin (CIEMAT))*
cc: *Frank de Leeuw*
Sent: *5 Sep 2012 13:15*
Subject: *Request for spatial air quality modeling GIS data for Spain*

Dear Maj-Britt, Fernando,

About a year ago we approached you on one of the tasks within the European Topic Centre on Air and Climate change Mitigation (ETC/ACM) which relates to *spatial* air quality data and assessments. Under this task executed under contract of the EEA we produce annually European air quality maps based on national deliveries of monitoring data to AirBase in combination with other data like land-use, population, meteorology and EMEP model results. The results of this can be accessed from our web site (latest report: http://acm.eionet.europa.eu/reports/ETCACM_TP_2011_11_spatAQmaps_2009

Under this spatial assessment task we would like to make better use of the results of air quality models at the national or regional level. We are aiming at combining the results of these models into a European composite map showing the results of all national air quality models. Such composite map may highlight the comparability (and differences) between the national models; next steps might be to improve the comparability of the models.
As a starting point we focus on the **annual averages of PM10, NO2 and SO2 for the year 2010**.

From the information given in the air quality reporting questionnaire and from web sites on the internet we have learned that most Member States use somehow spatial models for the assessment of one or more pollutants. For Spain we found quite some activity, such as:

> Evaluacion de la calidad del aire en españa utilizado modelización. Preevaluacion año 2009. (15 May 2010). Marta G. Vivanco, Inmaculada Palomino, Fernando Martín, Juan Luis Garrido y Mª Ángeles González. Unidad de Contaminación Atmosférica. CIEMAT.
> http://www.magrama.gob.es/es/calidad-y-evaluacion-ambiental/temas/atmosfera-y-calidad-del-aire/preevaluacion_2009-ciemat_tcm7-151374.pdf

Our request to you is:

For Spain we are very much interested in receiving the most recent modeled map results on 2010 annual average PM_{10}, NO2 and SO2 that we could use for the combined modeled air quality map of Europe we like to compose. Do you have any such 2010 data for us?

We would prefer to receive the maps digitally in GIS format as shape, raster or grid file set.
We are also interested in a brief description of the main characteristics of the model(s), such as pollutants, time and spatial resolution, methodology, etc. (In case our Model Documentation System (MDS, http://acm.eionet.europa.eu/databases/MDS/index_html) contains the model(s), you may refer simply to that.)

For data transfer you may best use the free internet tool http://www.wetransfer.com (max. 2 Gb per transfer) and address it to peter.de.smet@rivm.nl

Please, let us know whether you are able to deliver the requested information.

We thank you very much in advance.

Best regards,
Frank de Leeuw and Peter de Smet.
ETC/ACM at RIVM

Annex 3. List of national persons contacted by email with modelling data request

Based on the systematic internet search results (Annex 1) the following persons have been approached by email (example in Annex 2), requesting for data and information on national and/or regional spatial air quality modelling activities in assessments and evaluations.

Country ****		First name	Last name	Email	Institution	Role
Alpha-2	Short name					
AL	Albania ***	-	-	-	-	-
AT	Austria *	Wolfgang	Spangl	wolfgang.spangl@umweltbundesamt.at	UBA Vienna	NRC-AQ, AQQ contact, EoI contact
BA	Bosnia-Herzegovina ***	-	-	-	-	-
BE	Belgium *	Elke	Trimpeneers	trimpeneers@irceline.be	CELINE - IRCEL	NRC-AQ, AQQ contact, EoI contact
BG	Bulgaria *	Valerie	Serafimov	serafimov@eea.government.bg	Executive Environment Agency	NRC-AQ, AQQ contact, EoI contact
CH	Switzerland **	Rudolf	Weber	rudolf.weber@bafu.admin.ch	Bundesamt für Umwelt (BAFU)	NRC-AQ, AQQ contact, EoI contact
				luftreinhaltung@bafu.admin.ch	BAFU air department	by lack of other contact
				gis@bafu.admin.ch	BAFU GIS department	by lack of other contact
CY	Cyprus *	Savvas	Kleanthous	skleanthous@dli.mlsi.gov.cy	Min. Labour & Soc.Insurance, Dep. Labour Insp.	NRC-AQ, AQQ contact, EoI contact
CZ	Czech Republic *	Jan	Horálek	horalek@chmi.cz	CHMI	ETC/ACM, @ AQQ & EoI contact dep.
DE	Germany *	Arno	Graff	arno.graff@uba.de	UBA Dessau	AQQ contact
DK	Denmark *	Rune	Keller	rke@dmu.dk	Aarhus Uni, Danish Centre for Env. and Energy	AQQ contact, EoI contact
		Keld	Mortensen	kem@dmu.dk	Aarhus Uni, Danish Centre for Env. and Energy	EoI data supplier
		Thomas	Ellerman	tel@dmu.dk	Aarhus Uni, Danish Centre for Env. and Energy	NRC-AQ, AQ modeller
EE	Estonia *	Erik	Teinemaa	erik.teinemaa@klab.ee	Estonian Env. Res. Centre (Kesklabor, Central lab	head AQ Department
		Toivo	Truuts	toivo.truuts@klab.ee	Estonian Env. Res. Centre (Kesklabor, Central lab	EoI contact
		Margus	Kort	Margus.Kort@klab.ee	Estonian Env. Res. Centre (Kesklabor, Central lab	AQQ contact, EoI contact
ES	Spain *	Maj-Britt	Larka	mblarka@magrama.es	ministerio de la Agric.,Alimen. Y medio Ambiente	AQQ contact
		Fernando	Martin	fernando.martin@ciemat.es	CIEMAT - modelling person	research modelling for ministry
FI	Finland *	Tarja	Lahtinen	tarja.lahtinen@ymparisto.fi	Min. of Env.	AQQ contact
		Niko	Karvosenoja	niko.karvosenoja@ymparisto.fi	Min. of Env. (hinted by M. Posch)	PM modeller for policy assessment

(Table continues on next page)

(Table continuation)

Country ****		First name	Last name	Email	Institution	Role
Alpha-2	Short name					
GB	United Kingdom *	Emily	Connolly	emily.connolly@defra.gsi.gov.uk	DEFRA - Dep for Env., Food and Rural Affairs	NRC-AQ, AQQ contact
GR	Greece *	Anastasios	Adamopoulos	a.adamopoulos@prv.ypeka.gr	Min. Env. / AQ Dep.	NRC-AQ, AQQ contact, EoI contact
				air_quality@prv.ypeka.gr	Min. Env. / AQ Dep.	general AQ dep. address
HR	Croatia ***	Sonja	Vidic	vidic@cirus.dhz.hr	Meteo. & Hydrol. Service	Meteo. and hydrological service (DHMZ)
		Vladimira	VADJIĆ	vvadjic@imi.hr	Inst. for Medical Res.& Occupational Health (IMROH)	AQQ contact
HU	Hungary *	Judit	Varga	judit.varga@vm.gov.hu	Min. of Env.	NRC-AQ, AQQ contact
IE	Ireland *	Barbara	O'Leary	b.leary@epa.ie	EPA ireland	NRC-AQ, AQQ contact, EoI contact
IS	Iceland **	Thorstein	Johannssen	thorsteinnj@ust.is	The Environment Agency of Iceland	AQQ contact, EoI contact
IT	Italy *			DVA-III@minambiente.it	Central Min Ambiente Div 3 contact point	AQQ contact, EoI contact
		Anna	Di Leo	a.dileo@arpalombardia.it	ARPA Lombardia, Settore Aria e Agenti Fisici	ARPA Lombardia (does IAM)
		Nadia	Bardizza	n.bardizza@arpalombardia.it	ARPA Lombardia, Settore Aria e Agenti Fisici	ARPA Lombardia (does IAM)
LI	Liechtenstein **	Hanspeter	Eberle	Hanspeter.Eberle@aus.llv.li	Amt für Umweltschutz	EoI contact
LT	Lithuania *	Zita	Siliene	z.siliene@aaa.am.lt	Env Prot. Agency	NRC-AQ, AQQ contact
		Donatas	Perkauskas	d.perkauskas@aaa.am.lt	Env Prot. Agency	NRC-AQ, AQQ contact
LU	Luxembourg *	Eric	Vansuypeene	Eric.Vansuypeene@aev.etat.lu	Min du Dév. Dur. et des Infrastruct.; Admin. de l'Env.	NRC-AQ, AQQ contact, EoI contact
LV	Latvia *	Tamara	Vasiljeva	tamara.vasiljeva@lvgmc.lv	Environment, Geology and Meteorology Centre	AQQ contact, EoI contact
ME	Montenegro ***	-	-	-	-	-
MK	FYR of Macedonia ***	-	-	-	-	-
MT	Malta *	Michael	Nolle	michael.nolle@mepa.org.mt	Malta Environment and Planning Authority (MEPA)	NRC-AQ, AQQ contact, EoI contact
NL	Netherlands *	Guus	Velders	guus.velders@.rivm.nl	RIVM	AQ modelling for policy assess. and eval.
NO	Norway **	Sigmund	Guttu	sgu@klif.no	The Norwegian Climate and Pollution Agency (Klif)	NRC-AQ, AQQ contact
PL	Poland *	Magdalena	Brodowska	m.brodowska@gios.gov.pl	Chief Inspectorate of Environmental Protection	NRC-AQ, AQQ contact, EoI contact

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(Table continuation)

Country ****		First name	Last name	Email	Institution	Role
Alpha-2	Short name					
PT	Portugal *	Dilia	Jardim	dilia.jardim@apambiente.pt	Agência Portuguesa do Ambiente	NRC-AQ, AQQ contact, EoI contact
		Ana Isabel	Miranda	miranda@ua.pt	Univ. Aveiro (hinted by Cristina Guerreiro)	does AQ modelling for government
RO	Romania *	Aurora	Paunescu	aurora.paunescu@anpm.ro	National Environmental Protection Agency	AQQ contact
		Patricia	Lungu	patricia.lungu@anpm.ro	National Environmental Protection Agency	AQQ contact
RS	Serbia ***	-	-	-	-	-
SE	Sweden *	Niklas	Ricklund	niklas.ricklund@swedishepa.se	Swedish Env. Prot. Agency (EPA)	AQQ contact
		Karin	Persson	karin.persson@ ivl.se	Env.Research Inst. (IVL)	IVL - AQ contact
		Karin	Sjoberg	karin.sjoberg@ ivl.se	Env.Research Inst. (IVL)	IVL - AP & Abat Strategies contact
SI	Slovenia *	Andrej	Segula	andrej.segula@gov.si	Agencija RS za okolje	AQQ contact, EoI contact
SK	Slovak Republic *	Blanka	Fogelova	blanka.fogelova@shmu.sk	Slovak HydroMeteorological Institute (SHMU)	AQQ contact
		Jana	Krajcovica	jana.krajcovicova@shmu.sk	Slovak HydroMeteorological Institute (SHMU)	AQ modeller
		Lubor	Kozakovic	lubor.kozakovic@shmu.sk	Slovak HydroMeteorological Institute (SHMU)	NRC-AQ, AQQ contact, EoI contact
TR	Turkey **	-	-	-	-	-

* *EU-27 country*

** *Non EU-27 country, EEA-32 country*

*** *Non EU27 country, EEA cooperating country*

**** *ISO3166-1 codes: Alpha-2 element and Short Name*

Annex 4. List of national contact persons responding to the request for modelling data

Country ****		First name	Last name	Email	Institution	Offer /
Alpha-2	Short name				(and other organisational info)	National and/or regional modelling data contribution
AL	Albania ***	-	-	-	-	-
AT	Austria *	Wolfgang	Spangl	wolfgang.spangl@umweltbundesamt.at	UBA Vienna.	Forwarding request to national and regional authorities
		Dietmar	Öttl	dietmar.oettl@stmk.gv.at	Refer at für Luftgüteüberwachung / Section Air Quality Control; Dep. 15 Housing, Energy and Engineering.	Annual average NO_2 ($\mu g \cdot m^{-3}$) gridded data for province of Styria of 2006 and still valid for 2010. Update-version is under construction.
		Pieter	Riess	peter.riess@wien.gv.at	Wiener Umweltschutzabteilung, Leiter Bereich Luftmessnetz, www.umweltschutz.wien.at	Findings of the Vienna Immission-Model regarding the pollutants NO_2 and PM_{10} are not yet published. rainer.plank@wien.gv.at provided measurement data for Vienna similar to those in airBase. No modelling involved, so not included in the Compositie map.
BA	Bosnia-Herzegovina ***	-	-	-	-	-
BE	Belgium *	Frans	Fierens	fierens@irceline.be	dir. CELINE - IRCEL.	Annual average NO_2, SO_2, PM_{10} ($\mu g \cdot m^{-3}$) 2010 4x4km grids; whole Belgium territory.
BG	Bulgaria *	Valerie	Serafimov	serafimov@eea.government.bg	Executive Environment Agency.	Set of PM_{10} modelling results for a series of cities (minucipality programmes). Information very relevant but not simply available in digital format and therefore not included in the map. (Furthermore, it involves quite a variaty of information with specific focus on the EU plans and programmes reproting obligation. PM_{10} municipaility programmes: http://eea.government.bg/bg/nsmos/air/roukav/index.html
CH	Switzerland **	Rudolf	Weber	rudolf.weber@bafu.admin.ch	Bundesamt für Umwelt (BAFU). National representative and responsibility.	Annual average PM_{10} and NO_2 ($\mu g \cdot m\text{-}3$) 2010. (SO_2 map for 2010 will become available spring 2013).
		Jürg	Helbstab	juerg.heldstab@infras.ch	INFRAS Consulting, Analysis & Research	Provided additional background information on modelling activities
		Thomas	Kuenzle	thomas.kuenzle@meteotest.ch	Meteotest; Modeller to the Swiss admin. & appointed data supplier.	Provided the GIS data./ Contact for the data contents.

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(Table continuation)

Country ****		First name	Last name	Email	Institution	Offer /
Alpha-2	Short name				(and other organisational info)	National and/or regional modelling data contribution
CY	Cyprus *	Savvas	Kleanthous	skleanthous@dli.mlsi.gov.cy	Min. Labour & Soc.Insurance, Dep. Labour Insp.(National representative and responsibility).	Annual average PM_{10}, $PM_{2.5}$, NO_2, O_3, Benzene for 2010 become available spring 2013.
		Christos	Papadopoulos	cpapadopoulos@dli.mlsi.gov.cy	Labour Inspection Officer, Air Quality Section, Dep. of Labour Inspection, Ministry of Labour & Social Insurance.	Provided information on the actual status of the modelling activities.
CZ	Czech Republic *	Jan	Horálek	horalek@chmi.cz	CHMI at Div. AQ Protection; Dep. AQ Info.Systems and Dep. Modelling and Expertise Pool.	Annual average NO_2, SO_2, PM_{10} ($\mu g \cdot m^{-3}$) 2010 1x1km grids
DE	Germany *	Arno	Graff	arno.graff@uba.de	UBA Dessau.	Annual average NO_2, SO_2, PM_{10} ($\mu g \cdot m^{-3}$) 2010
DK	Denmark *	Thomas	Ellerman	tel@dmu.dk	Dep.of Env. Science - Atmospheric Environment, Aarhus Univ. (AQ modelling involved).	Forwarded our request to J H Christensen.
		Jesper Heile	Christensen	jc@dmu.dk	Senior Scientist, Physicist, Dep. of Env. Science - Atmospheric Environment, Fac. of Science and Technology, Aarhus Univ. (Responsible for model runs).	Annual average NO_2, SO_2, PM_{10} ($\mu g \cdot m^{-3}$) 2010, 5.67x5.67km grids.
EE	Estonia *	Erik	Teinemaa	erik.teinemaa@klab.ee	hDep. AQ, Env. Res. Centre (Kesklabor, Central lab. Does model runs himself.	Annual average NO_2, SO_2, PM_{10} ($\mu g \cdot m^{-3}$) 2010 grids. Note: NO_2 have some overestimation in NE EE. Some unresolved inconsistencies in PM_{10} map. Do no further analysis on these maps.
ES	Spain *	Fernando	Martin Llorente	fernando.martin@ciemat.es	hDiv.Atmospheric Pollution, Env. Dep., CIEMAT.- AQ modelling person and expert. (His cc's: Inmaculada Palomino Marquez, inma.palomino@ciemat.es; Marta Garcia Vivanco, m.garcia@ciemat.es; amoral@magrama.es.	Annual average NO_2, SO_2, PM_{10} ($\mu g \cdot m^{-3}$) 2010 160x90 gridcells (.1dgsdx.1dgs)

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(Table continuation)

Country ****		First name	Last name	Email	Institution	Offer /
Alpha-2	Short name				(and other organisational info)	National and/or regional modelling data contribution
FI	Finland *	Niko	Karvosenoja	niko.karvosenoja@ymparisto.fi	Min. of Env. (hinted by M. Posch) (National representative in this modelling work; FMI does the modelling runs).	Responded and forwarded request to actual modellers: Mikhail Sofiev, Ari Karpinnen; (they do also ann avg of conc. for primary $PM_{2.5}$ modelling on 1x1km grid)
		Ari	Karppinen	Ari.Karppinen@fmi.fi	Finnish Meteorological Institute (FMI).	Took lead in providing data.
		Julius	Vira	julius.vira@fmi.fi	FMI (Fi Meteor. Inst.); (delivered data extraction)	Annual average NO_2, SO_2, PM_{10} ($\mu g \cdot m^{-3}$) 2010, 1x1km grids.
FR	France *	Aurelie	Le Moullec	aurelie.le-moullec@developpement-durable.gouv.fr	Min de l'écol, de l'énergie, du dév.dur. et de la mer.	In contact with Laurence Rouïl: France has modelling data, but do not deliver because of fear for likely policy sensitivity.
GB	United Kingdom *	Emily	Connolly	emily.connolly@defra.gsi.gov.uk	DEFRA - Dep for Env., Food and Rural Affairs.	Forwarded request to actuakl AQ modeller.
		John	Stedman	John.Stedman@aeat.co.uk	Ricardo-AEA.	Annual average NO_2, SO_2, PM_{10} ($\mu g \cdot m^{-3}$) 2010 1x1km grid. NO_2 & PM_{10} for whole UK; SO_2 only for ecosystems mapped.
GR	Greece *	Anastasios	Adamopoulos	a.adamopoulos@prv.ypeka.gr	Min. Env., Energy & CC, DG Env., Div. Air & Noise Pollution Control.	Annual average NO_2, SO_2, PM_{10} ($\mu g \cdot m^{-3}$) 2010 few point data throughout GR.
HR	Croatia ***	Sonja	Vidic	vidic@cirus.dhz.hr	Meteo. & Hydrol. Service (DHMZ).	Infromed about status & forwarded to A.Jericevic.
		Amela	Jericevic	amela.jericevic@cirus.dhz.hr	Meteo. & Hydrol. Service (DHMZ) (Repsonsbile for all modelling work).	Annual average NO_2, SO_2, PM_{10} ($\mu g \cdot m^{-3}$) 2006 in netcdf in Lamb.Azim.Conformal. Likely in future some more activity.
HU	Hungary *	Judit	Varga	judit.varga@vm.gov.hu	Min. of Env.	No response at all from Hungary.
IE	Ireland *	Barbara	O'Leary	b.leary@epa.ie	EPA ireland.	Response: No modelling; Assessments based onf monitoring & estimates.
IS	Iceland **	Thorstein	Johannssen	thorsteinnj@ust.is	The Environment Agency of Iceland.	Response: some initial AQ modelling happens in captial area with expectation of having a NO_2 by end of 2013.
IT [(&)]	Italy *	-	-	DVA-III@minambiente.it	Central Min Ambiente Div 3 contact point.	Seems that our data request is forwarded to the regional modller and AQQ representatives.
		Anna	Di Leo	a.dileo@arpalombardia.it	ARPA Lombardia, Settore Aria e Agenti Fisici.	IA-modeller has ann.avg. PM_{10} and NO_2 2010 data for region of Lombardy.
		Francesco	Matera	francesco.matera@regione.piemonte.it	Regione Piemonte, Direzione Ambiente	Annual average NO_2, SO_2, PM_{10} ($\mu g \cdot m^{-3}$) 2010, region Piedmont.

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(Table continuation)

Country ****		First name	Last name	Email	Institution	Offer /
Alpha-2	Short name				(and other organisational info)	National and/or regional modelling data contribution
LU	Luxembourg *	Eric	Vansuypeene	Eric.Vansuypeene@aev.etat.lu	Min du Dév. Dur. et des Infrastruct.; Admin. de l'Env.	Response: AQ modelling for LU under development with Wallonian counterpart ISSeP (use of RIO); Early 2014 able to provide data on regular basis.
LV	Latvia *	Tamara	Vasiljeva	tamara.vasiljeva@lvgmc.lv	Environment, Geology and Meteorology Centre.	Response: No spatial concentration modelling data for LV; (Some urban ann.avg. NO_2 2010 done for Riga based on 2009 emission. However, no GIS digital data available.)
ME	Montenegro ***	-	-	-	-	-
MK	FYR of Macedonia ***	-	-	-	-	-
MT	Malta *	Michael	Nolle	michael.nolle@mepa.org.mt	Malta Environment and Planning Authority (MEPA).	Response: No spatial AQ modelling for MT.
NL	Netherlands *	Guus	Velders	guus.velders@.rivm.nl	RIVM	GCN: Annual average NO_2, SO_2, PM_{10} ($\mu g \cdot m^{-3}$) 2010 for 5x5 km grids.
NO	Norway **	Sigmund	Guttu	sgu@klif.no	The Norwegian Climate and Pollution Agency (Klif).	Response: Only some AQ modelling (on traffic based numbers) low level. NILU & Klif develop atlas on regional background conc. for relevant years. When ready: to our disposal; for now no data as requested.
PL	Poland *	Magdalena	Brodowska	m.brodowska@gios.gov.pl	Dep. of Monitoring and Env. Information, Chief Inspectorate of Environmental Protection.	Forwarding in Polish requests to national and regional authorities and collected data for 3 voivodeships: Annual averages NO_2, SO_2& PM_{10} 2010 for Łódź, Masovia and West Pomerania.
		Natalia	Bykowszczenko	n.bykowszczenko@wios.szczecin.pl	West Pomeranian voivodeship.	data supplier from West Pomeranian voivodeship.
PT	Portugal *	Dilia	Jardim	dilia.jardim@apambiente.pt	Agência Portuguesa do Ambiente; natl reprersentative.	National representative agreeing with data contribution according Ana Isabel.
		Ana Isabel	Miranda	miranda@ua.pt	Univ. Aveiro (hinted by Cristina Guerreiro).	Annual average NO_2, SO_2, PM_{10} ($\mu g \cdot m^{-3}$) 2010.

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(Table continuation)

Country ****		First name	Last name	Email	Institution	Offer /
Alpha-2	Short name				(and other organisational info)	National and/or regional modelling data contribution
SE		Martin	Torstensson	Martin.Torstensson@smhi.se	SHMI Modeller	Delivery of ann avg $SO_2$and NO_2 2010 that was on the shelf.
		Hans	Backström	Hans.Backstrom@smhi.se	SHMI product manager	Delivery of fresh and warm ann avg PM_{10} and higher resol. for NO_2 would come from SHMI, still in production phase. At map review Hans requested to insert the high resolution NO2 data instead.
SI	Slovenia *	Andrej	Šegula	andrej.segula@gov.si	Environmental Agency of the Republic of Slovenia, Air Quality Sector	Response: No AQ modelling for the whole country; Only around IPPC installations and only additional load, not covering entire zones. Planned: 4.4x4.4km model assessment for 2013 on all legislative pollutants (currently model is in test and validation phase).
SK	Slovak Republic*	Jana	Krajcovica	jana.krajcovicova@shmu.sk	Slovak HydroMeteorological Institute (SHMU)	Annual average NO_2, SO_2, PM_{10} ($\mu g \cdot m^{-3}$), 2010 grids.
TR	Turkey **	-	-	-	-	-

* *EU-27 country*
** *Non EU-27 country, EEA-32 country*
*** *Non EU-27 country, EEA cooperating country*
**** *ISO3166-1 codes: Alpha-2 element and Short Name*
No colour marking: No (recent) air quality modelling data available at the moment of inventory. (Several expect to implement air quality modelling in 2013 - 2014.)
Light green marking: air quality modelling data available but not for 2010
Dark green marking: 2010 data provided and included in the maps of this report.

(&) *Note: After finalisation of the European composite maps and just before release of this paper repsonse was received on national Italian modeling activities. For demonstration purpose materials and modeling information have been included in Annex 5.*

Annex 5. National modelling information as provided by the national representatives or modeller that provided data

This annex provides a table listing the models used by the countries in their modelling and mapping activities, including the indication whether the models are included in MDS.

Country (Region)	Model(s) applied	In MDS (1 = yes)
AT Styria	GRAL	1
BE	RIO	-
BG	PM10: modelling system SELMA GIS 3.3, AERMOD	- , 1
CH	new PM model; TA-Luft NO2; PolluMap	- , -, 1
CY	MARS, MEMO [1st quarter in 2013 avail.]	1 , 1
CZ	SO2, NO2,: SYMOS 2km; PM10: CAMx, EMEP	1; 1, 1
DE	REM-CALGRID (RCG)	1
DK	DEHM, UBM, OSPM, THOR system: NO2	-,-, 1, 1
EE	Aermod, Calpuff, SMHI Gauss, SMHI Grid, OSPM, Street Canyon, Heavy gas, MATCH, Receptor, Austal 2000G	1, -, -, -, 1, -, -, 1, -, 1
ES	CHIMERE (EMEP)	1,(1)
FI	SILAM	1
GB	PCM	-
IT Lombardia	FARM	1
Piedmont	FARM, ACA	1, -
LI	*see annex text.*	
LT	ADMS-Urban	1
NL	OPS	1
PL Lodz	CALMET, CALPUFF	-, -
Masovia	CALMET, CALPUFF	-, -
West Pomerania	CALMET, CALPUFF	-, -
PT	EURAD	1
SE	SIMAIR	1
SK	SPRAY, AUSTALL, GRAL, CALPUFF, WRFCHEM)	1, 1, 1, -, -

Note on Italy: After finalisation of the European composite maps and just before release of this paper repsonse was received on national Italian modeling activities. For demonstration purpose modeling information has been included in Annex 5: model MINNI uses as chemistry transport model FARM, which is included in MDS.

As the provided background information on the national model applications consists of quite a variety of details, the main communication relevant to the modeling and mapping has been reflected for each country in the second part ofg this annex.

AT (Austria)

Federal Umweltbundesamt

Wolfgang Spangl, 09/04/2012, relevant remark:

"… some of the Federal States in Austria which are already using models. These are, however, not applied for official AQ assessment, but rather for the determination of exceedance areas of checking the effects of measures."

Federal State Styria

Dietmar Öttl, 04-09-2012:

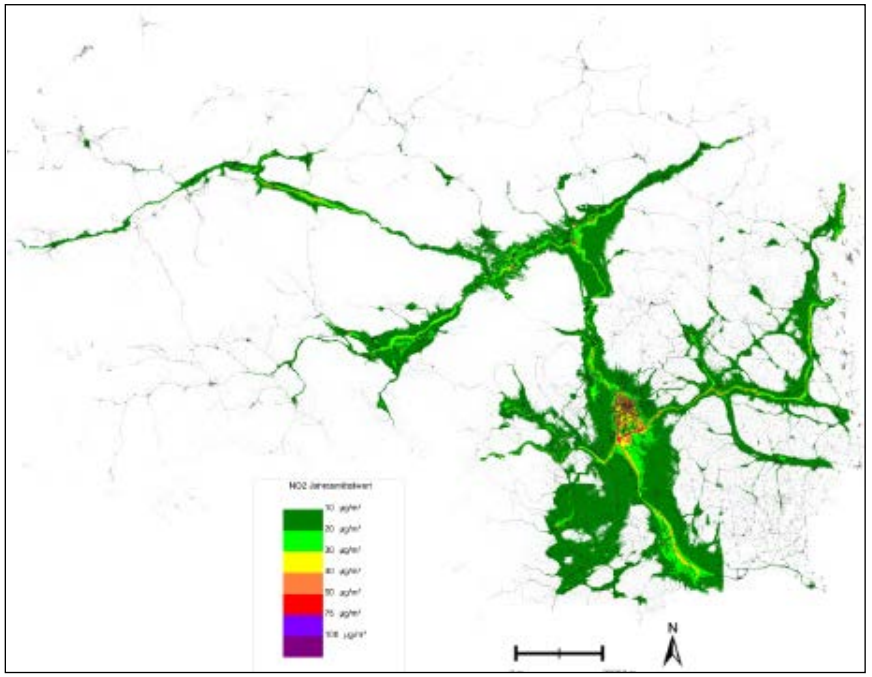
"For the Austrian county of Styria (~16.000km², ~1.2 mill. People) there exists an air quality map for the annual mean NO2 concentration with a spatial resolution of 10 m. Simulations have been performed with the Lagrangian dispersion model GRAL (see MDS). The map consists of 23 overlapping domains resulting sometimes in non-continuous concentration patterns at the edges.

It should be noted that most of the input data is based on the year 2006 and not 2010. According to our monitoring network in Styria, NO2 concentrations have not changed that much between 2006 and 2010, so results are still quite up to date in our opinion. Currently we are working on corresponding PM10, and Benzo(a)pyrene maps, which we hope to accomplish in 2013.

If our NO2 map is of interest to you (see attachment), I can upload the zipped results for the 23 domains (361 MB). Concentrations are stored in ASCII file format readably by ARC VIEW (there you can convert the ASCII files in Grid-file format and perhaps spatially join all)."

05-09-20912:

"The zipped file consists of 23 ASCII files that can be converted using ARC VIEW in grid format. When you are using the tool “spatial join” after conversion it is best to choose “keep maximum” in the overlapping margins."



Map of Austrian county Styria with the annual average NO2 (µg/m^3) for 2006 and still valid for 2010.

05-10-2012:
Projection system applied in the modelling for Styria:

WGS_1984_UTM_Zone_33N
Projection: Transverse_Mercator
False_Easting: 500000.000000
False_Northing: 0.000000
Central_Meridian: 15.000000
Scale_Factor: 0.999600
Latitude_Of_Origin: 0.000000
Linear Unit: Meter

GCS_WGS_1984
Datum: D_WGS_1984

06-12-2012, Dietmar Öttl: map review feedback; Federal State Styria we left out as it concerns 2006 data; here a motivated request for inclusion of NO2 for Styria in the map:
"Just a little comment regarding our NO2 map based on the year 2006: As we don't see any trend in our observed NO2 concentrations, the simulated concentrations for 2006 are still representative for the region of Styria. From a technical point of view, our maps could therefore be included in your presentation as well.

Currently we are working on an update using the year 2010, which we hope to finish by the end of 2013.
Please keep us informed about your work. In particular it would be interesting for us, whether you will compile simulation results in the future again, and more specifically for which base year. If we get such information in advance, we might be able to provide maps for the year in consideration."

BE (Belgium)

Federal representative: The Belgian State, the Flemish Region (VMM), the Walloon Region (ISSeP) and Brussels-Capital Region (IBGE – BIM) cooperate together and are represented to the EEA by the Belgian Interregional Environment Agency (IRCEL-CELINE) (http://www.irceline.be/~celinair/english/homeen_java.html). It provided modelling data (Frans Fierens, 12-09-2012):
"… - a shape file with 4x4 km grids for Belgium; - an excel document with the annual mean concentrations (2010) for PM10, NO2 and SO2 (µg/m3). The ID's in the xls correspond to the ID's in the shape file, so you can easily join the xls data with the 4x4 km shape.

The calculated concentrations are interpolated air quality measurements. More information about the used interpolation methodology can be found in the paper from Janssen et al. ...".

Reference to paper:
Spatial interpolation of air pollution measurements using CORINE land cover data. Stijn Janssen, Gerwin Dumont, Frans Fierens, Clemens Mensink. Atmospheric Environment 42 (2008) 4884–4903.
Abstract:
Real-time assessment of the ambient air quality has gained an increased interest in recent years. To give support to this evolution, the statistical air pollution interpolation model RIO is developed. Due to the very low computational cost, this interpolation model is an efficient tool for an environment agency when performing real-time air quality assessment. Beside this, a reliable interpolation model can be used to produce analysed maps of historical data records as well. Such maps are essential for correctly checking compliance with population exposure limit values as foreseen by the new EU Air Quality Directive. RIO is an interpolation model that can be classified as a detrended Kriging model. In a first step, the local character of the air pollution sampling values is removed in a detrending procedure. Subsequently, the site-independent data is interpolated by an Ordinary Kriging scheme. Finally, in a re-trending step, a local bias is added to the Kriging interpolation results. As spatially resolved driving force in the detrending process, a land use indicator is developed based on the CORINE land cover data set. The indicator is optimized independently for the three pollutants O3, NO2 and PM10.
As a result, the RIO model is able to account for the local character of the air pollution phenomenon at locations where no monitoring stations are available. Through a cross-validation procedure the superiority of the RIO model over standard interpolation techniques, such as the Ordinary Kriging is demonstrated. Air quality maps are presented for the three pollutants mentioned and compared to maps based on standard interpolation techniques.

BG (Bulgaria)

No modeling data have been submitted by Bulgaria, but the following details on modelling activities were given by Valeri Serafimov (15-11-2012) of the Executive Environmental Agency:
"… I forwarded your request to the Bulgarian Ministry of Environment for additional information.
According to the Commission Decision 2004/224/EC laying down arrangements for the submission of information on plans or programs required under Council Directive 96/62/EC in relation to limit values for certain pollutants in ambient air 29 populated areas in Bulgaria have developed models for PM10 level in ambient air using mainly Modeling System SELMA GIS, Version 3.3 and AERMOD. These two models are widely used and you can find the necessary information in the Internet.

The Municipalities programs with PM_{10} models, as well as maps can be found in the following link: http://eea.government.bg/bg/nsmos/air/roukav/index.html. Unfortunately, the information is available only in Bulgarian language."

CH (Switzerland)

National level: Rudolf Weber (BAFU) (27-09-2012):
"In the last weeks we were finishing the PM10 map for the year 2010. We can provide you now the maps with the annual averages of NO2 and PM10 for the year 2010. The NO2 maps are described in the report from 2011 (http://www.bafu.admin.ch/publikationen/publikation/01634/index.html?lang=en).
The report describing the new PM10 model will be published soon.

A modeling of the SO2 concentrations has just started and first results should be available next spring.

All these models use emissions for the year 2010, but an average meteorology. If you are interested in maps reflecting the meteorological conditions of a specific year, we generate also hybrid maps, combining results of dispersion modeling and measurements of a given year. However, those maps are only available up to 2007. An update will be done in the next time. http://www.bafu.admin.ch/luft/luftbelastung/schadstoffkarten/index.html?lang=en

The maps are (in a GIS system) hosted by our contractor, the company Meteotest. Please contact directly Thomas Künzle for a transfer of the data."

Thomas Kuenzle of Meteotest provided modelling data (03-10-2012) and projection information:

- Data format: gridascii (ASC) for annual average PM10 and NO2, 2010
- Projection system: OBLIQUE

Units	meters
Spheroid	BESSEL
Datum	user_defined 674. 14. 405.
Parameters	
2	/* Projection type < 1 | 2 >
1	/* Scale factor at the projection's center
7 26 22.5	/* Longitude of the projection's center (DMS)
46 57 08.66	/* Latitude of the projection's center (DMS)
90.000000	/* Azimuth at the projection's center
-9419820.5907	/* False easting (meters)
200000.0000	/* False northing (meters)

Jürg Helbstab of Infras provided some additional background information (20-10-2012):
"NO2 ambient concentrations in Switzerland, Modelling results for 2005, 2010, 2015, (http://www.bafu.admin.ch/publikationen/publikation/01634/index.html?lang=en) is the very most actual publication on NO2.
A new publication on PM10/PM2.5 is in preparation, the final results (grids for PM10, PM2.5 for 2005, 2010, 2020) are already available for you and will provided by Thomas Kuenzle, METEOTEST (Bern). Benzene and SO2 will be provided by next spring.
We have just updated the description of our model (Pollumap) on this website, being Model Documentation System (MDS, http://acm.eionet.europa.eu/databases/MDS/index_html)."

CY (Cyprus)

No modeling data have been submitted by Cyprus, but the following details on modelling activities were given by Christos Papadopoulos (16-11-2012) provided on behalf of Savvas Kleanthous (Ministry of Labour and Social Insurance, Department of Labour Inspection):

"1) We are using model for now-casting and forecasting of the air quality in Cyprus (MARS and MEMO). The model results are expected to be released to public in the first quarter of 2013 in our website (http://www.airquality.gov.cy).
2) The model runs are mainly for the following air pollutants: NO2, PM10, PM2.5, O3 and Benzene.
3) We are not able to provide you annual average maps in any type of GIS format."

CZ (Czech Republic)

National level: Jan Horálek from CHMI, where the modeling experts reside, provided national data (04-09-2012):
"Czech national maps for 2010 (PM10, NO2, SO2 annual averages). The maps are in 1x1 km resolution.
Methodology: Measured and modelled data (and altitude for PM10, resp. traffic emissions for NO2) are combined using linear regression, followed by the interpolation of its residuals. Rural, urban and joint rural/urban background maps are created separately and merged together using population density. For PM10 and NO2, the traffic layer (created based on the traffic stations and/or traffic emissions) is added (using traffic intensity grid). In principle, similar methodology as described in ETC/ACM Technical Papers 2006/6 and 2010/10 is used.
Related dispersion models used in this combination: SYMOS (2x2 km) is used for SO2 and NO2, CAMx (9x9 km) and EMEP (50x50 km) is used for PM10. (For the description of these dispersion models, see Model Documentation System.)"
Paper references:
ETC/ACM Technical Paper 2006/6: http://acm.eionet.europa.eu/reports/ETCACC_TechnPaper_2006_6_Spat_AQ
ETC/ACM Technical Paper 2010/10: http://acm.eionet.europa.eu/reports/ETCACC_TP_2010_10_spatAQmaps_2008

DE (Germany)

National level: Arno Graff of the German Umweltbundesamt attached to the data contribution the following documentation on the modelling (25-09-2012):
Abschlussbericht zum Forschungs- und Entwicklungsvorhaben 201 43 250 auf dem Gebiet des Umweltschutzes "Anwendung modellgestützter Beurteilungssysteme für die bundeseinheitliche Umsetzung der EU-Rahmenrichtlinie Luftqualität und ihre Tochterrichtlinien" - Teil: "Datenassimilation auf der Basis der Optimalen Interpolation für die Kartierung von Immissionsbelastungen, Beschreibung der Methodik und praktischen Anwendung für 2002". Johannes Flemming, Rainer Stern, Freie Univ. Berlin, Inst. für Meteorologie Troposphärische Umweltforschung, Mai 2004. Available at: http://www.umweltbundesamt.de/uba-info-medien/mysql_medien.php?anfrage=Kennummer&Suchwort=3612, with PDF as download: http://www.umweltdaten.de/publikationen/fpdf-l/3612.pdf
(Paper uploaded to Eionet Forum ETC/ACM IG at: http://forum.eionet.europa.eu/etc-acm-consortium/library/subvention-2012/task-deliveries-ip2012/1022-spatial-aq-data-and-assessments/c.-final-versions-approved-eea/subtaks-4-european-natl-model-composite-maps/national-regional-model-documentation-documents/de-germany/datenassimilation-auf-der-basis-der-optimalen-interpolation-fur-die-kartierung)

REM-CALGRID (RCG) model description. Document provides details sections: Overview, Hor. and vert. grid system, Chemistry, Aerosol treatment, Dry and wet deposition, Meterological input, emission input, Literature references.
(Document uploaded to Eionet Forum ETC/ACM IG at: http://forum.eionet.europa.eu/etc-acm-consortium/library/subvention-2012/task-deliveries-ip2012/1022-spatial-aq-data-and-assessments/c.-final-versions-approved-eea/subtaks-4-european-natl-model-composite-maps/national-regional-model-documentation-documents/de-germany/rem-calgrid-rcg-model-description)

Data assimilation for CTM based on optimum interpolation and Kalman filter. Johannes Flemming, Maarten van Loon, Rainer Stern. Paper presented at the 26th International Technical Meeting (ITM) on Air Pollution Modeling and its Application (ITM: http://int-tech-mtng.org/old/26th/default_26th.htm), Istanbul, Turkey (2003). (Paper uploaded to Eionet Forum ETC/ACM IG at: http://forum.eionet.europa.eu/etc-acm-consortium/library/subvention-2012/task-deliveries-ip2012/1022-spatial-aq-data-and-assessments/c.-final-versions-approved-eea/subtaks-4-european-natl-model-composite-maps/national-regional-model-documentation-documents/de-germany/data-assimilation-ctm-based-optimum-interpolation-and-kalman-filter.-johannes)

DK (Denmark)

National level: Jesper Heile Christensen (Aarhus University, Dep. of Env. Sc. – Aitm. Env.) provided national data (22-11-2012):
"… gridded data for 2010." "… not in any GIS format. When we run our model system we run the system
as a nested system so in reality we have 4 different model domains:
1. mother domain for the northern hemisphere polar stereographic grid system, 150 km resolution (an extension of the old 150 km EMEP grid),
2. nested domain for Europe, 50 km resolution
3. nested domain for northern part of Europe, 16.67 km resolution
4. nested domain for Denmark, 5.67 km resolution."
ETC/ACM expressed it preference for highest resolution, i.e. 5.67 km grids, and received data on that resolution:
"The lat long coordinate is the center of the gridpoints. There are 96x96 gridpoints.
The units of the SO2 and NO2 concentration are ppb, and the units of PM10 is ug/m3.
PM10 does not include Secondary organic aerosols, only inorganic aerosols (sulphate, nitrate and ammonia), primary PM as EC, OC and mineral dust, and seasalt."

Before merging the data into the composite map the ETC/ACM converted the *ppm* units of SO2 and NO2 into $\mu g/m^3$, applying a conversion factor for SO2 of 1 ppm = 2.67 $\mu g/m^3$ and for NO2 of 1 ppm = 1.92 $\mu g/m^3$.

Furtherbackground information on model activities in Denmark can be found in:
The Danish Air Quality Monitoring Programme. Annual Summary for 2010 (2011). NERI Technical Report No. 836. Ellermann, T, Nordstrøm, C, Brandt, J, Christensen, J, Ketzel, M & Jensen, S S. National Environmental Research Institute, Aarhus University. 55 pp. http://www2.dmu.dk/Pub/FR836.pdf

EE (Estonia)

National level: Erik Teinemaa of Kesklabor provided (05-09-2012) the following information about the range of Estonian modelling activities:
"Yes we are running models here in Estonia as well. Air quality management department in Estonian Environmental Research Centre (http://www.klab.ee/en/) is responsible for dispersion modelling in Estonia as part of national air quality management system. The www.klab.ee/ohuseire is the current portal for both monitoring and modelling information. Unfortunately it is in Estonian at the moment, but a new portal should be available within this year and there will be an English version as well.

For modelling we are using here SMHI Airviro system (http://www.smhi.se/airviro) - it is a system which incorporates dispersion models, monitoring stations (data collection and validation), data presentation and publication, alarm system and emission databases (input also from other national systems). It incorporates currently 10 models (Aermod, Calpuff, SMHI Gauss, SMHI Grid, OSPM, Street Canyon, Heavy gas, MATCH, Receptor and Austal 2000G). The models can run in parallel and it is possible to combine results, the automatic ensemble function will be available anytime soon. For different scale models there is a nesting option present as well. The same system is used to maintain emission databases and collect data from monitoring stations.

We can provide dispersion modelling results as shape files. Would you prefer them as isolines or grid cells? Also should we provide them for the whole of Estonia or some specific areas? Mostly we are using a Eulerian model (EU Grid - Swedish model) for regional calculations, for the local scale we usually combine different models."

19-10-2012; Erik Teinemaa provided 2011 data:
"I just wanted to validate results with monitoring data, but never sent the shape files out after that. Here are the PM10 modelled values for 2011. I will extract and validate NO2 and SO2 as well and send them directly." *[These 2011 data were not used by the ETC.It used the 2010 data.]*

25-10-2012; on request Erik Teinemaa provided also 2010 data (additional runs made):
"Here is our 2010 data for NO2 and SO2. I have to admit, that SO2 is slightly overestimated in north-eastern corner of Estonia. PM10 dispersion calculations should be finished today afternoon."

29-10-2012; Erik Teinemaa provided 2010 PM10 data (additional runs made):
"I just wanted to validate PM10 data for 2010, it took some time, but I'm not completely happy with the results, some areas there are some inconsistencies. Anyway I will send the datasets."

The following should be stressed:
Erik Teinemaa expresses his questions with the quality of model results for certain pollutants and for some areas of Estonia: SO2 is slightly overestimated in north-eastern corner of Estonia and at PM10 some areas in Estonia have some unresolved inconsistencies.
Therefore, no further analysis should be made on the (Estonian) data contributions presented in the European composite maps. One should only initiate a deeper analysis on revised results that have the full approved of the Estonian representative(s) to the EU.

ES (Spain)

National level: Fernando Martín of CIEMAT provided (27-09-2012) modelling data for the Spanish territory, including the following background information:
"My division (Atmospheric Pollution Division, CIEMAT) is supporting to our Agriculture, Food and Environment Ministry for air quality assessment using modelling combined by measurements. We are the authors of the report you referenced in your e-mail and we make maps of air pollution concentrations and probability of exceeding limit values for the Iberian Peninsula and Balearic Islands.

We have been appointed by our Ministry to provide the maps you require. Attached please find a ZIP file including the maps of annual averages concentrations of PM10 and NO2 for the year 2010 in ARCGIS grid format." … "We can generate the SO2 annual average concentration file and send it to you in few days.

The maps have been created from combining the results of the CHIMERE (included in the MDS data base) simulations and measurements of the air quality stations deployed in the Iberian Peninsula and Balearic Islands. Some particular details of our methodology are shown in the following paragraphs.

The CHIMERE model was run for 2010 in nested domains: a large European domain (with a resolution of 0.2x0.2º) and a Iberian Peninsula domain (with 0.1x0.1º resolution). WRF model was used to provide atmospheric variables fields to CHIMERE and EMEP emission data for 2008 (the last available data when the CHIMERE model was run). However, by March 2013, we will elaborate updated maps for 2010 air pollution based on CHIMERE simulations with 2010 emission data.

The model results were combined with the measurements of air quality stations using a methodology, which consists of using linear regression and kriging interpolation to correct the model results, improving the fit to the observations. It was separately applied to rural and urban conditions in order to obtain maps for each case, which were then combined by taking into account the distribution of rural and urban areas in the domain. More details of the methodology are in:
Martín F, Palomino I, Vivanco MG (2012). Combination of Modelling and Measured Data in Air Quality Assessment in Spain. International Journal of Environment and Pollution, 2012 Vol.49 No.1/2, pp.36-44. DOI: 10.1504/IJEP.2012.049773
Martín F, I Palomino, M G Vivanco (2009). Application of a method for combining measured data and modelling results en air quality assessment in Spain. Física de la Tierra, Vol 21, 65-78."
and the data files:
"… they consist of grids of 160x90 cells (data)."

It was observed that for Spain negative values exist for NO2 and SO2. These have been set to zero values in the presented maps to make them fit in the legend classification. As the intended use of the maps is more of qualitative character, such adaptation is of minor relevance. At further analysis one should better be alert on these questionable negative data and explain or revise them.

FI (Finland)

National level: Through Niko Karvosenoja of the Finnish Env. Inst. (SYKE) the colleagues Ari Karpinnen and Julius Vira of the Finnish Meteorlogical Institute (FMI) provided (27-09-2012) request modelling data:
Niko Karvosenoja (06-09-2012):
"We have a national IAM system called Finnish Regional Emission Scenario (FRES) model concentrating mainly on emissions and emission reductions. In addition, we can model primary PM2.5 dispersion. The spatial resolution is 1x1km grid. The descriptions can be found from links below: www.environment.fi/syke/pm-modeling and http://www.environment.fi/default.asp?contentid=298811&lan=EN
So what we can offer from SYKE is:
-Annual average of emissions of PM10, NOx and SO2 2010 at 1x1 km grid
-Modeled annual average concentrations of primary PM2.5 from Finnish sources 2010 at 1x1km grid
We have developed together and are collaborating with Finnish Met Institute on emission and dispersion studies. You may contact Ari Karppinen or Mikhail Sofiev (cc) about the availability of the requested data of modeled PM10, NO2 and SO2."

Julius Vira from FMI provided data (19/10/2012) and some modeling background information:
"For year 2010, we have run the SILAM model within the MACC project (http://www.gmes-atmosphere.eu/services/raq/). This includes both daily forecasts and a yearly reanalysis. From the reanalysis, I can extract the average PM, NO2 and SO2 fields with reasonable effort. This would be in a geographical lon/lat grid and Netcdf format.
However, it should be noted that this dataset is based on assimilation of hourly surface NO2 and O3 observations. In a sense this sets it apart from "pure" model runs."

Which Ari Karpinnen confirms (19/10/2012) on the supposition that it involves no model evaluation:,
"Sounds that this is the best we can send easily- and for this specific purpose it seems to be completely ok." … "Guess we are not aiming at any model evaluations with these, just providing the best available modeled concentrations for Finland - with those, assimilation with measurements should be completely ok."
The ETC/ACM clarified and guaranteed that no model evaluation will take place on current data contributions.

Julius Vira provided data (01-11-2012):
"I have created the attached netcdf file with the annual average NO2, SO2 and PM10 concentration fields. The data are in a lon-lat grid with 0.2 degree spacing…" … "The unit is micrograms/m3 for all species."

FR (France)

No modeling data have been submitted by France. Aurelie Le Moullec, the national representative, provided following "… Given the intended use of these data, it has unfortunately been decided not to access your request….". No further communication took place.

GB (United Kingdom)

National level: Through Emily Connolly (DEFRA), John Stedman of Ricardo - AEA provided (25-09-2012) request modelling data:
"I propose that we provide you with 1 km gridded output from our models. These represent concentrations in 'background' locations. Model results for traffic locations also form part of our compliance assessment but I do not think that these will be relevant for your study.
Annual mean concentrations of NO2 and PM10 are available for the whole of the UK, annual mean SO2 concentrations are only available for ecosystem areas as shown in the ukmaps2010.doc document. *(*)*
Concentration of NO2 in were unusually high in 2010 due to the very cold weather in the UK during 2010.
The GIS data are available on the GB national grid, which you should be able to transform into different coordinate systems in your GIS.
We can provide the GIS data in a choice of three different formats. Please let me know which would be most suitable for you. We will then upload the data as requested.
1) Arcinfo grid export file (.e00)
2) Arcinfo grid ascii file
3) xyz .csv file, where x and y represent the centres of the grid squares."

Data was submitted as grid ASCII files for modelled UK PM10, NO2 and SO2 for 2010 in µg/m^3; 1km grid on British National Grid.

(*) The maps referred to in above the communication are included in the following modelling background documentation:

- NO2 annual average: Fig. 6 in ukmaps2010.doc; Fig. 2.1 in UK modelling AQD 2010 report;
- PM10 annual average: Fig. 9 in ukmaps2010.doc; Fig. 4.1 in UK modelling AQD 2010 report;
- SO2ecosystems: Fig. 2 in ukmaps2010.doc; Fig. 3.1 in UK modelling AQD 2010 report.

ukmaps2010.doc
(Document uploaded to Eionet Forum ETC/ACM IG at: http://forum.eionet.europa.eu/etc-acm-consortium/library/subvention-2012/task-deliveries-ip2012/1022-spatial-aq-data-and-assessments/c.-final-versions-approved-eea/subtaks-4-european-natl-model-composite-maps/national-regional-model-documentation-documents/gb-united-kingdom/ukmaps2010.doc)

UK modelling AQD 2010 report:
DEFRA - Library - Air Quality Modeling Reports, http://uk-air.defra.gov.uk/library/reports?section_id=20:
"UK modelling under the Air Quality Directive (2008/50/EC) for 2010 covering the following air quality pollutants: SO2, NOx, NO2, PM10, PM2.5, lead, benzene, CO, and ozone" http://uk-air.defra.gov.uk/reports/cat09/1204301513_AQD2010mapsrep_master_v0.pdf
(Document uploaded to Eionet Forum ETC/ACM IG at:
http://forum.eionet.europa.eu/etc-acm-consortium/library/subvention-2012/task-deliveries-ip2012/1022-spatial-aq-data-and-assessments/c.-final-versions-approved-eea/subtaks-4-european-natl-model-composite-maps/national-regional-model-documentation-documents/gb-united-kingdom/uk-modelling-aqd-2010-report-aqd2010mapsrep_master_v0.pdf

GR (Greece)

National level: Anastasios Adamopoulos (Min. Env., energy & climate change, Dg Env., Div.
air & noise pollution control) provided shape files with point data spread throughout Greece (12-09-2012).
"Concerning the maps, please see the attached file and if you still have problems in viewing the maps I can send you the images.
Alternatively, click http://www.ypeka.gr/Default.aspx?tabid=491&language=el-GR to see the maps for all Greece (not for cities)."

Unclear is what these point data reflect as no additional information or clarification was given The point data are different from what was found on at the web site at the given URL. This web page is in Greek and a translation attempt results in:
"**The mapping of air pollution in Greece is a tool to improve the monitoring of air quality**
The development of the project "Assessment and mapping of air pollution in Greece" was held under the EPPER, CSF from the consortium of companies PRC EIA-TEM AU and had a budget of 673.072 €. The project aimed at creating a system of cartographic mapping of pollution in accordance with the requirements of the 96/62/EE and its subsidiaries for the assessment and management of air quality.

Relevant maps display the levels of air pollution in Greece, made using simulation models in 6x6 Km grid and relate to pollutants: sulfur dioxide (SO2), nitrogen dioxide (NO2), particulate matter with an aerodynamic diameter less than 10 microns (PM10), ozone (O3), carbon monoxide (CO) and benzene.
The ratings of each grid cell are power series, ie superior to others and so on. Summarizes the ratings used are as follows:
1 Excess LV + MOT (> LV + MOT)
2 Excess LV (LV <... <LV + MOT)
3 Excess UAT (UAT <... <LV)
4 Excess LAT (LAT <... <UAT)
5 None exceeded (<LAT)
LV threshold
MOT tolerance
UAT upper assessment threshold
LAT threshold estimation
The ratings of each cell resulting from the comparison of estimated values and limit values applied in 2008.

Maps depicting the levels of air pollution in Greece
Mapping of the average annual limit value for benzene http://www.ypeka.gr/LinkClick.aspx?fileticket=LFZj%2fQtdpmY%3d&tabid=491&language=el-GR
Mapping to the limit of carbon monoxide http://www.ypeka.gr/LinkClick.aspx?fileticket=8Fs3uqFukxM%3d&tabid=491&language=el-GR
Mapping of the average annual limit value for nitrogen dioxide http://www.ypeka.gr/LinkClick.aspx?fileticket=2ibQ48T0wp8%3d&tabid=491&language=el-GR
Mapping of the average hourly limit value for nitrogen dioxide http://www.ypeka.gr/LinkClick.aspx?fileticket=pWAXLoJDxfQ%3d&tabid=491&language=el-GR
Mapping to the target value for ozone
http://www.ypeka.gr/LinkClick.aspx?fileticket=SUawR7gmVQc%3d&tabid=491&language=el-GR
Mapping of the average annual limit particulate http://www.ypeka.gr/LinkClick.aspx?fileticket=pkIAFhj%2fju0%3d&tabid=491&language=el-GR
Mapping of the average daily price limit particulate http://www.ypeka.gr/LinkClick.aspx?fileticket=UM1KnhqvXYE%3d&tabid=491&language=el-GR
Mapping of the average daily limit value for sulfur dioxide http://www.ypeka.gr/LinkClick.aspx?fileticket=OzVwGrnqx2s%3d&tabid=491&language=el-GR
Mapping of the average hourly limit value for sulfur dioxide http://www.ypeka.gr/LinkClick.aspx?fileticket=93JZ7GfuXDc%3d&tabid=491&language=el-GR "

No data was available for these maps and the map legends indicated a production date of December 2004. The maps do not reflect the requested data of annual average concentrations and are considered by the ETC/ACM as not representative for the year 2010. Both the point data and web site maps seem not be the materials requested for and it is not clear whether they represent the year 2010. Therefore, no Greek data are included in the European composition map.

HR (Croatia)

No modelling data have been submitted by Croatia, but the following details on modelling activities were given by Sonja Vidic of the Met. & Hydr. Service (DHMZ) of Croatia (18-09-2012):
"Our modelling group has developed a modelling system on 10 km grid scale for Croatia based on EMEP chemical model and Aladin meteorological driver. Full description of the model has not been provided yet in a structured MDS format, but is well described in several peer reviewed articles. For the purpose of the project***(*)*** mentioned

below we have managed to obtain emission gridded data in 10 km resolution for 2005/2006, therefore our calculations refer to these years. We are struggling with the emissions in later years, so the model has not been yet used to calculate concentration and deposition fields for 2010.
Currently, modelling work is under the responsibility of dr. Amela Jericevic who can fully inform you on the situation and availability of data for 2010 in described formats, as well as with respect to model
description. Please note her as a contact person for any further inquiries (amela.jericevic@cirus.dhz.hr)
She is included in this conversation and I am sure she will respond to your request soon."
(*) "High Resolution Environmental Modelling and Evaluation Programme for Croatia (EMEP4HR)" (2006-2009), http://klima.hr/razno_e.php?id=projects&param=emep4hr_en

Response by Amela Jericevic of DHMZ (19-09-2012):
"At the moment we have 2006 yearly averages of all the requested pollutants in ncdf format in the Lambert conformal projection. We might work more on this but it depends on the time you need the data."
ETC/ACM thanked and mentioned that 2006 data are considered somewhat outdated to include in the 2010 maps. As the data were needed instantaneously, no runs for 2010 are made as the data requested for had to be kind of readily available.

HU (Hungary)

No modelling data have been submitted by Hungary as there was no response to our emailing.

IE (Ireland)

No modelling data have been submitted by Ireland, but the following details on modelling activities were given by Barbara O'Leary of the EPA (08-10-2012):
"Ireland does not currently use a model to assess air quality. All assessment is by monitoring combined with objective estimation.

If you would like a spatial assessment of monitored data then we can supply this. You can see the images of this assessment in our 2011 annual report (e.g. NO2 assessment on P.26), available to download from http://www.epa.ie/downloads/pubs/air/quality/name,33862,en.html.
If you want any of these then let me know which parameters you want and I will send you the shape files.

The reference Barbara O'Leary gives here is to the mapping of zones, which is typically reported through the air quality questionnaire and not exactly what we are aiming for in this exercise of composing a modelling based European air quality map. Relevant literature that suggests potential for modelling activities in Ireland is given in a report prepared by Barbara O'leary:
"Review of Ambient Air Quality Monitoring in Ireland". (Prepared in response to the commitment in the Programme for the Government to "Expand the network of air quality monitoring stations to improve national coverage"). Barbara O'Leary. Dec 2010.
http://www.epa.ie/downloads/pubs/air/quality/ReviewOfAirQualityMonitoring2010NoFinancialInfo.pdf

As feedback on the informal map review Barbary O'Leary gave (06-12-2012):
"Thank you for the maps. It is interesting to see them and I look forward to the paper.
I note there are a number of countries who did not supply data. I would appreciate if you could include on the paper which countries did not supply data because there is no model in place, such as Ireland. In addition to acknowledging the reason we did not supply data, ie it was not due to lack of co-operation, it would be useful to us to know what other countries are in a similar development phase.
I also hope the paper will compare the modelled results to the maps of actual results submitted, maps which the EEA have already produced. I think this would highlight the biggest issue we found so far in developing a model – PM10 outside cities is not accurately dealt with in models."
The ETC/ACM has included in Table 2 of this paper the requested information about which countries do or do not use modeling. European maps for the annual average of PM10, NO2 and SO2 for 2010 at the rural stations are included in the paper (Maps 1b, 2b and 3b) next to the European modelled air quality composite maps (Map 1, 2 and 3)

IS (Iceland)

No modelling data have been submitted by Iceland, but the following details on modelling activities were given by Thorstein johannssen of the Environment Agency of Iceland (03-10-2012):
"… there is very limited modeling about air quality in Iceland available. There are some spatial data available in the Icelandic Informative Inventory Report to LRTAP about emission, but only for dioxins/ furans and PAH, not for NO2, SO2, or PM10.
In this same report are data about total emission of NO2 and SO2 and also division between sectors but not spatial distribution. Unfortunately there are no data about PM 10 in this report. These reports from Iceland to LRTAP are available on http://cdr.eionet.europa.eu/is/un/UNECE_CLRTAP_IS
This lack of information is mainly due to low budget in the air quality field. We need more people this field.
But there is some work started regarding air quality modeling in the capital area, so after about one year the situation might be slightly better. But on the first stage only NO2 will be included in that modeling."

IT (Italy)

As response to our data request to the general email address of the Direzione generale per le valutazioni ambientali of the Ministero dell'ambiente and two contacts to ARPA Lombardia (air quality directive's questionnaire contact persons) we received two regional data contributions: one for Lombardy (annual average PM10 and NO2) and one for Piedmont (annual average PM10, NO2 and SO2).

Lombardy: Anna Di Leo from Agenzia Regionale per la Protezione dell'Ambiente (ARPA; http://ita.arpalombardia.it) provided modelled annual average PM10 and NO2 data for 2010 and a brief model reference (12-10-2012):
"The core of the modelling tool used is the Eulerian CTM FARM (Flexible Air quality Regional Model)
(MDS reference: http://pandora.meng.auth.gr/mds/showlong.php?id=130&MTG_Session=da7c462afac09b24e18c88f486b7d76d)
Maps were developed by Operative Unit Modelling of ARPA Lombardia."
Projection details (as ArcGIS .prj file):

PROJCS["WGS_1984_UTM_Zone_32N",GEOGCS["GCS_WGS_1984",DATUM["D_WGS_1984",SPHEROID["WGS_1984",6378137.0,298.257223563]],PRIMEM["Greenwich",0.0],UNIT["Degree",0.0174532925199433]],PROJECTION["Transverse_Mercator"],PARAMETER["False_Easting",500000.0],PARAMETER["False_Northing",0.0],PARAMETER["Central_Meridian",9.0],PARAMETER["Scale_Factor",0.9996],PARAMETER["Latitude_Of_Origin",0.0],UNIT["Meter",1.0]]

Piedmont: Francesco Matera from Agenzia Regionale per la Protezione dell'Ambiente (ARPA) Regione Piedmont (http://www.regione.piemonte.it), Direzione Ambiente provided modelled annual average PM10, NO2 and SO2 data for 2010 and included a document with model characteristics (12-10-2012):

"**CHARACTERISTICS OF AIR QUALITY MODELLING SYSTEM USED FOR ANNUAL AIR QUALITY ASSESSMENT IN PIEDMONT REGION**

ARPA Piemonte performs yearly air quality assessment running a modelling system based on a chemical transport model. The model is capable to simulate air pollutant emission, transport, diffusion and chemical transformation, to provide concentration fields of the main atmospheric pollutants (CO, NOX, SO2, PM10, PM2.5, O3, and benzene) on a hourly basis and to compute all the indicators required by EU legislation.

The Air Quality Assessment modelling systems (Bande et al., 2007; Finardi et al., 2008) is built around the trhee-dimensional deterministic modeling system (C.T.M. F.A.R.M., Chemostry Transport Model Flexible Air Quality Regional Model) that needs a series of detailed input datasets: emission inventories, geographic and physiographic data (to describe topography, surface land cover and urban details), large scale air quality and meteorological fields. Some specific modules are needed to process these data in order to produce emissions, meteorological and boundary conditions necessary as input to the air quality model.

Emission data coming from different resolution inventories available over the area (high resolution regional inventories for Piemonte, Lombardia and Valle d'Aosta regions, national CORINAIR inventory for the remaining Italian regions and EMEP for foreign countries) are processed to compute gridded emissions. This data processing involves space and time disaggregation - according to cartographic thematic layers and specific time modulation profiles (yearly, weekly and daily) - and non-methanic hydrocarbon speciation, to produce gridded hourly emission rates for the all the chemical species considered by the air quality model over all computational domains.

Meteorological fields to drive air quality simulations are reconstructed assimilating ARPA Piemonte meteorological network observations within background fields obtained by ECMWF analyses. Eddy diffusivities and deposition velocities are evaluated using parameterisations based on the surface energy balance and similarity theory, by the interface module SurfPRO, which uses. Air quality boundary values are defined from continental runs of the chemical transport model CHIMERE, from the INERIS Prev'Air service (http://prevair.ineris.fr).

The AQA modelling system works on a computational domain of 220x284 km^2, covering the whole Piemonte and Valle d'Aosta Regions, part of Liguria, the eastern part Lombardia (including Milan urban area) and portions of France and Switzerland (Figure 2 [*not included*]), with an horizontal resolution of 4 km and 12 vertical levels, spanning the lower 3500 metres of the atmosphere.

The observed air quality data from Piemonte regional network SRRQA and monitoring networks of the neighboring regions (Lombardia and Valle d'Aosta) are introduced inside model fields using kriging. Given the limited number of monitoring sites and their absence in a few areas, a "standard" kriging would not be able to provide a good pollutant prediction on the whole Piemonte region. In order to improve pollutant model output the simulated data has been processed through Kriging with External Drift (KDE, Wackernagel, 2003): kriging is applied on the observed data and the external drift in constituted by the deterministic model output. To perform kriging are selected some monitoring sites for each pollutant to ensure spatial representativeness consistent with model resolution and uniform coverage of the region."
(Document uploaded to Eionet Forum ETC/ACM IG at: http://forum.eionet.europa.eu/etc-acm-consortium/library/subvention-2012/task-deliveries-ip2012/1022-spatial-aq-data-and-assessments/c.-final-versions-approved-eea/subtaks-4-european-natl-model-composite-maps/national-regional-model-documentation-documents/it-italy/piedmont_model_explanation).

Projection details (as ArcGIS .prj file):
PROJCS["WGS_1984_UTM_Zone_32N",GEOGCS["GCS_WGS_1984",DATUM["D_WGS_1984",SPHEROID["WGS_1984",6378137,298.257223563]],PRIMEM["Greenwich",0],UNIT["Degree",0.0174532925199433295]],PROJECTION["Transverse_Mercator"],PARAMETER["latitude_of_origin",0],PARAMETER["central_meridian",9],PARAMETER["scale_factor",0.9996],PARAMETER["false_easting",500000],PARAMETER["false_northing",0],UNIT["Meter",1]]

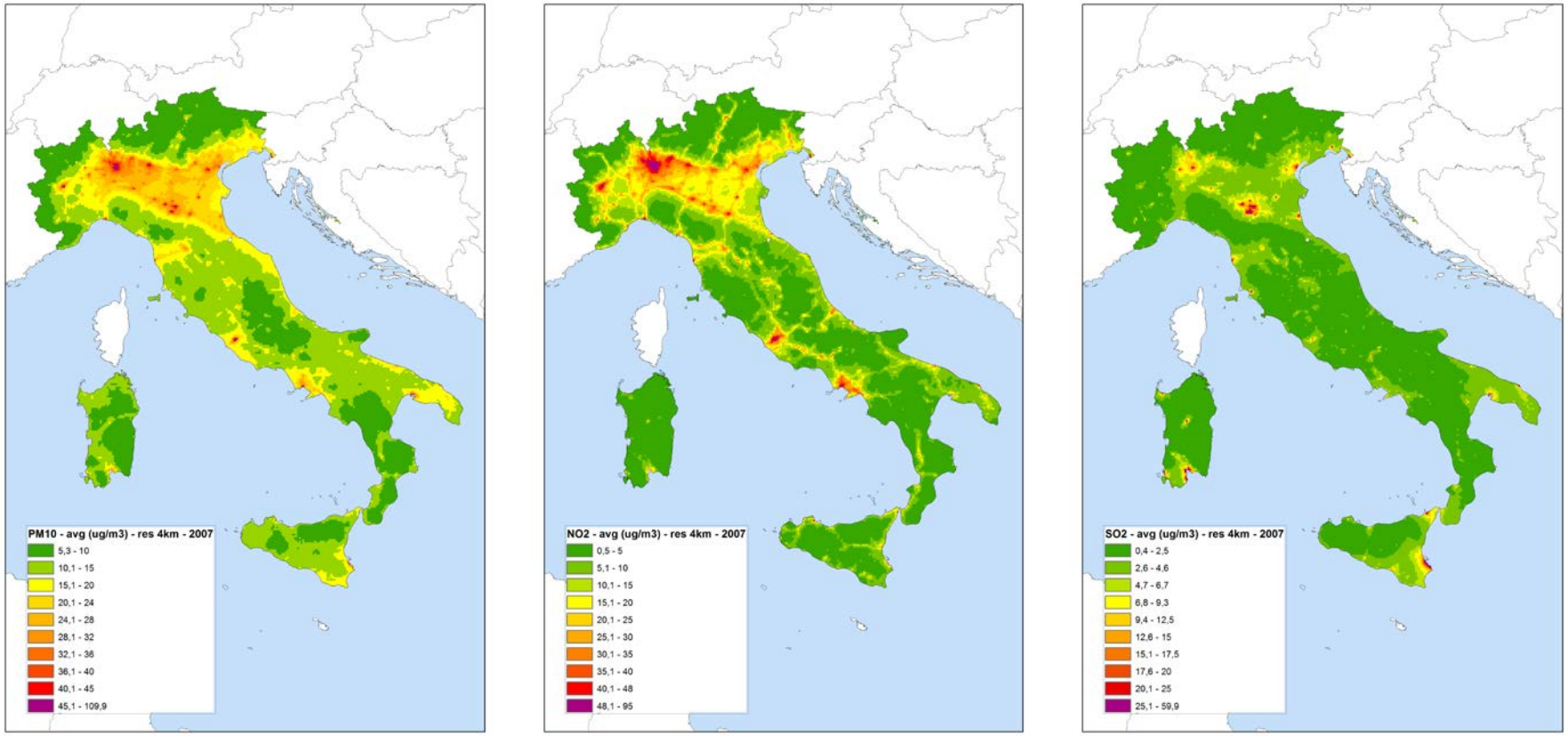
Italian national model application for the Ministry of Environment:
This information has been received after finalisation of the European composite maps and just before release of this paper. To demonstrate the national italian modelling activities the information has been included here.

(Contact person: Maria Gesuina Dirodi, DiRodi.MariaGesuina@minambiente.it; 12-03-2013)

At national scale, ENEA (national agency for new technologies, energy and sustainable economic development), on behalf of Italian Ministry of Environment, simulates air quality for specific meteorological and emissive years with 4 km spatial resolution and 1 hour temporal resolution (MINNI project, http://www.minni.org/benvenuto-in-minni-en?set_language=en).

MINNI's Atmospheric Modeling System is composed of the prognostic meteorological module RAMS, the emission inventory processor EMGR, the core Chemical Transport Model FARM, present in ETC/ACM Model Documentation System (http://pandora.meng.auth.gr/mds/showshort.php?id=130).
Until now 1999, 2003, 2005, 2007 years have been simulated and 2010 will be ready as soon as the national emission inventory is published at NUTS3 level.

In the following figures are shown some modeled map results of MINNI's Atmospheric Modeling System related to year 2007.



Three maps for Italy showing modeled map results of MINNI's Atmospheric Modeling System related to year 2007 for the annual average concentrations of PM_{10} (left), NO_2 (centre) and SO_2 (right)

LI (Lichtenstein)

National level: Hanspeter Eberle of the Amt für Umweltschutz Fürstentum Lichtenstein provided the following information on modeling activities (11-09-2012):

"Liechtenstein doesn't have any spatial air quality models. Neither do we produce any maps about pollutants. That is because Liechtenstein is very small and we have only few measuring stations. But Liechtenstein is embedded in the swith "Ostluft"-Projekt.

There the modeling of air immissions data for PM10 and NO2 (http://www.ostluft.ch/87.0.html?&tx_ttnews%5Btt_news%5D=81&cHash=9cf4abf8da80bf3754516e7aef32d6c9) for example is a recent project. First results were expected this summer.
There are also map about ozone (http://www.ostluft.ch/87.0.html?&tx_ttnews%5Btt_news%5D=18&cHash=b15429faaf85034650fa201c370c91cc).
For further information please contact the Swiss contact person on the Exchange of Information on Air Quality or Gian-Marco Alt."

Through Peter Maly of www.interkantlab.ch and involved in the 'Ostluft Projekt' (www.ostluft.ch) we received from Gian-Marco Alt (18-10-2012) data for Lichtenstein and the following modeling description and details:
"Today I got the ok from our colleagues of Fürstentum Liechtenstein to deliver you the modelled data 2010 annual means for PM10 and NO2. For SO2 we don't have any modelled data.
I'll send you the data as Arc/Info Grids (Export Format *.e00).
The data have to be divided by 1000 to get values in µg/m³.

Data characteristics:
Timestamps: 2005 / 2010 / 2015 and 2020
Spatial resolution: 100m x 100m

Description NO2 Grid	(Description of Grid: FL_NO2_2010)		
Cell Size =	100.000	Data Type:	Integer
Number of Rows =	248	Number of Values =	9989
Number of Columns =	124	Attribute Data (bytes) =	8
BOUNDARY		STATISTICS	
Xmin =	754400.000	Minimum Value =	257.000
Xmax =	766800.000	Maximum Value =	31269.000
Ymin =	212900.000	Mean =	10041.155
Ymax =	237700.000	Standard Deviation =	6604.114

Description PM10 Grid	(Description of Grid: FL_PM10_2010)		
Cell Size =	100.000	Data Type:	Floating
Point Number of Rows =		248	
Number of Columns =		124	

BOUNDARY		STATISTICS	
Xmin =	754400.000	Minimum Value =	6870.038
Xmax =	766800.000	Maximum Value =	18219.773
Ymin =	212900.000	Mean =	12482.390
Ymax =	237700.000	Standard Deviation =	3618.748

Projection	OBLIQUE_MERCATOR
Units	METERS
Spheroid	BESSEL
Parameters:	
Projection type < 1 | 2 >	2
Scale factor at the projection's center	1.00000
Longitude of the projection's center (DMS)	7 26 22.500
Latitude of the projection's center (DMS)	46 57 8.660
Azimuth at the projection's center	90.00000
False easting (meters)	-9419820.5907
False northing (meters)	200000.00000

For the modelling we use "PolluMap" (by Infras/Meteotest) which is already described in your Model Documentation System (MDS) and is also used for the modelling of Switzerland (BAFU, Rüdolf Weber)."
(See documentation provided at CH (Switzerland)).

Please, note that the primary contact for Lichtenstein stays with Hanspeter Eberle as national representative of Fürstentum Lichtenstein.

LT (Lithuania)

Vilnius area: Mindaugas Bernatonis of the Environmental Protection Agency provided modelled annual average PM10, NO2 and SO2 2010 data for the agglomeration Vilnius and modeling information (13-09-2012):
"Please, find the attached file about model options and characteristic of modelling annual concentrations in Vilnius (2010). The results show annual concentrations from ground level to 1.8 meters above ground level. Natural background concentrations are included.

Please note, that modelling results with ADMS-Urban model for Vilnius and Kaunas agglomerations we have for year 2011.
Talking about Kaunas agglomeration for year 2010, there is a lack of potential data which you need, because modelling for Kaunas were done by other institution and with old AIRVIRO (SMHI, Sweden) version."

Short description of model 'ADMS-Urban':

For VILNIUS agglomeration 2010 modelling we used ADMS-Urban model (CERC, Great Britain).
Policy issue: Urban air quality
Application type: Air quality assessment; Public information
Model output: Concentrations, µg/m^3
Type of air pollution source: Emissions from the stack of a plant (point source); Traffic emissions (line source); Area source; Emission inventory database (gridded data)
Spatial scale of model application: Local (up to 30 km)
Simulation character: Statistical (analysis of long-term AQ indicators)
Form of release: Sulphur Dioxide (SO2); Carbon monoxide (CO); Nitrogen Oxides (NOx / NO_2); Volatile Organic Compounds (VOCs); PM10
Contaminant properties: Non-reactive primary pollutants
Type of model: Gaussian model
Duration of the simulation: More than 24 hours
Computer Platform: PC
Input data of meteorological parameters:
- Data from Vilnius meteorological station of the year 2010; Met. data are hourly sequential;
- Included met. parameters are: Air temperature (2 m high); Wind speed and Wind direction (10 m high); Cloudiness; Monin-Obukhov length;
Resolution (output interpolation of concentrations):
- Gridded output of intelligent gridding: 0.1 x 0.1 km
- Regular grid spacing: 0.7 x 0.7 km
Modelling results:
- Raster
- Zipped file name: „raster_2010_EUR.zip“
- Annual averages of PM10; NO_2 and SO_2 for year 2010; Vilnius agglomeration.

The ETC/ACM found on the internet relevant information about modeling activities (2010):
- "Lithuanian Air Monitoring System Modernization Using Diffusive Samplers Final Report", Contract No 4F10-101, 2010 September 28 (http://oras.gamta.lt/files/Final%20Report_LAQMO_En.pdf), Section 4.7.8 "Maps of annual mean concentrations distribution of sulfur dioxide, nitrogen dioxide, benzene and ozone" (p.165 - 185), with spatial air quality model results for urban areas as well nation wide (based on EMEP 50km grid points, zone points and sampling points based air quality modelling interpolations) for the period 3.11.2010 – 4.7.2011.
- Some air quality modelling results for 2010 for Vilnius (in Lithuanian): http://gamta.lt/files/EK%20oro%20apzvalga%202010_09-19_4doc.pdf

LU (Luxembourg)

No modelling data have been submitted by Luxembourg, but the following details on modelling activities were given by Eric Vansuypeene of the Min. du Dév. Dur. et des Infrstruct. (Admin. de l'Env.) by phone (24-09-2012). Notes of the conversation:

Since July 2011 a co-operation has been launched with Irceline (ISSeP = Wallonian Institute) to implement the Belgium methods (RIO based) on LU territory. Within 1-1.5 years Eric expects to have modeling up and running for Luxembourg. When implemented, Eric expects to be able to deliver modeling data on a regular routine basis.

Peter de Smet explained to Eric that we are currently doing a first exploration of materials available in the countries to see if harmonization efforts may be needed.

Reaction by Eric: LU is harmonized with BE by their co-operation with IRCELINE (ISSeP) in same methodology; Main distinction is that each country uses its own national statistics as input data sources.

(Currently up and running: actual AQ status web site (including past weeks and few days forecast): http://www.environnement.public.lu/air_bruit/dossiersPA-reseaux_mesure_air/reseau_automatique/resultats_mesures_live/index.html

Methods to be used on requested pollutants.
Ozone: done with CHIMERE model.
NO2, PM10: makes use of CORINE land cover, reclassified to RIO-like classes (incorporating LU statistics data) and compared and adapted to similar cases as occurred in the past to tune the air quality forecast to the specific locations (accounting for the typical local situations and characteristics in AQ). (PM10 is done at interregional scale).

LV (Latvia)

No modelling data have been submitted by Latvia, but the following details on modelling activities were given by Tamara Vasiljeva (EEA EIONET NRC-AIR Quality Latvia) of the Latvian Environment, Geology and Meteorology Centre, Air and Climate Division (28-09-2012):
"Herewith I would like to send you information about urban spatial air quality modelling.
I regret to say that we haven't got any spatial air quality modeling results for Latvia which are based on data of emission taken from year 2010.
In 2010 a modeling for Riga city (annual average NO2) has been done, but the modelling results were based on data of emission taken from year 2009, but unfortunately the results are not available in GIS format as shape, raster or grid file set."

ME (Montenegro)

No modelling information has been found on the internet. Montenegro has not been contacted. The reason is that we expect that no modelling activity of relevance takes place yet, since Montenegro launched the implementation of monitoring networks some years after its independency (2006). In follow up activities to this paper Montenegro should be approached about (intended?) modelling activities. Potential contact person is Gordana Djukanovic of the EPA Montenegro.

MK (FYR of Macedonia)

No modelling information has been found on the internet. FYROM has not been contacted. In follow up activities to this paper FYROM should be approached about (intended?) modelling activities.

MT (Malta)

No modelling data have been submitted by Malta. The following information was provided by Michael Nolle of the Malta Environment and Planning Authority – Waste, Air, Radiation & Noise Unit (18-09-2012):
"Malta is currently not using modelling tools for spatial assessment.
Besides the near real time monitoring network, we are also running a network of diffusion tubes. Monitoring by means of diffusion tubes does not fulfill the data quality objectives, and this data is therefore not used for reporting purposes."

NL (The Netherlands)

National level: Through Guus Velders of RIVM modelling data for annual average PM10, NO2 and SO2 2010 were provided (14-09-2012):
"As you know we produce maps annually for a series of compounds. The maps for historical years are calculated with the OPS-model and then calibrated using measurements in the Netherlands. Attached are the maps (suitable for ArcGis) for NO2, PM10 and SO2.
The maps are described in the attached report *[in Dutch]*. The attached paper describes the methodology (in English)." ***(*)***
(*) References are:
- "Grootschalige concentratie- en depositiekaarten Nederland", Rapportage 2011, RIVM Rapport 680362001/2011. G.J.M. Velders, J.M.M. Aben, B.A. Jimmink, E. van der Swaluw, W.J. de Vries. (2011)
http://www.rivm.nl/Bibliotheek/Wetenschappelijk/Rapporten/2011/mei/Grootschalige_concentratie_en_depositiekaarten_Nederland_Rapportage_2011 (in Dutch)
- "Likelihood of meeting the EU limit values for NO2 and PM10 concentrations in the Netherlands". (2009). Guus J.M. Velders*, Hub S.M.A. Diederen, Atmospheric Environment, Vol 43, p. 3060–3069

Other relevant references:
- GCN web site (modelled concentration maps) (in Dutch):
http://www.rivm.nl/Onderwerpen/Onderwerpen/G/GCN_GDN_kaarten_2012/Concentratiekaarten/Cijfers_achter_de_concentratiekaarten
GCN map viewer: http://geodata.rivm.nl/gcn/

Projection system used in NL:
RD_New.prj or RDNew.prj: (= the same)
"RD_New"
Projection: Double_Stereographic
False_Easting: 155000.000000
False_Northing: 463000.000000
Central_Meridian: 5.387639
Scale_Factor: 0.999908
Latitude_Of_Origin: 52.156161
Linear Unit: Meter (1.000000)

Geographic Coordinate System: GCS_Amersfoort
Angular Unit: Degree (0.017453292519943295)
Prime Meridian: Greenwich (0.000000000000000000)
Datum: D_Amersfoort
Spheroid: Bessel_1841
Semimajor Axis: 6377397.155000000300000000
Semiminor Axis: 6356078.962818188600000000
Inverse Flattening: 299.152812799999990000

As feedback on the informal map review Guus Velders gave (14-12-2012):
"Great maps you produced. The differences in concentrations at the country borders are very intriguing and raise several questions. The only question I have now is if there are descriptions how the maps for the individual countries are made?"
On ETC's reflection that underlying annex meets with his request, Guus responds (17-12-2012):
"I will – within the context of the GCN-maps – look into it further next year. Currently, we do not use foreign measurement data / model data within the GCN maps, but perhaps this is an omission."

NO (Norway)

No modelling data have been submitted by Norway. Sigmund Guttu of the Climate and Pollution Agency (Klif), Section of Transport and Energy explained the following details on modelling activities are ongoing at the moment (26-09-2012):
"… we are not able to provide such data. The modelling in Norway is still on a low level of complexity. The figures you refer to on http://www.environment.no/Topics/Air-pollution/Local-air-pollution are from CAFÉ ***(*)***. The reporting of model results under the EU directives you refer to are just simple calculations based on basic traffic numbers made for some years ago (2007)***(**)***. However, a regional background atlas is now developed by NILU for Klif. We would be happy to provide results from this on relevant years, when it is finished."
(*) Refers to the air quality directive questionnaire where for some pollutants for 2010 at least one air quality management zone has been reported for which model data has been used somehow.
(**) Found on the internet some information on local air quality modelling taking place in Norway, e.g., http://www.environment.no/Topics/Air-pollution/Local-air-pollution.

PL (Poland)

Regional level: Magdalena Brodowska of the Chief Inspectorate of Environmental Protection, Dep. of Monitoring and Environmental Information provided data (05-10-2012) for three voivodeships of Łódź, Masovia and West Pomerania, with additional information on modeling:

"Replying to your request concerning modelling results of PM10, SO2 and NO2"…"annual mean values of PM10, SO2 and NO2 in 2010 from three viovodships: Lódzkie, mazowieckie and zachodniopomorskie (as grid files and as isoline files).
Below please find short description of models:
- models: CALMET/CALPUFF,
- mesoscale meteorological WRF model (The Weather Research and Forecasting Model) also used,
- transport from outside of the viovodship taken into account,
- included impact of large point sources located in the voivodship, low point sources, road transport and household sources,
- irregular network of receptors depending of population density and landuse,
- calibration of model results by comparison with in-situ measurement results."

As feedback on the informal map review Magdalena Brodowska gave (12-12-2012):

"We would be grateful for sending us the results in shp (in WGS 1984). The scale of the attached files is too small to assess levels of for example regional background between Poland, Germany and Czech Republic.
The above request comes from my colleague from one of the three regions (Lódzkie voivodeship).
None the less I already see on the maps very interesting results of the exercise."

The ETC/ACM will make the final map data as shape files available to the persons that cooperated in this project. However, these data are not suitable to execute in depth analysis as they were not intended and submitted for such usage.

Furthermore, on the web site of the Chief Inspectorate the ETC/ACM found quite a series of references to regional and local web sites providing information (often in polish only) on their specific local air quality modelling activities: http://www.gios.gov.pl/artykuly/418/Lista-Wojewodzkich-Inspektoratow-Ochrony-Srodowiska.

PT (Portugal)

National level: As national modeling expert on air quality models and Portugal member of FAIRMODE on behalf of Portuguese Environment Agency, Ana Isabel Miranda at the University of Aveiro (http://www.ua.pt/gemac) provided - with confirmed agreement of national representative Dilia Jardim of the Agência Portuguesa do Ambiente - data for annual average PM10, NO2 and SO2, including the following modeling information (03-10-2012):

"I fully support your initiative to combine results from national/regional modeling activities and I'm sure you'll be able to get very interesting results. Since some years ago we're delivering to the Portuguese Environmental Agency (Dília Jardim) the maps you're asking for and it will be a pleasure to provide them to you."

And (09-10-2012):

"Please, find attached the AQ maps regarding 2010 annual average for PM10, SO2 and NO2 over Portugal, provided by the EURAD-IM model (http://pandora.meng.auth.gr/mds/showlong.php?id=169).

[…] GIS information containing the simulation grid and the annual average concentrations of each pollutant requested for each cell of the grid. The projection of this shapefile is Datum 73 Hayford Gauss IGEOE - Transverse Mercator, as defined in .prj file.

Note that AQ modelling results were combined with observational data through a bias-correction technique, based on the application of a correction factor for each cell of the domain. The benefits of the application of this technique (RAT04) have already been demonstrated by
Borrego, C., Monteiro, A., Pay, M.T., Ribeiro, I., Miranda, A.I., Basart, S., Baldasano, J.M. (2011). "How bias-correction can improve air quality forecast over Portugal". Atmospheric Environment, 45, 6629-6641.

We also have modeling results for 2011 and for PM2.5, C6H6 and O3. So, please let me know if you need something else."

As feedback on the informal map review Ana Miranda provided (12-12-2012) a freshly produced data update data for 2010, now based on 2009 emissions:
"I'm sending updated maps based on 2009 emissions instead of 2008. Our national emission inventory was updated recently and we had to run the system again because we realised emissions decreased a lot, namely SO2 due to the closure of some industries in the southern region of Lisbon. We were finalising the runs and we were just finishing the files to send you.
We're curious about the description of different modelling techniques and input data."

Projection parameter specifications:
PROJCS["Datum_73_Hayford_Gauss_IGeoE",GEOGCS["GCS_Datum_73",DATUM["D_Datum_73",SPHEROID["International_1924",6378388.0,297.0]],PRIMEM["Greenwich",0.0],UNIT["Degree",0.0174532925199433]],PROJECTION["Transverse_Mercator"],PARAMETER["False_Easting",200180.598],PARAMETER["False_Northing",299913.01],PARAMETER["Central_Meridian",-8.131906111111112],PARAMETER["Scale_Factor",1.0],PARAMETER["Latitude_Of_Origin",39.66666666666666],UNIT["Meter",1.0]]

RO (Romania)

No modelling data have been submitted by Romania. The following information was provided by Aurora Paunescu of the Romanian Environmental Protection Agency (26-09-2012): "Regarding on your request sent to us, please note that, unfortunately, we do not have the data on spatial air quality modelling results on the annual averages of PM10, NO2 and SO2 for the year 2010."

SE (Sweden)

National level: Matthew Ross-Jones of the Swedish Environmental Protection Agency
provided data for annual average SO2 and NO2 and some brief modeling information (14-09-2012), but announced already an update for PM10 and NO2:

"A map of modelled 2010 anunual mean SO2 concentrations across Sweden is available at the following link: http://www.smhi.se/sgn0102/miljoovervakning/kartvisare.php?lager=10CAIR_SO2__M. These results can also be downloaded as a shape file. Results for NO2 are also available to download here:
http://www.smhi.se/sgn0102/miljoovervakning/kartvisare.php?lager=10CAIR_NO2__M
In addition to these maps, the Swedish Meteorological and Hydrological Institute (SMHI) can also provide a map of PM10 concentrations, as well as a map of NO2 concentrations with a slightly higher resolution. These concentrations have been modelled with their SIMAIR modeling system and the maps are currently under preparation. They hope to be able to send the maps to you within the next couple of weeks."

Martin Torstensson of SHMI contributed with a higher resolution data for PM10 and NO2 (03-10-2012):
"We are in the later stage of delivering higher resolution data to our customers via our tool Simair, and expect to be finished with that within a week. After that, we need to compile the datasets you want, so within a couple of week, three at most, we should be able to deliver this to you.
But we only have NO2 and PM10 in this resolution, not SO2. "

Hans Backström of SHMI provided updated versions for annual average PM10 and NO2 (12-11-2012):
"We have this week produced maps in Shape format for NO2 and PM10. Data was only yesterday available to our Swedish clients. *[…]*
The coordinate system is Sweref99 TM, which is also specified in the .prj-file (see below), for your further conversions.
The results are supposed to be used over Swedish territory, which means that data over parts of Norway and Denmark should probably not be used from this dataset. The concentration data is expressed in µg/m3 for NO2 and for PM10.
I should point out that the data that you previously downloaded from our site (in early October) were expressed as NO2-N and SO2-S. Therefore you had to apply a conversion factor for NO2 (46/14) and for SO2 (64/32). I believe that this information is hard to find from that site, but it is an important piece of information.
I hope that the new fields arrive in time for building your mosaic over Europe. It would be interesting to see the results, when they become available."

As feedback on the informal map review Hans Backström reflected (06-12-2012) with:
"Many thanks for your draft map of modeled air quality in Europe 2010. We have looked in detail at the results over Sweden and found that data for NO2 are too low.
The reason is probably that you received two datasets for NO2 from our institute. The first in late October was downloaded from our site www.smhi.se and the second in November *[…]*.
I want to point out that the first dataset for NO2 was given in the unit [µg NO2-N/m3] and in low resolution (20 km). It is preferable to use the second dataset *[…]*

The second dataset is produced with the SIMAIR system, using modeled data from MATCH with 11 km resolution, nested with an urban background model, with 1 km resolution. Actually data from the first dataset are used in the second, but with better resolution, a different projection (SWEREF99TM) and in the unit [µg NO2/m3].

You have probably already downloaded the second dataset, but it seems that it hasn't been used in the composite map. I would therefore urge you to change the dataset over Sweden.

I think that your composite map is inspiring for future cooperation. It is also interesting to notice that model data are for the year 2010, while monitoring data at your web site (using the link below) are for the year 2008. It will be interesting to compare results for 2010 with monitoring data over Europe, when they become available."

ETC/ACM responded to the last remark in the feedback with (06-12-2012:
"The current inventory was a one-off activity to get some feeling what happens actually in the countries. It is not part of a regular activity. Nevertheless, I will forward your wish for future cooperation / activity to EEA and hopefully it will result in some spin-off for the future in the context of their project FAIRMODE which EEA runs in cooperation with JRC.
The 2008 data you refer to are not the latest version. See http://acm.eionet.europa.eu/databases/airbase/annual_reports.html where you will find maps with annual average values for the three pollutants at station level for 2010. (e.g. Map > 2010 > Annual mean concentration > Annual mean PM10 map for all available stations: http://acm.eionet.europa.eu/databases/airbase/eoi_maps/eoi2011/map_annavg_PM10_conc2010.png).
From Ireland we just received the same suggestion: present the model composite map next to the rural station map using the same legend classifications. We will take this action on board."

Projection parameter specifications applied by SHMI:
PROJCS["SWEREF99 TM",GEOGCS["SWEREF99",DATUM["D_SWEREF99",SPHEROID["GRS_1980",
6378137,298.257222101]],PRIMEM["Greenwich",0],UNIT["Degree",0.01745329251994295]],PROJECTION["Transverse_Mercator"],PARAMETER["latitude_of_origin",0],PARAMETER["central_meridian",15],PARAMETER["scale_factor",0.9996],PARAMETER["false_easting",500000],PARAMETER["false_northing",0],UNIT["Meter",1]]

SI (Slovenia)

No modelling data have been submitted by Slovenia, but the following information on modelling activities was provided by Andrej Šegula of the Environmental Agency of the Republic of Slovenia, Air Quality Sector (13-09-2012):
"Slovenia does not have an operational model for spatial assessment for pollutants for the whole country.
We made assessments of relevant pollutants around IPPC installations with dispersion modelling (models SPRAY, AUSTALL, GRAL, CALPUFF, WRFCHEM), but only additional load, that means that only emissions of those installations were considered. Those calculations did not cover entire zones.

We developed a model for assessment and forecasting purposes. It combines operational meso-meteorological model ALADIN, running 4 times per day at meteorological section of our Agency and US dispersion model CAMx.
Resolution of the model is 4.4 km, chemistry takes into account all in air directive cited pollutants. Outer domain covers Middle Europe area; inner domain includes our county and the area few hundred km from Slovenian borders. We use our emission database with resolution better than the resolution of meteorological model. Next week we will start operational testing of the model together with validation of results. We plan to make assessments for Slovenia for the year 2013."

SK (Slovakia)

National level: Jana Krajcovica of the Slovak HydroMeteorological Institute (SHMU) provided annual average PM10, NO2 and SO2 data for 2010, including some brief modelling information (05-10-2012):
"…deliver the data … in JTSK projection… Krovak projection. Attached is an excel file with annual data for the pollutants you had required."
(9-10-2012):

"The data on SO2 and NO2 are from 2010, while PM10 from 2011. The first two are produced by CEMOD model and the delay is caused by late availability of national emission inventory. PM10 is a result of intelligent interpolation of measurements (IDWA model). Both models are described briefly in the Annual air quality assessment, together with the results. The last you can find on the web is http://www.shmu.sk/File/oko/hodnotenie/2010_Hodnotenie_KO_v_SR.pdf (in Slovak). However, it is not the latest - the one related to the data I have sent you will be published in a short time and will be available from the same website (http://www.shmu.sk/sk/?page=996). The file name will be 2011_Hodnotenie_KO_v_SR.pdf."

TR (Turkey)

No modelling information has been found on the internet. Turkey has not been contacted. In follow up activities to this paper Turkey should be approached about (intended) modelling activities.